(No Model.) 6 Sheets—Sheet 1.

L. HUSSEY.

STEAM VACUUM DREDGER.

No. 523,838. Patented July 31, 1894.

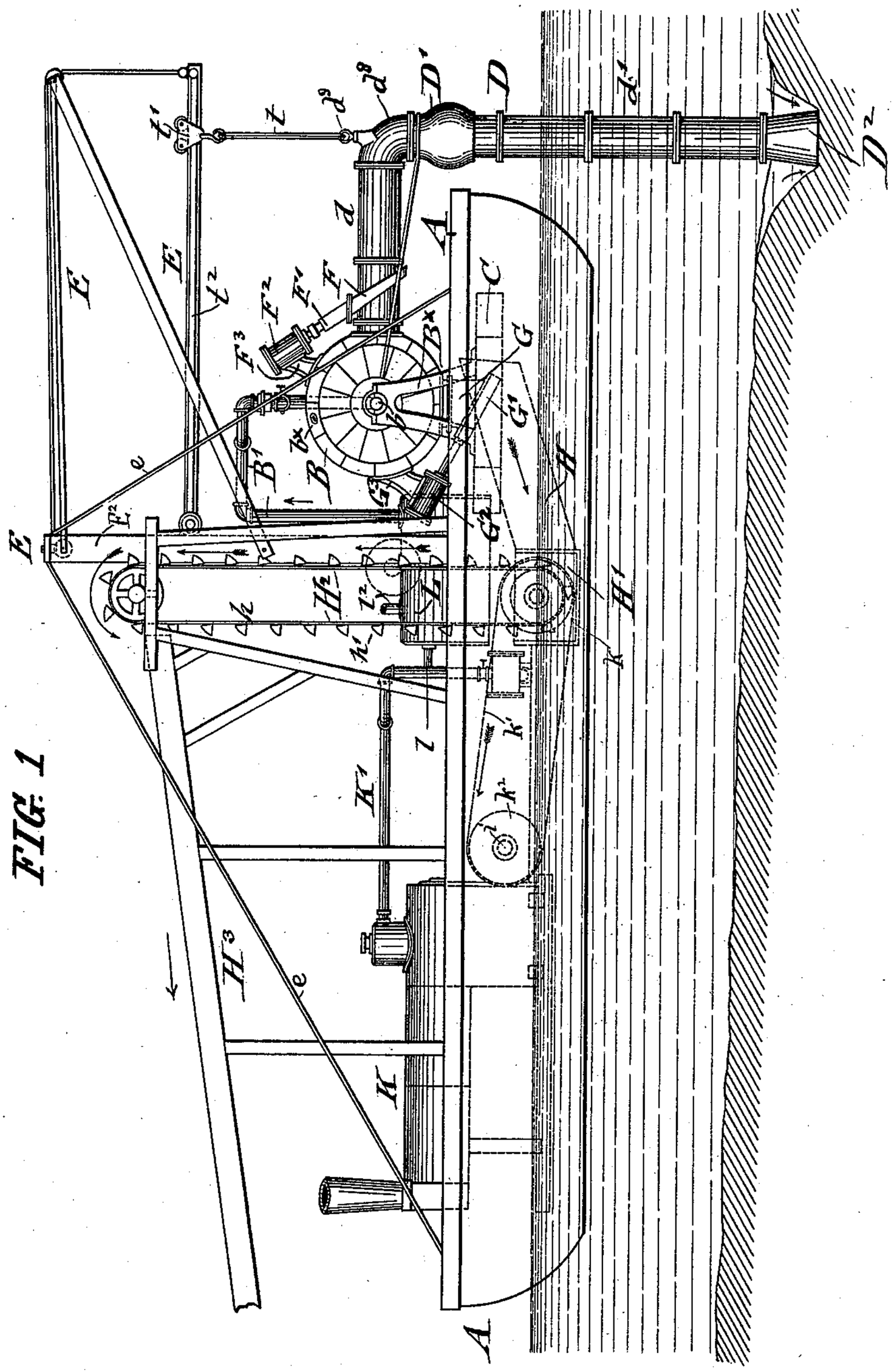


FIG. 1

WITNESSES:
Charles Schroeder
Charles Bles.

INVENTOR
Levi Hussey
BY Lowe & Kaegener
ATTORNEYS.

(No Model.) 6 Sheets—Sheet 2.

L. HUSSEY.

STEAM VACUUM DREDGER.

No. 523,838. Patented July 31, 1894.

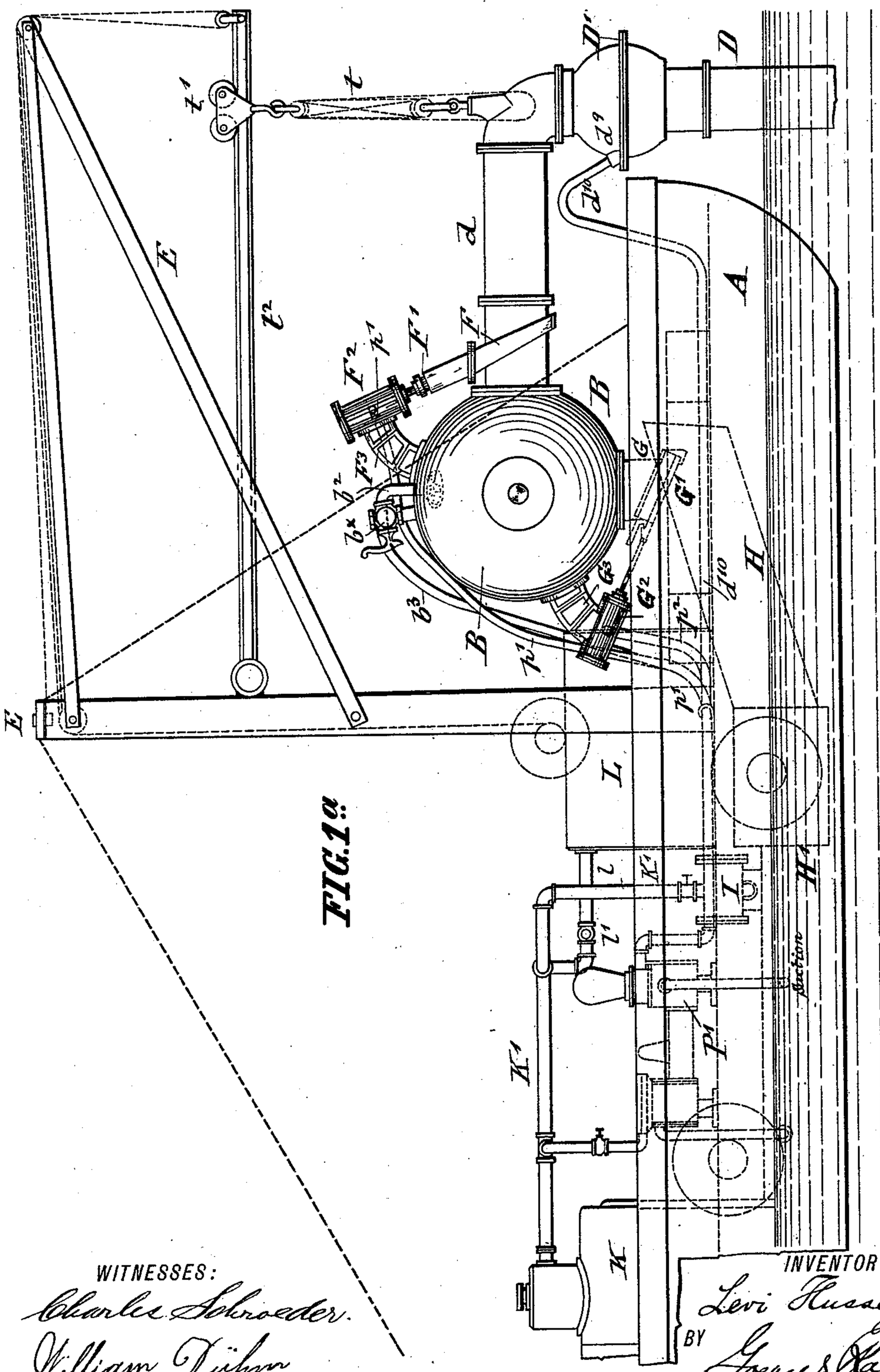


FIG. 1.

WITNESSES:
Charles Schroeder.
William Dühn

INVENTOR
Levi Hussey
BY Goepel & Kaegener
ATTORNEYS.

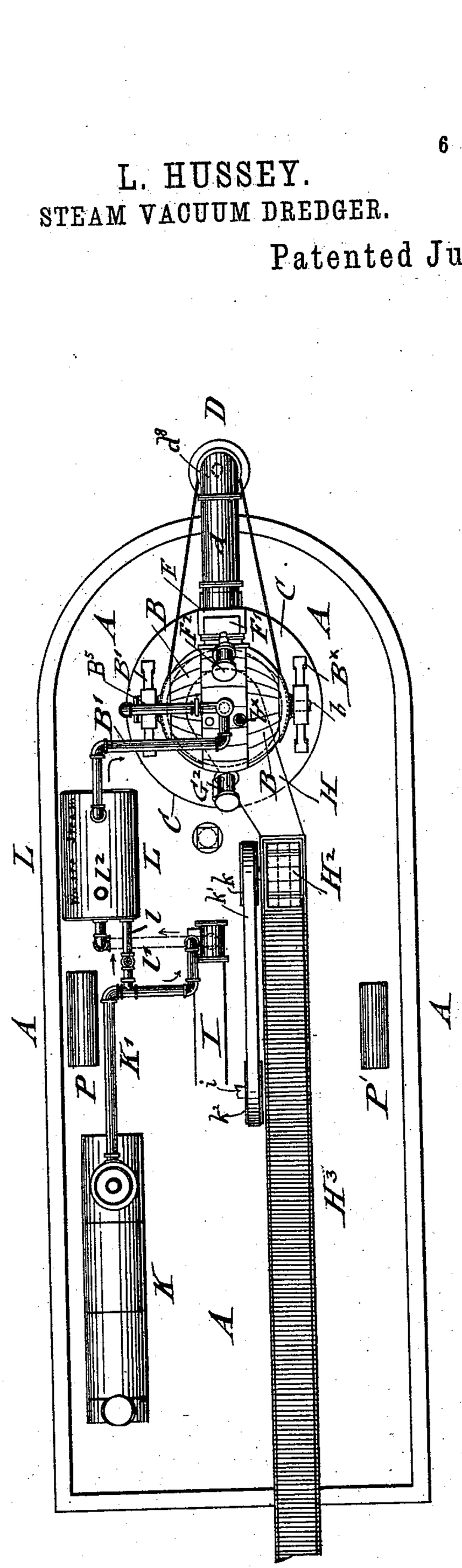
(No Model.) 6 Sheets—Sheet 3.

L. HUSSEY.

STEAM VACUUM DREDGER.

No. 523,838. Patented July 31, 1894.

FIG. 2



WITNESSES:

Charles Schroeder

Charles Bles.

INVENTOR

Leo Hussey

BY Geo. H. Graves

ATTORNEYS.

(No Model.)

6 Sheets—Sheet 4.

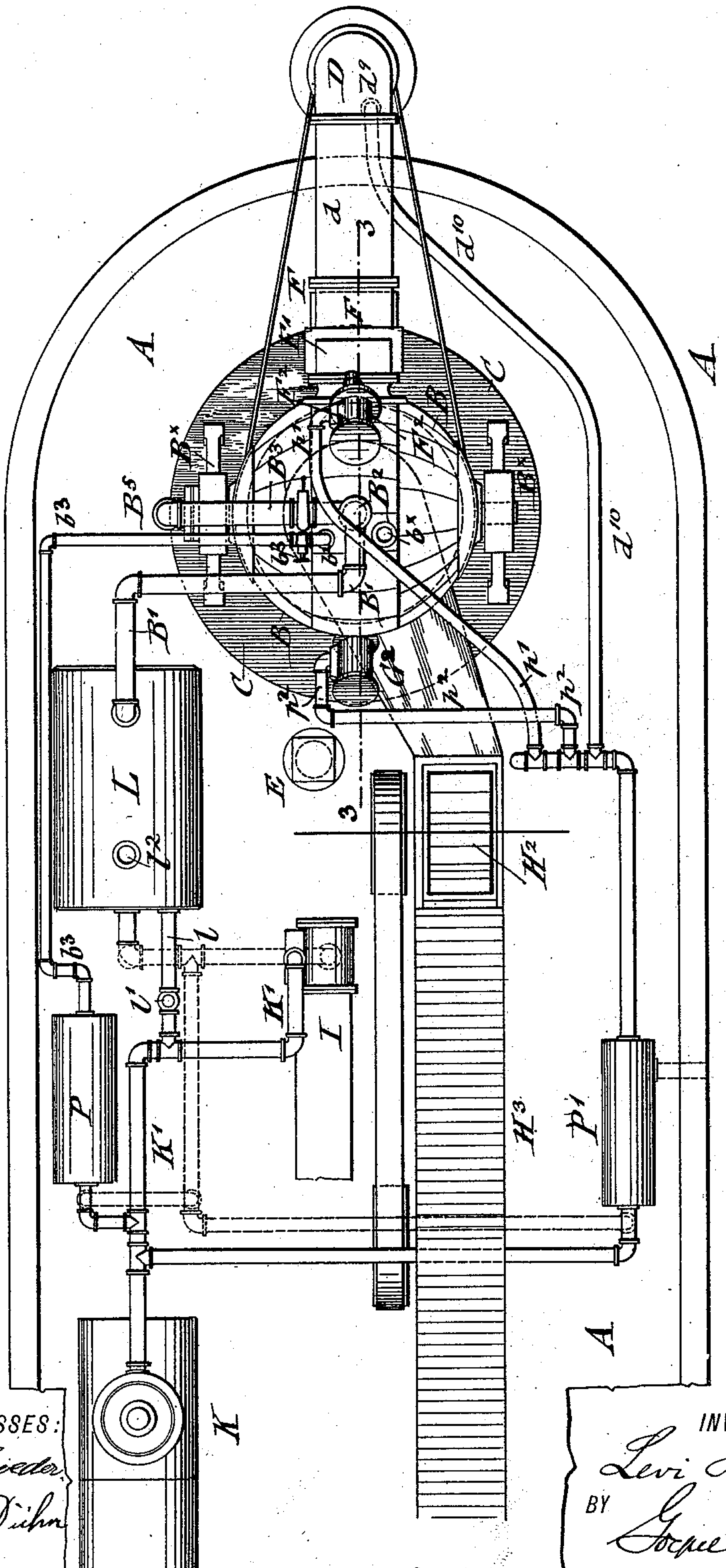
L. HUSSEY.

STEAM VACUUM DREDGER.

No. 523,838.

Patented July 31, 1894.

FIG. 2ª



WITNESSES:

Charles Schroeder

William Diehn

INVENTOR

Levi Hussey

BY

Goepel & Raegener

ATTORNEYS.

(No Model.)

6 Sheets—Sheet 5.

L. HUSSEY.

STEAM VACUUM DREDGER.

No. 523,838. Patented July 31, 1894.

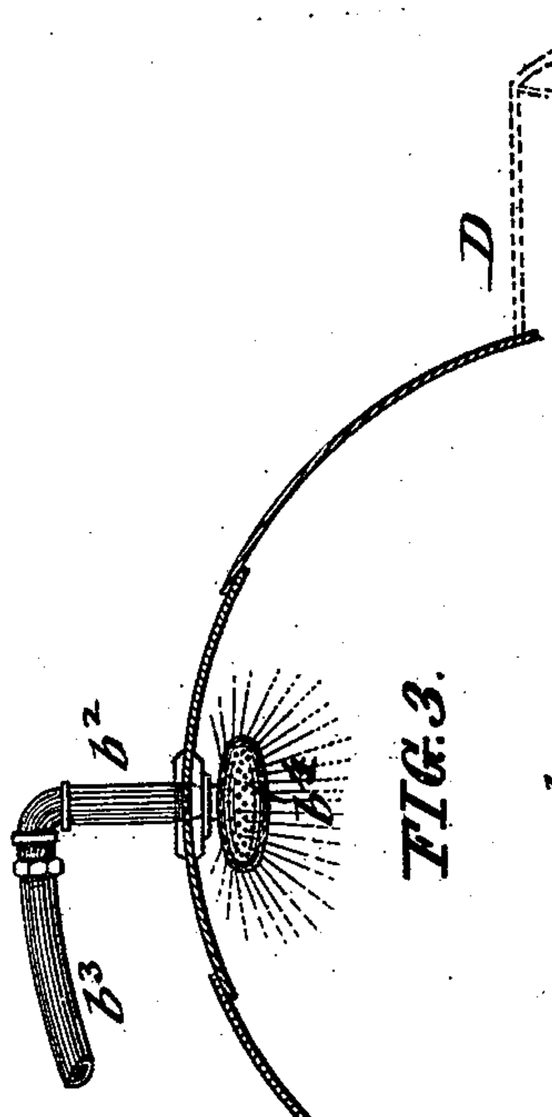


FIG. 3.

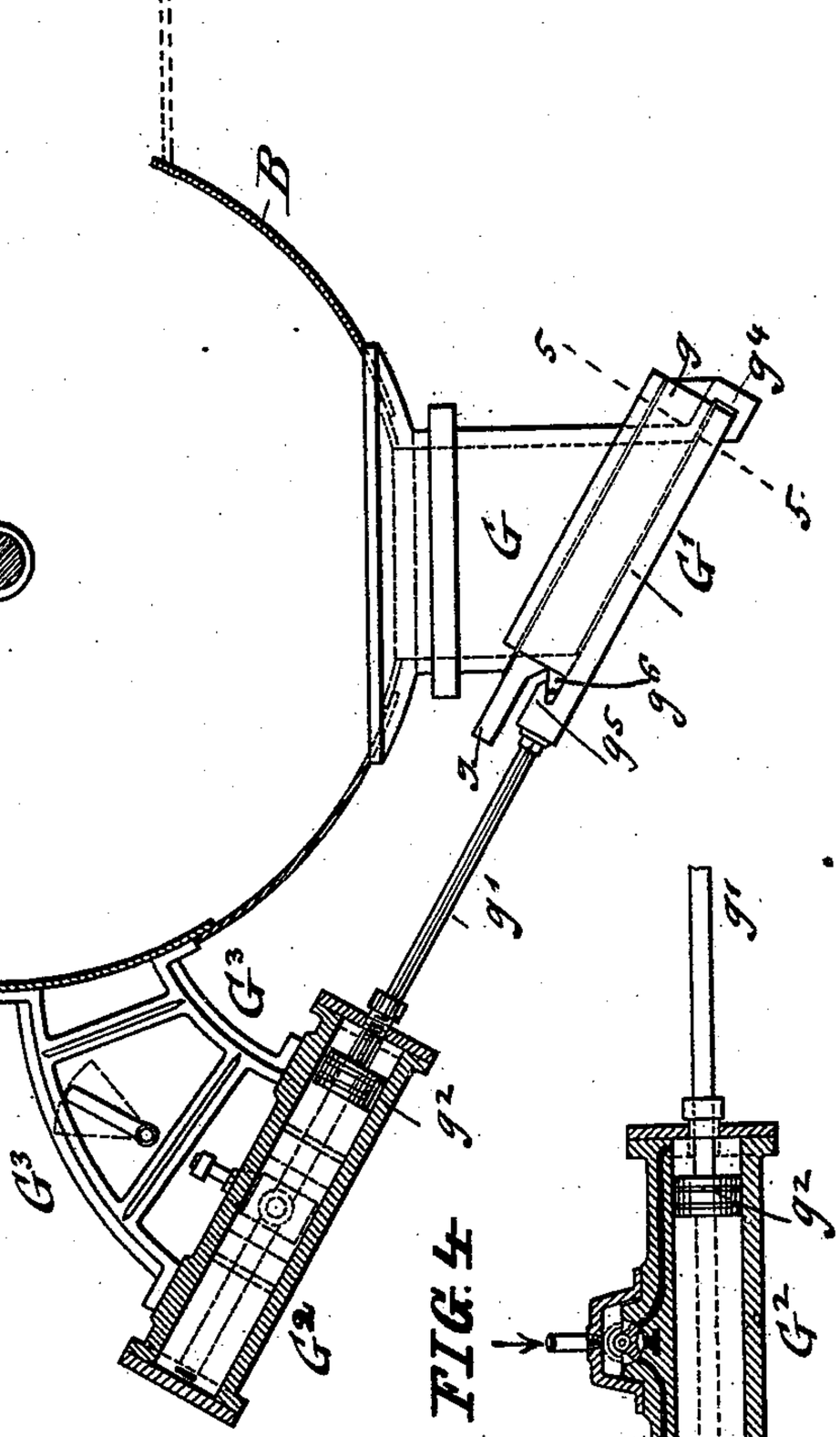


FIG. 4.

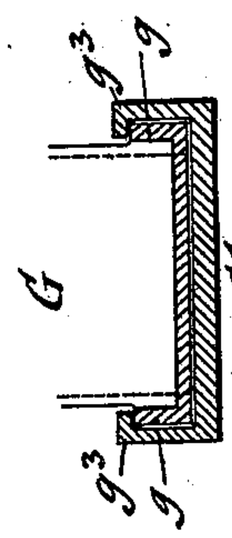


FIG. 5.

WITNESSES:
Charles Schroeder
Charles Bles.

INVENTOR
Levi Hussey
BY Foster & Freeman
ATTORNEYS.

(No Model.) 6 Sheets—Sheet 6.

L. HUSSEY.

STEAM VACUUM DREDGER.

No. 523,838. Patented July 31, 1894.

FIG. 6

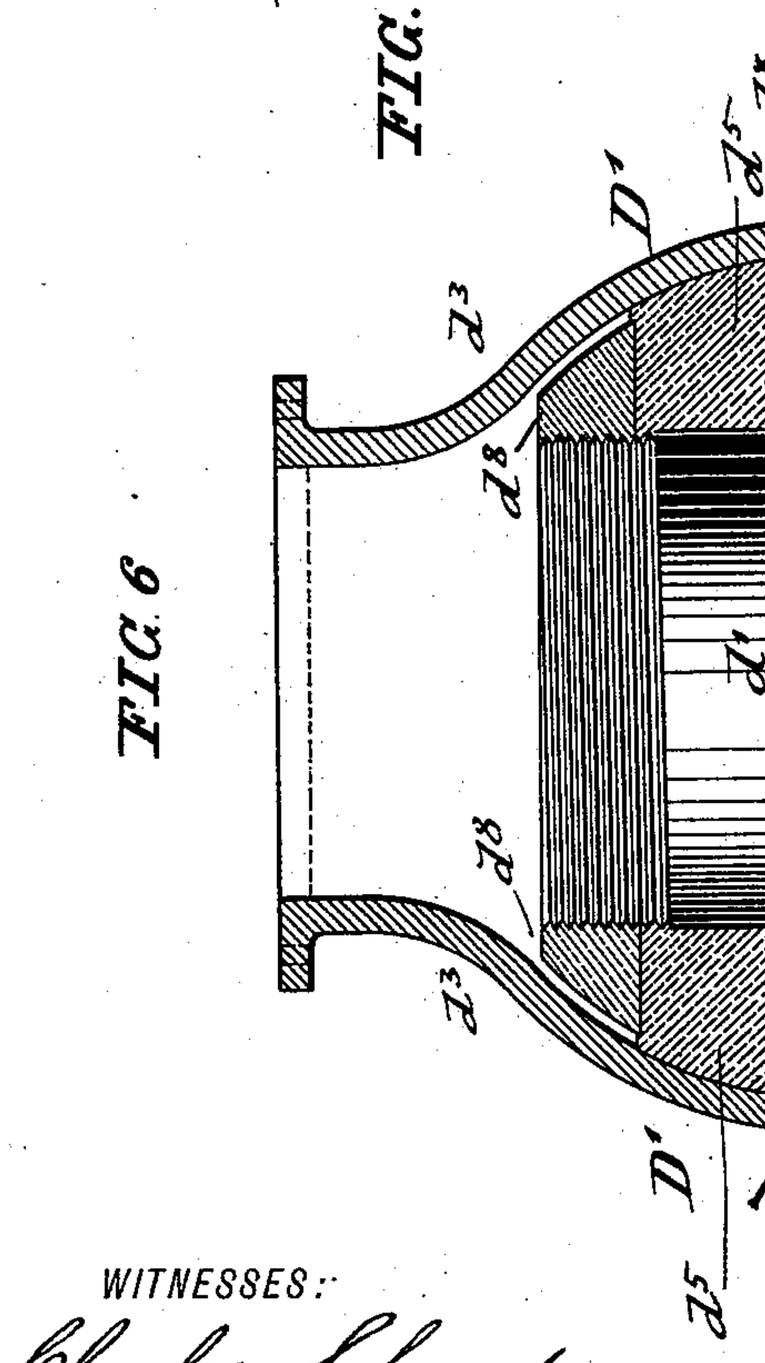


FIG. 7

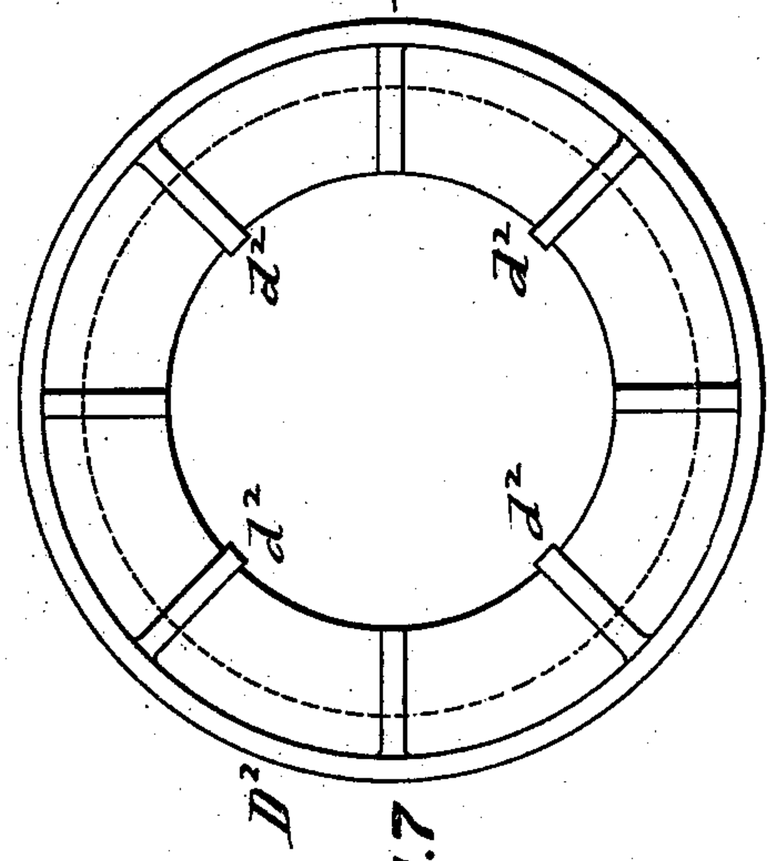
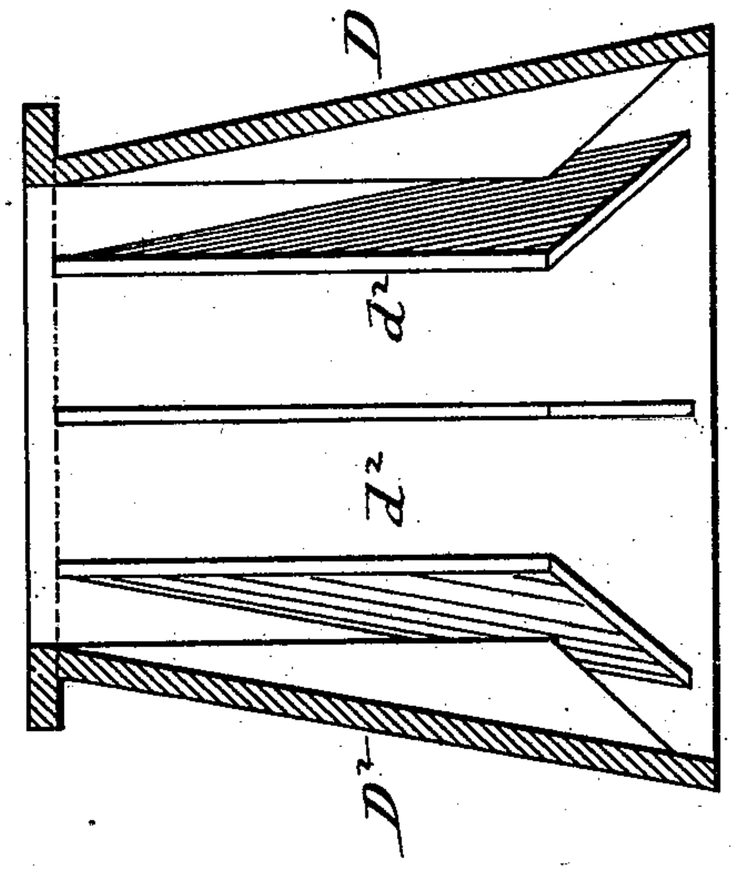


FIG. 8



WITNESSES:

Charles Schroeder

Charles Files.

INVENTOR

Levi Hussey

BY

Goepel & Weisgerber

ATTORNEYS.

UNITED STATES PATENT OFFICE.

LEVI HUSSEY, OF NEW YORK, N. Y., ASSIGNOR TO THE MINING AND DREDGING POWER COMPANY, OF WEST VIRGINIA.

STEAM VACUUM-DREDGER.

SPECIFICATION forming part of Letters Patent No. 523,838, dated July 31, 1894.

Application filed April 14, 1891. Renewed December 10, 1892. Again renewed June 20, 1893, and again renewed January 5, 1894. Serial No. 495,868. (No model.)

To all whom it may concern:

Be it known that I, LEVI HUSSEY, a citizen of the United States, residing at New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Steam Vacuum-Dredgers; and I do declare the following to be a full, clear, and exact description of the invention.

This invention has reference to an improved apparatus for dredging the bottom of rivers, harbors, canals and other water-courses and elevating the material so as to discharge it into scows or to the banks of the rivers; the dredging operation being accomplished by the vacuum produced in a pump-chamber by the condensation of steam admitted into the same and supplied thereto from a suitable low pressure receiving tank; and in carrying out my invention I employ a steam vacuum dredger which is supported on a suitable float or barge, that is rounded off at one end, at which is arranged a pump-chamber which is made of spherical shape and supported by trunnions on upright standards that are applied to a turntable guided on rollers on the deck of the barge. The pump-chamber is provided with a suction-pipe the horizontal section of which is connected by a flexible joint with a vertical downwardly-extending section, the lower end of which is provided with a flaring mouth-piece having interior ribs, that takes up the sand or other material to be removed from the bottom of the river or other body of water. The horizontal section of the suction-pipe is supported by suitable tackle from the traveler of a swinging crane, which latter follows the motion of the suction-pipe in its up and down as well as in its horizontal motion. The suction-pipe is provided with a gate-valve that is operated by a piston located in the cylinder supported on the pump-chamber, said cylinder being preferably operated by hydraulic action. At the lower part of the pump-chamber is arranged the discharge-pipe, the inclined gate-valve of which is operated in the same manner as the suction-valve by a piston arranged in a cylinder operated by hydraulic pressure. The cylinders are supported by brackets on the walls of the pump-chamber. The discharge-pipe opens into an inclined chute at the lower part of which a receiver is arranged from which the material discharged from the pump-chamber is elevated by buckets and conveyed to an inclined sluiceway from which the material is discharged either into a scow or to the banks of the river or canal. The upper part of the pump-chamber is connected by a hose with a water-supply pipe having a spray nozzle by which the water is sprayed into the pump-chamber so as to produce a vacuum therein by the condensation of the steam supplied to the same. The steam is supplied to the pump-chamber from a receiving tank by a valved and jointed pipe which is connected with the hollow trunnion of the pump-chamber; the receiving tank being connected with the exhaust parts of the cylinders of the steam-engine and pumps, and also with the steam boiler so as to supply live steam if necessary. In the upper part of the pump-chamber is also arranged an air-valve which serves for the egress of the air in the pump-chamber when steam is admitted into the same, and for the ingress of the air when the material is discharged from the pump-chamber.

In the accompanying drawings: Figure 1 represents a side-elevation of my improved steam-vacuum dredger. Fig. 1ª is also a side-elevation, drawn on a larger scale and showing the steam and water supply-pipes for the pump-chamber, cylinders and suction-pipe. Fig. 2 is a plan of the same. Fig. 2ª is a plan of Fig. 1ª. Fig. 3 is a vertical longitudinal section of the pump-chamber, and the cylinder of the discharge-valve, drawn on a larger scale; said figure being taken on line 3 3, Fig. 2ª. Fig. 4 is a longitudinal section of the cylinder of the discharge-valve, said section being taken at right-angles to the section of the cylinder shown in Fig. 3. Fig. 5 is a vertical transverse section through the discharge-valve, on line 5, 5, Fig. 3. Fig. 6 is a vertical central section of the flexible joint for connecting the horizontal and vertical sections of the suction-pipe; and Figs. 7 and 8 are respect-

ively a bottom view and a vertical longitudinal section of the flaring mouth of the suction-pipe.

Similar letters of reference indicate corresponding parts.

Referring to the drawings, A represents a suitable barge or float which is preferably rounded off at that end at which the pump-chamber is arranged, so as to permit the sweep of the suction-pipe of the pump-chamber in a semi-circle around the same.

On the deck of the barge or float A is arranged a pump-chamber B which is preferably made of spherical shape and of boiler-iron or steel of the required strength; said pump-chamber being supported by trunnions *b*, *b*, on vertical standards $B^{\times}$ which are attached to a turntable C arranged on the deck of the barge or float A. To the front part of the spherical pump-chamber B is applied the horizontal section *d* of an elbow-shaped suction-pipe D, the vertical section *d'* of which is composed of a number of flanged sections which are bolted together, the vertical section *d'* being connected by a flexible joint D' with the horizontal section and provided at the lower end with an outwardly-flaring mouth D^2 having interior ribs d^2, as shown clearly in Figs. 7 and 8. The bend or elbow d^8 of the suction-pipe D above the flexible joint D' is provided with a ring d^9 and connected by suitable tackle *t* with a traveler *t'* that is supported on horizontal ways t^2 of a swinging crane E; the vertical beam E^2 of which is braced by suitable guy-ropes *e* that are anchored into the beams of the float or barge A.

The crane E is provided with the usual tackle (as shown in Fig. 2^a) for raising or lowering the suction-pipe D and adapting the same to the bottom of the harbor, river, canal or other water-course.

The flexible joint D' is shown in detail in Fig. 6, and is constructed of a casing that is made in two parts d^3, d^4, which are bolted together so as to facilitate the separating of the parts when the joint is required to be adjusted or repaired. The upper part of the casing is flanged and bolted to the connecting bend or elbow of the suction-pipe D. The packing of the flexible joint D' is made of two ring-shaped sections d^5 of hard rubber, metal or other suitable material, between which are placed one or more metallic ring-shaped washers d^6 by which the slack occasioned by the gradual wear of the packing rings may be taken up. The packing-rings d^5 rest on a collar d^7 on the upper end of the vertical section of the suction-pipe D; which end enters into the casing of the joint D', and which is made of cast steel or other suitable material and provided with an exterior screw-thread for a screw-collar d^8. The packing rings d^5 are supported by the collar d^7 and are tightly held in position in the casing by the screw-collar d^8 at the upper end of the vertical section *d'* of the suction-pipe D. The packing rings d^5 are provided with an annular groove $d^{\times}$ at their outer circumference near the joint of the casing, to which groove water under pressure is supplied by a suitable hose-connection d^{10} which communicates with an opening d^9 in the casing, said hose leading to a pump P', as shown in Figs. 1^a and 2^a by which the pressure of the water in the groove of the flexible joint D' is always kept up and thereby the entry of grit or other material between the contact-surfaces of the joint and consequent wear of the same are prevented. Any water passing through the packing of the joint is carried along by the material passing through the suction-pipe. The flaring mouth-piece D^2 is flanged at the top, so as to be bolted to the lowermost section of the suction-pipe D. It is made wider at the bottom, so that the area covered by the bottom is twice as large, more or less, as the area of the cross-section of the suction-pipe to which it is connected. The ribs d^2 at the inside of the flaring mouth D^2 are tapered at their lower ends and made parallel with the axis of the mouth D^2 at the upper parts, the distance between diametrically-opposite ribs being equal to the diameter of the suction-pipe and prevent the ingress of stones or other obstructions larger than the diameter of the suction-pipe which would block or choke the suction-pipe.

The horizontal section *d* of the suction-pipe D is provided with an inclined valve-casing F and a gate-valve F' guided in the same, which valve is connected by a piston-rod with a piston that is guided in a cylinder F^2 which is supported by a suitable bracket F^3 on the upper part of the pump-chamber B. To a discharge-opening in the bottom of the pump-chamber B is attached the discharge-pipe G, the lower end of which is provided with inclined parallel guide-ways *g* for a gate-valve G' that is connected by a piston-rod *g'* with a piston g^2 arranged in a cylinder G^2 that is supported by a bracket G^3 on the lower part of the pump-chamber B, as shown in Figs. 1 and 3. The pistons of the suction and discharge-valves F' and G' are operated by hydraulic pressure, the water required for this purpose being supplied by the pump P' which is connected by pipes *p'* and p^2 with the chests of the oscillating valves of the cylinders, as shown in Figs. 1^a and 2^a said valve-chests being again connected with the posts of the inlet and outlet channels of the cylinders F' and G'. The oscillating valves of the cylinders are operated at the proper time by means of suitable hand-levers by an attendant who is stationed on a suitable platform above the pump-chamber, which for the sake of clearness is omitted from the drawings.

The construction of the valve-operating cylinders and their oscillating valves is shown in Fig. 4 and is made in any approved manner.

The ways *g* of the discharge-pipe G are extended beyond the discharge-pipe so as to support the discharge-valve G' when the same is moved into open position. The discharge-

valve G′ is provided at its sides with upwardly-extending guide-portions g^3 that are flanged so as to rest on the inclined ways of the discharge-valve, as shown in Figs. 3 and 5. By this means, the guide-ways are outside of the mouth of the discharge-pipe so that no material such as gravel, sand or mud can pass on to the same and interfere with the easy working of the valve. The lower ends of the ways g of the discharge-valve G′ are connected by a transverse lip g^4 into which the lower end of the valve is accurately fitted. A transverse tapering projection or tip g^5 at the upper end of the valve engages a transverse tapering projection g^6 at the upper ends of the guide-ways, as shown in Fig. 3. The valve G′ closes tightly to its seat when its projection g^5 and its lower end engage respectively the tapering projection g^6 and the lip g^4, which tight closing is still further increased by applying rubber or other suitable packing material to the body of the valve.

The discharge-pipe G opens into an inclined chute H which leads to a suitable receiver H′ in the hold of the barge A. A conveyer H^2 composed of an endless chain h having buckets h' extends into the receiver and takes up the material collected therein and discharges it on to an inclined sluice-way H^3 which conveys it to a scow anchored alongside of the barge or float, or to either bank of the river or canal, as desired, so as to facilitate the conveying and dumping of the material dredged from the bottom of the river by the machine. The driving pulley of the endless bucket-chain h is operated by a belt and pulley transmission from the driving shaft of the engine I, as shown in Figs. 1 and 2. The engine is supplied with steam from the boiler K that is arranged on the barge. At one side of the pump-chamber is arranged on the barge a receiving tank or reservoir L which is connected by pipes with the cylinders of the engine and of the different pumps as shown in dotted lines in Fig. 2^a so as to collect the exhaust steam from the same. From the main steam-pipe K′ which leads from the boiler K to the cylinder of the engine I, extends to the tank L a branch steam-pipe l in which a pressure-reducing valve l' is arranged. The tank L is made of sufficient capacity to permit the cylinders of the engine and pumps to exhaust into it for some time before the pressure exceeds five pounds in the same. When the pressure reaches this point a relief-valve l^2 arranged at the top of the tank permits the surplus-steam to escape. This relief-valve can be adjusted so as to work at any desired pressure which it may be deemed advisable to carry in the tank L.

When the engine K or the pumps P, P′, are not running and if it be still desired to operate the pump-chamber B, live steam may be admitted directly from the boiler through the branch-pipe l to the tank L, the pressure-reducing valve reducing the pressure of the live steam. From the tank L a steam supply pipe B′ leads to a point vertically above the center of the pump-chamber, where it is connected by a swivel-joint B^2 with a valved horizontal portion B^3 which leads to one of the trunnions of the pump-chamber B to which it is also connected by a swivel-joint B^5, as shown in Figs. 1, 2 and 2^a, so as to supply the steam from the tank L to the pump-chamber B without interfering with the horizontal and vertical motion of the same. When the exhaust-steam from the cylinders of the engine and pumps is not sufficient to supply the pump-chamber, the deficiency can be made up by the admission of live steam in the same manner as before described.

The pump-chamber B is, in addition to the steam supply-pipe, provided at its top-part with an air-valve b^x which is opened when steam is admitted into the pump-chamber, so as to permit the air to escape from the same when it is desired to destroy the vacuum in the pump-chamber. At the top of the pump-chamber B is also arranged a valved supply pipe b^2 for the injection of the water by which the vacuum in the pump-chamber is produced. This pipe is connected by a hose b^3 with the pump P and provided at the inside of the pump-chamber with a perforated disk or rose b^4 which sprays the water as it is admitted so as to produce the vacuum in the pump-chamber by rapidly condensing the steam.

While the pump P supplies the water to the injection-pipe b^2 the pump P′ supplies the water for the operation of the gate-valves of the suction and discharge-pipes and for the hydraulic packing of the flexible joint of the suction pipe as before described.

The operation of the dredging apparatus is as follows:—The suction-pipe is first adjusted to the proper length required, by adding or removing one or more of its sections; and is then lowered to the bed of the river or other water-course, the valves of the suction and discharge-pipes being in closed position. Steam is next admitted from the receiving tank to the pump-chamber by opening the valve of the steam supply-pipe. Simultaneously, the air valve is opened for a short time so as to allow the air to escape from the valve-chamber, from which it is blown out by the steam. The air-valve is then closed and cold water admitted through the water injection-pipe. The water quickly condenses the steam in the pump-chamber and forms a vacuum therein. The suction-valve is next opened by turning the lever of the oscillating valve of its operating cylinder. As soon as the suction-valve is opened, the pressure of the atmosphere and the pressure of the water cause a rush of material around the mouth-piece of the suction-pipe; so that, by the suction of the vacuum in the pump-chamber, the same is quickly filled by the loose material at the river bottom, which material is drawn up through the suction pipe. The weight of the suction-pipe and of the flaring mouth-piece will keep the latter down in position on the

bottom of the river and produce, by the extra weight of the material and water sucked into the pump-chamber, the gradual lowering of the mouth-piece into the loose material at the bottom of the river. During the descending motion, or downstroke, so to say, of the suction-pipe, the pump-chamber turns on its trunnions; and, as the tackle of the crane is slackened when the pump is about to take its load, the mouth-piece of the suction-pipe is embedded in the loose material so as to permit only the passage of a small quantity of water sufficient for properly lubricating the material sucked in. The quantity of water and the quantity of material taken up can be regulated by the downward motion or drop which the suction-pipe is permitted to take while in the act of taking up its load. When the pump-chamber is filled, the suction-valve is closed and, if necessary, the suction-pipe is raised by the tackle on the crane in order to bring the discharge-outlet vertically over the upper end of the inclined chute. The discharge-valve is then opened, by operating the valve lever of its cylinder, so that the material in the vacuum-chamber is permitted to drop into the inclined chute by gravity. If necessary, the air-valve of the pump-chamber is opened, so as to permit the air to rush in and assist in the quick discharge of the contents of the pump-chamber. The loose material runs down along the chute and is immediately taken up by the buckets of the endless conveying chain and dropped into the sluice-way and conveyed by the same to a scow or barge. Water is discharged from one of the pumps into the sluice-way so that the material is quickly carried off. When the machine is used for dredging a river or canal, the inclined sluice-way carries the material from the point from which it is taken directly to the banks, thus saving a great deal of time and expense in handling.

When the dredge is used for dredging gold-bearing gravel or sand, the sluice-way is provided with riffles or gratings so as to produce undercurrents for collecting the gold-dust while the water and material may be passed on to amalgamators or to barges or returned to the water again.

While the material is being discharged from the pump-chamber, the cylinders of the engine and pumps are exhausting into the receiving tank so as to gradually compress the exhaust-steam from atmospheric pressure up to five pounds or higher, as required. The receiving tank is of such capacity that it requires about two minutes to make a compression of five pounds per square inch. The relief-valve on the tank allows the surplus steam to pass off into the atmosphere, when the pressure rises above the required pressure. In this manner the receiving tank contains always a body of steam under low pressure, so that the pump-chamber can be quickly filled from the tank whenever steam is wanted to displace the air in the cylinder.

As the pump-chamber is arranged at the rounded end of the barge and supported by trunnions and standards arranged on a turn-table, the pump-chamber can readily be turned in a horizontal as well as a vertical plane, so that it can be moved around the end of the barge and suck in a large quantity of material without changing the position of the barge.

When the depth of the water increases or decreases, sections of pipe can be readily put in or taken out of the suction pipe, which is, by the flexible joint, always kept in perpendicular position whenever it is raised or lowered.

By utilizing the exhaust-steam from the engine and pumps for the formation of the vacuum in the pump-chamber, a considerable saving is obtained, as the steam is made to do double work, namely, first by elevating the material and water by means of the buckets and the pumps, and, secondly by sucking in the material into the pump-chamber by the vacuum formed therein. The dredging machine can thereby be operated with considerably less expense than the dredging machines heretofore in use, while the work accomplished by the same is very reliable and effective so that the dredger is adapted with great advantage for many different applications in hydraulic engineering.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination, of a pump-chamber mounted to turn in vertical and horizontal planes, a suction pipe connected with the pump-chamber and formed of a horizontal section, a vertical section and a flexible joint for said sections, a discharge-pipe at the bottom of the pump-chamber and valves in said suction and discharge-pipes, substantially as set forth.

2. The combination, of a pump-chamber mounted to turn in horizontal and vertical planes, of a flexibly-jointed suction-pipe connected with said pump-chamber, a discharge-pipe at the bottom of the same, valves for the suction and discharge-pipes, and a swinging crane for supporting the suction pipe, substantially as set forth.

3. The combination of a pump-chamber mounted to swing in vertical and horizontal planes, a flexibly-jointed suction-pipe connected with said pump-chamber, a discharge-pipe at the bottom of the same, valves in said suction and discharge-pipes, an inclined chute below the discharge-pipe, a receiver at the lower end of the chute, a bucket or other conveyer for elevating the discharged material, and an inclined sluice-way connected with the upper end of the conveyer, substantially as set forth.

4. A vertically and horizontally-swinging pump-chamber, provided with a suction-pipe and a discharge-pipe having gate-valves, and with means for operating the gate-valves, said

operating means being supported on said pump-chamber, substantially as set forth.

5. A vertically and horizontally-swinging pump-chamber, provided with a suction-pipe and a discharge-pipe, gate-valves for said pipes, means for operating said gate-valves, and a steam-supply-valve, an air-discharge valve, and a water injection-pipe for said chamber, substantially as set forth.

6. The combination, of a pump-chamber mounted to turn in vertical and horizontal planes, with a suction pipe connected with said pump-chamber and formed of a horizontal section, a vertical section and a flexible joint for said sections, the lower end of the suction-pipe being provided with an outwardly flaring mouth-piece, substantially as set forth.

7. The combination, of a pump-chamber mounted to turn in a vertical and horizontal plane, a suction-pipe connecting with said pump-chamber, a discharge-pipe at the bottom of the same, gate-valves guided in ways of the suction and discharge-pipes, cylinders for operating said valves, brackets for supporting said cylinders on the pump-chamber, and valves on the cylinders for admitting the medium by which the gate-valves are operated, substantially as set forth.

8. The combination, of a pump-chamber having an air-valve, said pump-chamber being mounted to swing in vertical and horizontal planes, a receiving tank for the steam, a valved and jointed steam supply-pipe connecting said tank with the pump-chamber, a valved water supply-pipe for said pump-chamber, suction and discharge pipes connected with the pump-chamber, and gate-valves in said pipes, substantially as set forth.

9. The combination of a pump-chamber, with a suction pipe formed of a horizontal section, a vertical section and a flexible joint connecting said sections, and a water supply pipe connecting said joint with one of the pumps, so as to supply a hydraulic packing to the same, substantially as set forth.

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

LEVI HUSSEY.

Witnesses:

PAUL GOEPEL,

A. M. BAKER.