(No Model.)

A. B. BOWERS.

HYDRAULIC DREDGING APPARATUS.

No. 355,251. Patented Dec. 28, 1886.

Fig. 1.

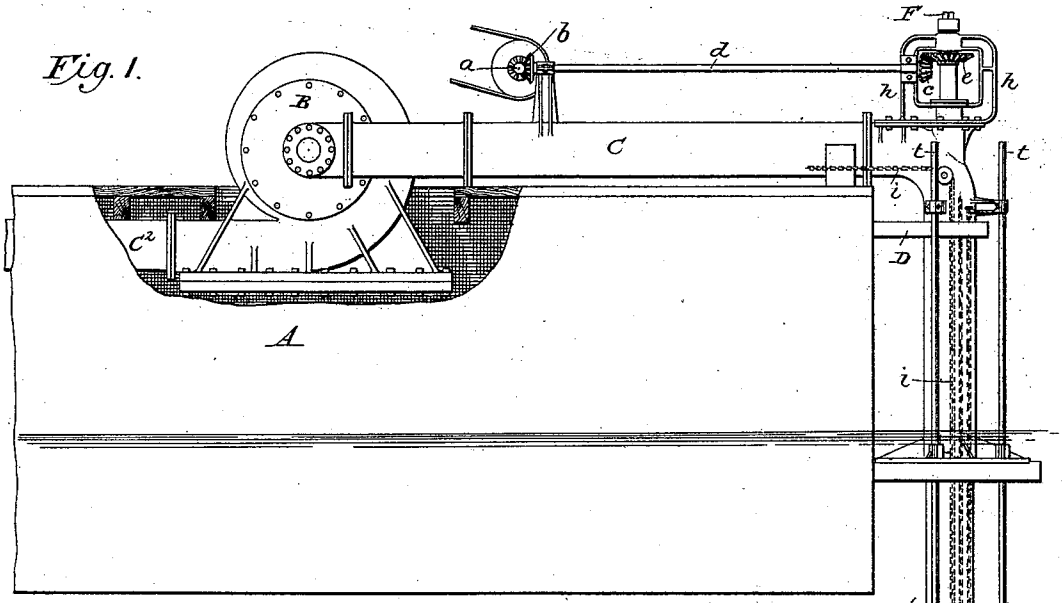


Fig. 2.

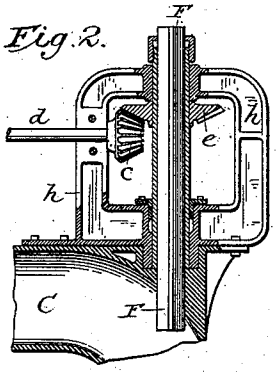


Fig. 5.

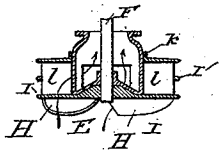


Fig. 9.

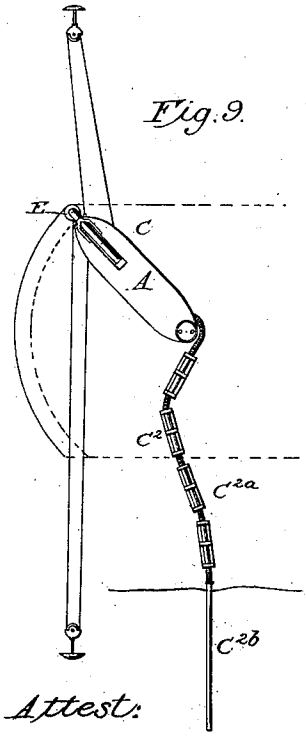


Fig. 6

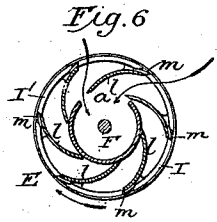


Fig. 3.

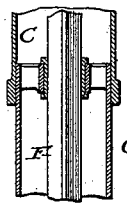


Fig. 7.

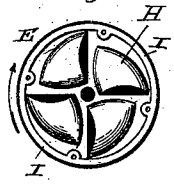
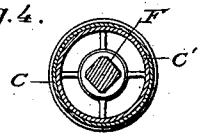
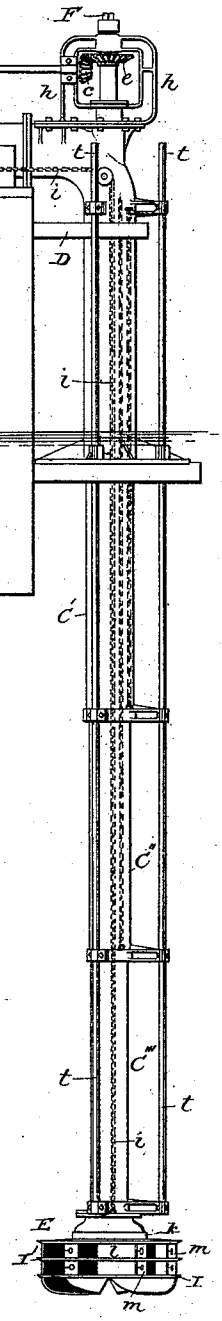


Fig. 4.



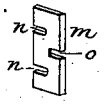


Attest:

Sidney P. Hollingsworth

W. A. Kennedy

Fig. 8.



Inventor:

A. B. Bowers.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

ALPHONZO B. BOWERS, OF SAN FRANCISCO, CALIFORNIA.

HYDRAULIC DREDGING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 355,251, dated December 28, 1886.

Application filed August 3, 1886. Serial No. 209,890. (No model.)

To all whom it may concern:

Be it known that I, ALPHONZO B. BOWERS, of San Francisco, California, civil engineer, have invented certain Improvements in Hydraulic Dredging Apparatus, of which this and the accompanying drawings form the specification.

It is a fifth division of the application filed December 9, 1876, being that portion shown in Figure 11 of the original drawings, and detailed in original Figs. 2, 3, 4, 5, 6, 7, 8, 9.

It consists, mainly, of a telescoping suction-pipe provided at its lower end with a hollow and usually rotary excavating device that delivers its spoil inward through itself to said pipe, said excavator being generally provided with detachable cutting-edges usually constructed and arranged to work with a side feed and swing in lateral planes, fenders to prevent said excavator from catching on obstructions, excavating devices on its lower end to cut downward as the excavator is lowered preparatory to each side swing, and devices to cut off or separate from the top and bottom the successive slices made by the side cutters, the excavator and pipe being constructed and arranged to be drawn up nearly even with and preferably above the bottom of the boat by which they are carried.

Fig. 1 is a side view of the suction-pipe, slide-rods, excavator, and actuating apparatus shown in Fig. 11 of the original drawings. Fig. 2 shows details of the upper bearings, glands, and actuating-gears of the excavator-shaft. Fig. 3 shows sectional details, and Fig. 4 a plan, of the intermediate bearings of said shaft. Fig. 5 shows the bearing at the lower end of the suction-pipe, the opening through which spoil is admitted to said pipe, and a part sectional and part side view of the excavator. Fig. 6 shows a side view of the middle ring-knife, I, and a cross-section through the side knives, vanes, suction-pipe, and excavator-shaft just below said ring. Fig. 7 is a view of the lower end of the excavator. Fig. 8 shows one form of side cutter. Fig. 9 is a reduced plan showing the pivot carried by the dredge-boat, appliances for swinging said boat on said pivot, the oscillating and non-oscillating sections of discharge-pipe, and the cut made by the excavator as it swings from side to side.

The figures show suitable devices for applying this invention; but I confine myself in no particular to the special devices shown, as each may be widely varied without departing from the principle or substance of said invention.

A is a floating hull capable of supporting the excavating, actuating, and discharging apparatus. It is provided with means for feeding forward, for swinging from side to side, and carries a pivot or center of oscillation, on which it so swings. It also swings, as occasion requires, on a secondary pivot or point, to which it may be connected by a cable or by a swinging section of discharge-pipe, being substantially the same in these respects as the hull, pivots, and swinging devices shown and described in Letters Patent Nos. 318,859 and 318,860, issued to me May 26, 1885, for the first and second divisions of the original application.

B is any exhausting and discharging device capable of drawing the spoil up the suction-pipe and sending it through the discharge-pipe to a place of delivery.

C is a suction-pipe provided with an elbow and telescoping section or sections, C'. It is also provided with stiffening slide-rods *t t t*, that pass through suitable slides or guides at the top and bottom of the elbow and at the lower end of each telescoping section, except the lowest, to the latter of which they are firmly secured by strong fastenings. These slide-rods are large and strong, to keep the telescoping sections of pipe and the bearings of the excavator-shaft in line and insure their easy working. The joints of the telescoping sections are placed below the surface of the water, to obviate the necessity for stuffing-boxes and packing. This pipe is also provided with a hollow (generally a rotary) excavator, that delivers its spoil inward through itself to said pipe. It is further provided with the chain *i*, secured to the lower end of the lowest telescoping section and passing over suitable sheaves to a hoisting device, by means of which it is raised and lowered in the process of dredging. Similar chains are attached to the lower ends of the intermediate telescoping pipes and to some suitable point above, to prevent said intermediate pipes from dropping out of the pipes above them.

C^2 is a discharge-pipe. It may be extended

by a series of sections flexibly joined together, as shown in Fig. 9, and fully explained in the patents for the first and second divisions hereinbefore specified, C^{2a} being the oscillating and C^{2b} the non-oscillating sections.

D is a strong frame for holding the elbow and telescoping pipes in a vertical position.

E is a hollow and usually a rotary excavator, that generally works with a side feed swinging in lateral planes and delivering its spoil inward through itself to the suction-pipe. It may be made in a great variety of forms, a rotary being the best for general work. It is usually provided with cutting devices to separate the slices made by the side cutters from the solid ground, the suction being rarely sufficient for this purpose. The form shown in this division is substantially the same as that shown in the patents of the first and second divisions, hereinbefore specified, and to which reference is again made. As herein shown, it consists of a strong ring, *k*, loosely fitting around the suction-pipe and generally provided with a broad brim or flange. From this ring, brim, or flange curved vanes *l* project downward to the disk or arm carried by the hub of the excavator, as shown in Fig. 7. Flared cutters H, or equivalent devices, project below this disk, to cut downward for each lateral swing. In making the necessary openings to admit the silt from said cutters said disk becomes changed to the form of a spider or series of arms that may be strengthened by a ring, I, forming a series of ties and braces, extending between said arms at or near their outer parts. This ring also severs from the bottom the slices cut by the vanes or by the knives *m*, while the brim or flange of the ring *k* performs a like office at the upper end of the excavator, the former being always a matter of much importance, and the latter almost equally important, when undercutting a high bank rising above the lower end of the telescoped pipes. The vanes *l* may consist, simply, of knives fastened to the lower ring, I, and to the ring or to the brim of the ring *k*, or to the ring I only when the ring *k* is omitted, or to the rings I and I′. These vanes may be stiffened, strengthened, and protected by such other rings I passing around, secured to, and preferably projecting beyond the cutting-edges of the knives or vanes. These rings are generally provided with beveled edges that cut like the revolving disk-colters of plows, and serve to subdivide the spoil and exclude substances too coarse to pass freely through to the place of delivery. They serve also as fenders to prevent the cutting-edges from catching against obstructions and getting broken, which, without these or equivalent devices, would be a continual source of expense and loss of time. The vanes may be made with sharp cutting-edges; or they may be armed with detachable steel knives of any suitable form or character, one form of which is shown in Fig. 8, the cutting-edge being beveled and the back slotted like the knives of a wood-planer, these slots *n* being for the reception of the bolts that hold it to the vane. Slots *o* are sometimes made in the cutting-edges into which fit the rings I, though these rings are not always used, and, when used, instead of one long knife, several short knives are sometimes preferable, one to each space between the rings. With exception of the detachable knives *m*, which are often omitted, (sharp-edged vanes being used instead,) the form of excavator here shown is usually cast in a single piece, the rings I being connected by webs to the backs of the vanes, as indicated in Fig. 6.

F is the driving-shaft of the excavator. It is here shown as passing from the hub of said excavator through a bearing in the lower end of the suction-pipe, up said pipe, out through the elbow, and through a gland in the hub, hollow shaft, or sleeve of the wheel *e*, by which it is actuated, this hub, hollow shaft, or sleeve being also provided with another gland, to make an air-tight connection with the suction-pipe. This shaft, when long enough to make it desirable, may be provided with intermediate bearings in the upper ends of the telescoping sections of pipe. Except at the lower bearing, this shaft consists of a smoothly-finished square rod, its angles well rounded, so as not to cut the packing in the gland of the hub, sleeve, or hollow shaft of the wheel *e*, through which it slides, and also to avoid the weakening that would otherwise be caused by sharp angles in the longitudinal aperture of said hub, sleeve, or hollow shaft. The intermediate bearings consist of small cylinders, running in suitable boxes connected by ribs with the upper ends of the pipes, Figs. 3, 4. These cylinders are provided with longitudinal apertures that fit the shaft, and through which said shaft slides freely, these bearings being similar to the hub of the driving-wheel, but much smaller and without its glands.

In this fifth division of the original application I claim—

1. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, and a hollow excavator constructed and arranged to deliver its spoil inward through its side to said pipe.

2. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, and hollow excavator constructed and arranged to deliver its spoil inward to said pipe, said excavator being provided with fenders to prevent its cutting-edges from catching against obstructions.

3. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, and a hollow excavator constructed and arranged to deliver its spoil inward through itself to said pipe, and having fenders to exclude substances too coarse to pass freely through to the place of delivery.

4. In combination, a dredge-boat, exhausting device, and telescoping sections of suction-pipe provided with freely-sliding devices for keeping the telescoping sections in line.

5. In combination, a dredge-boat, exhausting device, rotary excavator, and telescoping suction-pipe provided with sliding devices for keeping the sections of pipe and bearings of the excavator-shaft in line.

6. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, and a rotary excavator provided with fenders to prevent said excavator from catching against obstructions.

7. In combination, a telescoping suction-pipe and hollow rotary excavator provided with side cutters, and arranged to work with a side feed and deliver its spoil inward through itself to said pipe.

8. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, and a rotary excavator having side cutters supported by a hub, arms, and a ring arranged to deliver its spoil inward to the suction-pipe.

9. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, and a rotary excavator having side and end cutters supported by a hub, arms, and a ring, and arranged to deliver spoil inward through said ring to the suction-pipe.

10. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, and a rotary excavator having side cutting-edges, secured to a ring or to rings, and provided with a device for separating from the bottom the slices cut by said edges.

11. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, and a rotary excavator having side cutting-edges supported by a ring, or by rings, and provided with a device for separating from the earth above the slices cut by said edges.

12. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, and a rotary excavator having side cutting-edges constructed and arranged to completely sever from the unexcavated earth the slices made by said edges.

13. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, and a rotary excavator provided with detachable cutting-edges.

14. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, and a rotary excavator with inward delivery through itself to said pipe, said excavator being provided with detachable cutting-edges.

15. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, and a rotary excavator having detachable cutting-edges supported by a ring or by rings.

16. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, a hollow rotary excavator constructed with side cutters and arranged to work with a side feed and deliver its spoil inward through itself to said pipe, and a pipe consisting of a series of sections flexibly joined together for discharging the spoil.

17. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, and a swinging section of discharge-pipe flexibly joined to the boat and to an outer stationary section, to allow said boat to feed forward and said oscillating pipe to swing on the joint connecting the oscillating and non-oscillating sections.

18. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, rotary excavator, and a swinging section of discharge-pipe flexibly joined to the boat and to an outer stationary section, to allow said boat to feed forward and said oscillating pipe to swing on the joint connecting said oscillating and non-oscillating sections.

19. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, and a rotary excavator constructed with side cutters and arranged to work with a side feed and deliver its spoil inward through itself to said pipe, the latter being constructed to telescope sufficiently to bring the bottom of the excavator even with the bottom of said boat.

20. In combination, a dredge-boat, exhausting device, vertically-telescoping suction-pipe, and a rotary excavator having downwardly-projecting excavating devices provided with strengthening-braces to re-enforce the supports that carry said devices.

21. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, and a rotary excavator having downwardly-projecting excavating devices provided with a strengthening-ring to re-enforce the supports that carry said devices.

22. In combination, a dredge-boat, exhausting device, telescoping suction-pipe, rotary excavator having cutting-edges arranged to work with a side feed, and an oscillating section of discharge-pipe flexibly joined to the boat and to an outer non-oscillating section, to allow the boat to feed forward and the oscillating section to swing on the joint connecting the oscillating and non-oscillating sections.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

A. B. BOWERS.

Witnesses:
D. P. COWL,
WM. P. PATTON.