No. 885,930. PATENTED APR. 28, 1908.

S. LAKE.

DREDGING APPARATUS.

APPLICATION FILED AUG. 10, 1907.

4 SHEETS—SHEET 1.

Fig. 1.

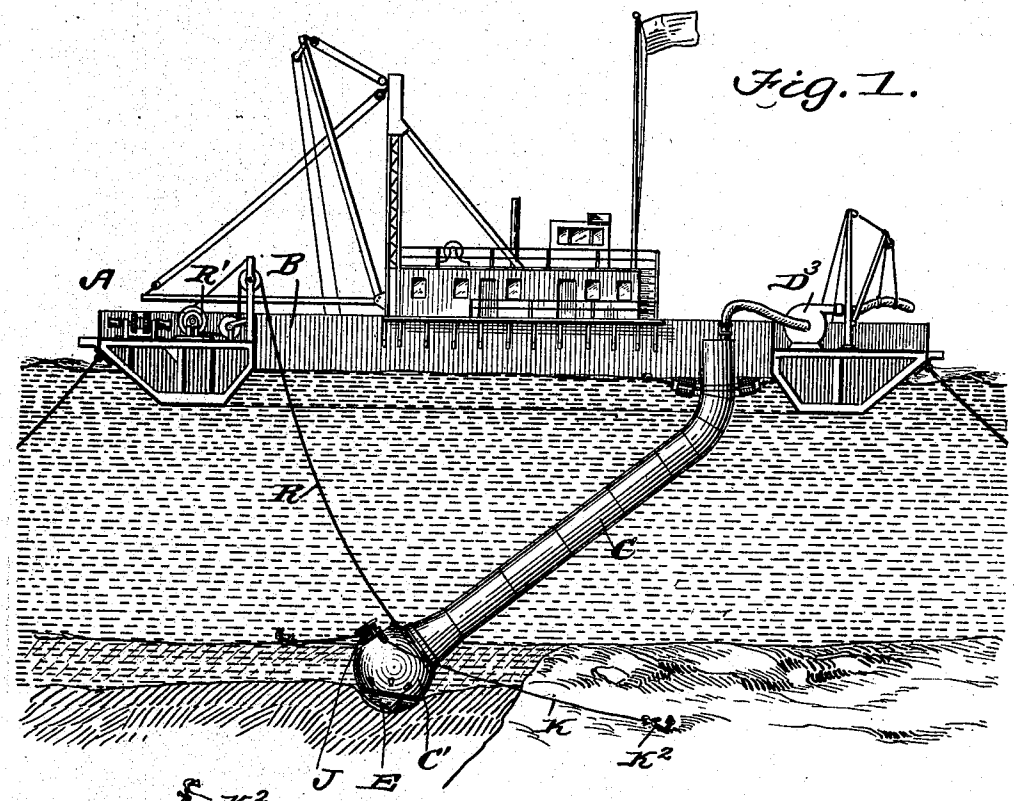


Fig. 2.

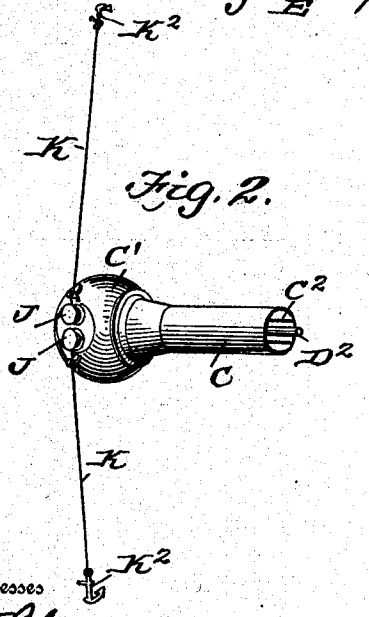
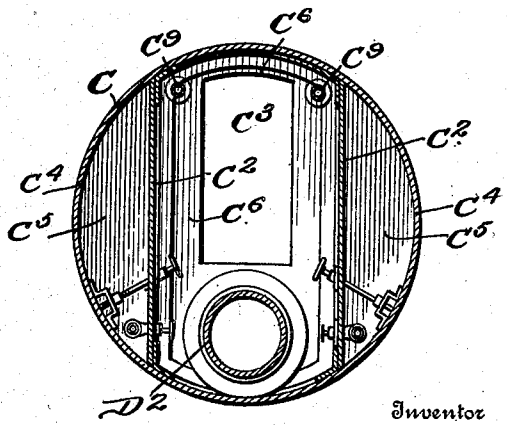


Fig. 3.



Witnesses

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4 SHEETS—SHEET 2.

Fig. 4.

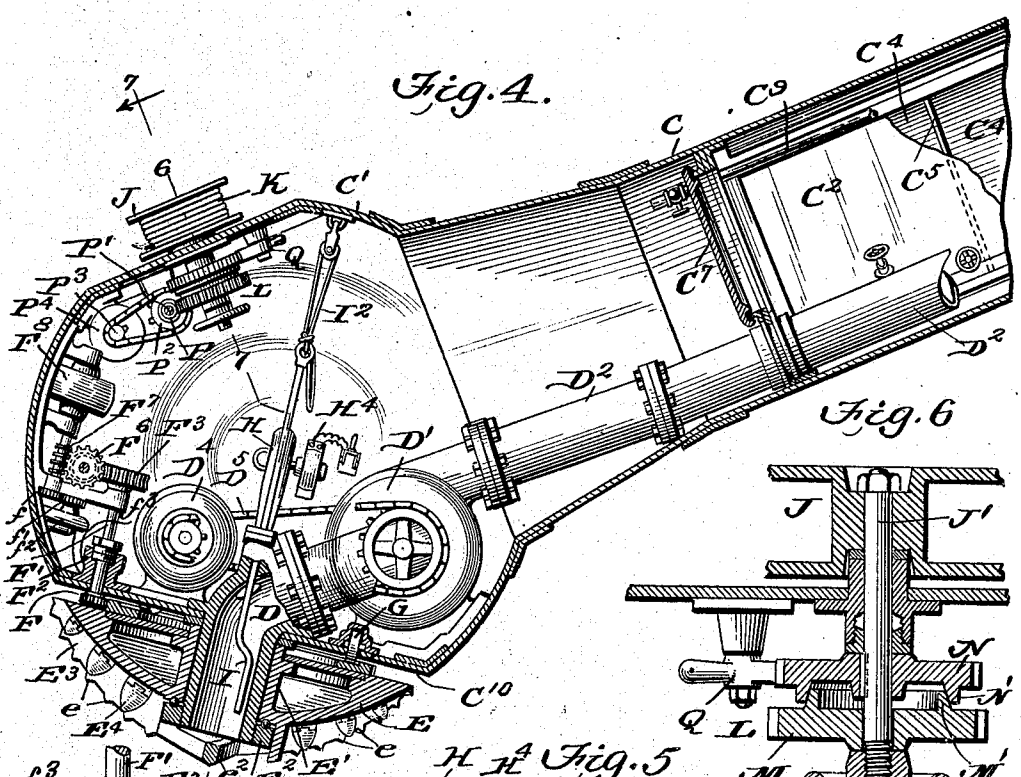


Fig. 6

Fig. 5

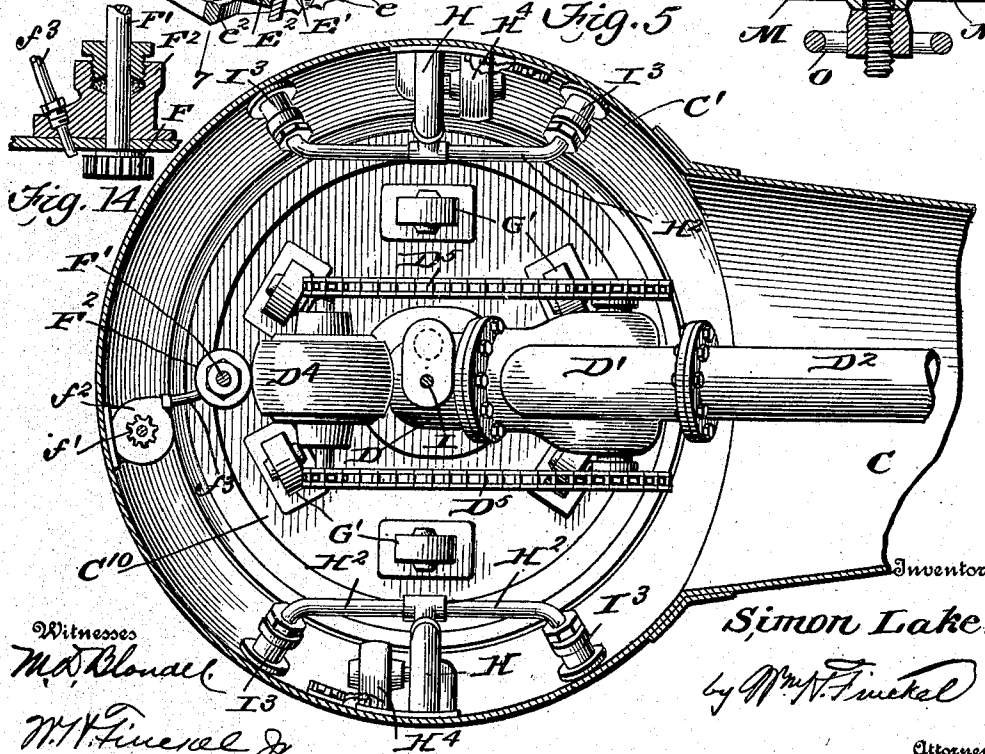


Fig. 14.

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4 SHEETS—SHEET 3.

Fig. 7.

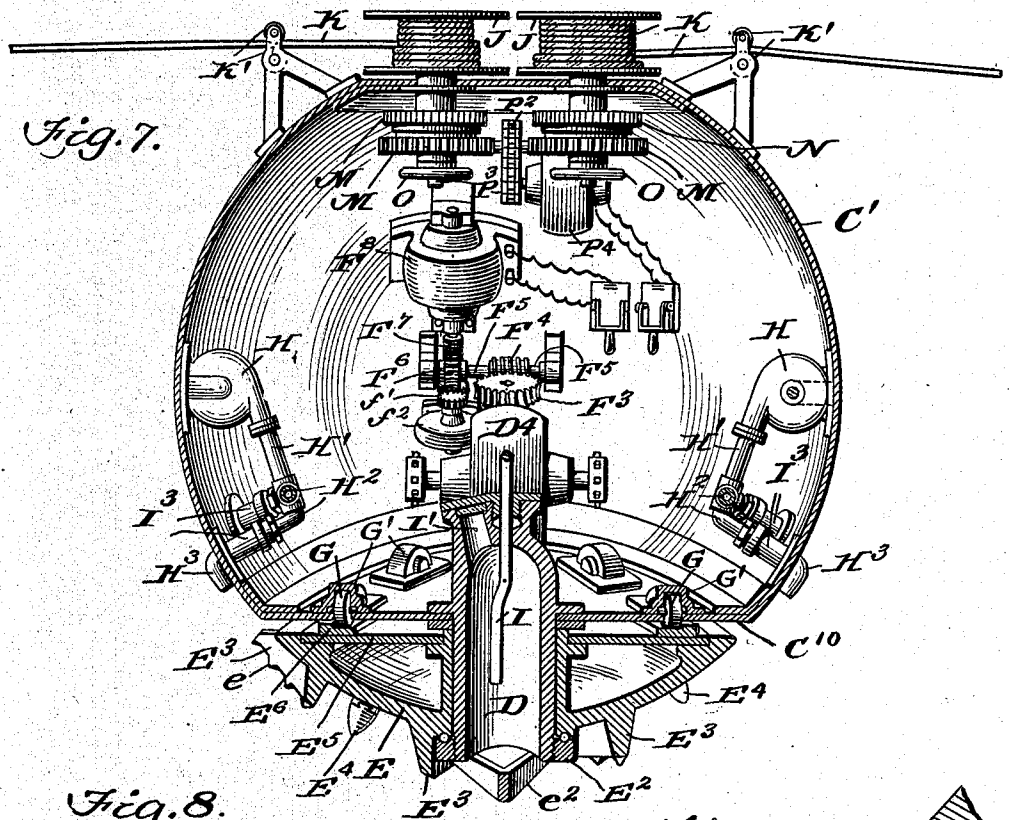


Fig. 8.

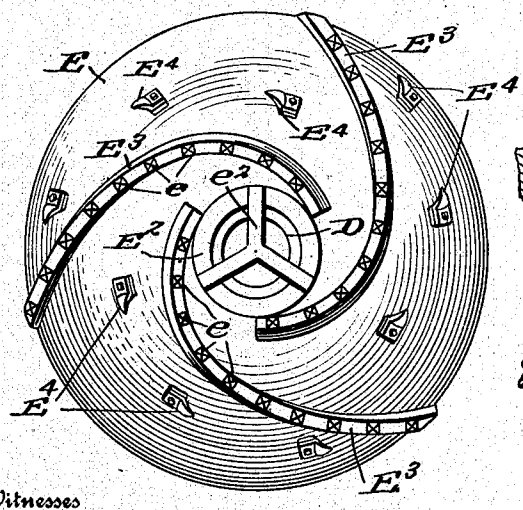


Fig. 9

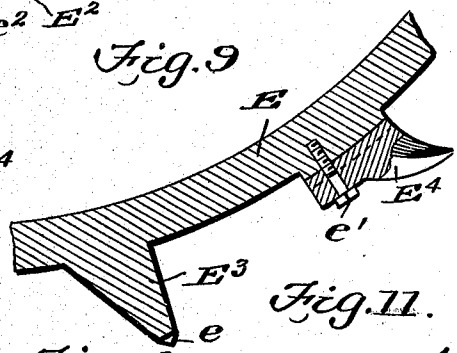


Fig. 11.

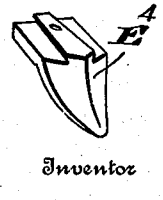
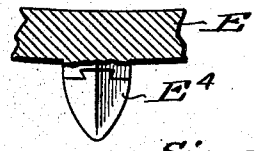


Fig. 10.



Witnesses

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4 SHEETS—SHEET 4.

Fig. 12.

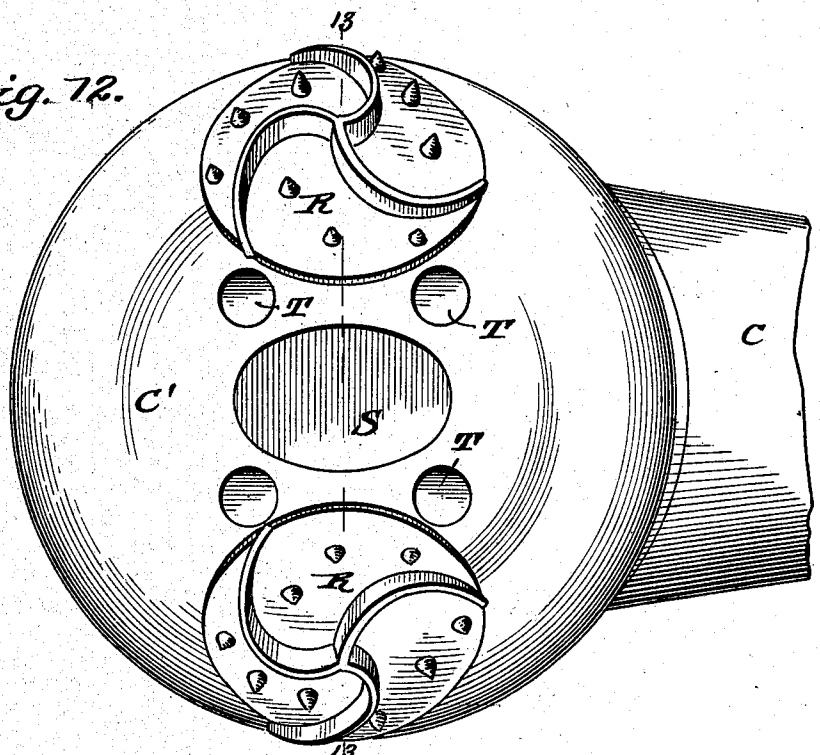
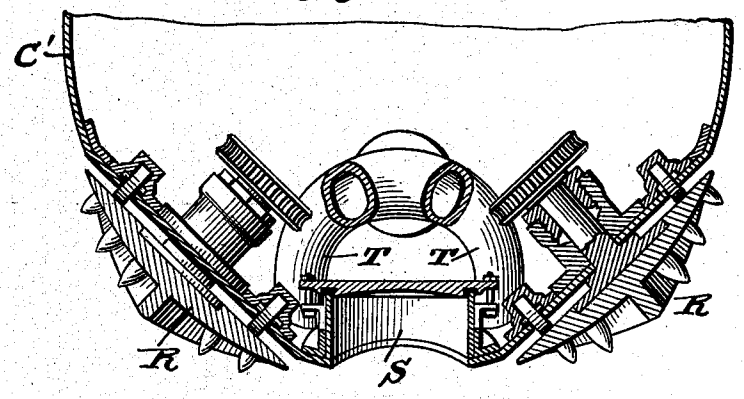


Fig. 13.



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UNITED STATES PATENT OFFICE.

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DREDGING APPARATUS.

No. 885,930. Specification of Letters Patent. Patented April 28, 1908.

Application filed August 10, 1907. Serial No. 388,050.

To all whom it may concern:

Be it known that I, SIMON LAKE, a citizen of the United States, and a resident of Bridgeport, in the county of Fairfield and State of Connecticut, temporarily residing in London, England, have invented a certain new and useful Improvement in Dredging Apparatus, of which the following is a specification.

The object of this invention is to provide apparatus for use in cutting trenches, deepening channels, waterways and harbors, and for other subaqueous operations.

The apparatus is especially adapted for rapidly cutting into and through rock, chalk, clay, and other hard or solid bottoms, and lifting the debris to the surface and either delivering it into suitable vessels provided for the purpose, or forcing it through pipes to any desired point where it will not be washed back into the channel or trench being cut.

The apparatus is carried by a vessel and operable from within the vessel and capable of being moved in lateral directions, so that a cut of some length may be made without changing the anchorage of the vessel.

In the accompanying drawings, illustrating the invention, in the several figures of which like parts are similarly designated, Figure 1 is a diagrammatic view, in elevation, illustrating the application of my invention. Fig. 2 is a similar view, in plan, of the lower or working end of the tube and illustrating the manner of anchoring the said lower end. Fig. 3 is a cross-section, on a larger scale, of the tube, drawn adjacent to the lower or working end. Fig. 4 is a longitudinal section, on a larger scale, of the lower or working end of the tube. Fig. 5 is a horizontal section, on a still larger scale, of the said lower end. Fig. 6 is a cross-section of a detail, drawn on the line 6—6 of Fig. 4. Fig. 7 is a transverse section of the working end of the tube, drawn on the irregular line 7—7 of Fig. 4, and looking in the direction indicated by the arrow. Fig. 8 is an inverted plan view of the cutter-head. Fig. 9 is a section, on a larger scale, of a portion of the cutter-head. Fig. 10 is an elevation and Fig. 11 is a perspective view illustrating one of the removable furrow-points carried by the cutter-head. Fig. 12 is an inverted plan view of the lower end of the tube, illustrating the use of two cutter-heads and the construction of a hatch in the said lower end. Fig. 13 is a cross-section, drawn on the line 13—13 of Fig. 12. Fig. 14 is a cross-section of a detail of construction.

A designates a surface vessel of any suitable construction, having a well B, in one end of which is yieldingly supported the upper end of a submergible tube C, having its lower end constructed as a working-chamber C′, of any preferred shape, but shown in the present instance as a segment of a sphere. The tube C is provided with divisional plates C^2, which extend nearly its entire length, so as to divide it into a central compartment C^3, forming a passage-way to the working-chamber, and two chambers C^4, C^4, which are subdivided by transverse divisional plates C^5, to provide a series of water-ballast compartments into which water may be admitted to submerge the lower end of the tube so that the working end may rest firmly upon the bed to effectively throw the cutter-head into engagement with the said bed. The plates C^2 end near the lower end of the tube, and are connected to a frame or bulkhead C^6 (Fig. 3), having a central opening or door-way which is closed by a door C^7, (Fig. 4) hinged to the frame. The plates C^5, at intervals throughout the length of the tube, are provided with valve-controlled openings by which communication may be established between the compartments, and the valves controlling the openings may be operated from within the central passage-way of the tube. Air-supply pipes C^9, extend through the passage-way C^3 to the working-chamber, and are connected at their upper ends to an air force-pump (not shown) carried by the surface vessel, to supply fresh air to the working-chamber, and also to supply compressed air to the chamber to counterbalance the external pressure of water at the bottom of the tube and to prevent ingress of water when the hatch, shown in Figs. 12 and 13, is open.

The lower flat surface C^{10} of the working-chamber has an elbow-pipe D projecting through its center, and at right angles thereto. The inner end of pipe D is connected to a suction-pump D′, having a discharge pipe D^2, which extends upwardly through the tube to the upper end thereof, where it is connected to a suitable discharge pipe which may be extended to any desired point. In practice I may connect the upper end of the tube with a suction-pump D^3, to assist the pump D′ in lifting the debris to the surface,

as shown in Fig. 1. The pump D′ is operatively connected to a motor D⁴, through chains and sprockets D⁵. When the pump D³ is employed, it may be operated by a motor carried by the surface vessel, and the upper end of the pipe D² will be connected with the pump by a flexible hose, so as to compensate for any movement of the vessel which may be caused by wave motion. The lower protruding end of the pipe D forms a spindle upon which is mounted a rotary cutter-head E, concavo-convex in cross-section and of a size sufficient to round out the body of the working-chamber. The cutter-head E has a hub E′, Fig. 4, snugly fitting the spindle end of the pipe D, and held in position by a collar E², threaded upon the lower end of the pipe, between which and the cutter-head are interposed anti-friction balls to facilitate the movement of the cutter-head.

The outer surface of the cutter-head is provided with a series of cutting ribs or blades E³, extending from the hub E′, upon involute curve lines, thereby providing a series of shearing or cutting edges and an arrangement by which the debris is fed toward the hub into the sphere of influence of the suction-pump D³. The ribs are tapered from their inner toward their outer ends. They are provided along their longitudinal edges with a series of pointed projections or teeth *e*, which are alternately arranged upon the ribs, so that the teeth of one rib will cut into the surface left uncut by the teeth of the adjacent ribs.

The surface of the cutter-head between the ribs is provided with alternately arranged, wedge-shaped, furrow-points E⁴, which are designed to penetrate the surface operated upon and dig or cut rows of furrows, the resulting debris being taken up by the ribs and conveyed toward the center where it is drawn up by the action of the pump or pumps. The ribs are preferably cast integral with the cutter-head, but the furrow-points are made detachable and preferably of chilled steel, and these furrow-points are held in position in any suitable manner. As shown in Figs. 9–11, the points are provided with dovetail ribs which fit correspondingly shaped grooves produced in short projections cast upon the cutter-head, and they are held from displacement by screw-bolts *e′*.

The upper face of the cutter-head is provided with a plate E⁵, upon which is mounted a circular rack-bar E⁶, which is engaged by a pinion F, carried at the outer end of a shaft F′, projecting through the flat surface of the casing and journaled in a bearing F², having a stuffing-box to prevent ingress of water to the chamber, Figs. 4 and 14. The upper end of the shaft F′ is provided with a worm-wheel F³, which is engaged by a worm F⁴ (Fig. 7), carried by a shaft F⁵, journaled in brackets secured to the casing. The shaft F⁵ carries a worm-wheel F⁶, Figs. 4 and 7, which is engaged by a worm F⁷, held upon the shaft of an electric motor F⁸, the current wires to which run from a dynamo (not shown) located upon the surface vessel. A switch is interposed in the wires to control the operation of the motor, and is arranged in any convenient place in the working-chamber. The shaft of the motor also carries a gear *f*, Fig. 4, which meshes with a gear *f′*, carried by the shaft of a force-pump *f²*, which communicates with the surrounding water, and has a discharge pipe *f³*, extending through the bearing F², or the casing adjacent thereto, and discharging upon the teeth of the gear and rack-bar to wash out any obstructions that may become lodged between the intermeshing teeth.

G indicates anti-friction rollers projecting from the bottom of the casing and bearing upon the rack-bar E⁶, to take up the pressure of the cutter-head, and prevent the entire strain of the latter coming upon its spindle. The rollers are mounted in casings G′, which surround the openings and prevent ingress of water to the chamber.

In order to force the debris toward the central opening and prevent its being washed away by the water currents or the movement of the working end of the vessel, and also to assist the ribs in conveying the debris toward the pipe D, a series of streams of water may be projected toward the cutter-head points adjacent to the peripheral edge thereof, by means of hydraulic force-pumps H, Figs. 5 and 7, which communicate with the surrounding water, and have their discharge pipes H′ connected with a series of branch pipes H², Fig. 5, which extend through the stuffing-boxes I³ and the casing and have their outer ends made as discharge nozzles H³, Fig. 7, which are directed toward the cutter-head. Suitable electric motors H⁴, Fig. 5, are employed for operating these pumps, the current wires to which also extend from a dynamo (not shown) located upon the surface vessel.

The collar E², which holds the cutter-head upon the spindle, is provided with a series of arms *e²*, Figs. 7 and 8, which are connected at their meeting ends, and form a screen for the lower end of the pipe D, to prevent entrance into the pipe of large pieces of rock or other material which would clog the pipe or pump, and in order to dislodge any obstructions that may stick in the space or spaces between the arms, I employ a ram-rod I, Figs. 4 and 7, which projects through an opening in the elbow of the pipe and which is arranged in alinement with the longitudinal axis of the lower end thereof. The lower end of the rod is bent out of longitudinal alinement with the upper end so as to fit in any one of the openings between the arms *e²*. In order to enable the operator to ob-

serve conditions in the pipe D, the upper end of the pipe adjacent to the central opening is made with a sight opening I′, Fig. 7, which is closed by a suitable glass cover. The ram-rod I is normally held in an elevated position by a cable I^2, Fig. 4, supported by a pulley which is suspended from the top of the working-chamber.

In order to hold the lower or working end of the tube at any point while the cutter-head is in operation and to prevent its "walking", and also to shift the lower end in lateral directions, I employ two winding drums or reels J, J, mounted upon short vertical shafts J′, J′, which project upwardly through a flattened upper portion of the working-chamber casing, and upon the drums are wound cables K, which extend in opposite directions through guide pulleys K′, K′, held in brackets secured to the casing, and have anchors K^2, at their free ends, which in use are planted at suitable points away from the lower end of the tube, as illustrated in Fig. 2. Each shaft J′ (see Fig. 6) is provided with a clutch L, for controlling the movement of its respective drum or reel, and each clutch comprises a worm-wheel M, loosely mounted upon the inner end of the shaft, and having an annular tapering flange M′, which is forced into contact with a similar flange N′, formed upon a ratchet wheel N, keyed to the shaft. The hand wheel O, operating upon the extreme lower threaded end of the shaft, serves as the medium for operating the clutch. Continuous movement is imparted to both worm-wheels M by worms P, (Fig. 4), held upon a shaft P, journaled in brackets extending from the casing. The shaft P′ is provided with a sprocket wheel P^2, around which operates a chain which also extends over a sprocket P^3, held upon the shaft of an electric motor P^4, the current wires to which, like those of the other motors, extend from a dynamo on the surface vessel.

So long as current is supplied to the motor, motion will be constantly imparted to both worm-wheels M, and when it is desired to move the lower end of the tube, in either lateral direction, the clutching surfaces of the wheels of the appropriate shaft are thrown into engagement and the drum is rotated and its cable wound upon the drum, whereby the lower end of the tube will be moved toward the anchored point of the cable. In the meantime, the cable upon the opposite drum is being unwound. By loosening the clutching surfaces of the wheels of one shaft and throwing those of the opposite shaft into engagement, the tube may be moved in opposite directions. Pawls Q are employed for engagement with the ratchets N, to hold the ratchets and drums against movement when the clutching surfaces are disengaged.

As shown in Figs. 12 and 13, the lower or working end of the tube may be provided with two cutter-heads R, R of the same general construction and mode of operation as previously described; and there may be also between these cutter-heads a hatch S, formed in the casing and by which exit may be had from the chamber to examine the condition of the surface to be operated upon. Before the hatch is opened, the door of the bulkhead C^7 in the lower end of the tube, will be closed and enough compressed air admitted to the working-chamber to counterbalance the external water pressure, when the cover of the hatch S may be removed without danger of ingress of water to the working-chamber. Between the cutter-heads and hatch are arranged a series of openings which are surrounded by suction pipes T, extending from a suitable suction-pump. Having cutter-heads upon each side of the working chamber, provides an arrangement for cutting into the sides of a trench or embankment as well as an arrangement that affords a cutting surface on alternate sides of the tube as it is moved in lateral directions, as one or the other cutter-head will always rest upon the water-bed. The hatch not only provides an exit through which the bottom of the water-bed may be examined, but permits of the removal of various forms of obstructions that may be encountered by the cutter-heads.

The operation is as follows: The submergible tube is lowered into the water and allowed to rest firmly upon the bottom. The anchors are then lowered at the proper distance upon each side of the tube and the suction-pump D′ set in motion to draw in water and force it upwardly through the pipe D^2 to the surface vessel. The motor F^8 is then energized and through the medium of the worms and gears, imparts a rotary movement to the cutter-head, which cuts into the bed and conveys the debris toward the end of the inlet pipe to the suction-pump, and as soon as the material or debris comes within the sphere of action of the pump, it is drawn up into the pipe with the water and conveyed through the pipe D^2 to the surface. During this operation either one or the other of the cable drums J is actuated so as to move the lower end of the tube laterally, and thereby cause the rotary cutter-head to cut into fresh surfaces as fast as the material is removed. When the lower end of the tube has been moved laterally to its extreme position, the engaged drum is stopped and the opposite drum actuated and the tube moved in the opposite direction, or toward the other anchor point. During this operation the length of cable previously wound upon the drum is unwound therefrom. These operations are repeated alternately until a trench of the proper depth and width has been dug, when the surface vessel and anchors, together with the submergible tube are moved and the operation repeated. It will thus be

seen that the operation is exceedingly simple and that a trench of any desired width and depth may be rapidly dug. It will also be seen that I provide a cutter-head that will not only rapidly cut into the surface, but an arrangement by which the material is fed or pushed toward the suction openings of the pump in one operation.

When the surface vessel and submergible tube are transported to any considerable distance, the submergible tube is drawn up into the well B of the surface vessel and held in such position by a cable R, extending from a suitable winch R′, carried by the surface vessel, as shown in Fig. 1.

I do not wish to limit myself to the exact construction shown herein, it being obvious that the pump D^3, located on the surface vessel, could be used instead of the pump in the working-chamber, and be effective for the purpose of lifting light materials from shallow depths. If desired, the two pumps may be used at the same time, especially should the device be employed in very deep water.

What I claim is:—

1. A dredging apparatus, comprising a submergible tube, having a water-tight working-chamber at its lower end, a rotary cutter-head beneath said working-chamber, a suction-pump having its intake immediately adjacent to the cutter-head for collecting the debris caused by the cutter-head, means for operating the cutter-head, and means for operating the pump.

2. A dredging apparatus, comprising a submergible tube, having a water-tight working-chamber at its lower end, a rotary cutter-head beneath said chamber, a suction-pump having its intake immediately adjacent to the cutter-head, means for operating the cutter-head, means for operating the pump, and means for moving the lower end of the tube in lateral directions.

3. A dredging apparatus, comprising a submergible tube, having a water-tight working-chamber at its lower end, a pipe projecting therefrom, a rotary cutter-head mounted upon the projecting end of the pipe, a suction-pump connected to the inner end of the pipe, and independent means for operating the cutter-head and the pump.

4. A dredging apparatus, comprising a submergible tube, a cutter-head carried thereby and having a convex lower surface, a suction-pump co-acting with the cutter-head, and independent means for operating the cutter-head and the pump.

5. A dredging apparatus, comprising a submergible tube, a rotary cutter-head carried at its lower end and having a central opening and ribs arranged upon its lower face and extending outwardly from the central opening upon involute curve lines, and a suction-pump having a pipe which projects through the opening.

6. A dredging apparatus, comprising a submergible tube, a rotary cutter-head arranged at the lower end thereof, said cutter-head having ribs which extend outwardly from the center upon involute curve lines, whereby the debris caused by the ribs is conveyed toward the center of the cutter-head, means for operating the cutter-head, and a suction-pump for lifting the material collected by the ribs.

7. A dredging apparatus, comprising a submergible tube, a cutter-head having a convex lower surface mounted at the lower end thereof, said cutter-head having ribs formed upon it and furrow-points carried by it, means for operating the cutter-head, and a suction-pump for collecting the debris caused by the cutter-head.

8. A dredging apparatus, comprising a submergible tube having a spherical segment at its lower end which provides a working-chamber, a rotary cutter-head carried at the said lower end, a suction-pump having an intake pipe extending through the casing of the chamber, means controlled from within the working-chamber for operating the cutter-head, and means also controlled from within the chamber for operating the suction-pump.

9. A dredging apparatus, comprising a submergible tube, a rotary cutter-head mounted at the lower end thereof, a suction-pump arranged in the lower end of the said tube, independent means for operating the cutter-head and the pump, and means controlled from within the tube for moving the said tube in lateral directions.

10. A dredging apparatus, comprising a submergible tube, a pipe projecting therefrom, a suction-pump connected to the inner end of the pipe, a cutter-head mounted to rotate upon the pipe and having ribs upon its lower surface which extend outwardly from the center upon involute curve lines, whereby the cuttings are directed toward the center and into the sphere of influence of the suction-pump, means for projecting streams of water toward the center of the cutter-head, and independent means for operating the cutter-head and the pump.

11. A dredging apparatus, comprising a submergible tube having its lower end terminating in a spherical-shaped working-chamber, a pipe projecting from the casing of the chamber, the outer end of which forms a spindle, a cutter-head rotatably mounted upon the said outer end, a suction-pump connected to the inner end of the pipe, and independent means for operating the said cutter-head and the said pump.

12. A dredging apparatus, comprising a submergible tube, the lower end of which terminates in a working-chamber, a pipe projecting through the casing of the chamber, a cutter-head rotatably mounted upon the projecting end of the pipe and having ribs formed

upon its lower face which extend outwardly from the center thereof upon involute curve lines, a suction-pump connected to the inner end of the pipe, means for directing streams of water from points adjacent to the periphery of the cutter-head toward the center thereof, and independent means for operating the cutter-head and the pump.

13. A dredging apparatus, comprising a submergible tube, a cutter-head rotatably mounted at the lower end thereof, a suction-pump co-acting with the cutter-head, drums journaled upon the lower end of the tube and having cables wound thereon, anchors at the outer ends of the cables, means for rotating the drums, and a clutch carried by the shaft of each drum, whereby either drum may be rotated for the purpose of winding up the cable to move the lower end of the tube in lateral directions.

14. A dredging apparatus, comprising a submergible tube, a cutter-head arranged at the lower end thereof, a suction-pump co-acting with the cutter-head, drums carrying cables arranged at the lower end of the said tube and having anchors at their free ends which are adapted to be held upon each side of the tube, means operable from within the tube for rotating the said drums, including clutches whereby either drum may be operated as specified.

15. A dredging apparatus, comprising a submergible tube having its lower end constructed as a working-chamber, a cutter-head mounted at the working-chamber whose lower face is convex and provided with furrow-points, a suction-pump for collecting the debris caused by the cutter-head, independent means for operating the cutter-head and the pump, and means for directing streams of water toward the sphere of influence of the pump.

16. A dredging apparatus, comprising a submergible tube having its lower end constructed as a working-chamber, a passage-way formed throughout the length of the tube and communicating with the working-chamber through a bulkhead adjacent to the lower end thereof, ballast compartments arranged in the tube upon opposite sides of the passage-way, a rotating cutter-head supported at the working-chamber end of the tube, a motor operatively connected with the cutter-head, a suction-pump for collecting the débris caused by the cutter-head, a motor for operating the pump, and means for moving the lower end of the tube in lateral directions.

17. A dredging apparatus, comprising a tubular casing having one end terminating in a working-chamber provided with a flattened surface, a pipe projecting through the center of the flattened surface, a cutter-head having a convex lower surface and journaled upon the extended end of the pipe, ribs formed upon the convex surface and furrow-points held upon the convex surface between the ribs, a pump connected to the inner end of the said pipe and having a discharge pipe, a motor operatively connected to the cutter-head, and a motor for operating the pump.

18. A dredging apparatus, comprising a tube having its lower end constructed as a working-chamber, a pipe extending through the casing of the chamber, a cutter-head mounted upon the extended end of the pipe, a circular rack-bar carried by the cutter-head, a shaft extending through the casing and having a pinion at its outer end which is adapted to mesh with the rack-bar, a motor operatively connected to the shaft, a suction pump connected to the inner end of the said pipe, and means for operating the pump.

19. A dredging apparatus, comprising a submergible tube having its lower end constructed as a working-chamber, a pipe extending through the casing of the chamber, a cutter-head rotatably mounted upon the extended end of said pipe, a rack-bar carried by the cutter-head, a shaft extending through the casing and having a pinion at its outer end which meshes with the rack-bar, a worm-wheel upon the inner end of the shaft, a motor geared to the worm-wheel, a suction pump connected to the inner end of the pipe, and a discharge pipe extending from the pump.

20. A dredging apparatus, comprising a submergible tube having a working-chamber at one end, a bulkhead and door adjacent to the chamber which control communication between the upper end of the tube and the said chamber, a pipe extending through the casing of the chamber, a cutter-head rotatably mounted upon the extended end of the pipe, a suction-pump connected to the inner end of the pipe and having a discharge pipe which extends throughout the length of the tube, means for operating the cutter-head, means for operating the pump, and means for moving the working end of the tube in lateral directions.

21. A dredging apparatus, comprising a submergible tube having a working-chamber at one end, a cutter-head rotatably mounted at the said end, a suction-pump co-acting with the cutter-head, shafts extending through the casing of the working-chamber, drums or pulleys held upon the extended ends of the shafts, worm-wheels loosely mounted upon the inner ends of the shafts, a shaft having worms meshing with the worm-wheels, and a motor therefor, a wheel or disk keyed to each shaft, said wheels or disks being adapted for engagement by the worm-wheel of its respective shaft, and means for throwing said wheels into engagement.

22. A dredging apparatus, comprising a submergible tube having a working-chamber at its lower end, a pipe extending through the casing of the chamber, a cutter-head rotata-

bly mounted upon the extended end of the pipe, antifriction rollers engaging the cutter-head, a pump connected to the inner end of the said pipe, and independent means for operating the cutter-head and the pump.

23. A dredging apparatus, comprising a submergible tube having a working-chamber at its lower end, a pipe extending from the casing of the chamber, a cutter-head journaled upon the extended end of the pipe, a rack-bar carried by the cutter-head, a shaft having a pinion at one end which meshes with the rack-bar and a worm-wheel at its opposite end, a motor having a worm which meshes with the worm-wheel, means for clearing the intermeshing teeth of the pinion and rack-bar of any obstructions which may be lodged therein, a suction-pump connected to the inner end of the said pipe, means for operating the pump, and means for moving the lower or working end of the tube in lateral directions.

24. A dredging apparatus, comprising a submergible tube having a working-chamber at one end, a pipe extending through the casing of the chamber, a cutter-head rotatably mounted upon the extended end of the pipe, means controlled from within the chamber for operating the cutter-head, a pump connected to the inner end of the said pipe, means controlled from within the tube for operating the pump, a frame held over the lower end of the pipe, and means for dislodging obstructions which may become wedged in the openings of the frame.

25. A dredging apparatus, comprising a submergible tube having a working-chamber at one end which is provided with a suction-opening, a cutter-head rotatably mounted adjacent to the suction-opening and adapted to feed the debris resulting from the action of the cutter-head toward the suction-opening, and a suction-pump having a pipe extending to the suction-opening.

26. A dredging apparatus, comprising a submergible tube, a cutter-head carried at the end thereof and having a body portion provided with a central opening and a convex outer surface and ribs formed upon the convex surface and extending outwardly from a central opening upon involute curve lines.

27. A dredging apparatus, comprising a submergible tube, a cutter-head carried at the end thereof, said cutter-head having a body portion provided with a central opening and a convex outer surface, ribs formed upon the convex surface which extend outwardly from the central opening upon involute curve lines, teeth alternately arranged upon the longitudinal edges of the ribs, and detachable furrow-points held upon the convex surface of the cutter-head between the ribs.

28. A cutter-head for dredging apparatus, comprising a body portion having a central opening and a convex working face, cutting ribs formed upon the convex surface and which extend outwardly from the central opening upon involute curve lines so as to cut the material and sweep in the cuttings toward the central opening, and furrow-points detachably held to the cutter-head between the ribs and assisting in cutting the material.

In testimony whereof I have hereunto set my hand this 30″ day of July A. D. 1907.

SIMON LAKE.

Witnesses:
M. D. BLONDEL,
H. D. JAMESON.