(No Model.)

6 Sheets—Sheet 1.

C. G. COLLINS.

DREDGING APPARATUS.

No. 501,870. Patented July 18, 1893.

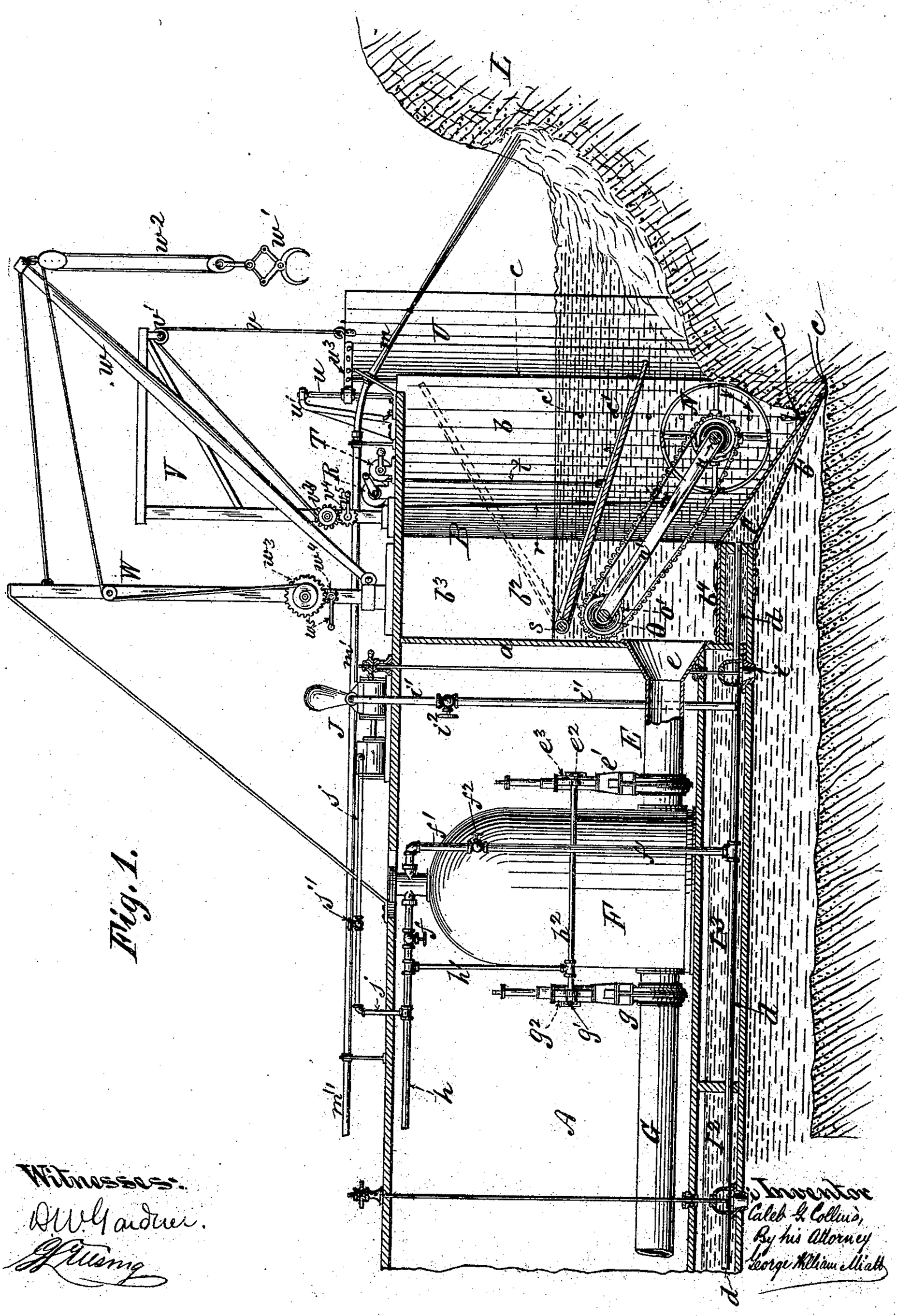

Fig. 1.

Witnesses:
D. W. Gardner.
J. Ewing

Inventor
Caleb G. Collins,
By his Attorney
George William Miatt

(No Model.)

6 Sheets—Sheet 2.

C. G. COLLINS.

DREDGING APPARATUS.

No. 501,870.

Patented July 18, 1893.

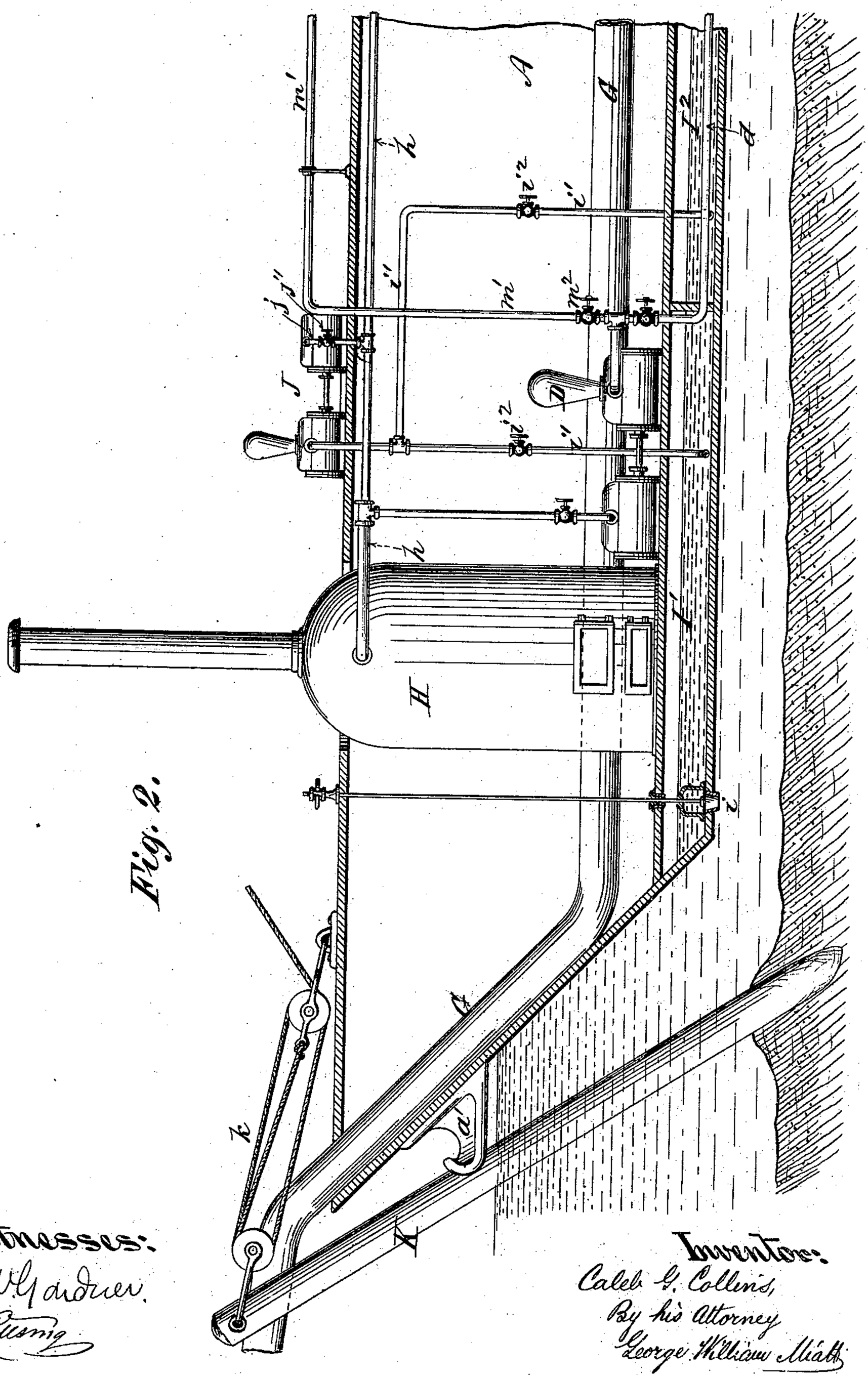

Fig. 2.

Witnesses:
D. W. Gardner.
G. Rüsing

Inventor:
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(No Model.)

6 Sheets—Sheet 3.

C. G. COLLINS.

DREDGING APPARATUS.

No. 501,870. Patented July 18, 1893.

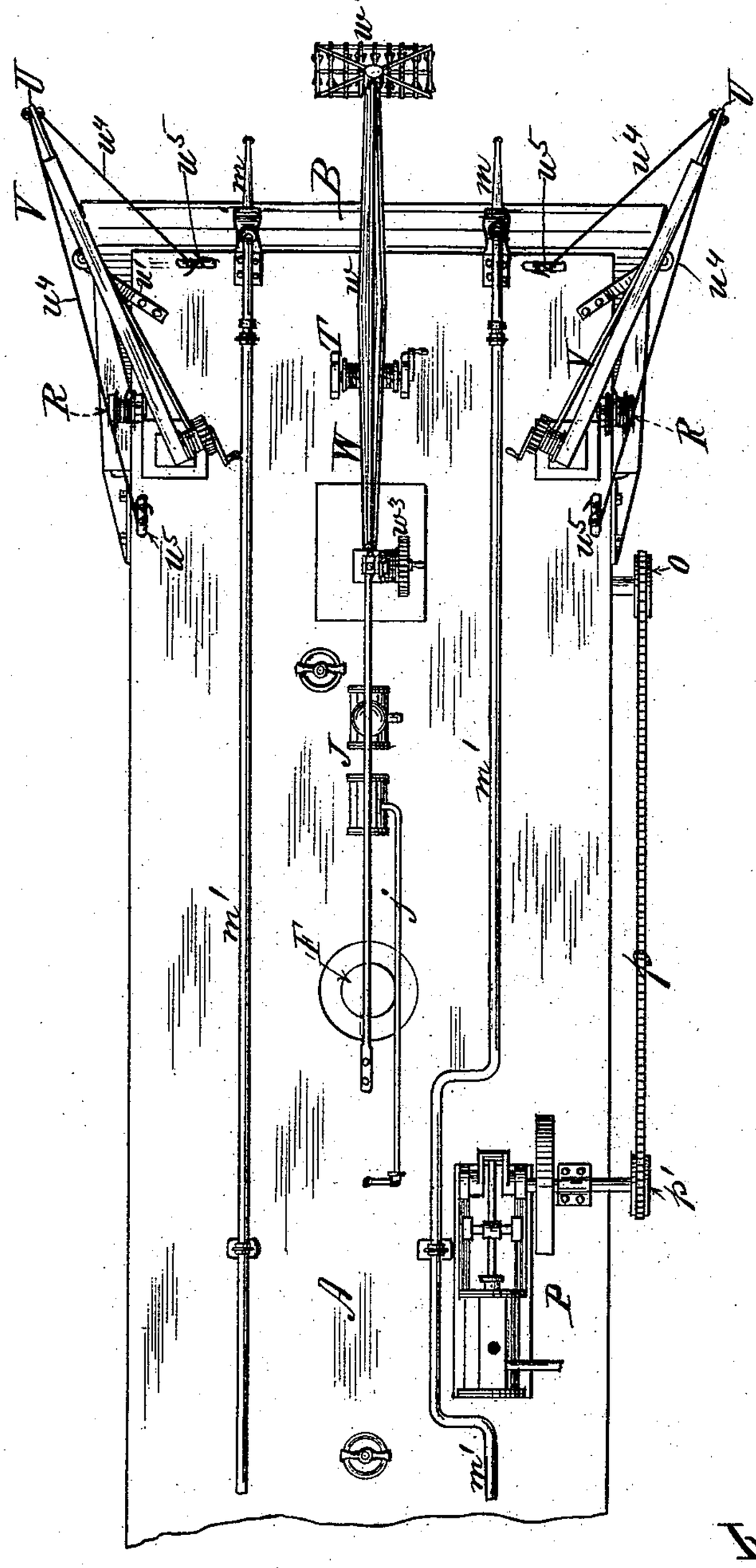

Fig. 3.

Witnesses:
D. W. Gardner,
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(No Model.)

6 Sheets—Sheet 4.

C. G. COLLINS.

DREDGING APPARATUS.

No. 501,870. Patented July 18, 1893.

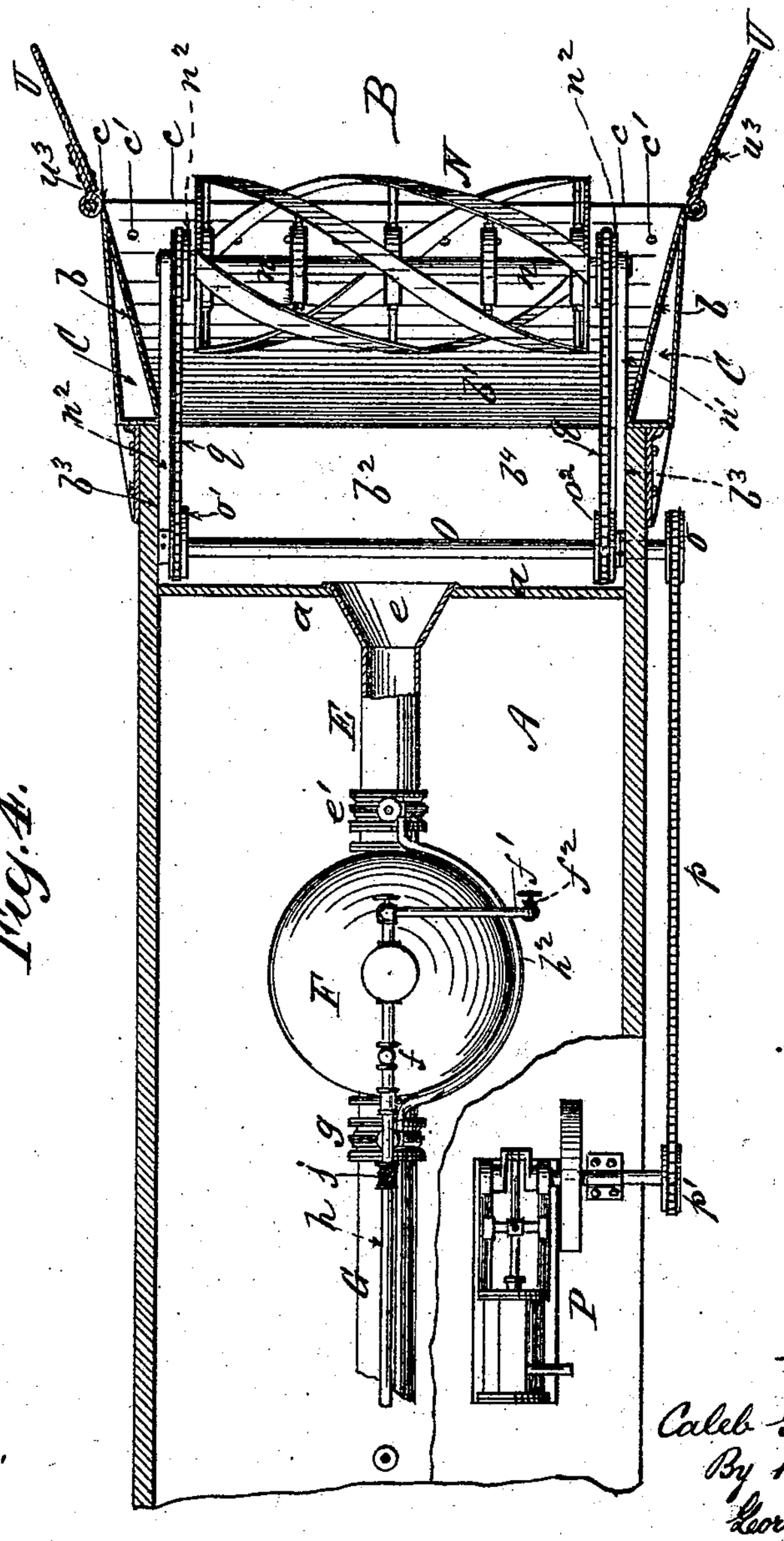

Fig. 4.

Witnesses:
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(No Model.)

6 Sheets—Sheet 5.

C. G. COLLINS.

DREDGING APPARATUS.

No. 501,870. Patented July 18, 1893.

Fig. 6.

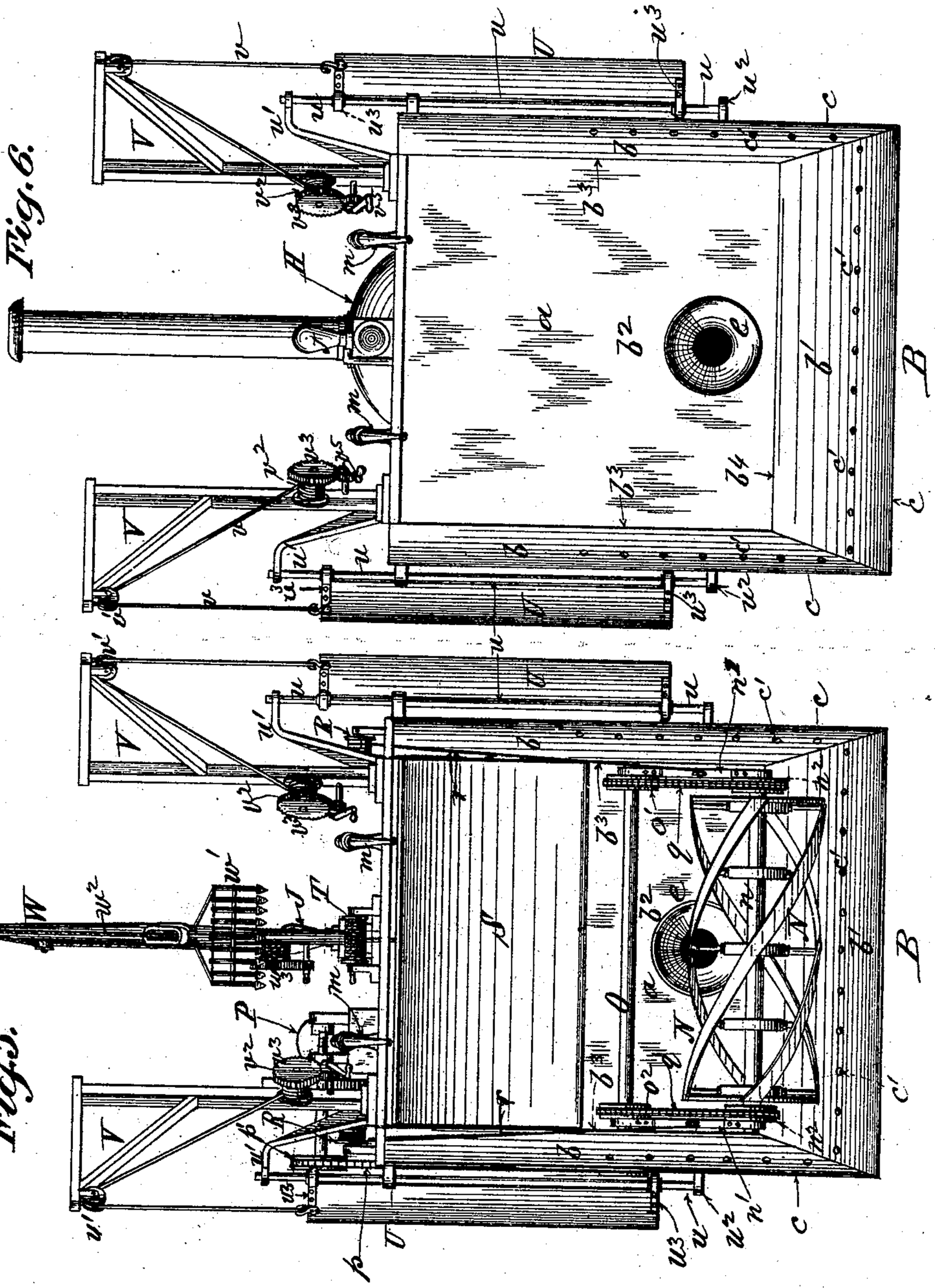

Fig. 5.

Witnesses:
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George William Meath

(No Model.)

6 Sheets—Sheet 6.

C. G. COLLINS.

DREDGING APPARATUS.

No. 501,870. Patented July 18, 1893.

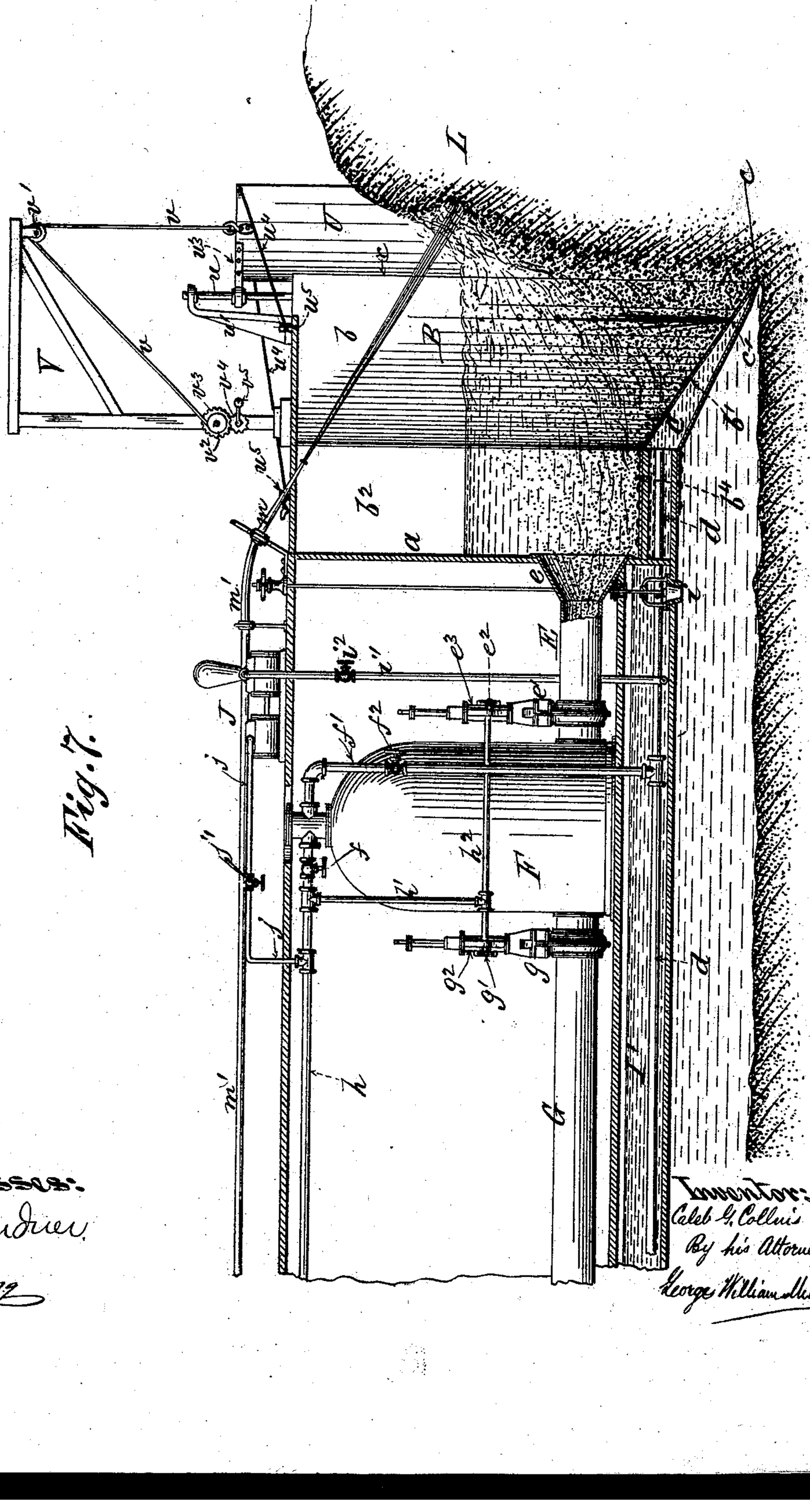

Fig. 1.

Witnesses:
D. W. Gardner.
[illegible]

Inventor:
Caleb G. Collins
By his Attorney
George William Mead

UNITED STATES PATENT OFFICE.

CALEB G. COLLINS, OF WOODSBURG, ASSIGNOR TO CALVIN AMORY STEVENS, OF NEW YORK, N. Y.

DREDGING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 501,870, dated July 18, 1893.

Application filed September 10, 1892. Serial No. 445,486. (No model.)

To all whom it may concern:

Be it known that I, CALEB GROZIER COLLINS, a citizen of the United States, residing at Woodsburg, in the county of Queens and State of New York, have invented certain new and useful Improvements in Dredging Apparatus, of which the following is a specification sufficient to enable others skilled in the art to which the invention appertains to make and use the same.

My improvements relate to the class of apparatus in which steam vacuum pumps are utilized in connection with the operations of dredging or excavating spoil, as in my application for patent dated May 27, 1892, Serial No. 434,534, in which case however ordinary means are resorted to for detaching and lifting the spoil, and the speed and capacity of the apparatus are limited thereby.

The distinguishing feature of my present invention consists in so constructing the bow of the vessel upon which the vacuum pump and other parts of the apparatus are mounted that it may be used to detach and receive the spoil and conduct it directly to the vacuum cylinder without the intervention of hoists, dippers, endless chains and buckets or other intermediate appliances heretofore resorted to. In fact the bow of the vessel itself acts as an enlarged scoop or shovel which digs into and under the spoil to be removed, the vessel being forced forward as the detached spoil is disposed of through the steam vacuum chamber by which it is expelled from the vessel. The practical advantages attained by this novel method of dredging or excavating are important. Great economy of labor is effected in the handling and disposal of the spoil, while the operation of the apparatus may be carried on continuously and much more rapidly than heretofore. A wide evenly graded floor or channel is left in the path of the apparatus which is a feature of special importance in certain kinds of work.

My invention also includes secondary features in the construction and arrangement of parts.

In conjunction with the scoop or shovel shaped bow I employ hydraulic jets for loosening up the spoil when necessary and washing it within the area of suction exerted by the steam vacuum cylinder. These jets are directed against the spoil from above to detach and start the spoil, and are also directed centrally from the inner sides of the scoop or shovel in order to agitate the spoil and forward it to the vacuum cylinder suction conduit in the most favorable condition for passage through the apparatus.

My invention also includes the employment of wings or extensions in connection with the scoop or shovel bow, which are utilized under certain conditions, to enlarge or contract more or less, as well as to inclose, the area covered by the bow, so that the loosened spoil may not escape but rather will be directed within the influence of the hydraulic jets and of the suction of the pump.

Another feature of my invention in this connection consists in an adjustable shield which is used where the spoil is to be removed from any considerable distance below the surface of the water,—the shield being for the purpose of excluding the main body of water above from the direct influence of the vacuum pump, and to deflect the inflowing currents of water, and concentrate them upon and among the loosened spoil. Taken in conjunction, these vertical wings or deflectors and the horizontal shield may be made to virtually control the character or consistency of the charges of spoil presented to the vacuum apparatus by excluding the exterior water more or less from the scoop bow.

I provide for submerging or raising the scoop bow with the rest of the hull, more or less, by means of water admitted to, or pumped from, suitable water compartments. I am thus enabled to accurately adjust the lower edge of the scoop bow against and under a bank of spoil to be removed, and to "trim" or balance the scoop bow and hull horizontally, a feature of importance when it is understood that my apparatus produces a finished evenly graded channel at one operation or passage.

When the nature of the spoil to be removed renders it desirable, I employ in conjunction with the scoop bow of the apparatus suitable grappling and hoisting mechanism for the extraction of heavy bowlders and possible obstructions from the spoil in front of

the scoop bow. This is for the removal of obstacles that cannot be broken up and reduced either by the hydraulic jets, or by the rotary cutter and agitator which I employ within the scoop bow when operating against earth of a compact, tenacious character. Ordinarily the powerful hydraulic jet directed over the scoop bow and against the material in front thereof is sufficient to reduce even the more refractory earths to a condition suitable for transmission through the vacuum apparatus; but if the spoil resists such treatment, or only partially yields to it, the revolving cutter positively detaches the material, breaks up the larger masses washed down by the hydraulic jet, and agitates the resulting admixture into a semi-liquid mass which is readily sucked in through the receiving conduit by reason of the vacuum within the chamber.

In the accompanying drawings I illustrate more or less diagrammatically the combination and construction of parts essential in operating under my invention, although I do not wish to confine myself strictly to any special form and arrangement, since various modifications may be made without departing from the spirit and intent of my invention.

Figure 1, is a sectional elevation of the front or bow end of the float or vessel upon which the operative parts of the apparatus are supported. Fig. 2, is a similar view of the rear portion of the same. Fig. 3, is a plan of the bow end of the vessel with parts arranged as shown in Fig. 1. Fig. 4, is a sectional plan of the bow end of the vessel, showing a portion of the deck and engine thereon for actuating the rotary cutter. Fig. 5, is a front view of the bow of the boat, with the rotary cutter and adjustable shield or deflector in place. Fig. 6, is a similar view in which the rotary cutter and adjustable shield are omitted. Fig. 7, is a sectional elevation of the bow of the boat arranged simply for the excavation of sand or other very light spoil.

The main body of the float, scow or other vessel A, upon which the operative parts are mounted may be of any ordinary or desired construction, the bow B, being the part which differs essentially from prior structures of this class. This bow B, beyond the bulk-head a, is constructed after the manner of a scoop or shovel, having outwardly flaring side walls b, b, and bottom b'. These bottom and side walls are preferably made of metal, and are double, so as to form a chamber C, between the metallic plates, which at the forward ends come together to form the comparatively sharp cutting edges c, c.

The space C, between the plates forming the shovel bow B, is sealed so as to create (excepting for the discharge openings c', c',) a water tight compartment into which water may be forced under pressure when desired, through a pipe or pipes d, from a pump D, shown in Fig. 2.

The funnel-shaped mouth e, of the suction pipe E, which leads to the vacuum cylinder F, opens through the bulk-head a, into the space between the side walls b, b, and bottom b', or into an extension b^2, thereof, as shown in the drawings, formed by the parallel side walls b^3, b^3, and bottom b^4, from which the flaring side walls b, b, and bottom b' extend outward and forward.

The vacuum chamber F, may be of any appropriate construction, preferably of that set forth in my last application for patent, Serial No. 445,070, filed September 5, 1892. It is provided with a discharge conduit G, extending usually to the rear of, and beyond, the vessel to the point of discharge, through which the spoil is ejected, and with an inlet gate valve e', and an outlet gate valve g. These gate valves e', g, are also preferably, though not necessarily, of the construction set forth in my last application above referred to, in which case they are operated by steam derived from a boiler H, (shown in Fig. 2) through the main steam supply pipe h, and branch pipes h', h^2, the steam being controlled, and the gates operated, through the medium of levers e^2, and f', connected with throttle valves attached to the steam cylinders e^3, and g^2. The main steam supply pipe h, also supplies steam, through the valve f, to the vacuum chamber F, which is supplied with water from the pump D, through the medium of the pipes d, and f', and valves f^2.

The function and operation of the vacuum apparatus is substantially as follows. A suitable quantity of steam having been admitted to the vacuum chamber through the valve f, the latter inclosed and the valve f^2, in the water pipe f', is opened admitting sufficient water to spray and condense the steam and thereby create a partial vacuum in the chamber F. The water valve f^2, being closed, steam is admitted to the cylinder e^3, through the throttle valve controlled by the lever e^2, in such manner as to raise the gate of the valve e', thus admitting water and spoil from the scoop B, the admixture being driven in by atmosphereic pressure to destroy the vacuum within the chamber F. The throttle valve to the steam cylinder e^3, is now reversed by means of the lever e^2, and the gate of the valve e', closed, when the throttle valve to the steam cylinder g^2, is turned by the lever g', to admit steam to raise the gate of the discharge valve g, and steam is again admitted to the upper part of the vacuum chamber through the valve f, in sufficient quantity to expel the charge through the discharge conduit G, when the gate in the discharge valve is closed, and the whole operation repeated.

It will be seen that the mouth e, of the suction conduit E, must necessarily be submerged more or less before the apparatus can be operated, and it is also necessary to submerge the whole vessel more or less in order to adjust the shovel bow B, to the requirements of the work to be done. This I accomplish by

increasing or diminishing the quantity of water in the compartments I′, I², I³, preferably arranged in the bottom of the vessel as indicated in the drawings, although they may be otherwise situated or arranged with like effect. Each compartment is provided with one or more valves *i*, for the admission of water, and with one or more suction pipes *i′*, *i′*, provided with valves *i²*, *i²*, and connected with a steam pump or pumps J, J, which latter are shown as operated by steam derived from the main supply pipe *h*, through the medium of the branch pipes *j*, *j*, and valves *j′*, *j′*. By the manipulation of these valves *i*, *i*, and the pump, J, J, the edge *c*, of the bottom *b′*, of the shovel bow B, may be made to impinge against the spoil to be removed at a greater or less depth, as may be desired; and by a plurality of such water compartments I′, I², I³, the barge or float may be trimmed or balanced to compensate for variations in the distribution of weight, &c., or changes in the tide, &c. It will be noticed by reference to Figs. 1, and 7, that the outward flaring of the bottom *b′*, of the shovel B, insures sufficient clearance of water space below the bottom of the vessel; and in a similar manner the flaring of the shields *b*, *b*, insures the clearance of the sides of the vessel, so that it is practicable for the apparatus as a whole to be forced through a solid bank of spoil, since the channel it excavates in advancing is wider than the body of the vessel, the sharp edges *c*, *c*, *c*, of the scoop alone coming in contact with the sides and bottom of the channel while in the act of creating it.

When engaged in the reduction and removal of mud, silt or sand and other spoil of a light nature the shovel bow may readily be advanced without the aid of various accessories desirable where compact material is to be removed, or where rocks, bowlders, and other obstructions are encountered. Thus in Figs. 6 and 7, I have shown the scoop-bow B, as adapted simply for the removal of sand, mud and other forms of spoil easily detached and mixed with water, whereas in the other figures ample provision is made for rendering the shovel-bow B, effective where the material to be removed is of a hard, tenacious character, and obstructions are to be encountered and removed.

The float or vessel A, and consequently the shovel-bow B, is forced forward by any suitable or well known means, and I do not confine myself in this respect to the means shown by way of illustration in the drawings, in which a spud K, is represented as driven into the ground below water at an angle in such position as to rest against a bearing *a′*, at the stern of the vessel A, so that by suitable tackle *k*, connecting the upper part of the spud with the vessel the upper end of the spud may be gradually hauled forward into a perpendicular position, thereby moving the vessel A, forward bodily and forcing the shovel bow into the spoil. In lieu of this contrivance hydraulic jacks or other appropriate means may be used to effect the advance of the float or vessel; and under certain conditions a screw propeller at the stern of the vessel would transmit sufficient power to force and hold the shovel bow to its position and work.

In connection with the scoop bow I employ one or more powerful hydraulic jets for the purpose of loosening and washing the spoil down into the shovel or scoop B, as indicated in Figs. 1, and 7, in each of which a stream of water is represented as directed against a bank of spoil L from a nozzle *m*, which is supplied with water under pressure by pump D, through the medium of the pipe *m′*, and valve *m²*. One or more of these hydraulic jets arranged above the spoil, either alone or in conjunction with the series of jets *e′*, which eject water under pressure from the sides and bottom of the shovel, are sufficient ordinarily to effect the disintegration of sand, mud and ordinary spoil, and its admixture with the water in sufficiently small portions to pass freely through the suction pipe of the vacuum chamber and discharge conduit. Where however the material to be reduced is more coherent and tenacious I employ a rotating cutter N, or similar device for positively detaching and disintegrating the spoil. This rotary cutter may consist of a series of blades or beaters arranged radially, or of blades or edges arranged spirally and longitudinally as in the drawings. It is arranged to rotate in the direction of the arrow in Fig. 1, so as to throw the matter as detached downward against and along the bottom of the shovel and toward the mouth *e*, of the suction pipe E. The rotating cutter N, is attached to a shaft *n*, mounted upon the outer ends of the arms *n′*, *n′*, which are pivotally connected at their inner ends with the shaft O, mounted in the side walls *b³*, of the scoop B. This shaft O, which is mounted in stationary bearings, is provided with a sprocket wheel *o*, which is connected by the endless sprocket chain *p*, with the sprocket wheel *p′*, which derives its motion from a steam engine P, or other source of power. The counter shaft O, carries two other sprocket wheels *o′*, *o²*, which transmit the motion of the said countershaft O, to the cutter shaft *n*, through the medium of the chains *q*, *q*, which engage with the sprocket wheels *n²*, *n²*, on the cutter shaft *n*. It will thus be seen that the shaft *n*, and cutter N, may be raised and lowered upon the countershaft as a fulcrum without interfering with their rotation. This may be accomplished by a simple hoist consisting of a rope *r*, and windlass R, or by other suitable or well known means. I am thus enabled to raise or lower the rotating cutter along the face of the material to be removed, and to thereby quickly and conveniently detach and reduce the most refractory earths to a condition in which they can be passed through the vacuum apparatus.

A shield S, is pivotally supported between

the side walls b^3, b^3, of the scoop B, above the counter shaft O. This shield can be raised and lowered upon its pivots by a rope t, and hoist T, or equivalent mechanism, and is designed to exclude the body of water above it from the space below, so that the main body of water rushing in to take the place of that drawn in through the mouth e, of the suction pipe E, must necessarily pass over, around and through the rotating cutter N, thereby preventing the escape of detached spoil and aiding in its comminution. Were it not for the use of this adjustable shield in cases where the spoil is heavy and difficult to move, the vacuum pump would suck in and transfer such a large proportion of water as to render the operation wasteful both of time and power. Of a similar character to the horizontal shield S, are the vertical side wings U, U, pivotally supported upon the vertical guide rods u, u, extending between brackets u', u', u^2, u^2, secured to the hull. The side wings are secured to the guide rods u, u, by straps u^3, u^3, or other devices which will admit of the raising or lowering of the wings and of their being turned at angles with relation to the side walls b, b, of the scoop bow B. The wings U, U, are adjusted and held in position vertically by means of suitable hoisting mechanism, that shown in the drawings consisting of a suspender rope v, which passes over sheave v', upon the crane V, and from thence to the windlass v^2, which is operated by the spur wheel v^3, pinion v^4, and crank v^5. The desired inclination of the wings U, U, with relation to the sides of the shovel is effected and maintained by means of stays u^4, u^4, which are belayed to cleats u^5, u^5. The wings may thus be readily adjusted both vertically and laterally to the varying requirements of actual use, the object being to regulate the area brought under the influence of the currents of water flowing inward toward the suction pipe e, E, and to cause such currents to do effective work in carrying into the shovel spoil that would otherwise settle outside of it. The vertical adjustment of the wings U, U, permits of their lower edges being kept in contact with the higher parts of the spoil in front of the edges c, of the side walls b, so that the wings supplement the shield S, in excluding superfluous water from the scoop B.

A derrick W, may be mounted upon the deck above the scoop bow B, when the apparatus is to be used in situations in which bowlders and other possible obstructions are liable to be encountered. In such case a "clam shell" dredge, or grappling tongs w', or an equivalent device, is suspended from the boom w, of the derrick W, by the rope w^2, and is raised and lowered to dispose of obstacles too large for the vacuum apparatus by means of the winding apparatus represented by the spur wheel w^3, pinion w^4, and crank w^5.

It is obvious that if desired the scoop bow B, and the hull A, may be made large enough to accommodate two or more distinct vacuum cylinder systems having suction pipes E, e, opening into a common shovel, and that thus a comparatively wide channel can be advantageously excavated by a single passage of the apparatus. The scoop-bow leaves the bed of the channel finished and graded.

While the apparatus may be used effectively without the water compartment C, in the bottom and sides of the scoop B, the jets c', c', are very useful in effecting a thorough reduction of the spoil, to a semi-fluid condition, prior to its entrance into the mouth e, of the suction pipe E.

Instead of the water jacket C, formed with the perforations c', c', it is obvious that a series of pipes or nozzles may be substituted and arranged to thus inject jets of water under pressure laterally into the scoop B, with a like result.

I am aware that it has been proposed to build a pocket or compartment in front of the bulk head of a dredge for the reception of spoil which is to be dumped therein from ordinary dredging appliances, as in Patent No. 479,375, issued to J. M. Miller July 19, 1892, in which it is also proposed to use vacuum pumps for discharging the spoil. This however is not the equivalent of my invention in which ordinary dredging appliances are dispensed with and my scoop bow detaches and receives the spoil under the water line. The scoop bow is in no sense a pocket, since it is entirely open in front, and its front edges are formed and designed to penetrate the material to be removed.

The horizontal shield S is described hereinbefore as compelling most of the water drawn in to pass through and around the rotary cutter N, but I do not confine myself to its use in conjunction with the cutter. It can be used equally as well where the cutter is not wanted, as in mud, silt, and sand, in which case it may be used to contract the entrance to the lower part of the scoop in such manner that the water in seeking entrance will be compelled to carry with it a large proportion of the spoil between the outer end of the shield and the bottom of the scoop.

I am aware that in forming subterranean tunnels the idea of pumping diluted material from in front of a sealed excavating shield is old. My invention however relates exclusively to dredging and excavating operations performed in, and under the surface of the water, and the parts employed are incorporated in a portable dredge boat. I do not seek to cover broadly the feature of pumping in spoil from an excavating shield through a sealed partition; but

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A dredge boat formed with an open scoop bow in front of its bulk-head, with a pump having a suction pipe opening into said scoop bow through said bulk-head and with means for forcing the float forward substantially in the manner and for the purpose described.

2. A dredge boat formed with an open scoop bow in front of its bulk-head having sides and bottom flaring outward so that the front edges of the scoop bow will cut a channel wider and deeper than the hull of the boat with a pump having a suction pipe opening into said scoop bow through said bulk-head, and with means for forcing the float forward substantially in the manner and for the purpose described.

3. In a dredge boat the combination of a scoop bow in front of the bulk-head, a pump formed with a suction pipe opening into said scoop bow through said bulk-head, a water compartment formed in the walls of said scoop bow, the inner walls of said scoop bow formed with perforations which open into said water compartment means for supplying water under pressure to said water compartment, and means for forcing the boat forward substantially in the manner and for the purpose described.

4. In a dredge boat, the combination of a scoop bow formed in front of the bulk-head, a pump with a suction pipe opening through said bulk-head into said scoop bow, means for injecting jets of water laterally into said scoop bow, and means for forcing the boat forward for the purpose and substantially in the manner described.

5. In a dredge boat, the combination of a scoop bow formed in front of the bulk-head, a pump with a suction pipe opening through the said bulk-head into the said scoop bow, one or more water tight compartments formed in the hull of the boat, means for admitting or discharging water from said water tight compartments, and means for forcing the boat forward, substantially in the manner and for the purpose described.

6. In a dredge boat, the combination of a scoop bow formed in front of the bulk-head, a pump with a suction pipe opening through the said bulk-head in to the said scoop bow, vertically adjustable wings or extensions attached to the exterior side walls of the said scoop bow, and means for forcing the boat forward, for the purpose and substantially in the manner described.

7. In a dredge boat, the combination of a scoop bow formed in front of the bulk-head, a pump with a suction pipe opening through the said bulk-head into the said scoop bow, wings or extension pieces attached to the exterior side walls of the said scoop bow, means for adjusting the angle of the said wings or extension pieces with relation to the sides of the scoop bow, and means for forcing the boat forward, for the purpose and substantially in the manner described.

8. In a dredge boat, the combination of a scoop bow formed in front of the bulk-head, a pump with a suction pipe opening through the said bulk-head into the said scoop-bow, a horizontal shield within the scoop bow for separating the water above from the lower portion of the scoop, and means for forcing the boat forward, substantially in the manner and for the purpose described.

9. In a dredge boat, the combination of a scoop bow formed in front of the bulk-head, a pump with a suction pipe opening through the said bulk-head, into the said scoop bow, a horizontal shield pivoted within the scoop bow, means for adjusting the said pivoted shield vertically, and means for forcing the boat forward substantially in the manner and for the purpose described.

10. In a dredge boat, the combination of a scoop bow formed in front of the bulk-head, a pump with a suction pipe opening through the said bulk-head into the said scoop bow, a horizontally rotating cutter within the scoop bow, means for forcibly rotating the said cutter and means for forcing the boat forward, substantially in the manner and for the purpose described.

11. In a dredge boat, the combination of a scoop bow formed in front of the bulk-head, a pump with a suction pipe opening through said bulk-head into said scoop bow, a horizontally rotating cutter within the scoop bow, means for forcibly rotating the said cutter, means for adjusting the said cutter vertically, and means for forcing the boat forward substantially in the manner and for the purpose described.

12. In a dredge boat, the combination of a scoop bow formed in front of the bulk-head, a pump with a suction pipe opening through said bulk-head into said scoop bow, means for projecting jets of water under pressure from above the said scoop bow against the material in and in front of the said scoop bow, and means for forcing the boat forward substantially in the manner and for the purpose described.

13. In a dredge boat, the combination of a scoop bow formed in front of the bulk-head, a pump with a suction pipe opening through said bulk-head into said scoop bow, a grapple and hoist for raising obstructions out of the scoop bow, and means for forcing the boat forward, substantially in the manner and for the purpose described.

CALEB G. COLLINS.

Witnesses:
D. W. GARDNER,
GEORGE WILLIAM MIATT.