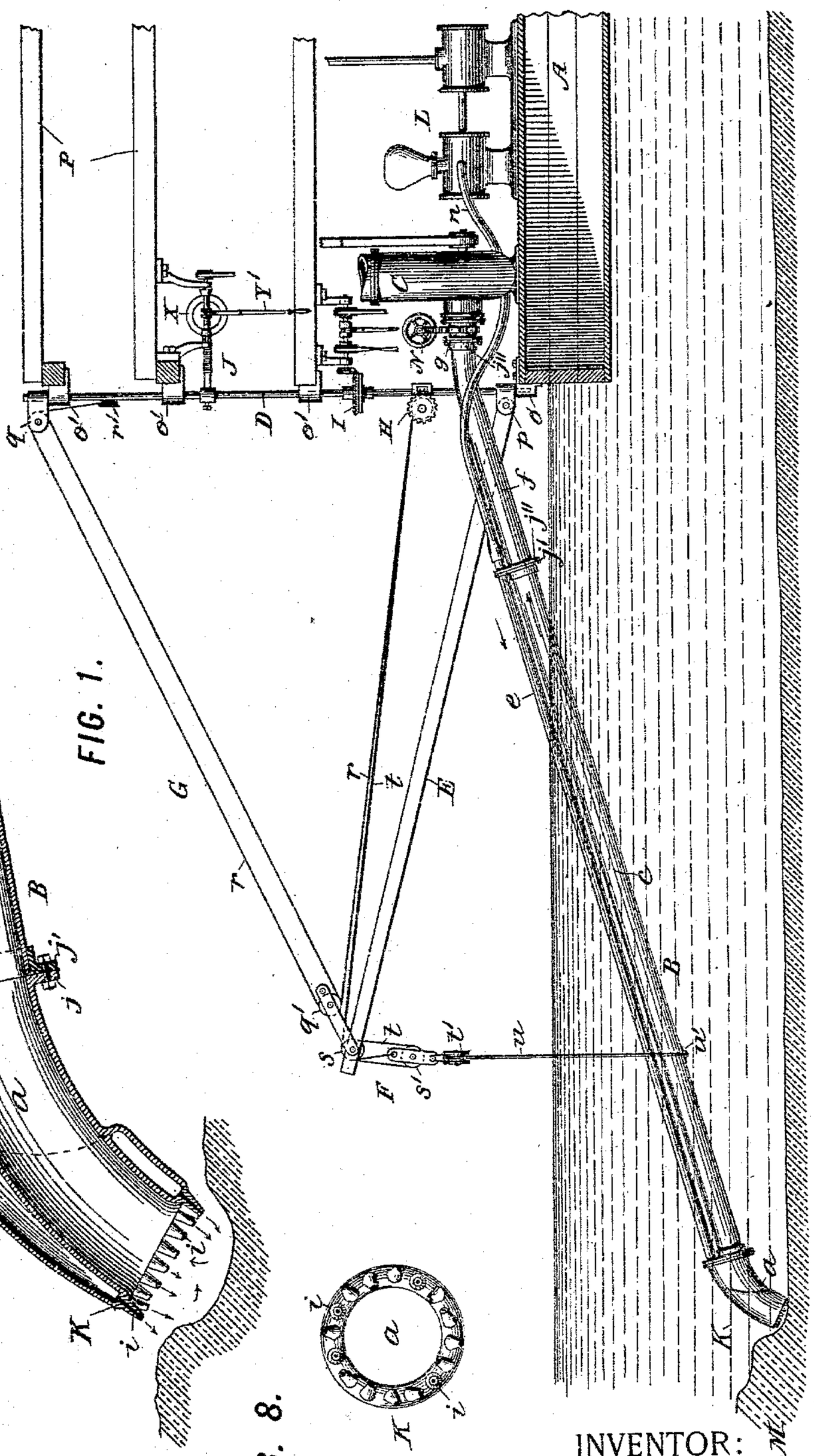
(No Model.) 3 Sheets—Sheet 1.

W. M. BAILEY.

METHOD OF AND APPARATUS FOR DREDGING.

No. 494,728. Patented Apr. 4, 1893.



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(No Model.) 3 Sheets—Sheet 2.

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FIG. 2.

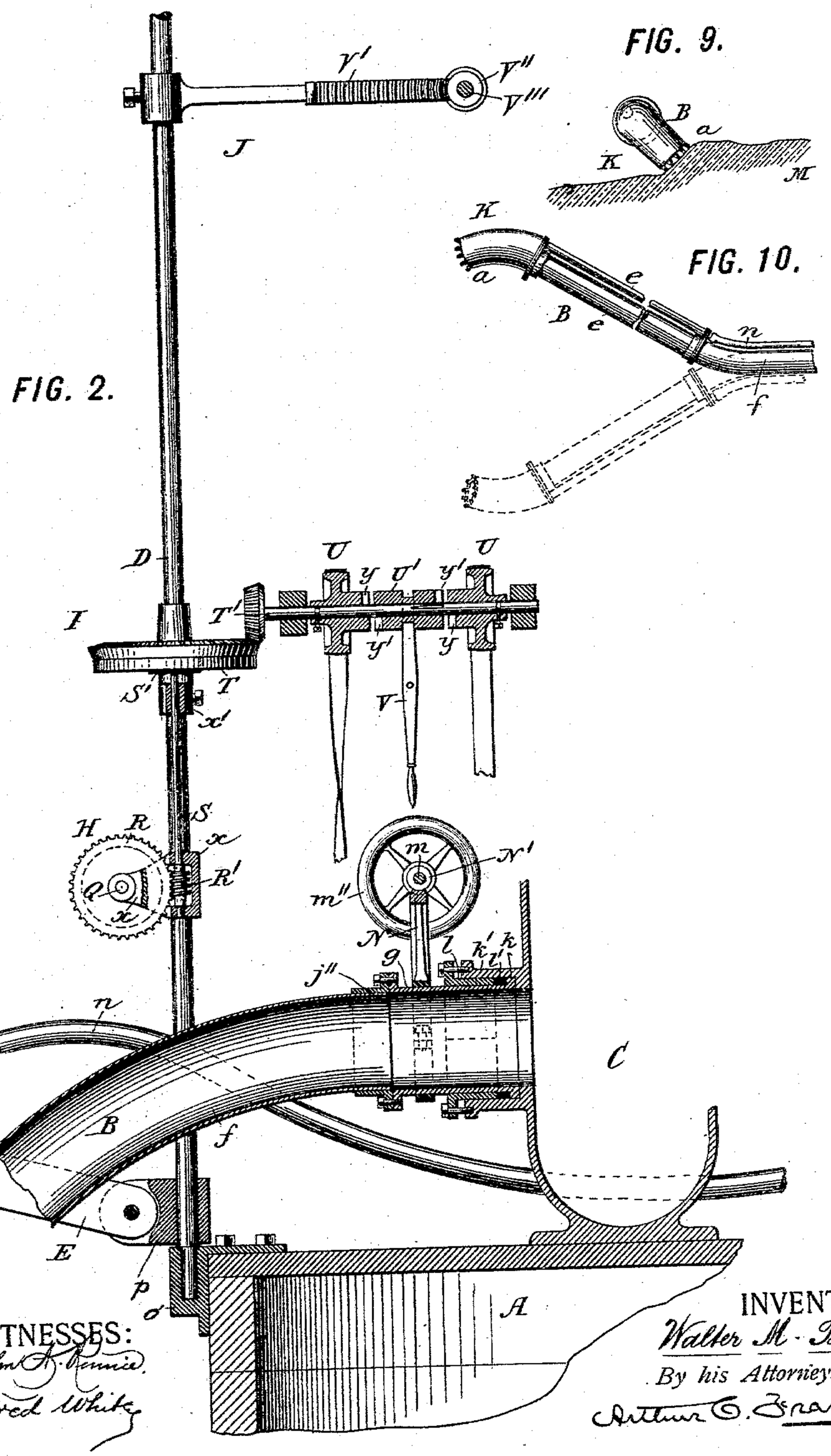

FIG. 9.

FIG. 10.

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FIG. 3.

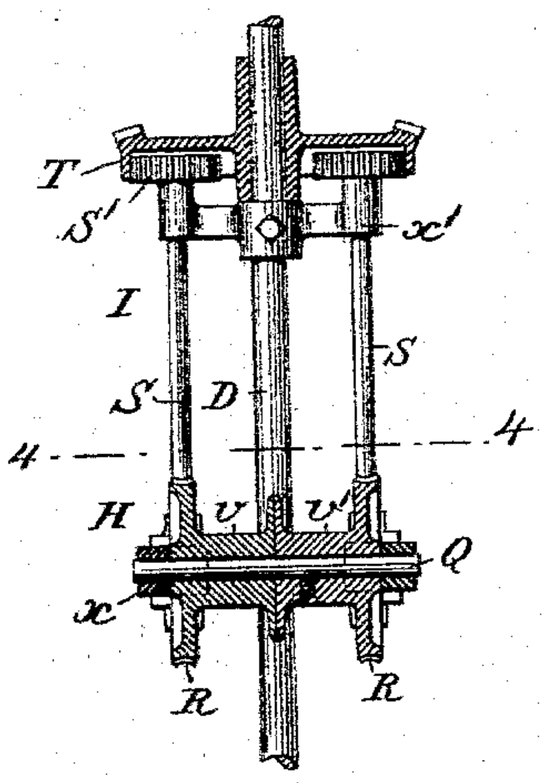


FIG. 4.

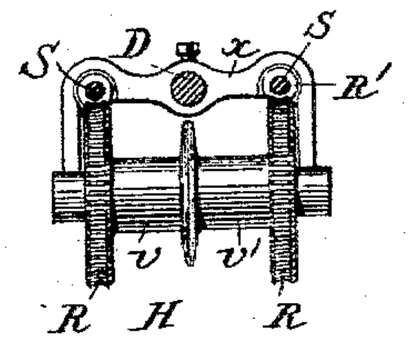


FIG. 5.

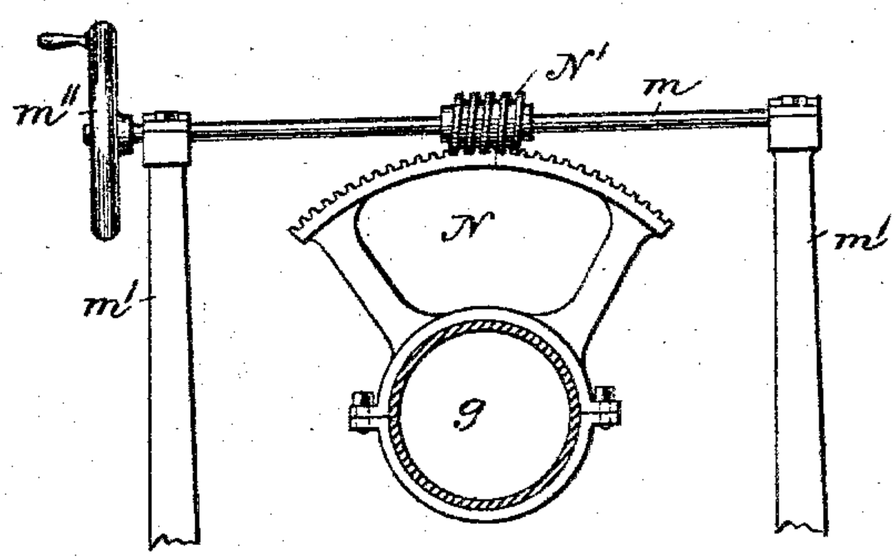
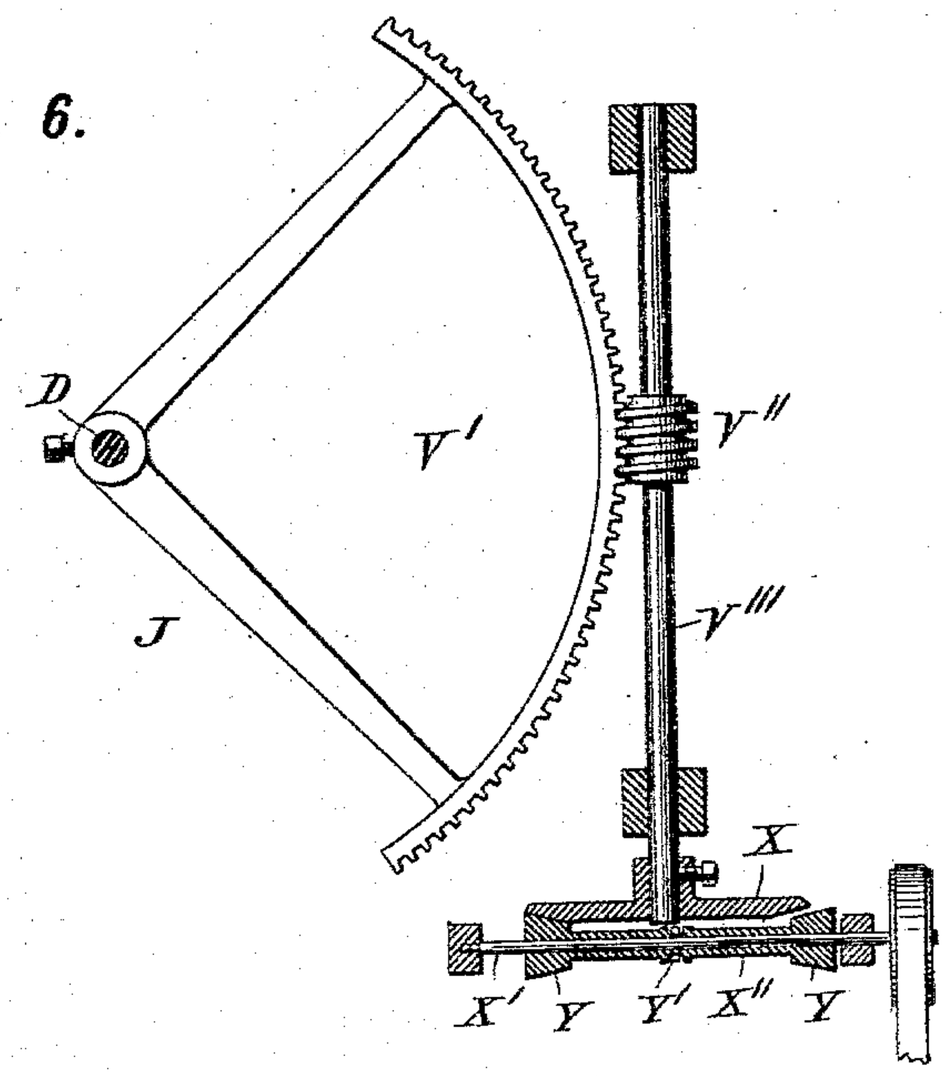


FIG. 6.



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UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR DREDGING.

SPECIFICATION forming part of Letters Patent No. 494,728, dated April 4, 1893.

Application filed May 16, 1892. Serial No. 433,098. (No model.)

To all whom it may concern:

Be it known that I, WALTER M. BAILEY, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Apparatus for Dredging, of which the following is a specification.

This invention relates to the method of and apparatus for dredging sand, mud, silt, and other materials, and particularly to apparatus of this character wherein the dredging is accomplished by suction. Heretofore in such apparatus a suction pipe having a suction nozzle has been employed carried by a crane and adapted to be adjusted vertically toward and from the material to be dredged and laterally thereover, the pipe being provided with a flexible portion to permit such adjustment. The dredging has been effected by an induced current, tending to suck the material to be dredged into the suction nozzle and up through the pipe. Various well known devices are employed for creating this induced current or suction through the pipe, that most generally used being a centrifugal pump in connection with the suction pipe and adapted to create a powerful suction therethrough and discharge the material lifted at a predetermined place. The pump and crane in such apparatus are usually carried by a barge or other vessel adapted to be floated over the spot to be dredged, and to be advanced as the dredging proceeds. In dredging with such apparatus, great difficulty has been experienced in grasping and lefting the material to be dredged in sufficient proportion relative to the amount of water raised to the suction pipe, especially where the material has consisted of hard sand or mud, clay, or other firmly deposited or tenacious materials, and in such cases it has been necessary to adjust the suction nozzle into close proximity to the material in order to increase the velocity of the induced current at the nozzle sufficiently to loosen and raise the material. This adjustment causes a great resistance to the suction, and consequently throws a greater load on the suction pump. To obviate this difficulty, mechanical means, such as rotary cutters, have been employed to loosen the material adjacent to the suction nozzle, and for the same purpose hydraulic jets at the nozzle have been used.

My invention aims to provide an improved dredging apparatus which will be facile of and effective in operation, and by which the above described method of dredging may be availed of.

To this end, in carrying out my invention I construct my improved dredging apparatus in its preferred form with certain structural improvements in the apparatus for increasing its efficiency and convenience of operation, as will be more fully hereinafter set forth.

In the accompanying drawings, which illustrate the preferred form of my improved apparatus, Figure 1 is a vertical section of a dredging barge showing the working parts of the dredging mechanism in elevation. Fig. 2 is an enlarged fragmentary view of the mast and manipulating mechanism partially in section. Fig. 3 is a fragmentary elevation of the mast showing the tackle-drum and its driving gear partially in section. Fig. 4 is a cross-section thereof on the line 4—4. Fig. 5 is a fragmentary elevation of the mechanism for axially adjusting the suction pipe. Fig. 6 is a fragmentary plan partly in section of the gearing for oscillating the mast and the suction pipe carried thereby. Fig. 7 is an enlarged fragmentary axial section of my improved nozzle. Fig. 8 is an end view thereof. Fig. 9 is a diagrammatic view showing the preferred position of the nozzle in operation. Fig. 10 is a diagrammatic view showing in full lines the preferred initial position of the nozzle at the beginning of its stroke in one direction, and in dotted lines the initial position at the beginning of its stroke in the reverse direction.

Referring to the drawings, let A indicate a barge or other suitable provision for carrying the dredging apparatus, B the suction pipe as a whole, C a centrifugal pump connected to the pipe B for inducing the suction current therethrough, D the pivoted mast, E the boom carried thereby and supporting the suction pipe B, F a lifting tackle between the outer portion of the boom and the suction pipe for adjusting the latter relatively to the former, G a tackle between the outer part of the boom and the mast D for lifting the boom, H a drum on which the hauling falls of said tackles are wound to adjust the boom or the

suction pipe, I gearing for operating the drum H, J gearing for oscillating the mast D and its boom and the suction pipe, K a hydraulic jet nozzle, and L a pump for supplying water under pressure thereto. The bottom or material to be dredged is indicated at M.

The suction pipe B may be of any suitable construction, the form shown being preferred. In this construction it consists of a curved suction nozzle or passage *a* open at its outer end, a sheet metal pipe *c* extending thence upwardly and clamped to, and continuing in the form of, a flexible pipe *f* of any suitable material adjacent to the pump, and terminating in a metallic sleeve *g* to which the flexible pipe *f* is clamped, and which is itself connected to the inlet of the pump C. The suction nozzle *a* here shown is my improved integral combined suction nozzle and hydraulic jet nozzle, which is a feature of my invention, consisting of a casing K′ having an inner tubular passage or suction nozzle *a* and an outer inclosed chamber *b*, shown as entirely surrounding the nozzle *a* at its outer end in the form of an annular chamber, and extending thence upwardly and adapted at its upper end for connection with a water-pipe, and having outlet orifices at its lower end adjacent to the nozzle or passage *a*, and adapted when water is forced through said chamber to direct hydraulic jets against the material in front of the nozzle. Preferably the outlet orifices surround the open end of the suction nozzle *a*, and are staggered in direction to project their respective hydraulic jets outwardly past the nozzle in different directions against the material to be acted upon. The jet orifices *i* are shown in Fig. 7, as tubular projecting nozzles surrounding the mouth of the suction nozzle *a*, arranged at a sufficient distance apart to permit the necessary inflow to feed the suction. Preferably a flange *j* is provided at the upper end of the nozzle *a*, and the pipe *c* is fastened to the nozzle by a collar *j′* surrounding it and bolted to the flange *j*. A similar collar *j′* is preferably provided at the other end of the pipe *c*, and a like collar *j″* on the flexible portion *f* is clamped thereto to secure the pipes *c* and *f* together. At its other end the pipe *f* has a similar collar *j″*, which is clamped to a flange on the sleeve *g* in order to connect the latter and the pipe *f* together. The sleeve *g* is preferably a cast iron tube having an external flange *k* at its end adjacent to the pump C, fitting within a stuffing box *k′* on the latter and held in position in the said box by a divided gland *l* surrounding the sleeve and entering the stuffing box, and constructed to prevent the escape of the sleeve G therefrom, but to permit its axial adjustment therein. To prevent leakage, a packing *l′* is interposed within the stuffing box and between the gland *l* and flange *k*. By this construction the suction pipe can be adjusted vertically or swung laterally by reason of its flexible portion *f*, and can be adjusted axially by reason of the connection between its sleeve *g* and the pump C. The two first named adjustments are known, but the latter constitutes a novel feature of my invention, and is important in that by axially adjusting the suction pipe, its suction nozzle *a* can be presented to the material to be dredged with its mouth inclined to such angle relatively thereto as may be advantageous, and thereby the suction pipe may be utilized in dredging according to that feature of my improved method which consists in feeding the suction nozzle toward the material to be dredged with its mouth inclined from the horizontal and toward the material against which it is advancing.

Any suitable means for axially adjusting the suction pipe or its nozzle may be employed, but I prefer to use that shown, which consists of a segmental worm-gear N clamped around the sleeve *g*, and driven by a worm N′ carried on a shaft *m* having bearings in posts *m′*, and operating by a hand-wheel *m″*, as best seen in Fig. 5. By this construction the rotation of the worm oscillates the sleeve *g* on its axis, and this oscillation is communicated through the flexible pipe *f* and pipe *c* to the suction nozzle *a*, tilting the latter relatively to the material to be dredged.

Any suitable hydraulic jet nozzle may be provided which will serve to agitate or loosen the material to be dredged sufficiently adjacent to the suction nozzle, but I prefer to use my improved combined jet and suction nozzle before described. Any means for supplying pressure of water to the jet nozzle, or for communicating between the source of supply and the nozzle may be utilized, but for convenience and simplicity I prefer the construction shown in Fig. 1, wherein an ordinary force pump is employed for supplying the water under pressure, and communication between this pump and the jet nozzle K is afforded by a flexible pipe *n* and a metallic pipe *e*, the latter being preferably screwed into the upper end of the water chamber *b* through the flange *j*, closing the latter, and extending thence over and substantially parallel with the pipe *c* to and through the flange *j′* at the upper end thereof, where the pipe *n* is coupled to it in any suitable manner. By this construction the pipes *c* and *e* are fastened rigidly together in advantageous relative positions.

The mast D, boom E, tackles F and G, and the mechanism for manipulating them, and the suction pipe by means of them, are in general of well known principles of construction, but embody certain details constituting features of my invention. The mast is pivotally supported in a step *o* at the bottom, and retained by bearings *o′ o′* at intervals throughout its length, these bearings being carried by the framework P of the barge A. The boom E is pivoted to a bracket *p* carried on the mast, and extends thence outwardly nearly over the suction pipe B, which it supports from its outer end through the tackle F, be-

ing itself supported at this end by the tackle G from the upper part of the mast. The tackle G consists of a block q carried at the upper part of the mast, a block q' connected to the outer end of the boom E, and an intervening rope or fall r wound at its hauling end on the drum H and fastened at its standing end to the mast at r', whereby as the fall is wound upon or unwound from the drum, the boom is adjusted. The tackle F consists of a block s carried by the boom E, a block s' connected to the suction pipe, and a rope or fall t intervening between said blocks and wound upon the drum H. Preferably the connection between the block s' and the suction pipe consists of a pulley t' connected to the block, and a chain or cable u passing over this pulley and around the pipe c within an eye u' secured to the latter to prevent the displacement of the chain u. By this arrangement, as the suction pipe is axially adjusted, the chain u will travel slightly around the block t' without resisting the adjustment of the pipe. By running the hauling ends of the falls of both tackles to the drum H, a single drum can be utilized for operating both tackles.

I prefer to construct the drum H and the mechanism for operating it as shown in Figs. 2, 3 and 4. Here the drum is constructed of two halves or small drums v and v', both mounted on the same shaft Q, the one being fastened thereto and the other free thereon, and each drum being provided with a worm-gear R R driven by worms R' on vertical shafts S S carrying pinions S', each meshing with an internal spur-gear T rotatively mounted on the mast D, and constructed with an external bevel-gear meshing with and driven by a pinion mounted on a horizontal shaft T'. A U-shaped bracket x is fixed to the mast D and serves as a bearing for the shafts S S, incloses the worms R', and supports the shaft Q. A bracket x' is fixed to the mast D above the bracket x, and serves to support the spur-gear T thereon and to afford bearings for the upper portions of the shafts S. The shaft T' carries two loose belt-pulleys U U driven in opposite directions, and having clutch-teeth y y on their opposing hubs, and between these pulleys a clutch-sleeve U' is keyed on the shaft and constructed with clutch-teeth y' at its opposite ends, which when the sleeve is slid in one direction or the other engage with the teeth y of one or the other of the pulleys U, and thereby cause the shaft T' to rotate in one direction or the other according to which of the pulleys is engaged. When the sleeve is in the mid-position it is out of engagement with either pulley, whereby the shaft is then passive and free to rotate independently of the pulleys. A lever V engaging a peripheral groove in the clutch-sleeve is shown for operating the latter. The falls r and t of the respective tackle are preferably wound one on one of the halves v of the drum H and the other on the other half thereof.

The advantage of dividing the drum into two small drums is that each of the latter may carry one of the falls of the tackles thereby distributing the load on the drums and their driving worms and gearing so that half is carried by each and that the two drums can rotate slightly independently of each other to compensate for any irregularity or imperfection in their respective driving gears.

By using the spur-gear T and normally passive shaft T' their interchanging bevel-gears can be constantly in engagement during the oscillation of the mast D without altering the adjustment of the suction pipe, since as the mast oscillates and carries the spur-gear T with it the latter will simply rotate the shaft T' as it travels. It is desirable to have this constant engagement between the spur-gear T and shaft T' in order that at any position of the mast the suction pipe B may be adjusted immediately by throwing the clutch-sleeve U' into engagement to operate the drum H.

Any mast oscillating mechanism may be used, but I prefer the well known mechanism J shown in Figs. 1, 2 and 6. This is preferably constructed of a segmental worm-gear V' fixed to the mast D, a worm V'' meshing therewith carried on a shaft V''', which is provided with a beveled friction wheel X on its end. Opposite this friction wheel X is a driven shaft X' to which is keyed a sliding sleeve X'' having beveled friction wheels Y Y at its ends, which pulleys are adapted to engage respectively with the opposite sides of said friction wheel X, and thereby drive it in one direction or the other as the sleeve X'' is shifted to its extreme positions, and to be disengaged from said wheel when the sleeve is in the mid position. A lever Y' engaging a peripheral groove in the sleeve X'' serves for shifting the latter. By this construction the mast D, its boom and the suction pipe B can be conveniently oscillated laterally or can be adjusted to the desired position.

I will now describe the operation of the form of my improved dredging apparatus hereinbefore set forth when utilized to dredge according to the suction and jet method.

The dredge being properly located to act on the material to be dredged, the suction pipe B is lowered against the material by operating the drum H through its mechanism I until the suction pipe is properly adjusted, whereupon the operating mechanism I is thrown out of gear until further vertical adjustment of the suction pipe is desirable. The suction nozzle a is given the desired angle of inclination relatively to the material to be dredged by adjusting the suction pipe axially through the medium of the worm-gear N on its sleeve g. This adjustment is preferably such that the suction nozzle is inclined with its mouth toward the material to be dredged against which it is to be advanced during its lateral oscillation. The suction pump C and force pump L are each set in operation, and the dredging proceeds, the suction pipe being moved laterally by the mechanism J for oscil-

lating the mast D. At the limit of oscillation in one direction, the mechanism J is adjusted to reverse the motion of the mast and cause it to make the return stroke. At substantially the same time the position of the suction nozzle is reversed by axial adjustment of the suction pipe through the medium of the worm gear N, in order that the mouth of the suction nozzle shall be presented toward the material against which it advances on the return stroke.

It will be seen that my invention provides an improved apparatus which can be conveniently and effectively utilized in dredging. It will be understood that my improved dredging apparatus may be modified in certain of its structural features without departing from my invention which is not limited to the exact details of the the construction set forth herein as its preferred form.

What I claim is the following defined novel features and combinations, substantially as hereinbefore set forth, namely:

1. In a suction dredging apparatus, a stationary pump, in combination with a suction pipe adapted to dredge by an induced current and to be oscillated during dredging, constructed with a flexible member to permit said oscillation, and connected to said pump to permit its axial adjustment, and means for adjusting said pipe axially.

2. In a dredging apparatus, a stationary pump, in combination with a movable suction pipe communicating therewith adapted to dredge by an induced current, and consisting of a rigid pipe *c*, a flexible portion *f*, and a sleeve *g*, the latter connected to said pump by an oscillatory connection, whereby by oscillating said sleeve said pipe can be adjusted axially, and means for effecting said adjustment.

3. In a dredging apparatus, the suction pipe for dredging, in combination with a pivotally mounted mast, a boom carried thereby, tackle between the upper part of said mast and the outer portion of said boom for raising the latter, tackle connected to said suction pipe and carried by the outer portion of said boom for raising said pipe relatively thereto, and a drum carried by said mast and receiving the ropes of both said tackles, and adapted when driven to operate both the latter simultaneously, whereby in operation said pipe and boom are simultaneously moved at different speeds.

4. In a dredging apparatus, the suction pipe B adapted to be axially adjusted, in combination with the boom E for supporting said pipe, tackle F between said boom and pipe, pulley *t'* connected to said tackle, and chain *u* running over said pulley and around said pipe, whereby the axial adjustment of the latter is permitted.

5. In a dredging apparatus, the combination with the suction pipe B, pivoted mast D, boom E, and intervening tackle for supporting said boom and pipe, of drum H for the fall of said tackle, said drum constructed with worm-gear R, worm R' meshing with the latter, shaft S carrying said worm, pinion S' on said shaft, gear T meshing with said pinion, and normally passive shaft T' having gear meshing with said gear T and adapted normally to rotate freely therewith during the oscillation of said mast, and when driven to drive said gear T and drum H.

6. In a dredging apparatus, the pivoted mast D, brackets *x* and *x'* fixed thereon, in combination with a tackle operating drum H constructed of small drums *v v'*, worm-gears R R on said drums *v v'*, and worms R' R' engaging respectively with said gears for driving said drums.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

WALTER M. BAILEY.

Witnesses:
GEORGE H. FRASER,
CHARLES K. FRASER.