

**No. 662,293.**

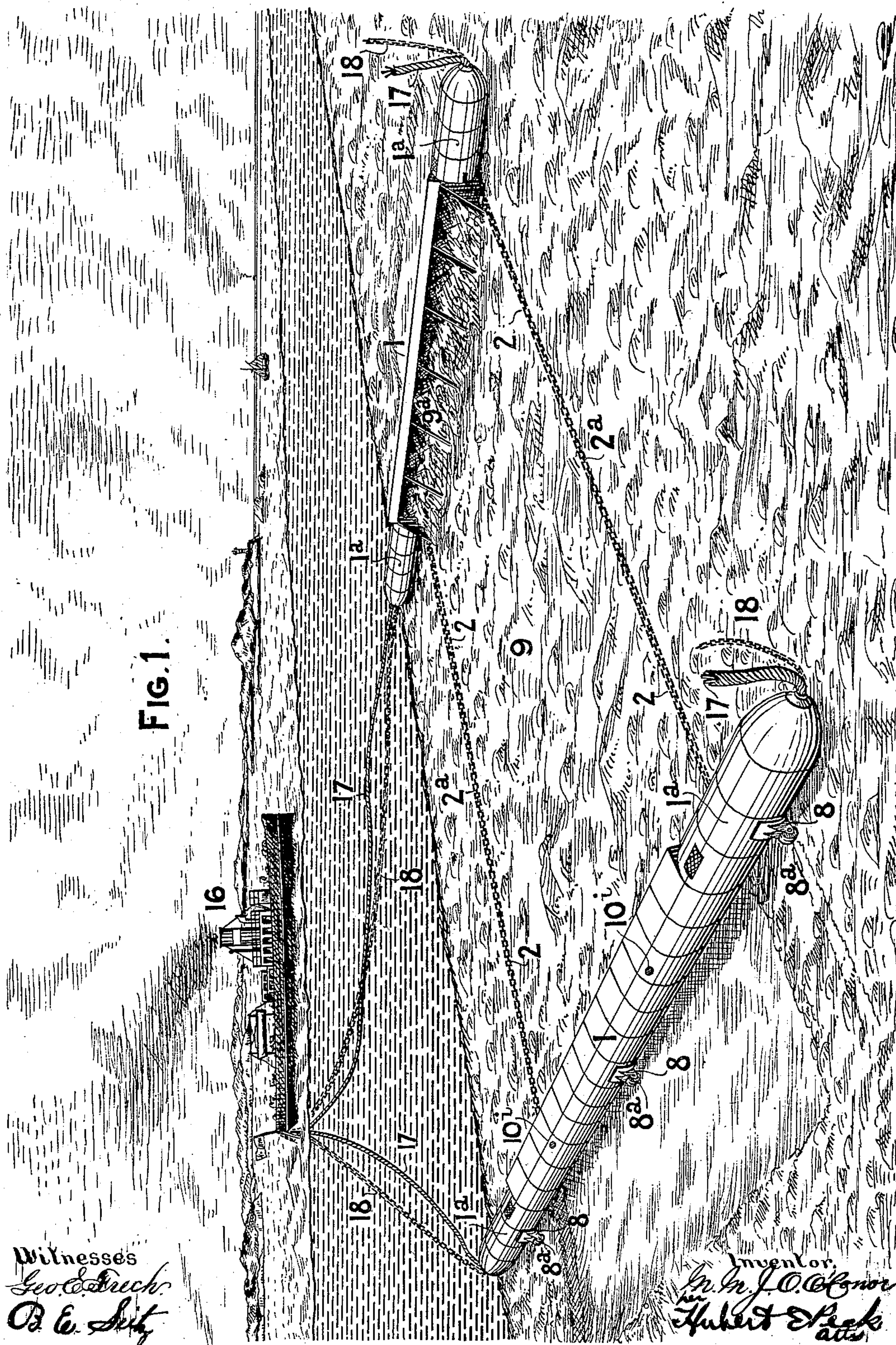
**Patented Nov. 20, 1909.**

**M. M. J. O. O'CONOR.**  
**DREDGING APPARATUS.**

(Application filed Aug. 10, 1898.)

(No Model.)

**9 Sheets—Sheet 1.**



Witnesses  
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No. 662,293.

M. M. J. O. O'CONOR.  
DREDGING APPARATUS.

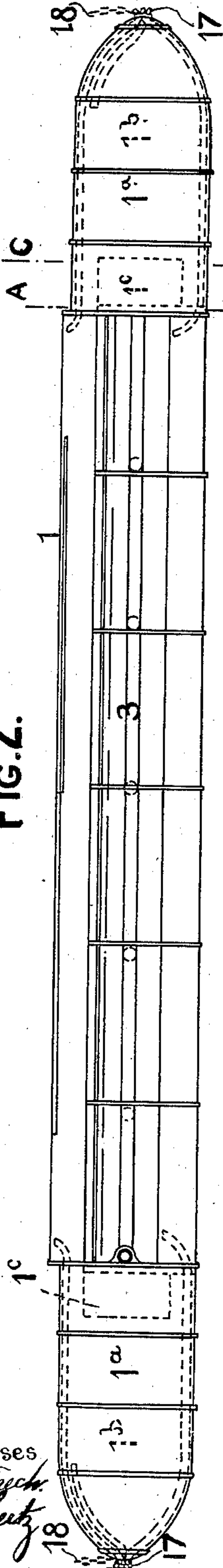
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(No Model.)

9 Sheets—Sheet 2.

FIG. 2.



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FIG. 3.

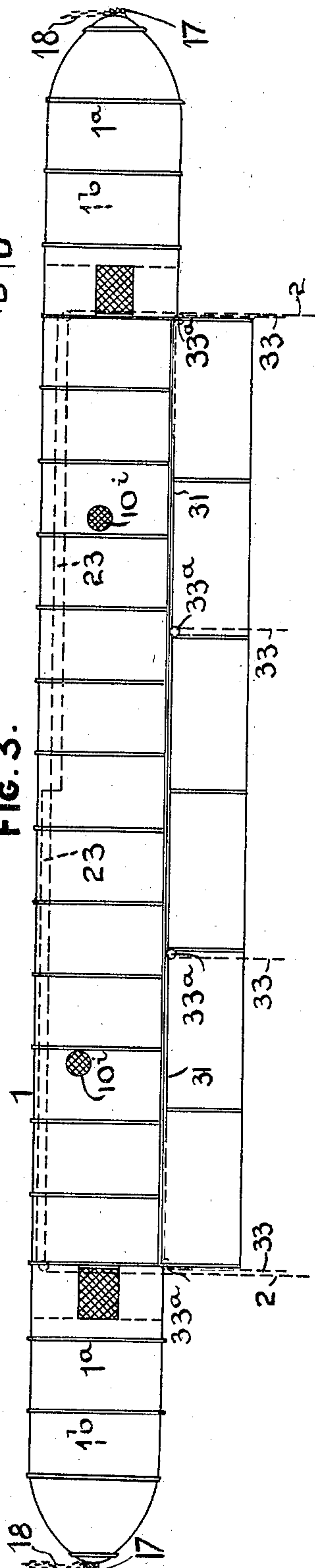
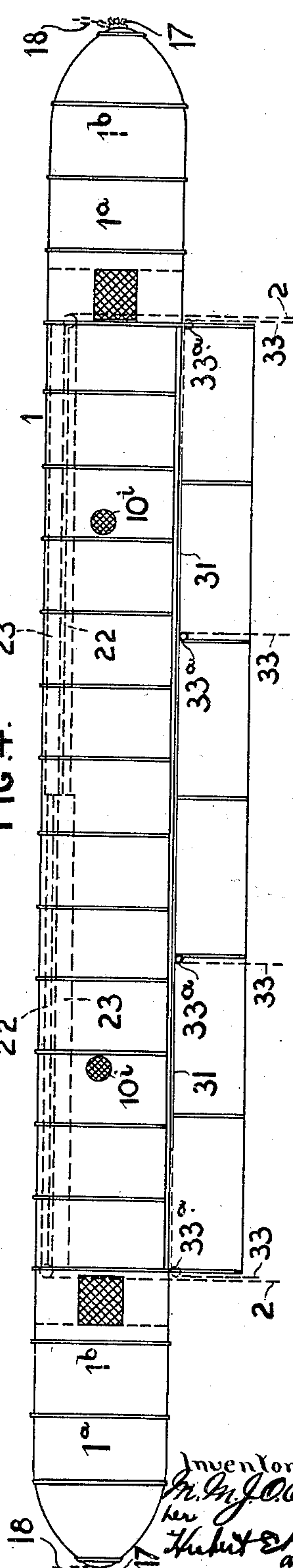


FIG. 4.



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FIG. 5.

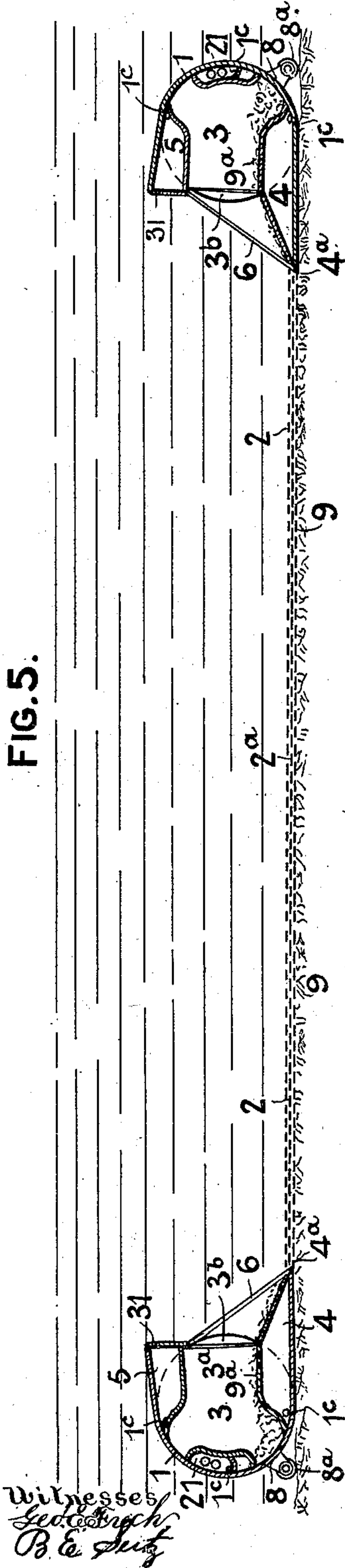


FIG. 6.

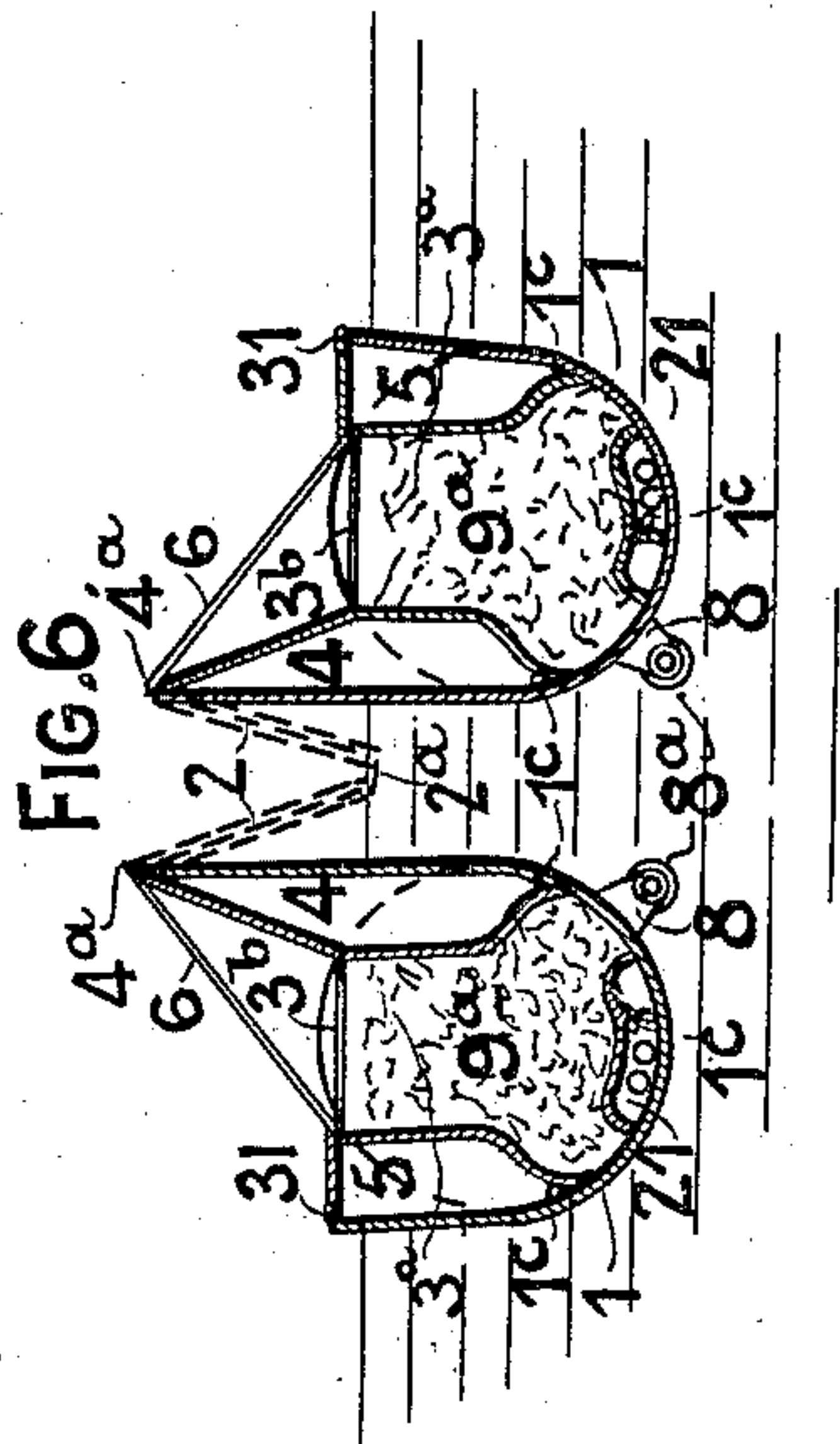
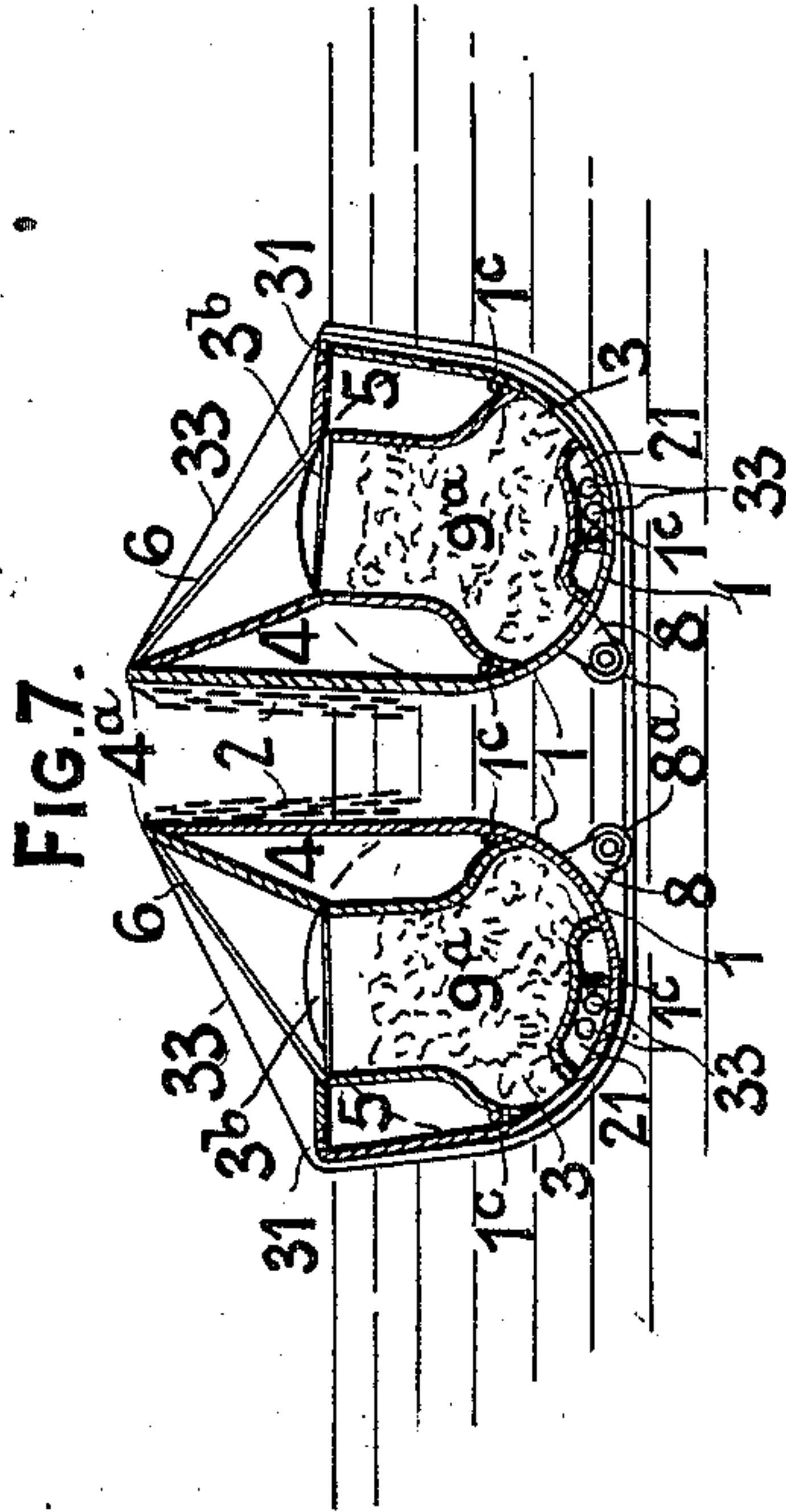


FIG. 7.





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FIG. 9.

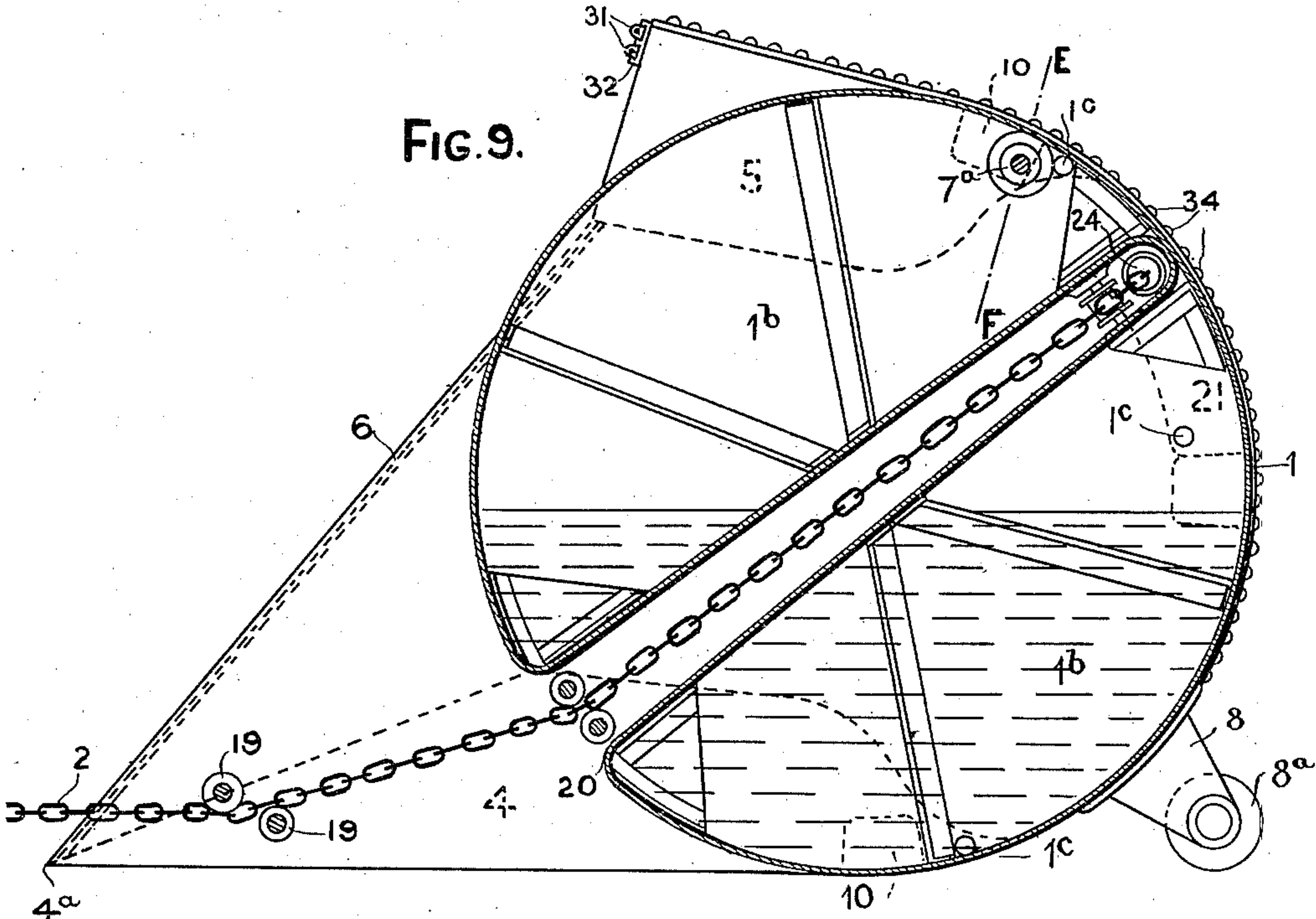


FIG. 10.

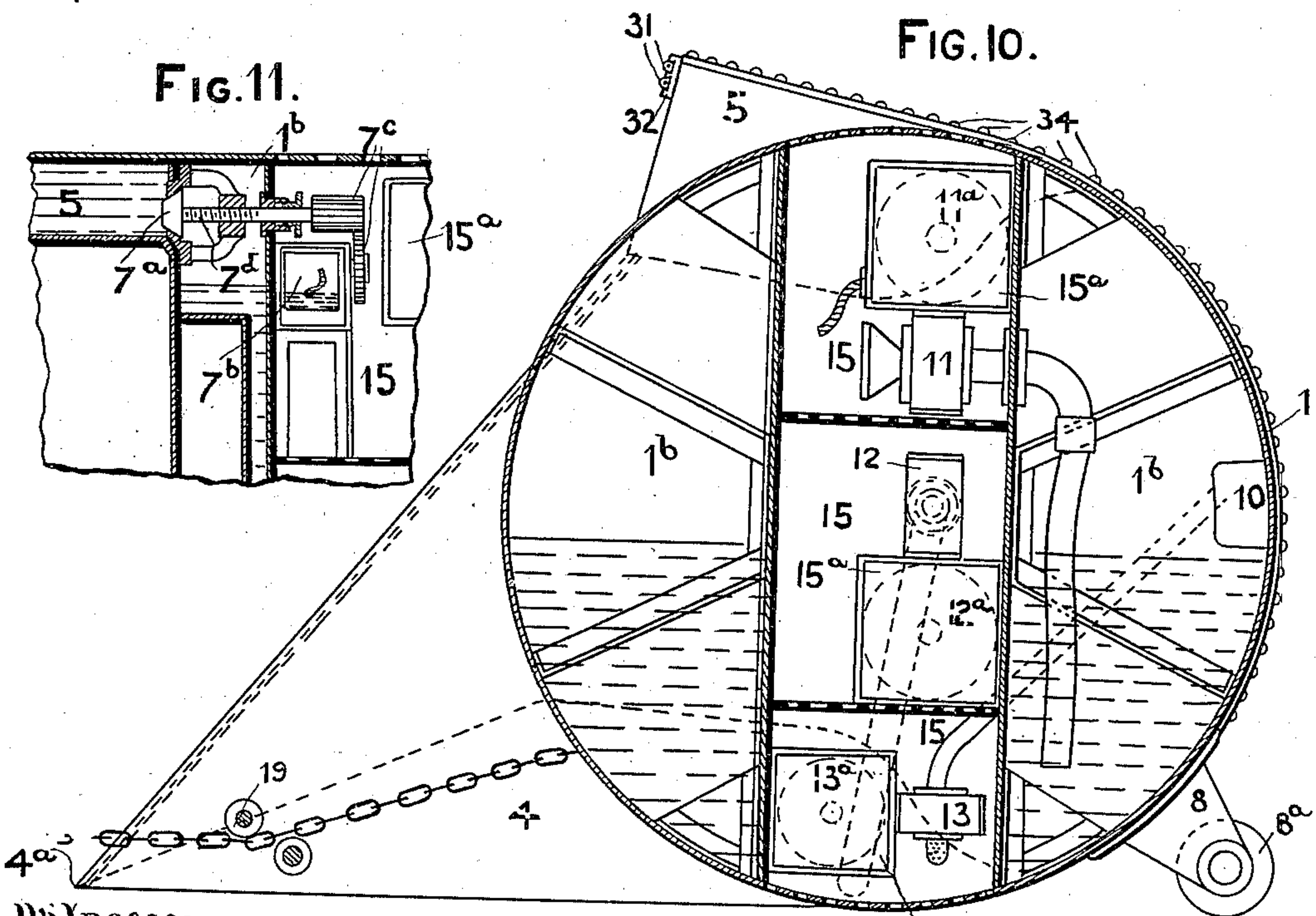
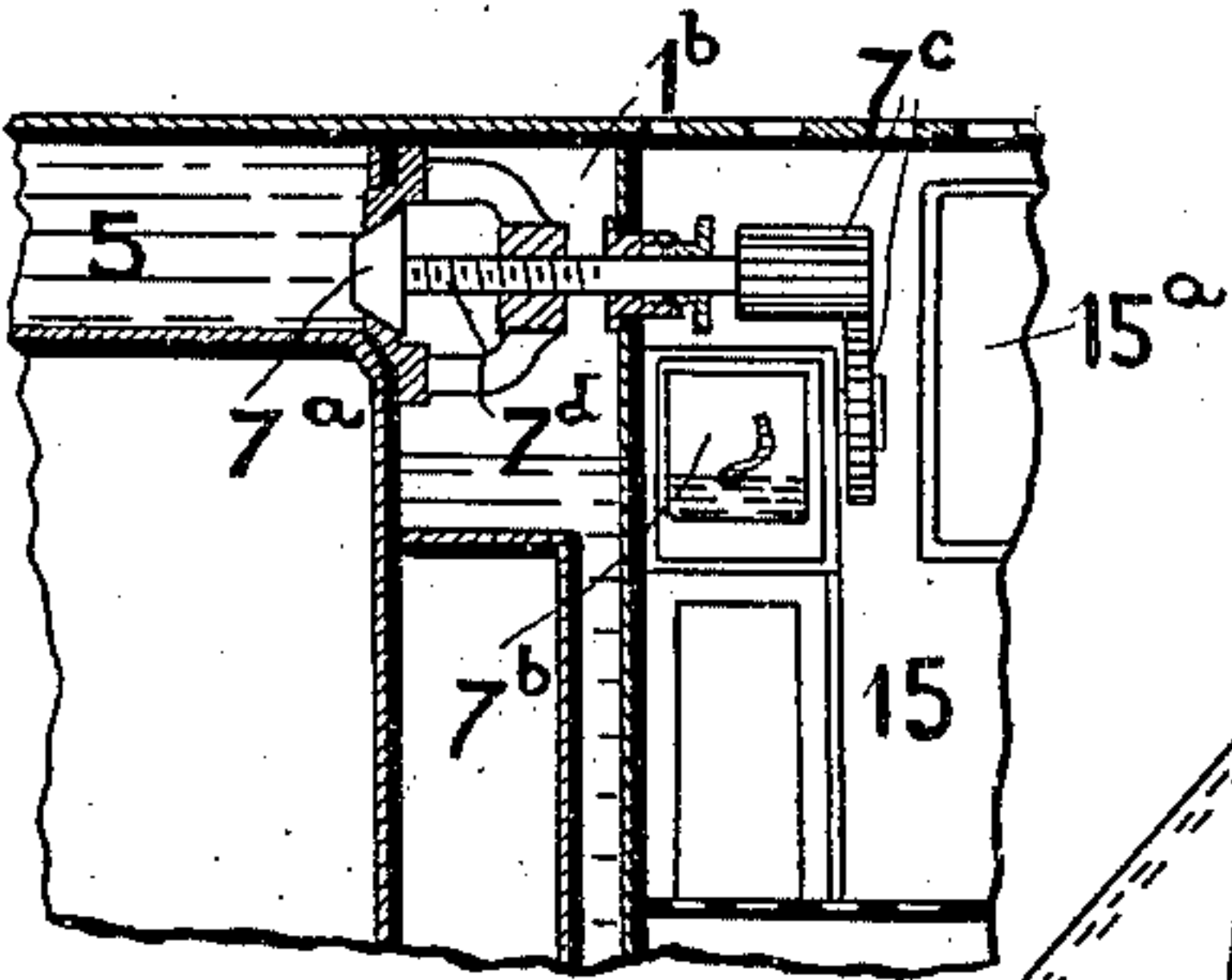


FIG. 11.



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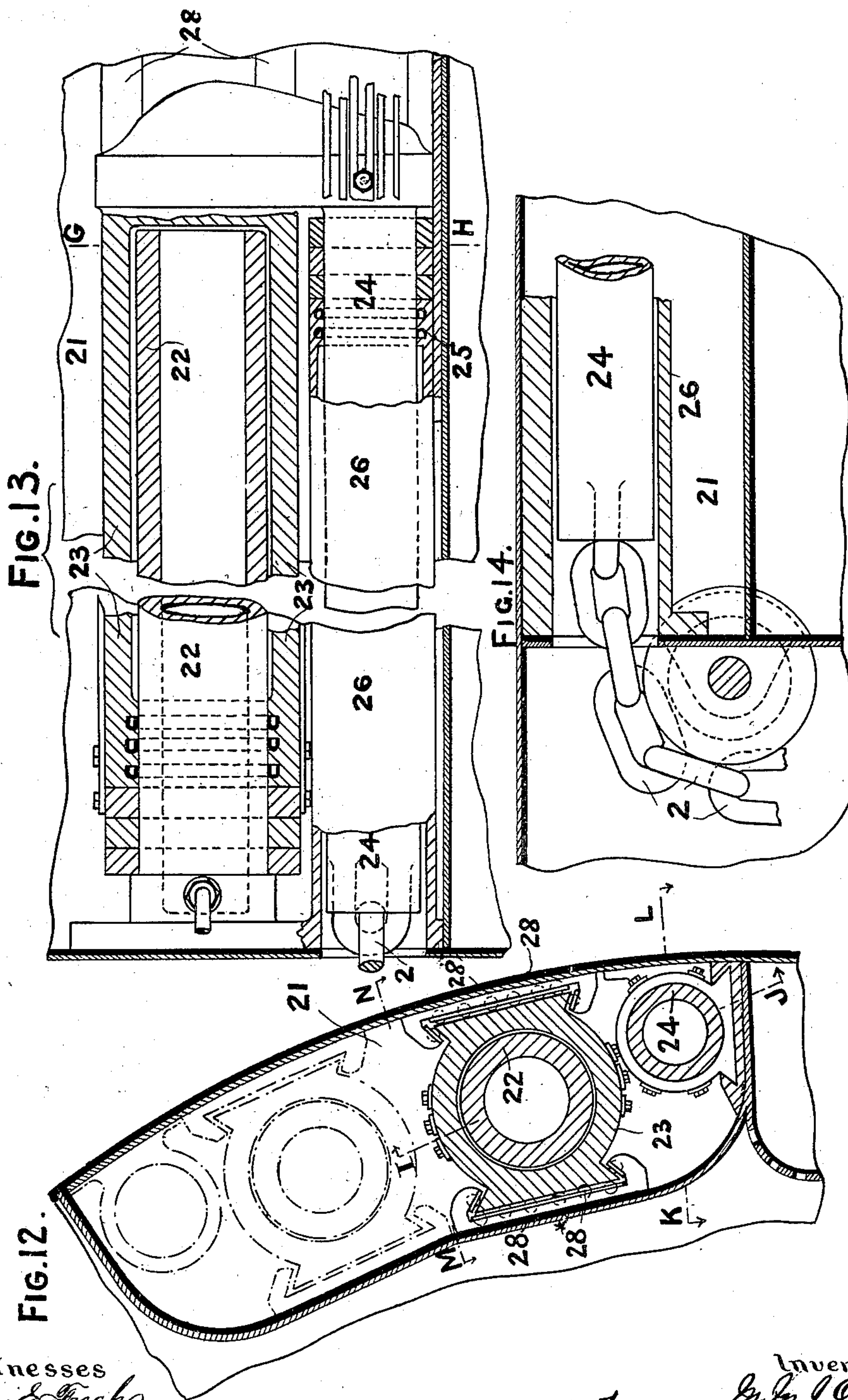
**M. M. J. O. O'CONOR.**  
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## DREDGING APPARATUS.

(Application filed Aug. 10, 1898.)

(No Model.)

9 Sheets—Sheet 5.



Witnesses  
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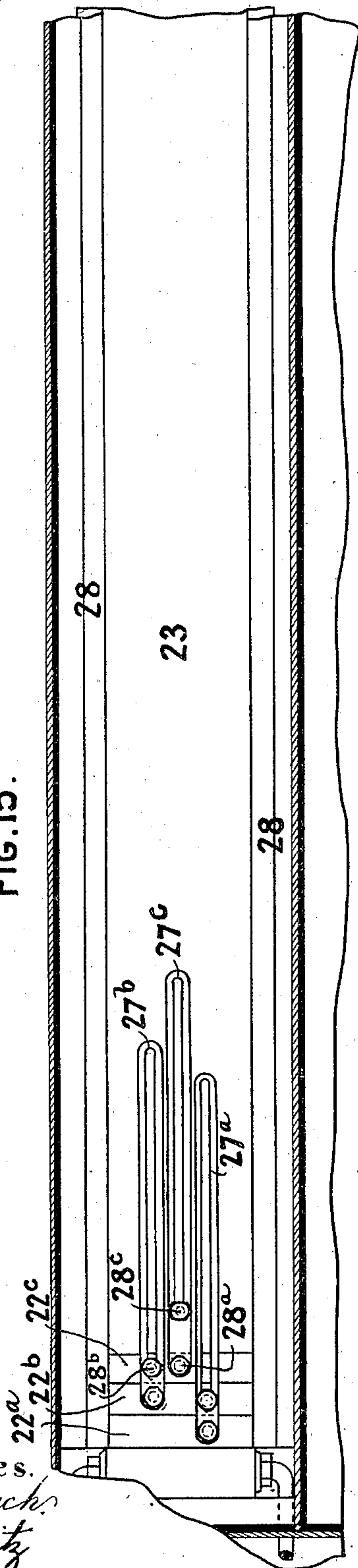
M. M. J. O. O'CONOR.  
DREDGING APPARATUS.

(Application filed Aug. 10, 1898.)

(No Model.)

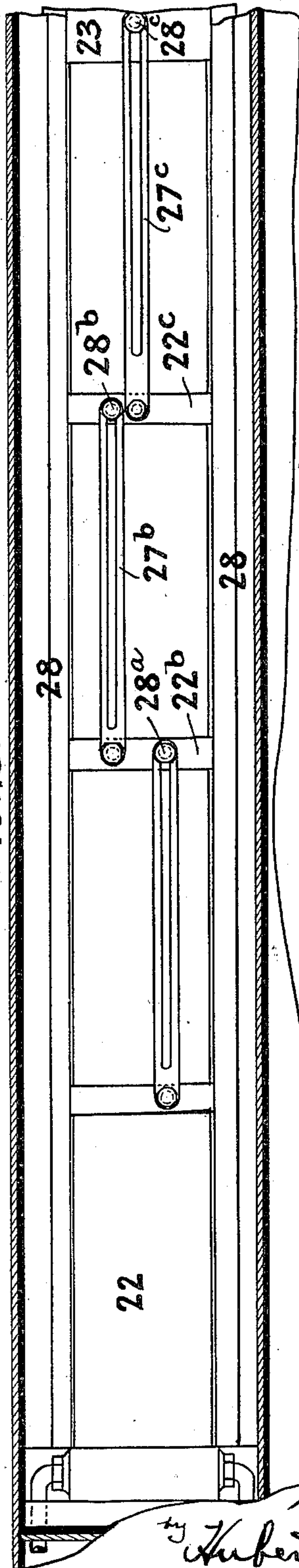
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FIG. 15.



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FIG. 16.



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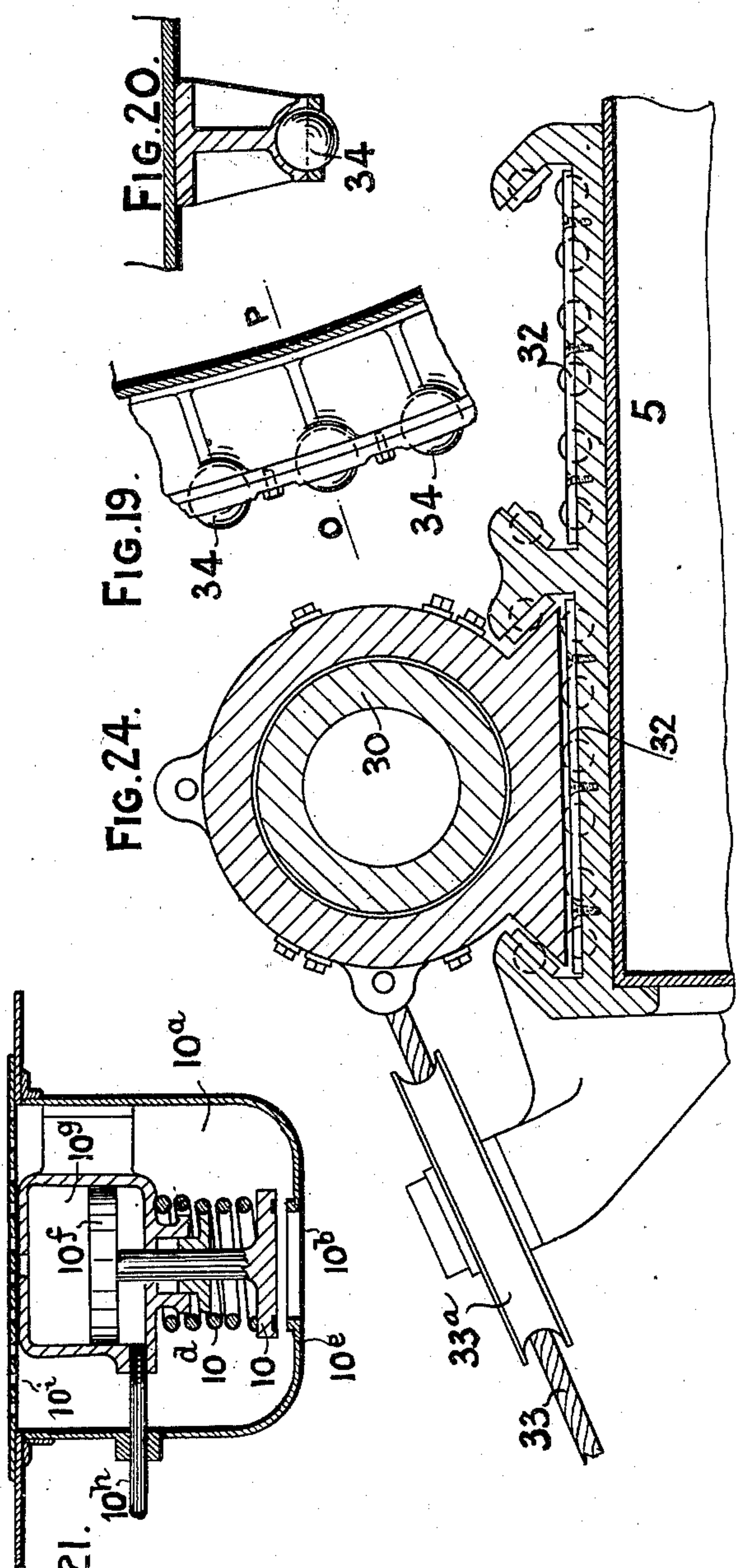
Patented Nov. 20, 1900.

**M. M. J. O. O'CONOR.**  
**DREDGING APPARATUS.**

(Application filed Aug. 10, 1898.)

(No Model.)

**9 Sheets—Sheet 8.**



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No. 662,293.

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FIG. 27.

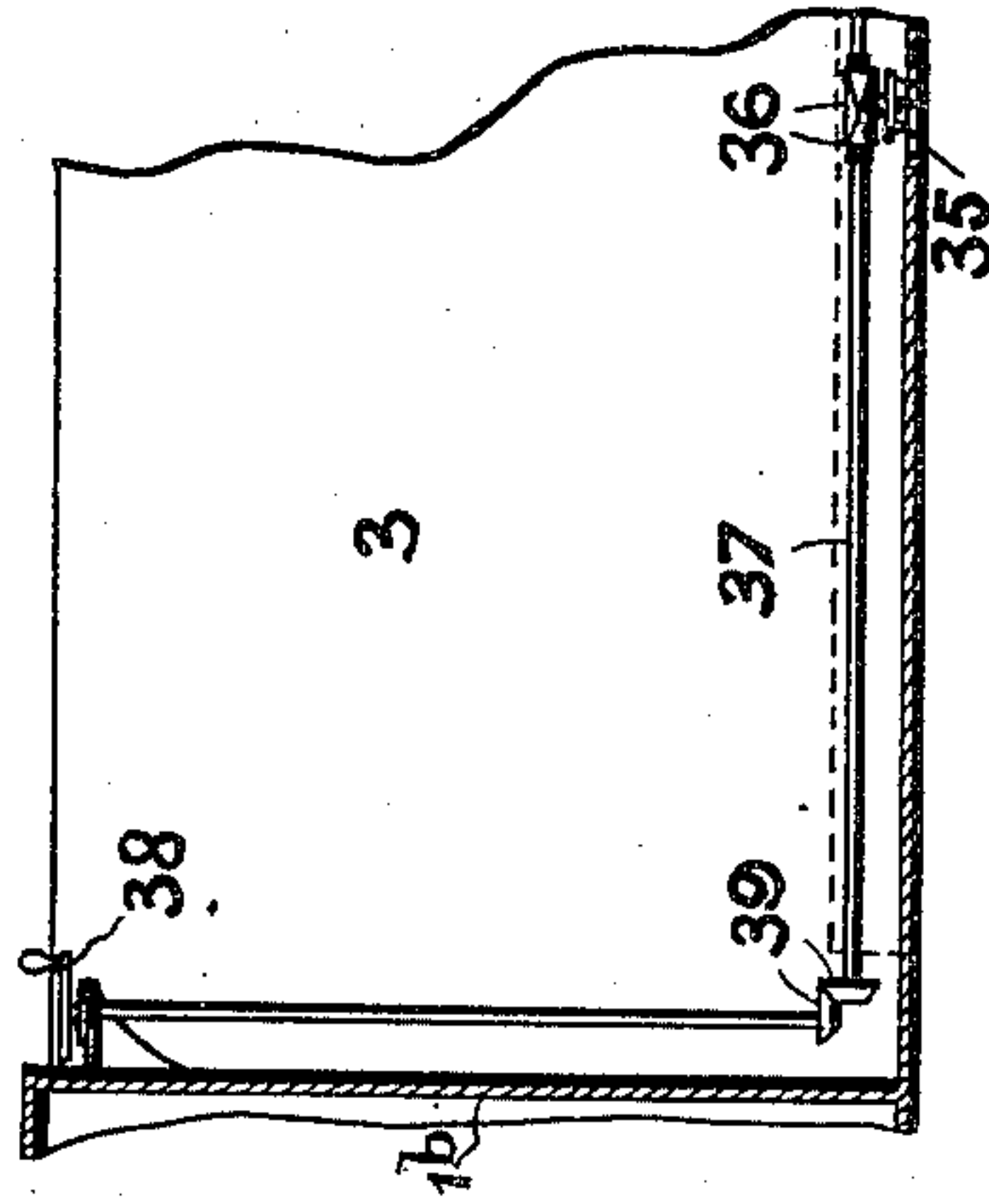


FIG. 26.

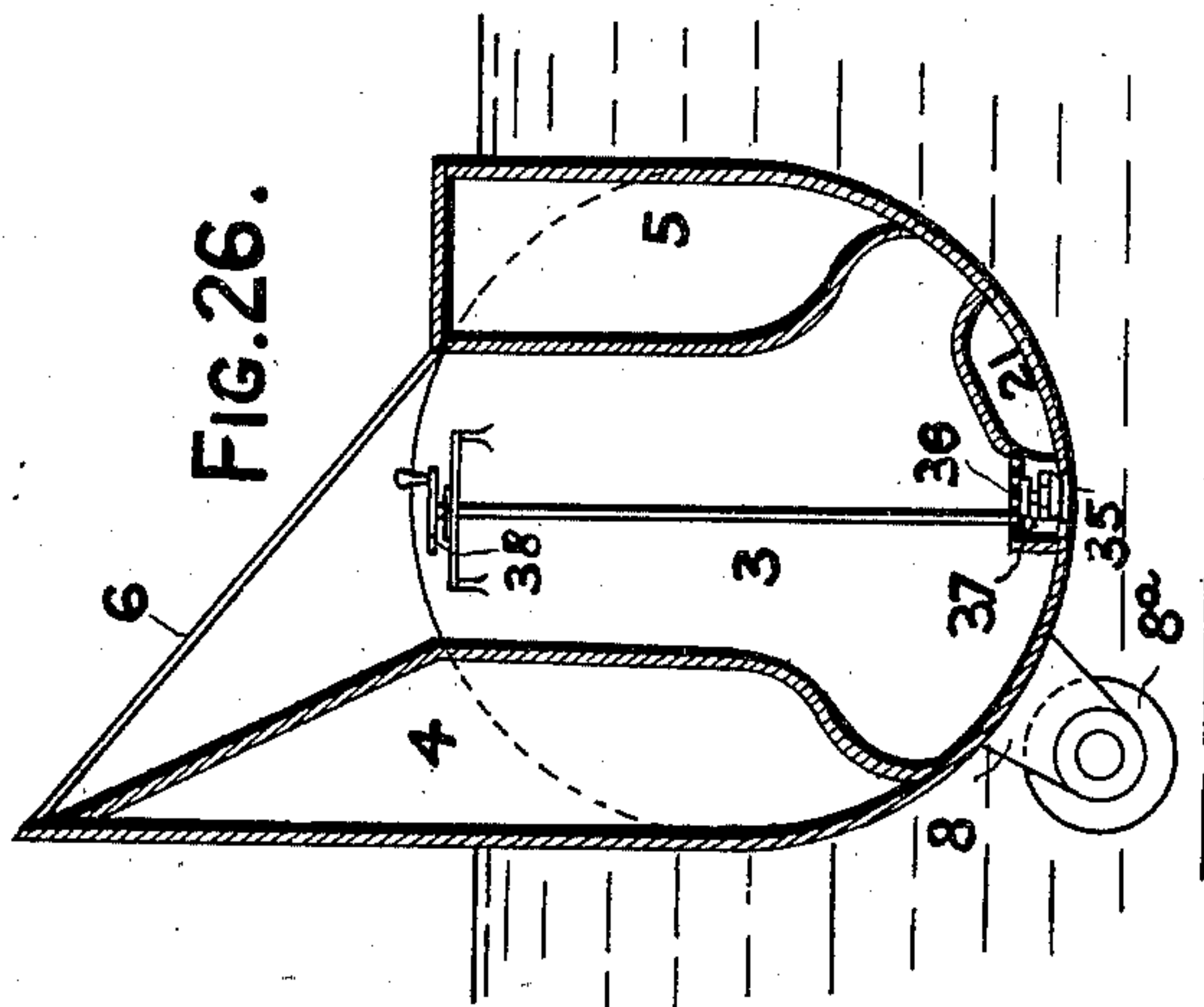
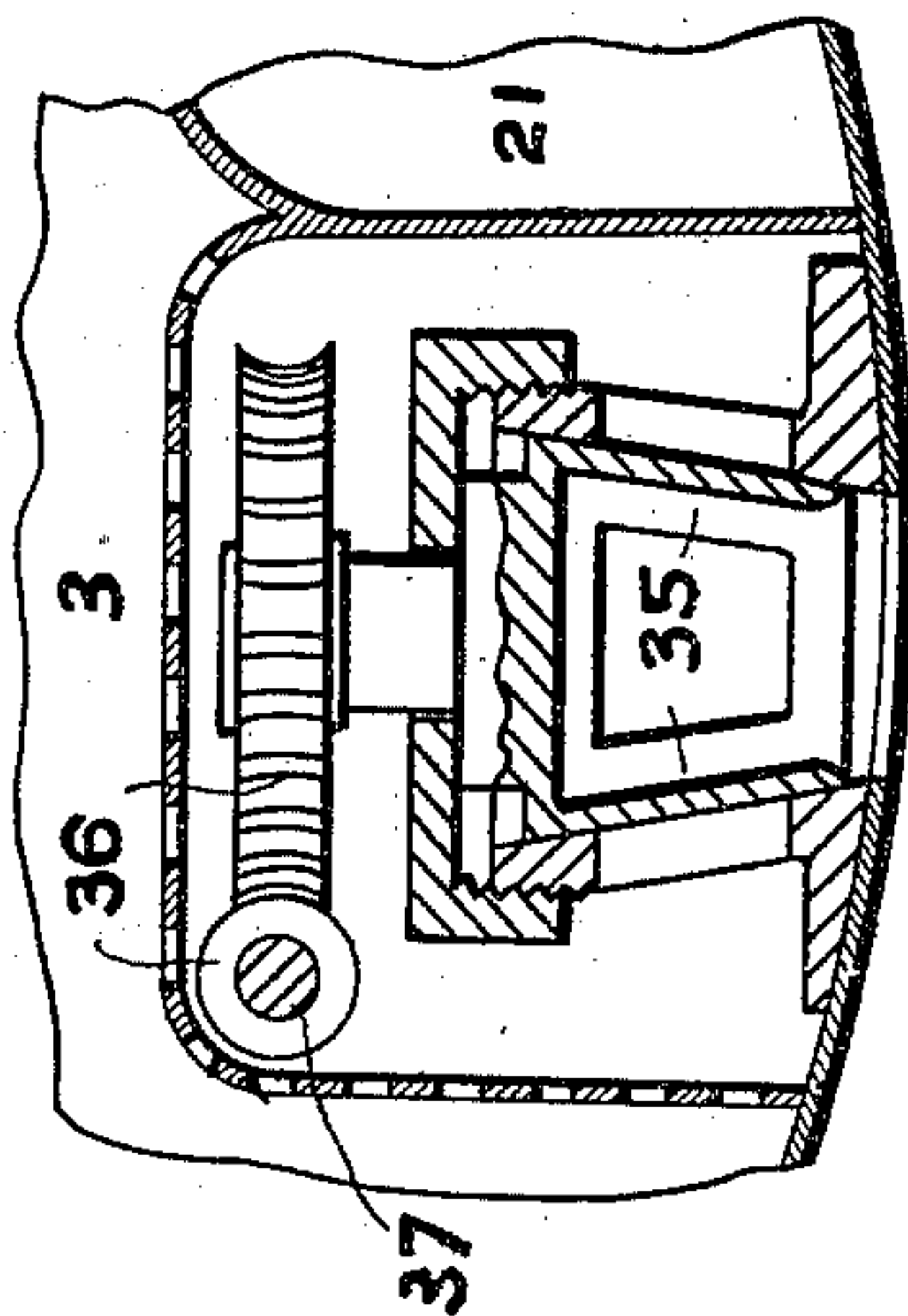


FIG. 25.



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# UNITED STATES PATENT OFFICE.

MAURICE MARY JOSEPH OWEN O'CONOR, OF DRUMSHAMBO, IRELAND.

## DREDGING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 662,293, dated November 20, 1900.

Application filed August 10, 1898. Serial No. 688,302. (No model.)

*To all whom it may concern:*

Be it known that I, MAURICE MARY JOSEPH OWEN O'CONOR, a subject of the Queen of Great Britain and Ireland, residing at Inisfale Island, Drumshambo, in the the county of Leitrim, Ireland, have invented Improvements in Dredging Apparatus, (for which patents have been granted in Great Britain, dated June 2, 1898, No. 12,439; in Canada, dated August 20, 1898, No. 60,988; in France, dated October 5, 1898, No. 281,898; in Belgium, dated October 6, 1898, No. 138,232; in Italy, dated December 31, 1898, Reg. Att., Vol. 106, No. 244; in Austria, dated November 12, 1898, 48/5,666; in Spain, dated November 15, 1898, No. 23,177; in Turkey, dated October 24, 1898, No. 709; in Cape Colony, dated October 20, 1898, No. 916, Folio No. 1637; in Victoria, dated November 15, 1898, No. 15,719; in Natal, dated November 8, 1898, 4/1899; in India, dated April 24, 1899, No. 410 of 1898; in New South Wales, dated November 15, 1898, No. 8,807; in South Australia, dated November 15, 1898, No. 4,221; in New Zealand, dated June 2, 1898, No. 11,201; in Queensland, dated June 2, 1898, No. 4,690, and in West Australia, dated June 2, 1898, No. 2,303,) of which the following is a specification.

This invention has reference to apparatus whereby sand-banks, shallows, and the beds of rivers, harbors, canals, estuaries, and other waterways (hereinafter included in the term "river-beds") can be dredged in a simple, economical, and effective manner. Apparatus for this purpose according to this invention comprises, according to one arrangement, two elongated vessels, each formed with a large open receptacle to hold dredged material, with a wedge-like extension projecting from one side and adapted to cause material being dredged to enter the said receptacle, and with air and water tight compartments, means whereby water or air can be caused to enter the compartments of each vessel at will, chains or other flexible connections (hereinafter called "chains") connecting the vessels at suitable points, and hydraulic or other mechanism located in the said vessels and whereby the chains can be hauled in for the purpose of drawing the vessels laterally toward one another when dredging. The arrangement is such that the ves-

sels can be floated to any required position and then be drawn apart to any desired extent, can then be sunk to the river-bed and caused to bear thereon, so as with their chains to inclose or surround a large area requiring to be dredged and with their wedge-like extension pointing toward one another and slightly inclined to the river-bed, and can then be drawn laterally toward one another by hauling in the chains, whereby the wedge-like extensions will be forced to partly bury themselves in the material requiring to be dredged and traveling in this position will cause a layer of the material of any desired thickness to slide up over them and into the receptacles in the vessels, after which the position of the vessels can be altered so as to cause them to partly turn or rotate in such a way as to bring the mouths of the receptacles uppermost, and the buoyancy of the vessels can then be increased, so as to bring them with their contained dredged material to the surface of the water and permit of their being towed to any desired place where their contents can be discharged.

In order that the two vessels may, after being floated to the surface of the water and towed to any desired place, be further rotated for the purpose of discharging the dredged material therefrom by inverting the vessels, there are provided on or in each vessel sets of suitable hauling-up mechanism, to a movable part of each of which is attached one end of one or more chains or other flexible connection that is or are led under the two adjacent vessels and has its or their other end or ends connected to a suitable part of the adjacent vessel, the arrangement being such that by operating the hauling-up mechanism on the two vessels and so drawing up the flexible connections the vessels can be partly rotated in such a way that the wedge-like extensions of the two vessels which at starting are projecting upward will be turned away from each other and in a downward direction, so as to bring the vessels into positions in which the dredged material will fall out of the same and be discharged into water by gravity.

Apparatus to operate in the manner described can be constructed in various forms. Figure 1 of the accompanying illustrative



drawings is a perspective view showing the apparatus at work on the bed of the sea, the water for the sake of clearness being omitted from that portion of the sea-bed on which the apparatus is working. Fig. 2 shows in front elevation, and Fig. 3 in plan, one of the elongated vessels to a larger scale than Fig. 1. Fig. 4 is a similar view to Fig. 3, but showing hydraulic rams hauling in the chains and so drawing the vessel along the bed of the sea and laterally toward one another while dredging and also hydraulic rams for inverting the vessels by partial rotation thereof. Fig. 5 is a cross-section showing the apparatus at work on the bed of the sea. Fig. 6 is a cross-section showing the connected vessels drawn near together, partly rotated, so as to bring the mouths of the receptacles uppermost and raised to the surface of the water. Fig. 7 is a similar view to Fig. 6, but showing the chains by which the vessels are drawn together disconnected at the center and the vessels connected by flexible connections for partly rotating them. Fig. 8 shows the vessels partly rotated and the dredged material being discharged therefrom. Figs. 9 and 10 show to a still larger scale cross-sections corresponding to the lines A B and C D of Fig. 2. Fig. 11 is a part longitudinal section on the line E E of Fig. 9. Figs. 12 to 18 are detail views of the hydraulic rams for hauling in the chains, whereby the vessels are drawn laterally together along a river-bed, Fig. 12 being a cross-section on the line G H of Fig. 13; Fig. 13, a part longitudinal section on the line I J of Fig. 12; Fig. 14, a horizontal section on the line K L of Fig. 12; Fig. 15, a horizontal section on the line M N of Fig. 12, showing the ram and adjacent parts in the positions they occupy before the commencement of the outward stroke of the ram; Fig. 16, a similar view to Fig. 15, but showing the said parts in the positions they occupy at the completion of the stroke; Fig. 17, a side elevation showing means connected with the ram and adapted for operating a hauling-in chain and at the same time preventing the entry of water to the machinery-compartment, the positions of the parts being that which obtains before the said ram makes its working stroke, and Fig. 18 a similar view to Fig. 17, but showing the various parts in the positions which obtain at the end of the stroke of the said ram. Figs. 15 to 18 are not to scale as regards the length of stroke of the ram. For the sake of clearness the rams are shown of shorter stroke than in actual practice would ever be likely to obtain. Fig. 19 shows in end elevation part of a circumferential girder with antifriction ball-bearing arrangement, and Fig. 20 is a cross-section thereof on the line O P of Fig. 19. Fig. 21 shows partly in section and partly in elevation an arrangement of water-inlet valve. Fig. 22 shows in plan part of one of the vessels with the rams for rotation, the rams being in the positions they occupy before making their working stroke. Fig. 23 is a

similar view to Fig. 22, but showing the rams in the positions they occupy after making their working stroke. Fig. 24 is a cross-section corresponding to the line Q R of Fig. 22, but drawn to a larger scale. Figs. 22 and 23 are not to scale as regards the length of stroke of the rams; but for the sake of clearness the rams are shown of short stroke. Also for the sake of clearness the means for drawing out the supporting blocks or bearings for the rams are not shown in these two figures. Fig. 25 shows in transverse section a construction of cock suitable for admitting air or water to the receptacle in which the dredged material is received. Figs. 26 and 27 show, respectively, in cross-section and longitudinal section and to a smaller scale than Fig. 25 part of the dredging vessel with cock and means for operating the same.

1 1, Fig. 1, are the two elongated vessels bearing upon the bed to be dredged and connected together at intervals by hauling-in chains 2, which extend laterally from each vessel and are adapted to be connected together at their ends, as at 2<sup>a</sup>, by suitable coupling devices, such as ordinary shackles. In the construction shown, Figs. 2 to 27, inclusive, each vessel 1 is built up of suitable material, such as angle-iron and metal plating, its end portions 1<sup>a</sup> being made of hollow cylindrical shape with tapered ends and so as to form air and water tight compartments 1<sup>b</sup>, which communicate with one another, as by longitudinal pipes 1<sup>c</sup>. The central or intermediate portion of the vessel designed to serve as a hold or receptacle 3 for dredged material is made of hollow curved section and has at one part a wide longitudinal opening 3<sup>a</sup>, the sides of which are for the purpose of strengthening them connected together at intervals by suitable connections 3<sup>b</sup>—for example, angle or T irons—which may form part of the framing of the vessel. At opposite sides of the opening 3<sup>a</sup> the vessel is provided with longitudinal air and water tight chambers 4 and 5, one of which—viz, 4—is made of greater cross-section and weight than the other (5) and projects from the vessel 1 and is made of approximately wedge shape in cross-section, as shown, so as to form the wedge-like extension, over which material requiring to be dredged will enter the receptacle 3 when dredging. The edge portion of this wedge-like extension is or may be connected at intervals by E, T, or like angle-bar connections 6 to the vessel 1 at the opposite side of the longitudinal opening 3<sup>a</sup>, so as to strengthen the said extension and permit it to do its work efficiently. These connections 6 are shaped to offer very little obstruction and may extend back in the form of plate-metal partitions into the receptacle 3, so as to divide the same into a number of separate but adjacent receptacles which collectively make up what is herein called the “receptacle” 3. The smaller longitudinal chamber 5, at the opposite side of the longitudinal opening 3<sup>a</sup>, is adapted to be



placed in communication with the air and water tight compartments 1<sup>b</sup> in the end portions of the vessel through openings, each of which is governed by a valve that can be controlled from above the surface of the water—  
 5 as, for example, through mechanical or electrical connections operated or controlled from an attendant ship. Fig. 11 shows one arrangement for this purpose wherein the hole  
 10 7, connecting the chamber 5 with the adjacent end compartment 1<sup>b</sup>, is controlled by a valve 7<sup>a</sup>, adapted to be opened or closed by the rotation of an electric motor 7<sup>b</sup> in one or other direction and acting through gearing 7<sup>c</sup> on the  
 15 screw-threaded stem 7<sup>d</sup> of the valve which works in a screw-threaded bearing 7<sup>e</sup>.

To keep the sharp front edge 4<sup>a</sup> of the wedge-like extension 4 buried at the proper depth and angle when dredging and to prevent it  
 20 from tilting up by reason of the pull of the hauling-in chains 2, each vessel 1 is provided at intervals of its length with lateral arms or projections 8, that extend rearwardly from the vessel and bear upon the river-bed 9  
 25 when dredging, Figs. 1 and 5. These arms or projections 8 are or may be provided with rollers 8<sup>a</sup> to facilitate the passage of the vessel over the said bed.

Each vessel is provided with valves 10,  
 30 Figs. 3 and 4, or other suitable means whereby water can be admitted to the air and water tight compartments 1<sup>b</sup> therein and to the longitudinal air and water tight chambers 4 and 5 for the purpose of causing the vessel  
 35 to sink. These valves may be spring-valves located in pockets in the vessel and arranged to be opened by fluid under pressure supplied from an attendant ship, or cocks or valves adapted to be opened and closed mechanically may be used. Fig. 21 shows one  
 40 arrangement suitable for this purpose. The valve 10 is a spring-valve arranged within a pocket 10<sup>a</sup>, open to the water and controlling an opening 10<sup>b</sup>, leading to the compartment  
 45 or chamber to which water is to be admitted. 10<sup>d</sup> is a spring that tends to press the valve against its seat 10<sup>e</sup>. 10<sup>f</sup> is a piston connected to the stem of the valve and arranged to work in a cylinder 10<sup>g</sup>, and 10<sup>h</sup> is a pipe for supplying fluid under pressure to the cylinder  
 50 10<sup>g</sup>. The arrangement is such that by admitting fluid under pressure to the cylinder 10<sup>g</sup> the valve 10 can be opened against the action of its spring 10<sup>d</sup> and water allowed to  
 55 enter the corresponding compartment or chamber to sink the vessel 1, and upon exhausting the cylinder 10<sup>g</sup> the valve 10 will be closed against its seat 10<sup>e</sup> and be held there by the external pressure of the water in which  
 60 the vessel is submerged. 10<sup>i</sup> is a screen to prevent the entrance of foreign matter to the pocket 10<sup>a</sup>. The air-pipe 10<sup>h</sup> may be common to all the water-inlet valves and be led to the surface of the water with the air-tube and  
 65 electric cables hereinafter referred to, or cocks of the kind hereinafter described with reference to and shown in Fig. 25 may be

used for admitting water to the said compartments and chambers. Each vessel 1 is also provided with pumps 11, whereby the  
 70 water can be afterward withdrawn from the said end compartments 1<sup>b</sup> and the smaller—viz., 5—of the two longitudinal chambers 4 5, air being simultaneously admitted to these compartments and chamber from above the  
 75 surface of the water, with pumps 12, whereby water can be withdrawn from the larger longitudinal or wedge-shaped chamber 4, to which air is also simultaneously admitted from above the surface of the water, and with  
 80 pumps 13 for supplying water under pressure to hydraulic mechanism for hauling in the chains 2. The said pumps are driven by suitable motors 11<sup>a</sup> 12<sup>a</sup> 13<sup>a</sup>, respectively—for example, electric motors—controlled from above  
 85 the surface of the water. The pumps and their motors are preferably placed in suitable compartments 15 in the cylindrical end portions 1<sup>a</sup> of each vessel 1 and are or may be so arranged that the center of gravity of such  
 90 end portions shall be as near the axis of the end portions as possible. The electric motors (when used) may be of any suitable construction and are to be of adequate power and such as can through suitable conductors  
 95 be set in operation from an attendant ship 16, which is intended to carry suitable electric generators with adequate driving power and appliances or storage batteries. The electric motors should be carefully located in strongly-  
 100 constructed water-tight compartments 15<sup>a</sup>, suitable provision being made to afford access, when necessary, to such compartments and also for strongly closing them air and water tight at other times.  
 105

The pumps may be of any suitable construction, such as can be worked, through appropriate gear, from the particular motors employed, but care must be taken that all the  
 110 connections between the electric motors and the pumps they are to operate shall be so inclosed as to prevent, as far as possible, the entry of water into the compartments in which the electric motors are located. The working  
 115 part between each motor and its pump may, for this purpose, extend through one or more long and well-packed stuffing-boxes.

To one or to each end of each vessel 1 are connected strong armored flexible air-tubes 17, to which are secured electric cables. There  
 120 may be three air-tubes, one, say, for the two end compartments 1<sup>b</sup>, one for the chamber 4, and the other for the chamber 5. The arrangement of the air-tubes and electric cables is such that through the tubes air may, according  
 125 to requirement, enter or leave each of the several compartments 1<sup>b</sup> and chambers 4 and 5, (air entering as water is discharged and leaving as water is admitted,) and through the electric cables the necessary electric currents are conducted for the purpose of operating the electric motors 11<sup>a</sup> and 12<sup>a</sup>, whereby  
 130 to work, when required, the pumps for discharging water from the said compartments



and chambers, as also to work the motors 13<sup>a</sup> for operating the hydraulic mechanism (hereinafter described) used for hauling in the chains 2, connecting the vessels for the purpose of drawing the said vessels laterally toward one another while dredging and also for actuating other parts designed to be operated electrically. To obviate liability of fracture of the air-tubes 17 and electric cables, chains 18 may be used in conjunction therewith for taking the strain between each vessel 1 and the attendant ship 16.

In some cases the several pumps hereinbefore referred to may be placed in the attendant ship or ships and be connected by armored hose-pipes with the compartments and chambers and hydraulic mechanism which they are to serve. In such a case the pumps can be driven by steam-engines.

The chains 2 for drawing the vessels 1 together laterally are led over and under guide-pulleys 19, Fig. 9, and through openings 20, formed in each vessel near the ends of its wedge-like extension 4, and also, it may be, as in the example shown, at one or more intermediate points, (two are shown,) each chain or two or more chains being thence led to suitable hydraulic hauling-in mechanism arranged within a compartment 21, which is preferably so located as to be at or near the bottom of the dredge or receptacle 3 when the vessel 1 is floating and not inverted. (See Figs. 6 and 7.)

As will be obvious, the hydraulic apparatus can be constructed in various forms. According to the construction shown in Figs. 12 to 18, inclusive, each hydraulic apparatus comprises a fixed ram 22 and a movable cylinder 23, that is connected to one end of the corresponding chain 2 through a rod 24, which extends through a stuffing-box or packing ring or rings 25 into a tube 26, into which the chain 2 is drawn, the arrangement being such that water from without the vessel 1 cannot enter the machinery-compartment 21. Suitable supports are or may be provided for carrying each ram 22 when the same is uncovered by its cylinder 23. These supports may be arranged to be brought into position for use by the movement of the said cylinder. In the arrangement shown for this purpose in Figs. 12 to 16 each ram 22 is provided with three blocks or bearings 22<sup>a</sup>, 22<sup>b</sup>, and 22<sup>c</sup>, to which are secured pairs of slotted bars 27<sup>a</sup>, 27<sup>b</sup>, and 27<sup>c</sup>, respectively. 28<sup>a</sup>, 28<sup>b</sup>, and 28<sup>c</sup> are pins fixed to the bearings 22<sup>b</sup> and 22<sup>c</sup> and the cylinder 23, respectively, and extending through the slots in the bars 27<sup>a</sup>, 27<sup>b</sup>, and 27<sup>c</sup>, respectively. The bearings 22<sup>a</sup>, 22<sup>b</sup>, and 22<sup>c</sup> are shaped to slide in suitable guideways 28, in which the cylinder 23 also slides and which may be provided with antifriction balls or rollers 28\*. The arrangement is such that at commencement of the outstroke of the cylinder 23 the bearings 22<sup>a</sup>, 22<sup>b</sup>, and 22<sup>c</sup> remain close to the fixed end of the ram 22 until the pins 28<sup>c</sup> on the cylinder reach the ends of the

slots in the pair of bars 27<sup>c</sup>, whereupon the bearing 22<sup>c</sup> is caused to travel forward with the cylinder and support the ram from the guideways 28 at the part where it rests on the said bearing. Upon the pins 28<sup>b</sup>, carried by the bearing 22<sup>c</sup>, reaching the ends of the slots coming in the pair of bars 27<sup>b</sup>, the bearing 22<sup>b</sup> will be caused to travel forward with the cylinder and support the ram in like manner to the bearing 22<sup>c</sup>. When the pins 28<sup>a</sup> on the bearing 22<sup>b</sup> reach the ends of the slots in the bars 27<sup>a</sup>, the bearing 22<sup>a</sup> will also be caused to travel forward with the cylinder and support the ram, the various parts finally assuming the relative positions shown in Fig. 16. The rod 24 is supported in like manner by bearings 29<sup>a</sup>, 29<sup>b</sup>, and 29<sup>c</sup> when it is drawn out of the tube 26. (See Figs. 17 and 18.) In some cases for using very long chains or other flexible connections 2 the construction of the hydraulic mechanism may be such that each chain or other flexible connection is arranged to pass around fixed and movable sets of pulleys—such, for example, as are described in the specification of another application for Letters Patent filed by me June 6, 1898, Serial No. 682,709.

The sets of hauling-in mechanism are preferably placed, as shown in Figs. 5 to 9, inclusive, so as to be near the bottom of the vessel when the same is floating in the position shown in Figs. 6 and 7, and the volume and weight of the longitudinal chambers 4 and 5 are so relatively arranged that by admitting water to the larger longitudinal chamber 4 when the apparatus is floating each vessel 1 can be caused to partly turn or rotate, so as to bring the wedge-like extension 4 near to or below the surface of the water, after which by admitting water to the end compartments 1<sup>b</sup> the vessel can be caused to sink until it rests upon the river-bed, whereupon the smaller longitudinal chamber 5 is filled with water through the connections 7 between it and the end compartments 1<sup>b</sup>, the valves 7<sup>a</sup>, controlling the said connections, being suitably operated for the purpose. When the smaller chamber 5 has been thus filled with water, the valves 7<sup>a</sup>, controlling the said connections 7, are closed. During the dredging operation water is preferably pumped out of the end compartments 1<sup>b</sup> of each vessel in proportion to the weight of dredged material 9<sup>a</sup> entering the receptacle 3 of such vessel, so that the weight of the vessel and attached parts, with the contained dredged material, shall be approximately constant and the work necessary to be done to move the said parts on the river-bed 9 maintained approximately uniform. After the receptacles 3 in the two vessels 1 have been charged with dredged material 9<sup>a</sup> in the manner described the water is first pumped out of the larger or wedge-like chamber 4 of each vessel, so as by the buoyancy thus obtained on one side to partly turn or rotate the vessel in such a way as to bring the mouth 3<sup>a</sup> of the receptacle 3 verti-



cally upward, after which by opening the connections 7 between the smaller longitudinal chamber 5 and the end compartments 1<sup>b</sup> and withdrawing the water from the latter and admitting air to both the vessel 1, with its contained dredged material, can be caused to rise to the surface of the water, (see Fig. 6,) and thence be towed to any desired place.

When each end of each vessel 1 is provided with air-tubes 17, those not required for use at one end may be connected to a buoy.

The hauling-up apparatus for partly rotating the vessels 1 for discharging their contents by gravity may, as shown in Figs. 22, 23, and 24, conveniently comprise two fixed rams 30 and two cylinders 31, that are arranged to work in guides 32 in or on the smaller longitudinal chamber 5. To each cylinder 31 is or are connected one or more flexible connections 33, (two are shown,) which is or are led around a suitable guide pulley or pulleys 33<sup>a</sup> and thence under the two adjacent vessels 1, as shown in Fig. 7, the other end of the said flexible connection or connections being secured to the free edge of the wedge-like extension 4 of the vessel 1, that does not carry the hauling-up mechanism for such connection or connections. Each ram 30 of the hauling-up apparatus may be carried as it becomes uncovered by bearings or supports brought into position by the moving cylinder 31, as in the case of the hauling-in mechanism hereinbefore described with reference to and shown in Figs. 12 to 18, inclusive. As will be seen, the arrangement is such that when the cylinders 31 are caused to make their outstrokes and haul up the flexible connections 33 the vessels 1 will be caused to turn into the positions shown approximately in Fig. 8, in which their contents will be discharged by gravity.

To facilitate the rotary movement of the vessels 1, the latter may be each provided externally around a suitable portion of its circumference with antifriction balls or rollers 34, as shown in Figs. 9, 10, 19, and 20. As will be seen, these antifriction balls or rollers 34 are mounted on that side of each vessel that will be the outer side when the two vessels are floating in an upright position and are near together, as shown in Fig. 7. The arrangement is such that after the vessels have been drawn together, so that the rollers 8<sup>a</sup> on the arms 8 of each vessel bear against the side of the vessel, then upon partly rotating the two vessels the rollers 8<sup>a</sup> on one vessel will at first travel in contact with the outer surface of the opposite vessel and upon the further rotation of the vessel the rollers 8<sup>a</sup> will pass out of contact with the opposite vessel and the antifriction balls or rollers 34 on the two vessels will come into contact with one another to facilitate the further rotation of the vessels into the positions shown in Fig. 8.

To enable the receptacle 3 in each vessel to readily empty itself when inverted, each

vessel 1 may be provided with suitable means for admitting air to the upper part of the inverted receptacle. For this purpose the portion of each vessel in which the receptacle is formed may be provided with cocks or valves 35, the stems of which are geared, as by worm-gearing 36, Figs. 25, 26, and 27, to a common longitudinal shaft 37, which is adapted to be operated from a hand-wheel 38 through bevel-gearing 39, and whereby the several cocks or valves can be simultaneously opened or closed.

According to a modified arrangement suitable for use in narrow waterways a single vessel 1 of the kind hereinbefore described is employed. In this case the free or outer ends of its hauling-in chains 2 are anchored or secured to fixed points at a distance from the place where the vessel is to commence dredging, it may be to the shore or to submerged anchors, the chains being hauled in and the vessel caused to dredge in the manner hereinbefore described.

Hydraulic apparatus of the kind hereinbefore described with reference to and shown in Figs. 22, 23, and 24 for partly rotating the vessels 1 for emptying their receptacles of dredged material 9<sup>a</sup> may advantageously be used for turning, in a rotary sense, the vessels forming part of the ship-raising apparatus described in the specification of my said former application for Letters Patent, Serial No. 682,709, of 1898, the said rotary motion having for its object to alter the displacement of the said vessels in the water and at the same time to raise the chains or other flexible connections between the vessels from a position at the under side of the vessels and beneath the surface of the water to a position toward the upper side of the vessels and nearer to or above the surface of the water and carrying on them the ship or other body they support.

What I claim is—

1. In dredging apparatus, a vessel capable of being sunk to the bed of a river or other waterway to be dredged and of being afterward refloated by inflation and formed with an open receptacle for dredged material and with a part adapted to direct material being dredged into said receptacle, and means whereby said vessel can, when sunk, be caused to travel over said bed and cause a portion of said bed to enter said receptacle, as set forth.

2. Dredging apparatus comprising vessels capable of being sunk to the bed of a river or other waterway and of being afterward refloated and each formed with an open receptacle for dredged material and with a part adapted to cause material being dredged to enter said receptacle, flexible connections between said vessels, and mechanism located in said vessels and whereby the flexible connections can be hauled in and the vessels caused to approach each other in a lateral direction, as set forth.



3. In dredging apparatus, a vessel formed with an open receptacle for dredged material, with air and water tight compartments, and with air and water tight chambers means whereby water can be separately admitted to and afterward shut off from said compartments and chambers, means whereby water can afterward be withdrawn from and air admitted to said compartments and chambers, and means whereby said vessel when sunk onto the bed of the river or other waterway to be dredged can be drawn over said bed so as to cause a portion of said bed to enter said receptacle.

4. Dredging apparatus comprising two elongated vessels arranged parallel to one another and each formed with an open receptacle for dredged material, with air and water tight compartments, and with air and water tight chambers and provided with means whereby water can be separately admitted to and afterward shut off from said compartments and chambers and means whereby water can afterward be withdrawn from and air admitted to said compartments and chambers, flexible connections arranged at right angles to and connecting said vessels, and mechanism located in said vessels and whereby said connections can be hauled in and the said vessels caused to move over the bed to be dredged and in a direction toward one another, as set forth.

5. In dredging apparatus, a vessel capable of being partly rotated about a horizontal axis and of being sunk to the bed of a river or other waterway and of being afterward partly rotated in the reverse direction and refloated, said vessel being provided with a receptacle having an elongated opening and adapted to receive and hold dredged material, with a wedge-like extension arranged along one side of said opening and adapted, during dredging, to cause material being dredged to enter said receptacle, and with arms or projections extending laterally from said vessel in an opposite direction to said extension and so arranged that during dredging they can bear upon said bed and prevent such vessel rolling or turning thereon, substantially as described.

6. The combination with dredging vessels adapted to be partly rotated in contact with each other, of arms or projections extending from each vessel and provided with rollers, and antifriction balls or rollers mounted on each vessel on the side thereof that will be the outer side when the two vessels are floating in an upright position and are near together, substantially as described for the purpose specified.

7. Dredging apparatus comprising two elongated vessels each capable of being sunk to the bed of the river or other waterway to be dredged and of being refloated and each provided with an open receptacle for dredged material, with a wedge-like extension arranged along one side of the mouth of said

receptacle, and with arms or projections extending in an opposite direction to said wedge-like extension and adapted to bear upon said bed, the mouths of said receptacles and said wedge-like extensions facing one another, flexible connections between said vessels, and hauling-in mechanism located within said vessels and whereby said connections can be hauled in, substantially as described for the purpose specified.

8. In dredging apparatus, the combination with a vessel capable of being sunk to the bed of the waterway to be dredged and of being afterward refloated and formed with an open receptacle for dredged material, of a wedge-like extension arranged along one side of and projecting away from the mouth of said receptacle and adapted to cause material being dredged to enter said receptacle, arms or projections extending from said vessel in an opposite direction to said wedge-like extension and adapted to bear upon said bed during dredging, flexible connections extending from said vessel in the direction in which said wedge-like extension projects, mechanism carried by said vessel and whereby said flexible connections can be hauled in and the vessel moved parallel with itself, and additional hauling mechanism carried by said vessel and whereby other flexible connections can be hauled up for partially rotating said vessel about a horizontal axis, substantially as described for the purposes specified.

9. Dredging apparatus comprising an elongated vessel formed at its ends with air and water tight compartments, with a centrally-arranged longitudinal open receptacle for dredged material and with longitudinal air and water tight chambers arranged along the opposite sides of the mouth of said receptacle and one of which is made of wedge-like shape and of larger dimensions and so as to project to a greater extent than the other chamber from said vessel, arms or projections arranged to extend from said vessel in an opposite direction to said wedge-like extension, air-tubes whereby air can enter and leave said compartments and chambers, means whereby water can be admitted to and shut off from said compartments and chambers, means whereby water can be withdrawn from said compartments and chambers, and means whereby the vessel, when sunk upon the said bed so that the wedge-like extension and arms or projections bear thereon, can be drawn over said bed so as to dredge the same.

10. Dredging apparatus comprising an elongated vessel formed at its ends with air and water tight compartments, with a centrally-arranged longitudinal open receptacle for dredged material and with longitudinal air and water tight chambers arranged along the opposite sides of the mouth of said receptacle and one of which is made of wedge-like shape and of larger dimensions and so as to project to a greater extent than the other chamber from said vessel, arms or projections arranged



to extend from said vessel in an opposite direction to said wedge-like extension, air-tubes whereby air can enter and leave said compartments and chambers, means whereby water can be admitted to and shut off from said compartments and chambers, means whereby water can be withdrawn from said compartments and chambers, mechanism whereby the said vessel can be caused to travel over the bed to be dredged, and mechanism whereby the vessel, with dredged material, can, when refloated, be partly rotated about its axis for the purposes specified.

11. Dredging apparatus comprising two elongated vessels, flexible connections between said vessels, and mechanism located within said vessels and whereby said connections can be hauled in and the vessels thereby caused to approach each other, each of said vessels being provided with air and water tight compartments at its ends with a central open receptacle adapted to receive and hold dredged material, with longitudinal air and water tight chambers arranged at opposite sides of the mouth of said receptacle, one of said chambers being made of approximately wedge-like shape and of larger dimensions and so as to project from said vessel to a greater extent than the other, arms or projections arranged to extend from said vessel in an opposite direction to said wedge-like extension, air-tubes whereby air can enter and leave said compartments and chambers, means whereby water can be admitted to and shut off from each of said compartments and chambers separately, and means whereby water can be withdrawn from said compartments and chambers and replaced by air, substantially as described for the purposes specified.

12. In dredging apparatus the combination with two vessels capable of being sunk onto the river or other bed to be dredged and of being refloated with dredged material and each formed with an open receptacle for dredged material and with a wedge-like extension projecting from one side of the opening leading to said receptacle, of hauling-up mechanism comprising rams and cylinders carried by each of said vessels at the side of the opening therein opposite to that carrying said extensions, and flexible connections arranged to pass under the two vessels when the same are brought near together and each connected at one end to a movable part of the hauling-in mechanism on one vessel and at the opposite end to the other vessel at a part thereof at the opposite side of the opening therein to that carrying the hauling-up mechanism of said vessel, substantially as described for the purpose specified.

13. A dredging-vessel having cylindrical ends formed with air and water tight compartments capable of being filled with air or water at will and with spaces for machinery, a hollow central or intermediate compartment having an opening along one side, air

and water tight chambers arranged at opposite sides of said opening and one of which is of wedge-like shape and made larger than and so as to project to a greater distance from said vessel than the other, valves adapted to be controlled from above the surface of the water in which said vessel is to float and whereby water can be admitted to and shut off from each of said compartments and chambers at will, air-tubes leading to each of said compartments and chambers, hydraulic hauling-in mechanism arranged longitudinally within said vessel, passages extending laterally through said vessel and arranged near the ends of said receptacle and extension and flexible connections connected with said hauling-in mechanism and extending through said passages, guide-rollers for said flexible connections, and pumps and electric motors for driving the same located in said machinery-spaces, one or some of said pumps being adapted to withdraw water from the end compartments, another or others for withdrawing water from the larger of the two longitudinal chambers, and another or others for supplying water under pressure to said hydraulic hauling-in mechanism substantially as herein described.

14. The combination with a vessel capable of being sunk to the bed of a river or other waterway and of being afterward refloated as set forth, of hauling-in mechanism located within said vessel, and comprising a longitudinal movable part, a rod arranged parallel to and connected at its inner end to said longitudinal movable part and adapted to be connected at its outer end to a flexible connector, a long guide-tube open at one end to the external water and in which said rod is located, and water-tight packing located in said tube and surrounding said rod, substantially as described.

15. The combination with a vessel capable of being sunk to the bed of a river or other waterway and of being afterward refloated as set forth, of sets of hauling-in mechanism arranged to work longitudinally within said vessel and arranged so as to be at or near the bottom thereof when the same is floating normally in the water, longitudinally-arranged tubes each in communication at one end with the external water and at the other end with the machinery-compartment, and packing devices located in said tubes, each set of said mechanism comprising a hydraulic ram and cylinder, and a rod located in one of said tubes, connected at one end to the movable cylinder or ram, and arranged to work in a water-tight manner through the packing in said tube, substantially as described for the purpose specified.

16. The combination with a vessel capable of being sunk to the bed of a river or other waterway and drawn over the same and afterward refloated, of sets of hauling-up mechanism each comprising a hydraulic cylinder and ram arranged longitudinally upon said



vessel, and guiding devices whereby flexible connections attached to the movable parts of said mechanism can be led off transversely to said vessel substantially as described for the purpose specified.

17. The combination with a vessel formed with an open receptacle for dredged material, and capable of being sunk to the bed of a river or other waterway, of being drawn over said bed, and of being afterward refloated and partly rotated, of air-admission valves arranged to control communication between the bottom of said receptacles and the exterior of the vessel, and means whereby the valves can be opened to admit air to the receptacle when the same is inverted, substantially as described for the purpose specified.

18. The combination with a vessel formed with an open receptacle for dredged material, and capable of being sunk to the bed of a river or other waterway, of being drawn over said bed, and of being afterward refloated and partly rotated, of a number of cocks or valves arranged to control communications through the bottom of said receptacles, a longitudinal shaft geared to the stem of each cock or valve, and means substantially as described and shown for operating said shaft.

19. Dredging apparatus comprising an elongated vessel 1 formed with cylindrical end portions 1<sup>a</sup> having connected air and water tight compartments 1<sup>b</sup> and machinery-spaces 1<sup>c</sup> therein, and an intermediate portion formed with a receptacle 3 having an opening 3<sup>a</sup> at one side, and longitudinal air and water tight chambers 4 and 5 located at opposite sides of said opening and whereof 5 is in communication through suitable openings with said end compartments 1<sup>b</sup>, means for controlling said openings from the surface of the water, strengthening-stays connecting the forward projecting portion of said chamber 4 to the part of said vessel at the opposite side of the opening 3<sup>a</sup> therein arms or projections 8 with rollers extending from said vessel in an opposite direction to said chamber 4, air-tubes adapted to extend from above the surface of the water to each of the compartments 1<sup>b</sup> and chambers 4 and 5, means for admitting water to said compartments and chambers separately, pumps with motors located within said machinery-spaces 1<sup>c</sup> and adapted to separately withdraw water from said end compartments and from the chamber 4, sets of hydraulic apparatus arranged near the bottom of said receptacle, pumps with motors located in said machinery-spaces 1<sup>c</sup> and adapted to supply water under pressure to said hydraulic

apparatus, transverse passages 20 arranged near the ends of said receptacle 3 guiding devices whereby flexible connections attached to the movable parts of said hydraulic apparatus can extend away laterally from said vessel and means for admitting air or water to bottom part of said receptacle 3 all substantially as herein described for the purposes specified.

20. Dredging apparatus comprising an elongated vessel 1 formed with cylindrical end portions 1<sup>a</sup> having connected air and water tight compartments 1<sup>b</sup> and machinery-spaces 1<sup>c</sup> therein, and an intermediate portion formed with a receptacle 3 having an opening 3<sup>a</sup> at one side, and longitudinal air and water tight chambers 4 and 5 located at opposite sides of said opening and whereof 5 is in communication through suitable openings with said end compartments 1<sup>b</sup>, means for controlling said openings from the surface of the water, strengthening-stays connecting the forward projecting portion of said chamber 4 to the part of said vessel at the opposite side of the opening 3<sup>a</sup> therein arms or projections 8 with rollers extending from said vessel in an opposite direction to said chamber 4, air-tubes adapted to extend from above the surface of the water to each of the compartments 1<sup>b</sup> and chambers 4 and 5, means for admitting water to said compartments and chambers separately, pumps with motors located within said machinery-spaces 1<sup>c</sup> and adapted to separately withdraw water from said end compartments and from the chamber 4, sets of hydraulic apparatus arranged near the bottom of said receptacle, pumps with motors located in said machinery-spaces 1<sup>c</sup> and adapted to supply water under pressure to said hydraulic apparatus, transverse passages 20 arranged near the ends of said receptacle 3 guiding devices whereby flexible connections attached to the movable parts of said hydraulic apparatus can extend away laterally from said vessel, means for admitting air or water to bottom part of said receptacle 3, sets of hydraulic hauling-up mechanism arranged longitudinally on said chamber 5, and guiding devices whereby flexible connections attached to the movable parts of said hauling-up mechanism can be led away in a direction at right angles to said vessel, all substantially as herein described for the purpose specified.

Signed at 2 Pope's Head Alley, Cornhill, London, E. C., this 19th day of July, 1898.

MAURICE MARY JOSEPH OWEN O'CONOR.

Witnesses:

EDMUND S. SNEWIN,  
WM. O. BROWN.