

(No Model.)

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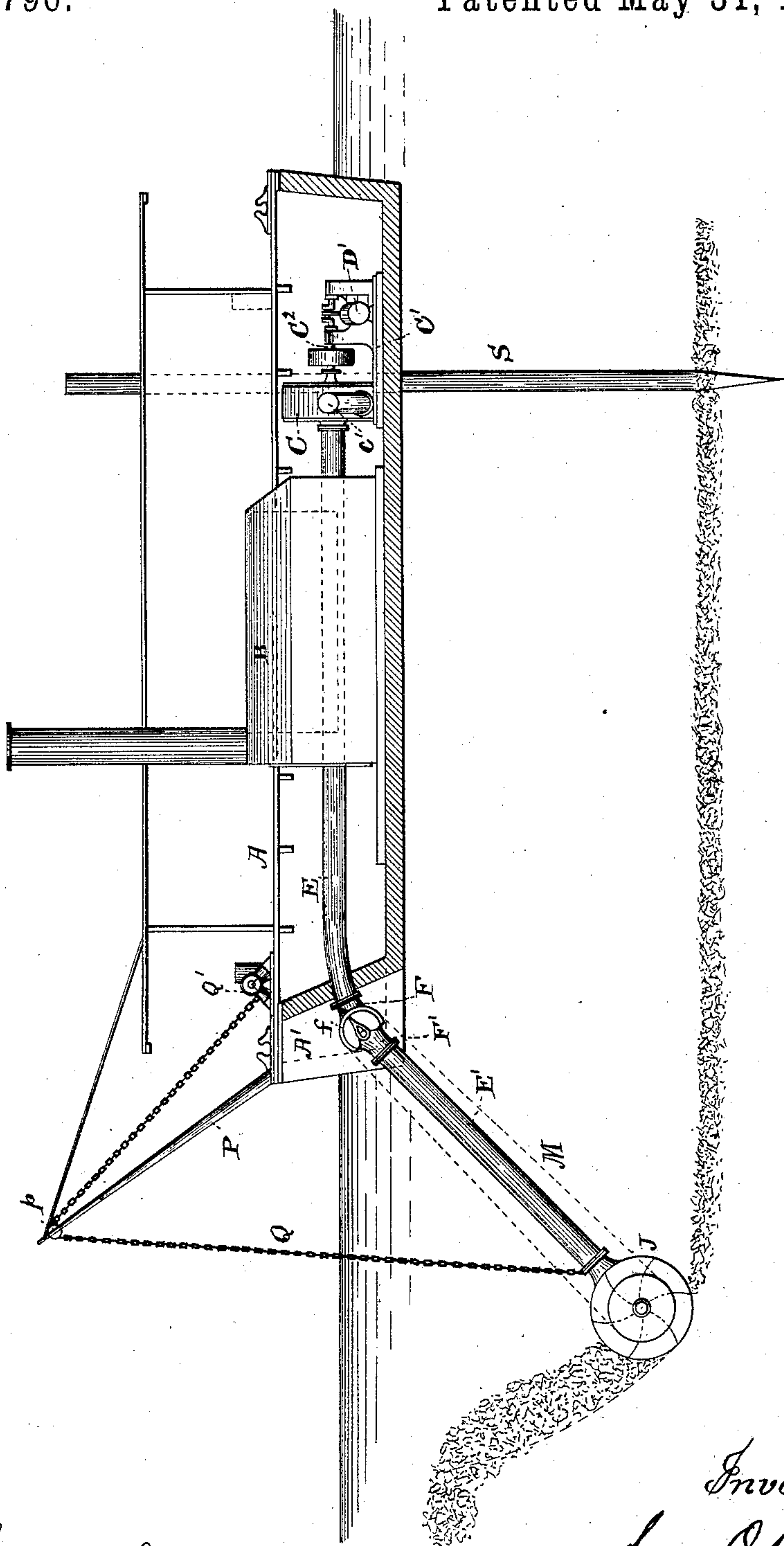
A. O. BOSTROM.

## HYDRAULIC EXCAVATOR.

No. 363,796.

Patented May 31, 1887.

**FIG. 1.**



Attest:  
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Inventor:  
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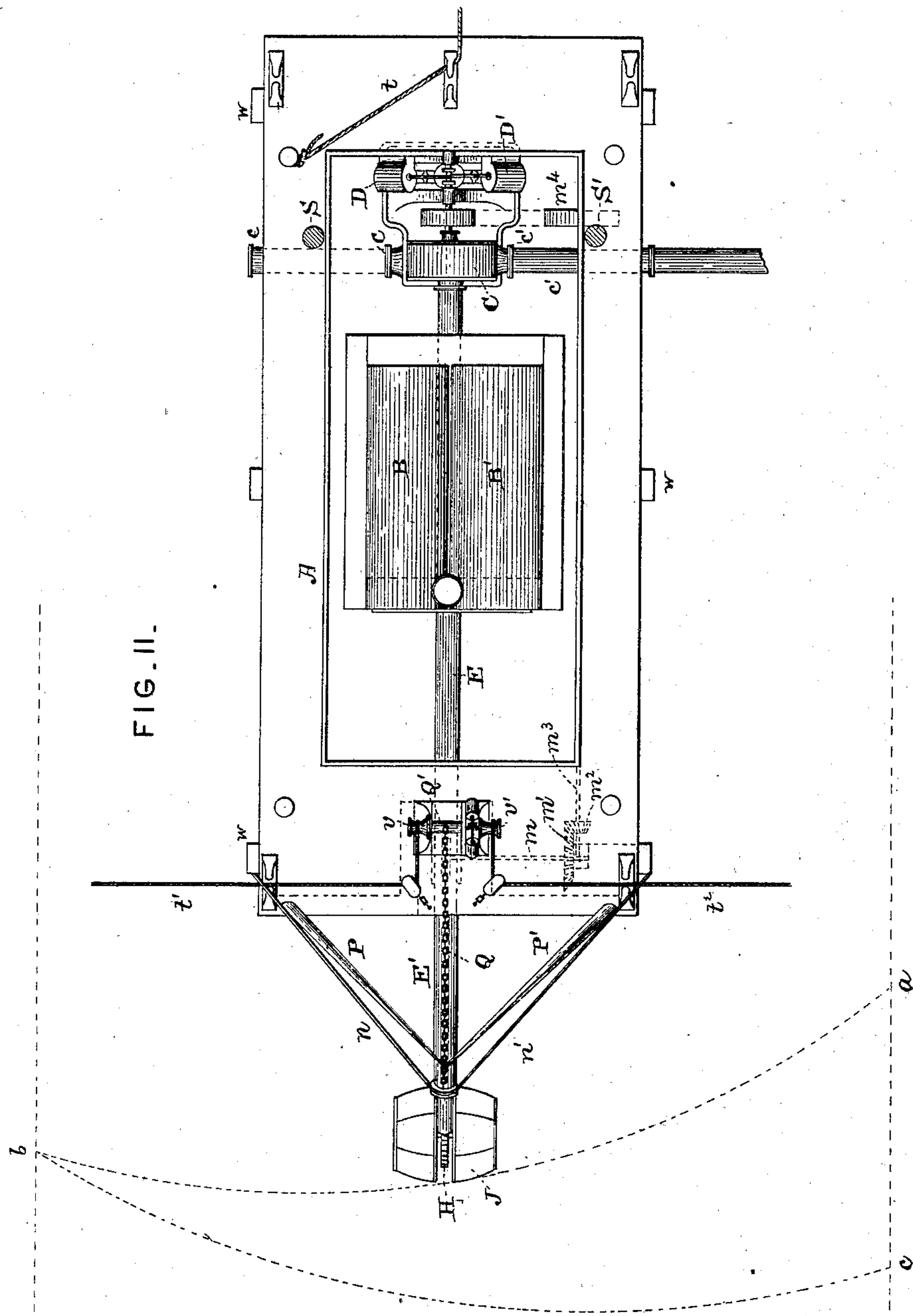
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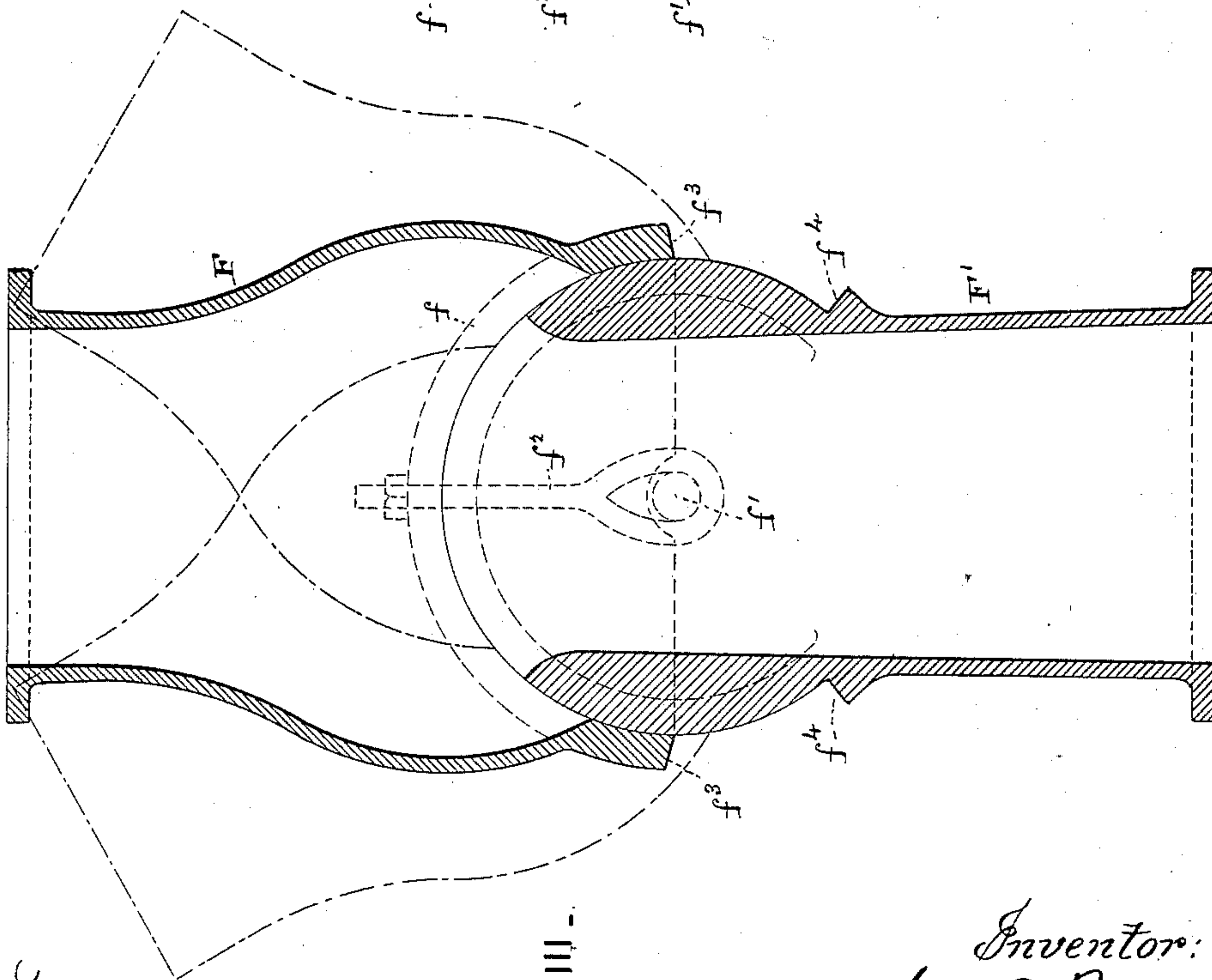
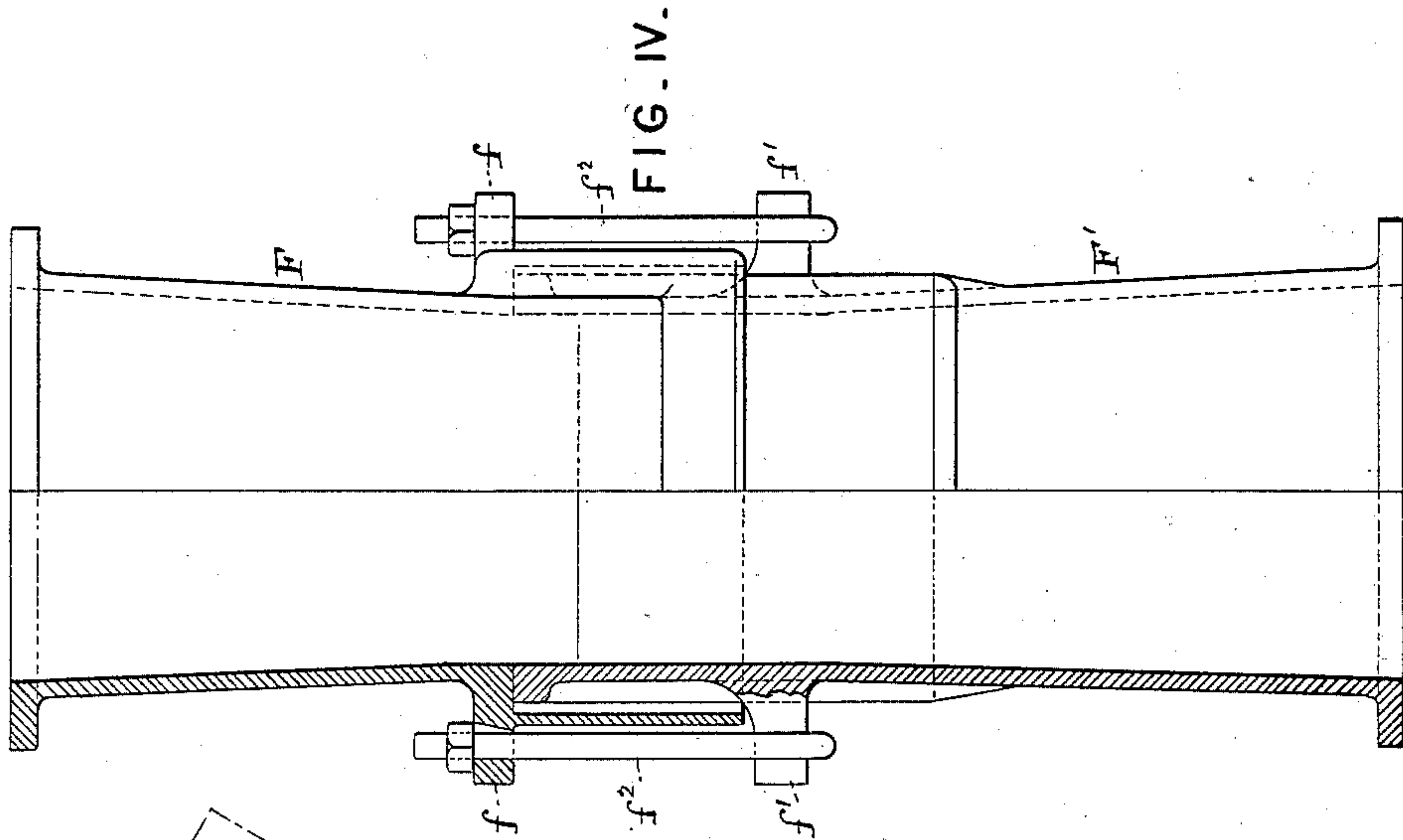
5 Sheets—Sheet 3.

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FIG. V.

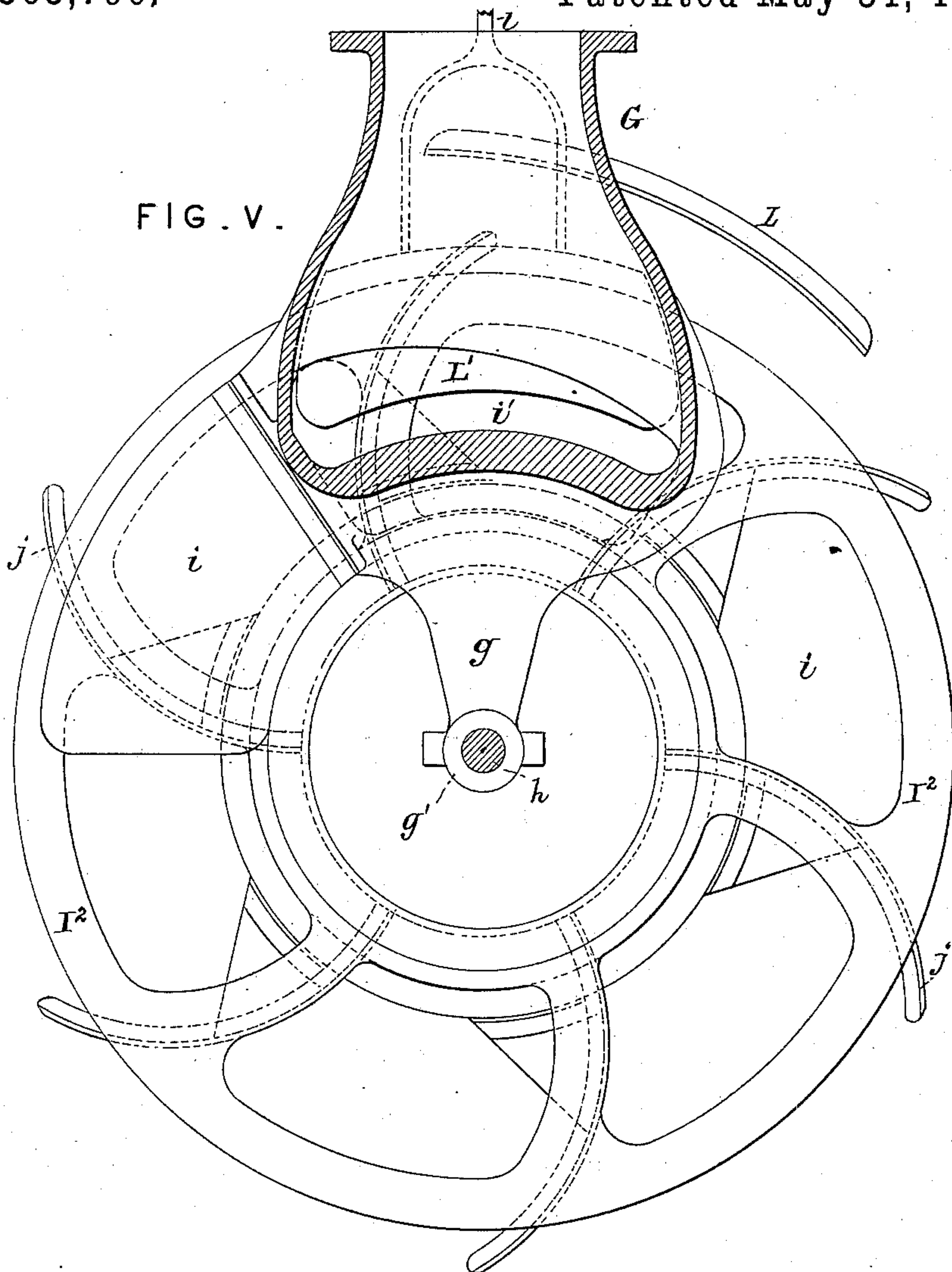
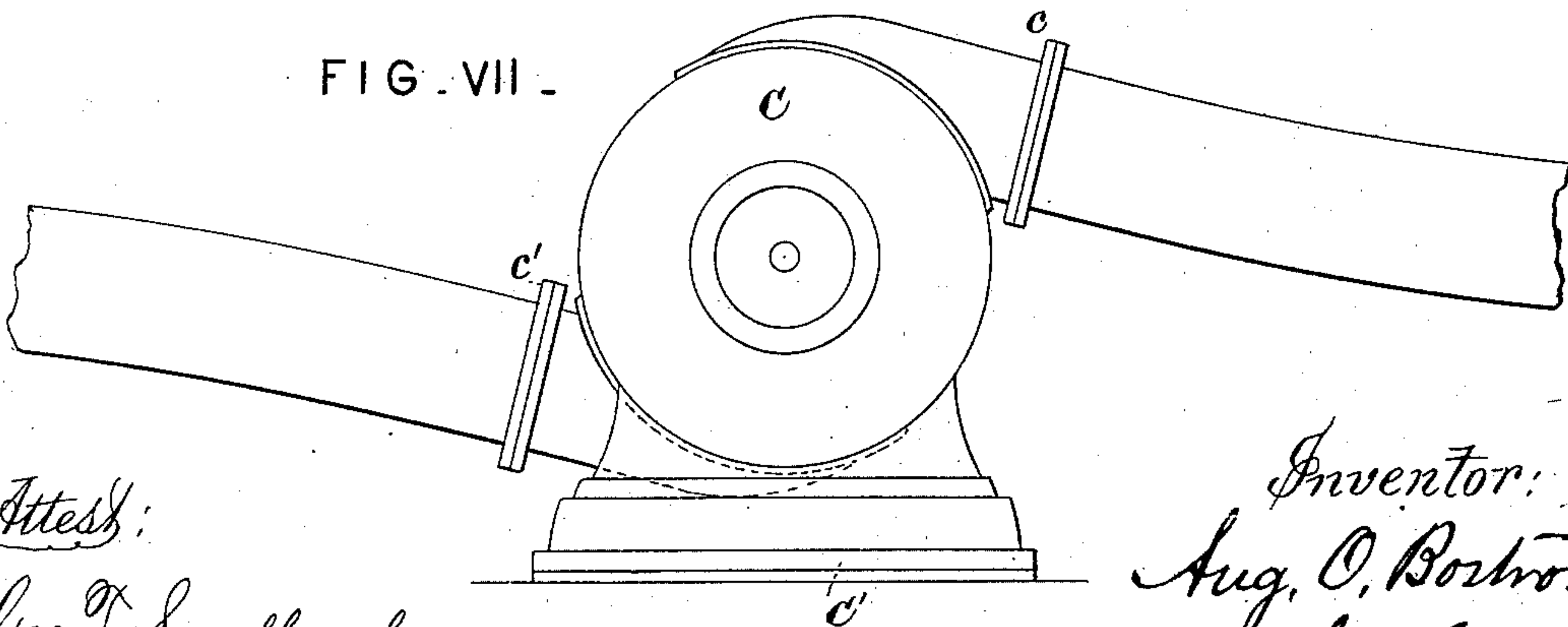


FIG. VII.



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(No Model.)

5 Sheets—Sheet 5.

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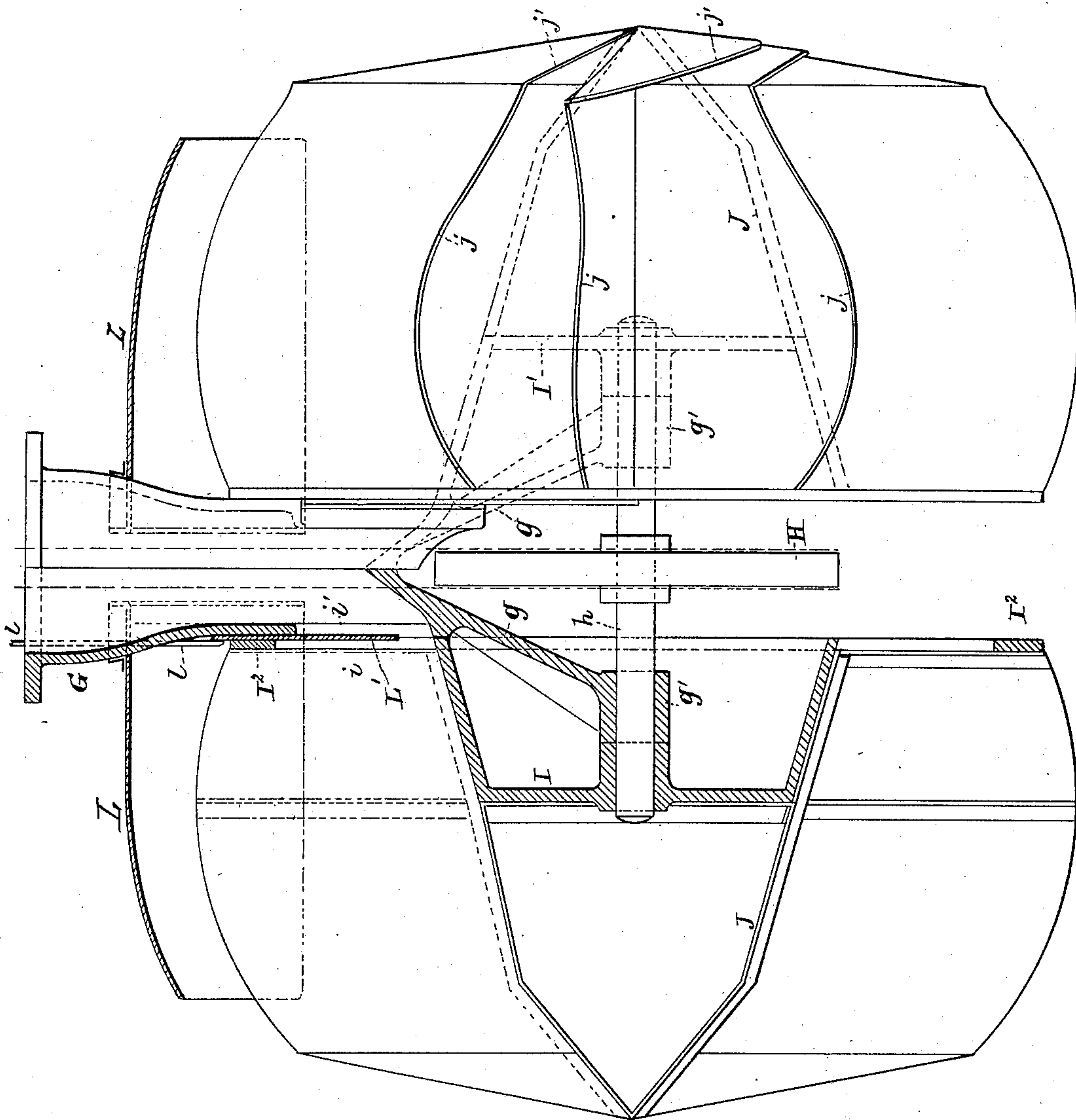


FIG. VI.

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# UNITED STATES PATENT OFFICE.

AUGUST O. BOSTROM, OF WASHINGTON, DISTRICT OF COLUMBIA.

## HYDRAULIC EXCAVATOR.

SPECIFICATION forming part of Letters Patent No. 363,796, dated May 31, 1887.

Application filed August 6, 1886. Serial No. 210,219. (No model.)

*To all whom it may concern:*

Be it known that I, AUGUST O. BOSTROM, of Washington, District of Columbia, have invented a new and useful Improvement in Hydraulic Excavators, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, making part of this specification.

My invention relates to a construction and arrangement of parts of a hydraulic excavator, whereby they are brought into compact shape, unnecessary bends in the suction or discharge pipes avoided, and the apparatus adapted to discharge the spoil with equal facility on either side, and to the construction of the cutting-tool, the means for actuating the same, and to the construction of the joint in the suction-pipe.

It consists in locating the suction and discharge pump as near as practicable to a line running transversely through the pivotal centers upon which the boat is swung for the purpose of relieving the discharge-pipe from undue strain or twisting, and preferably in close proximity to and upon the same bed-plate with its actuating engine or engines, and in the employment of a reversible pump adapting the spoils to be discharged upon either side of the boat without the use of abrupt bends in the pipe for that purpose.

It further consists in a novel construction of the cutting-tool, and to a novel arrangement of the suction-pipe in connection therewith, whereby the said tool is adapted to cut up and down, and also laterally in either direction when required, and to discharge its spoils centrally of its width into the suction-pipe.

It further consists in a novel arrangement of the mechanism for actuating the cutting-tool, whereby its operation is rendered certain, its adjustment to its work facilitated, and liability to disarrangement or obstruction of the driving mechanism obviated.

It further consists in certain details of construction and arrangement of parts, hereinafter described and claimed.

In the accompanying drawings, Figure I represents a vertical longitudinal section through the hull of a vessel having my improvements applied. Fig. II is a plan view of the same.

Fig. III is a vertical longitudinal section through my improved suction-pipe joint; and Fig. IV is a rear elevation of the same, partly in section. Fig. V is a vertical section through the improved cutting-tool, showing one side thereof in side elevation and the end of the suction-pipe connected therewith in section; Fig. VI, a rear elevation of said tool, partly in section; and Fig. VII, a side or end elevation of the pump.

A indicates a flat-bottomed boat of any suitable construction, except that preferably it is recessed longitudinally and vertically at its forward end at A', to accommodate the vertically-adjustable end of the suction-pipe carrying the cutter, for a purpose that will appear.

The boilers, (indicated at B B',) preferably two or more, are located at or near the center of the vessel, and in rear thereof, and preferably about in the same transverse line with the centers upon which the boat is designed to swing, is located the pump C, and in rear of the latter, and preferably on the same bed-plate, C', with the pump, the engines D D' are located, said engines being connected in any suitable manner with the boilers, and by means of connecting-rods and a crank or cranks with the shaft C<sup>2</sup> of the rotary pump C. These engines and the pump may be of any usual or suitable construction, except that for the purpose indicated it is preferable to make the pump reversible, or in such manner that it may be made to discharge the spoils on either side, as convenience or necessity may dictate. This may be done by making the pump-case to rotate sufficiently to bring the discharge-outlet c or c' upon either side; or said pump-case may be provided with two outlets arranged upon opposite sides, one of which outlets will be closed in any suitable manner when the other is open to discharge the spoils.

From the forward side of the pump-case a suction-pipe, E, extends forward, as indicated, and passing through the rear wall of and terminating in the recess A', said pipe extending in a right line, or nearly so, from the pump to near its forward end, where it is preferably bent to an angle of twenty-two and one-half degrees, or thereabout, to the line of the main portion of the pipe, for a purpose that will ap-



pear. To the end of this pipe, through suitable flanges, is secured one part, F, of a socket-joint, the other portion, F', of said joint being secured in a suitable manner to an adjustable extension, E', of the pipe E, the outer or swinging end of which portion carries the cutting-tool, as will be explained. The part F of the joint is flattened on its sides and expanded vertically, and the adjoining end of the part F', fitting within the open end of part F, is correspondingly flattened and expanded, and has its end cut away in such manner as to cause it to assume a form approximating a transverse cylinder, the flattened side walls of the part F overlapping and fitting snugly the side walls of the part F' and preventing lateral play or swing of the latter, while permitting free vertical movement thereof, as will be readily understood.

The part F is provided with side flanges, *f*, preferably curved in the arc of a circle concentric with the pins or trunnions *f'*, formed on the part F', and eyes on the links *f*<sup>2</sup> *f*<sup>2</sup> connect with said pins, and the opposite ends of the links pass through perforations in the lugs or flanges *f*, and are secured to the latter by nuts, which permit their adjustment for bringing the two parts of the joint into proper working relation. The trunnions *f'* can turn within the eyes of the link *f*<sup>2</sup> to accommodate the vertical movements of the part F' within certain limits indicated, and controlled by stops or shoulders *f*<sup>3</sup> *f*<sup>4</sup>, without disturbing the working relation of the parts, and at the same time the links serve to stiffen the parts of the joint against relative lateral movement. The pipe E' is designed to be adjusted in a vertical direction only, and is held against lateral movement relative to the vessel by suitable lateral stays or guys, which will be referred to, and this action is materially assisted by the joint described.

Where lateral as well as vertical movement of the cutter relative to the boat is desired, the ordinary spherical joint may be employed.

The pipe or extension E' may be of any length required for cutting to the desired depth without passing beyond an angle of forty-five degrees, or thereabout, to the horizontal plane of the pipe E, thereby, in connection with the bent end of the pipe E, to which it is jointed, avoiding any abrupt bend in the suction-pipe.

The form or construction of the cutting-tool and the arrangement of the suction-pipe in connection therewith are indicated in Figs. V and VI.

G represents a short section of the suction-pipe, provided with a suitable flange, through which it is secured to the swinging end of pipe E', said section below the flange being flattened laterally and expanded vertically, and provided at its lower end with a fork or diverging arms, *g g*, terminating in short sleeves *g' g'*, in which the shaft *h* of the revolving cutter is mounted. This shaft *h* has a sprocket-wheel, H, secured to it centrally of its length and be-

tween the arms *g g*, through which motion is imparted to the shaft and the rotary cutting-tool by means of an endless driving-chain, as will appear. The ends of the shaft *h* extend beyond the bearing-sleeves *g' g'*, and have secured to them the cutter heads or hubs I and I', made each in the form of a hollow frustum of a cone and secured to the axle through a central hub or sleeve, the outer shell of the cutter-head overhanging the central sleeve and terminating each in a perforated rim, I<sup>2</sup>, which revolves in close proximity with the flattened side of the pipe-section G. To each hub and rim thus formed and arranged is secured a cutter composed of a conical central drum, J, which fits over and is secured to the hub I, (or I'), and is provided with a series of curved or concavo-convex radial blades, *j*, forming scoops, which serve, as the cutting-tool is rotated, to pick up or cut and carry in toward the central drum, J, the material operated upon. These blades terminate at one end in contact with and are secured in any suitable manner to the arms or spokes of the perforated rims I<sup>2</sup>, and preferably project radially slightly beyond said rim, as shown in Fig. V. The outer ends of these blades have each a spirally-arranged blade, *j'*, secured to them, which serves the double purpose of partially closing the space between the blade *j*, to which it is joined, and the adjacent blade, and thereby forming, in connection with said contiguous blade and the flange I<sup>2</sup>, a bucket for the retention of the cut material, and also of a cutter for adapting the tool to cut laterally in either direction when required.

The openings *i* in the rim I<sup>2</sup> connect with openings *i'* in the sides of the section G of the suction-pipe, as in the rotation of the cutter they pass by the latter, and the spoils will thus be drawn from the bucket in rapid succession, in a manner that will be readily understood.

The openings *i'* in the flattened sides of the pipe G are by preference made tapering in width from front to rear (relative to the movement of the cutters) in a manner indicated in Fig. V, as by this construction, when the bucket is full, the largest area of escape-opening is obtained, such area gradually diminishing as the contents of the buckets are drawn off, thereby insuring a proper discharge of the spoils and preventing a too free admission of water. This latter action is assisted by means of curved laterally-extending guards or hoods L, secured to the pipe G above the cutting-tool, which, as the buckets are subjected to the action of the suction-pipe, prevent a too free admission of water at the periphery of the cutting-tool and compel it to enter at the ends between the spiral blades *j'*, or in close proximity thereto, and thereby to wash inward the contents of the buckets toward the suction-pipe.

The hoods or guards should be arranged to overlie the buckets just at that point where in rotating they open into the interposed suction-pipe to discharge their contents, and in



such close proximity to the periphery of the cutter-wheels as to prevent a too free inflow of water to the buckets at that point, thereby compelling the water for the supply of any vacuum created in the buckets by the action of the suction-pipe to enter mainly at or near the outer ends of the buckets, and thereby to assist in washing the spoils inward longitudinally toward the suction-pipe. At all other points in the periphery of the cutting-tool the buckets are open at the periphery for the free admission and expulsion of water. The admission of water to the suction-pipe may be further regulated by means of slides  $L'$ , which may be moved inward to diminish the capacity of the openings  $i'$  as required, to prevent the inflow of water. These slides are arranged at the sides of the flattened sections  $G$  between said sides and the rims or flanges  $I^2$ , and may be controlled or adjusted from the boat in any suitable manner by means of rods  $l$ . With the cutting-tool constructed as described it is adapted to cut up and down, and also laterally when it is required to move it laterally at the end of its vertical throw or movement.

It is preferred to move the cutting-tool downward to the required depth in the arc of a circle of which the joint  $F' F'$  in the suction-pipe is the center, and then swinging the boat and cutting laterally the width of the cutting-tool to move it upward again to the surface, then again moving laterally the width of the cutting-tool to repeat this operation until the desired width of channel is cut. It will be seen that the cutting-tool is divided centrally, one half moving upon one side and the other upon the opposite side of the flattened pipe-section  $G$ , arranged between the two parts, and receiving the spoils through openings in its flattened sides, as explained. The cutter-shaft carrying the sprocket-wheels  $H$  receives motion through an endless chain, (indicated in dotted lines at  $M$ ,) and which passes around a driving sprocket-wheel arranged upon a shaft located in line or nearly in line with the joint in the suction-pipe. This shaft (indicated in dotted lines at  $m$ , Fig. II) is provided at one end with a bevel-gear,  $m'$ , which engages a bevel-gear,  $m^2$ , on the forward end of a longitudinal shaft,  $m^3$ , which at its rear end is provided with a pulley at  $m^4$ , connected by a suitable band with a driving-pulley on the pump-shaft  $C^2$ . Other equivalent means may be employed for driving the cutter; but those described are admirably adapted to the purpose, are not liable to disarrangement of parts, and freely accommodate themselves to the adjustment of the cutter, as described.

The pipe  $E'$  has suitable guys,  $n n'$ , connected with it near its outerswinging end, and extending thence to the sides of the boat, to which they are connected about in the same transverse line with the joint in the suction-pipe, in such manner as to prevent lateral swinging of the pipe  $E'$  without interfering with its free vertical movement, and in this action they are materially aided by the construction of the

suction-pipe joint, as described.  $P P'$  are standards arranged on opposite sides of the recess  $A'$ , and preferably near the sides of the bow of the boat, said standards converging toward and being united at their upper ends, where they overhang the bow of the boat and form a support for the guiding sheave or pulley  $p$ .

A chain,  $Q$ , connected at one end to the swinging end of pipe  $E'$ , extends thence up over the sheave  $p$  and down to a winch, (indicated at  $Q'$ ,) which may be operated in any suitable manner, but which in practice will be operated from the engine for effecting the raising and lowering of the cutting-tool in the manner described.

The guards or walls of the boat are perforated vertically at the sides adjacent to the line of the transverse discharge-pipes, ( $c$  and  $c'$ ,) for the reception of the spuds  $S$  or  $S'$ , which are forced alternately and by any suitable means into the ground at the bottom of the channel, and form the pivotal centers on which the boat is swung from side to side of the channel by an intermittent movement or adjustment thereof in operating the cutting-tool, as above described. Thus in the drawing, Fig. II, the boat is represented as being swung on the line  $a b$  upon the spud  $S$  as a pivotal center. When its movement on said line is completed, the side of the boat upon which the spud  $S'$  is located will be in advance, obliquely, of the side carrying the spud  $S$ , and the spud  $S'$  being then inserted in the ground and the spud  $S$  withdrawn, the boat will then be swung gradually back on the line  $b c$ , after which the spud  $S$  will again be used and the spud  $S'$  withdrawn, thus giving the cutting-tool a zigzag advancing movement in its operation, as described. A rope (indicated at  $t$ ) may be used when required, said rope extending from the stern of the boat to a suitable anchor, for preventing undue strain on the spuds from the strength of the current or other cause. Ropes or cables  $t' t^2$  extend also from the bow of the boat to each side, and are connected with suitable anchors at the sides of the channel, and serve for the adjustment of the boat from side to side, as explained, and for holding the boat steady while the cutters are moving in a vertical path. These ropes in practice may be connected at their inner ends with a suitable winch or winches,  $v v'$ , which may be operated by hand or from the engine in any suitable manner.

Suitable projecting bumpers,  $w$ , protect the sides of the boat and the projecting end or ends of the discharge-pipes from injury when the boat is lying at a wharf or against another vessel.

Having now described my invention, I claim as new—

1. In a hydraulic excavator, the pump located in rear of the boilers and upon the same bed-plate with its actuating-engine, in combination with the suction-pipe passing between the boilers, and extending in a right line, or



nearly so, from the pump to the bow of the boat, substantially as described.

2. The reversible pump located in rear of the boiler and in the same transverse plane, or nearly so, with the pivotal centers upon which the boat is swung or adjusted from side to side, substantially as described.

3. The reversible rotary pump located near the transverse plane of the pivotal centers on which the boat is swung from side to side, in combination with the suction-pipe connected with said pump in line with its axial center, substantially as described.

4. The divided rotating cutting-tool, in combination with a suction-pipe centrally arranged and connecting with the adjacent ends of the parts of said cutting-tool, substantially as described.

5. The divided rotating cutting-tool, in combination with the suction-pipe interposed between the parts thereof, and the centrally-located driving-gear or sprocket-wheel for actuating said cutting-tool, substantially as described.

6. The divided cutting-tool provided with the curved radial blades, and the spiral blades connected with the outer ends of the radial blades and the intermediate central discharge-openings, substantially as and for the purpose described.

7. The divided rotary cutter, composed of the heads or hubs I and I', the conical drums J J, provided with the radial cutters j, and spiral cutters j', arranged and operating substantially as described.

8. The combination, in a rotary cutter, of the divided cutter-heads mounted on a common shaft, the interposed suction-pipe and driving-wheel, and cutters secured to and operated by said cutter-heads, substantially as described.

9. The combination of the divided cutting-tool, the single suction-pipe interposed between the parts thereof, the centrally-arranged sprocket-wheel, and the endless driving-chain for actuating the same, substantially as described.

10. The combination, with the rotating cutting-tool having the radially-arranged cutting-blades, forming intervening buckets open at the periphery of the cutting-tool, of the guards L, substantially as and for the purpose described.

11. The divided cutting-tool, in combination with the centrally-arranged suction-pipe connected therewith, and having the perforated sides, and the slides operating in connection with said perforated sides to regulate the admission of water to the pipe, substantially as described.

12. The divided cutting-tool, in combination with the centrally-arranged end of the suction-pipe, having the tapering openings formed therein for the admission of the spoils, substantially as and for the purpose described.

13. The single centrally-arranged jointed suction-pipe, in combination with the divided rotary cutter, the sprocket-wheel connected therewith in the same longitudinal plane with the suction-pipe, and the driving-chain for actuating said sprocket-wheel and cutter, actuated from a driving sprocket-wheel on a shaft located in the transverse line of the joint in the suction-pipe, substantially as described.

In testimony whereof I have hereunto set my hand this 6th day of August, A. D. 1886.

AUG. O. BOSTROM.

Witnesses:

W. P. BELL,  
JNO. AMBLER SMITH.