

No. 669,467.

Patented Mar. 5, 1901.

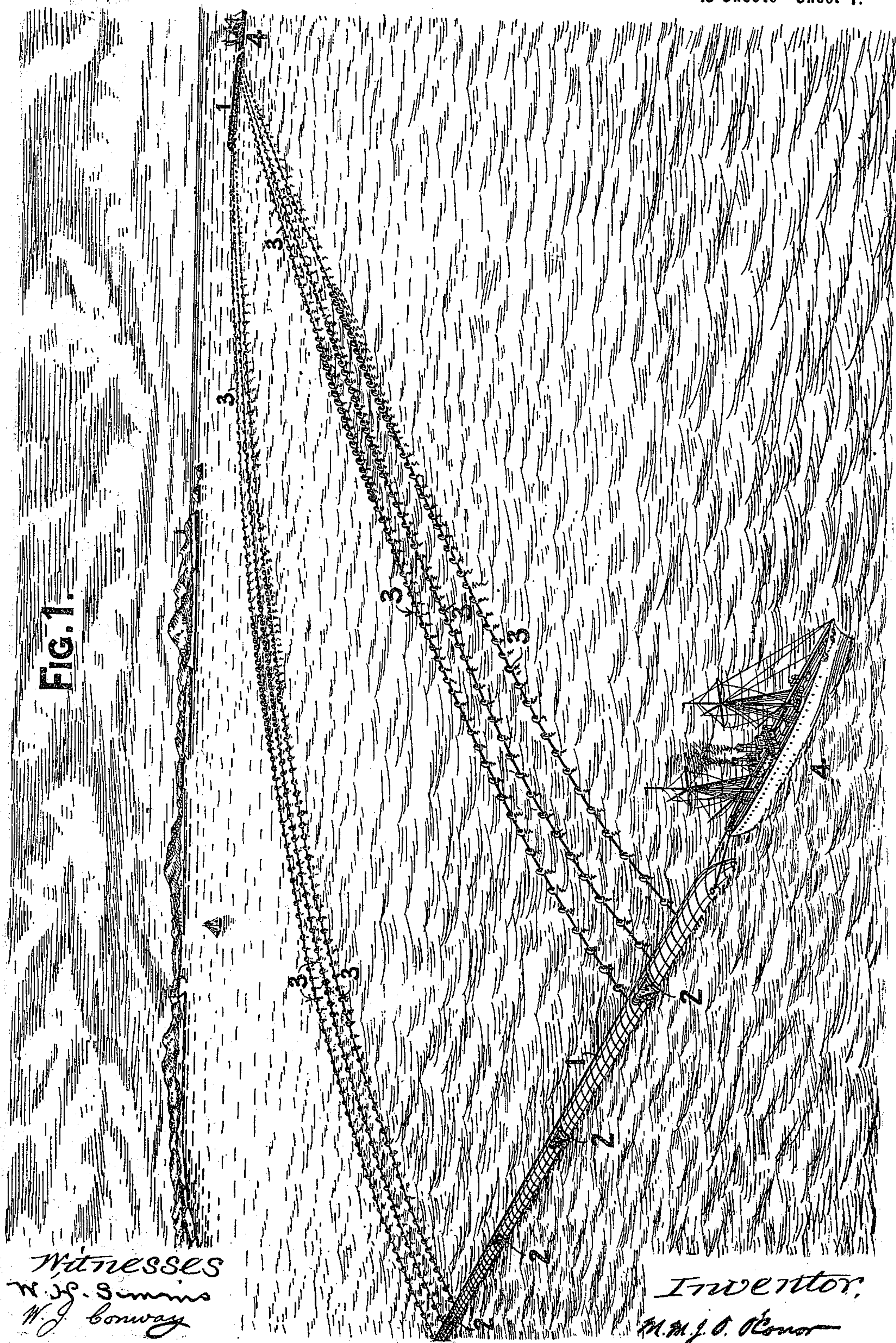
M. M. J. O. O'CONOR.

APPARATUS FOR RAISING AND CONVEYING SUNKEN BODIES.

(No Model.)

(Application filed June 6, 1898.)

18 Sheets—Sheet 1.



Witnesses
W. J. Simms
W. J. Conway

Inventor,
M. M. J. O. O'Conor

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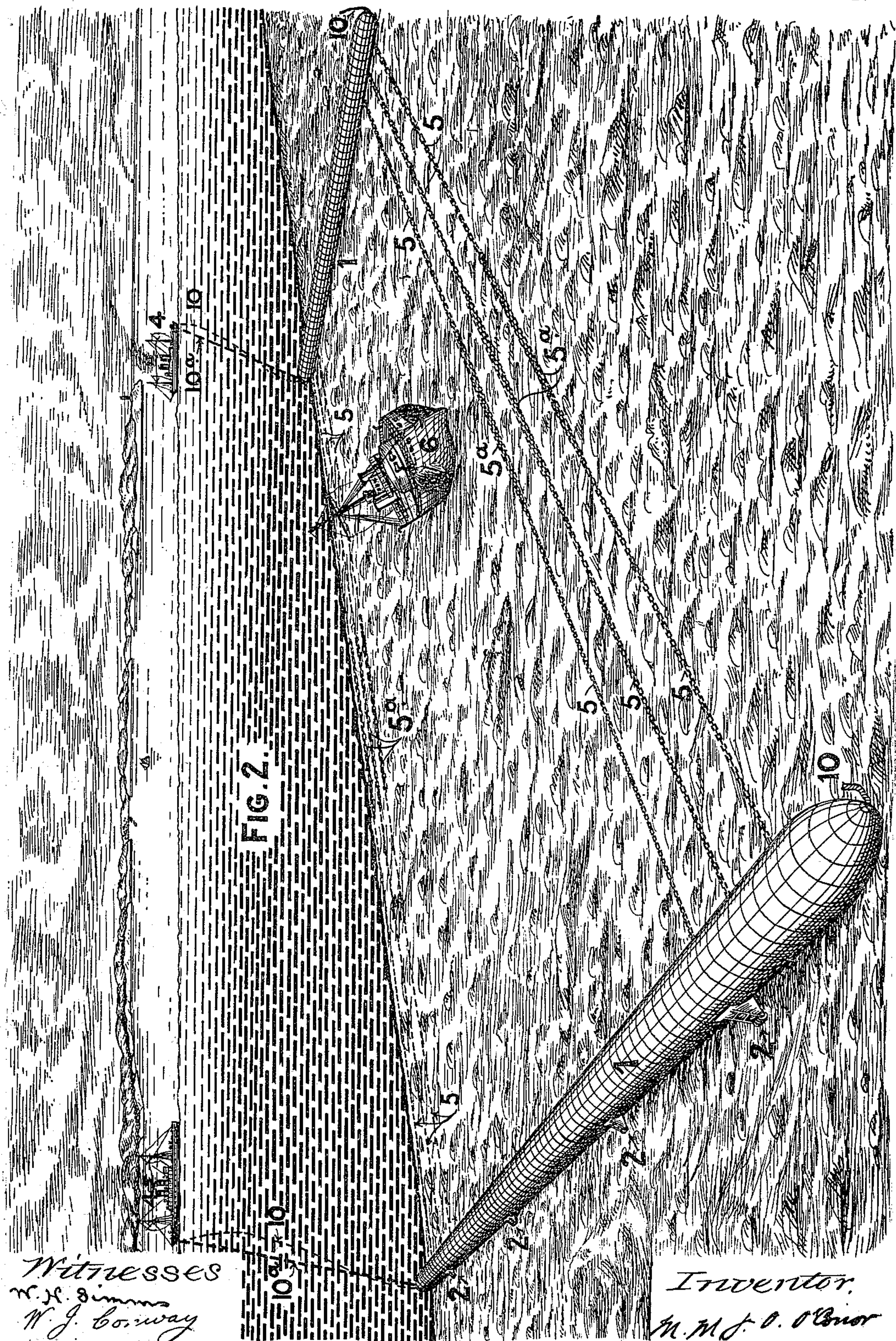
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W. J. Conway

Inventor
M. M. J. O. O'Conor

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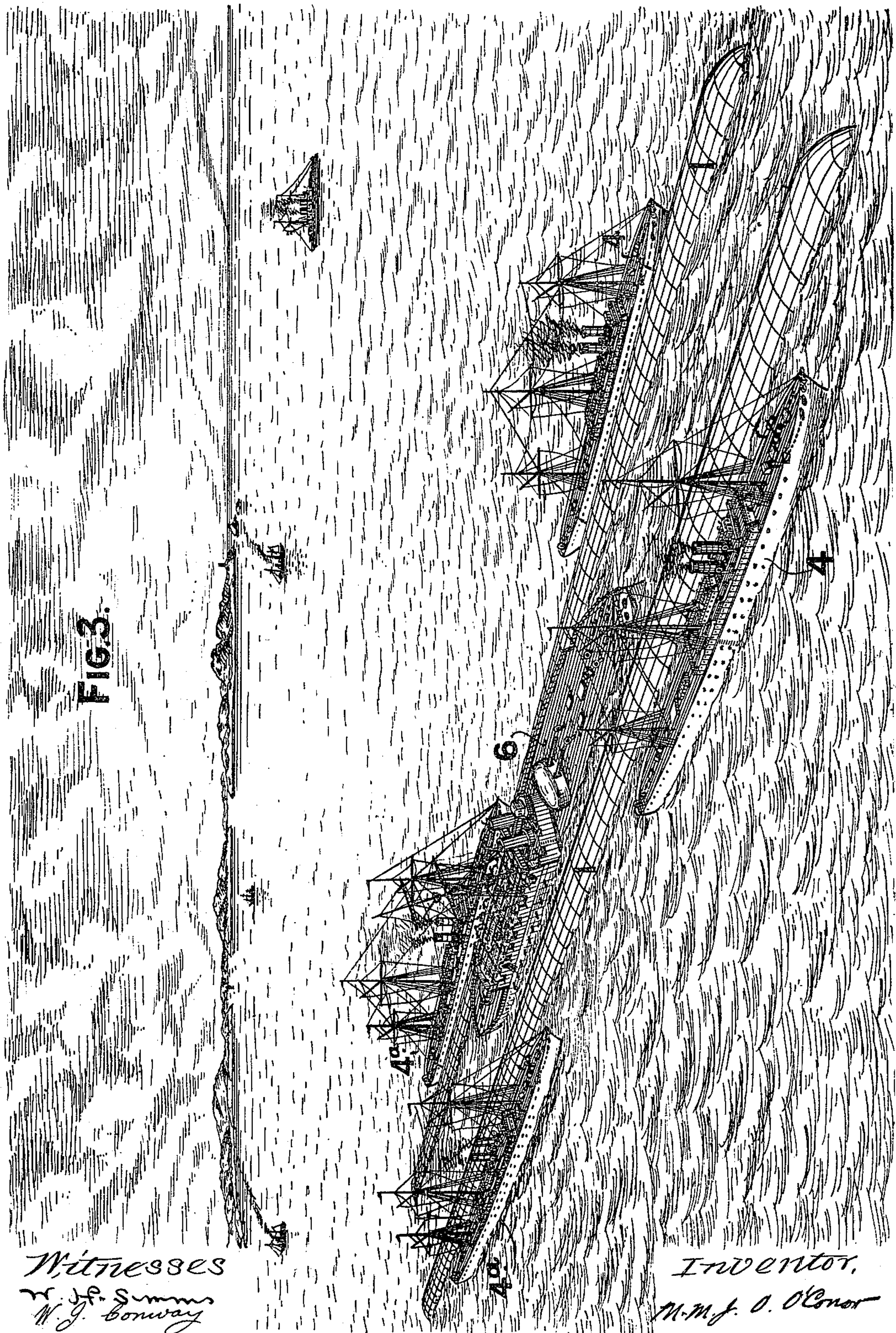
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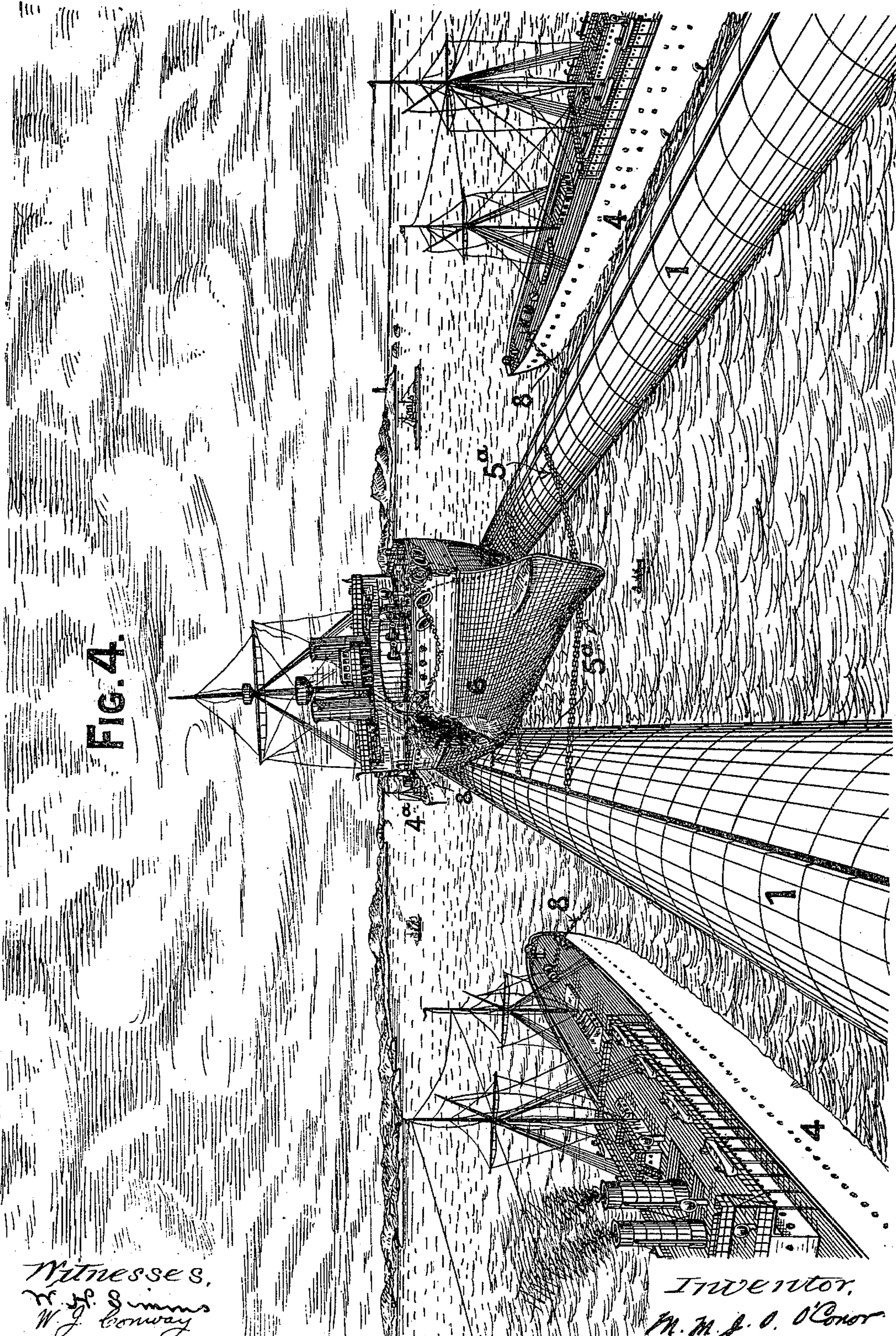
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18 Sheets—Sheet 4.

FIG. 4.



Witnesses,
W. J. Conway

Inventor,
M. M. J. O. O'Conor

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18 Sheets—Sheet 5.

FIG. 5.

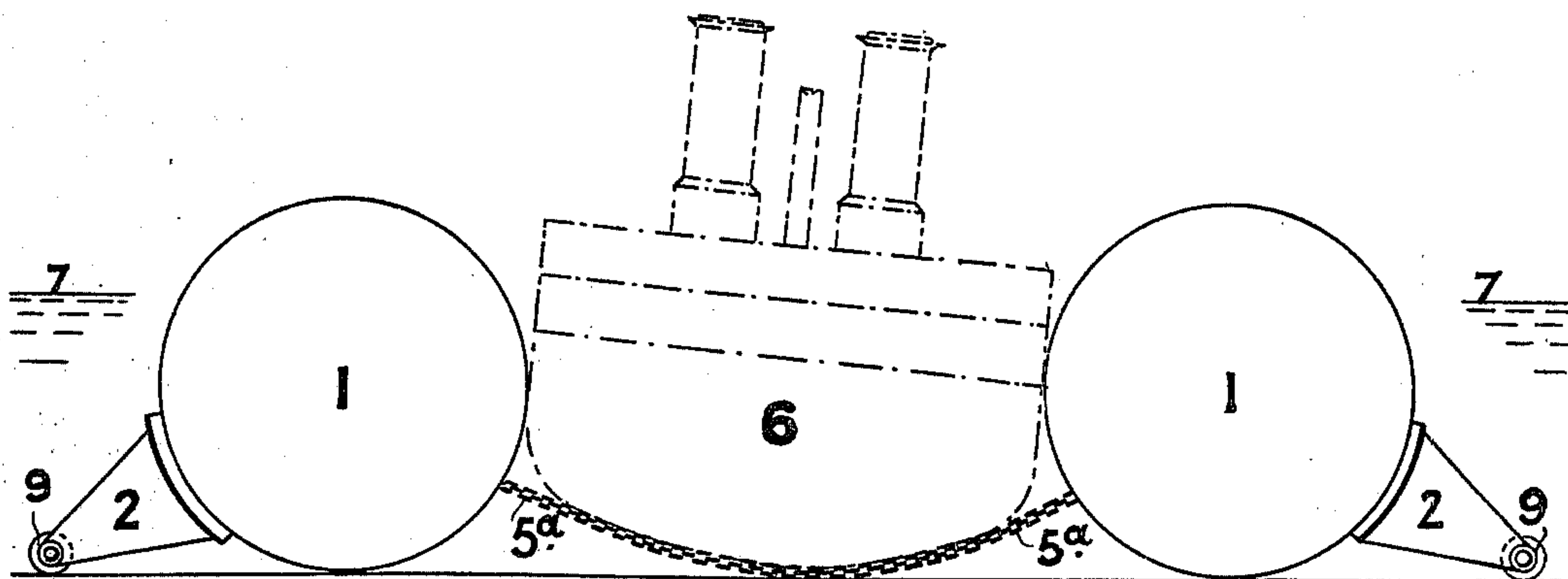
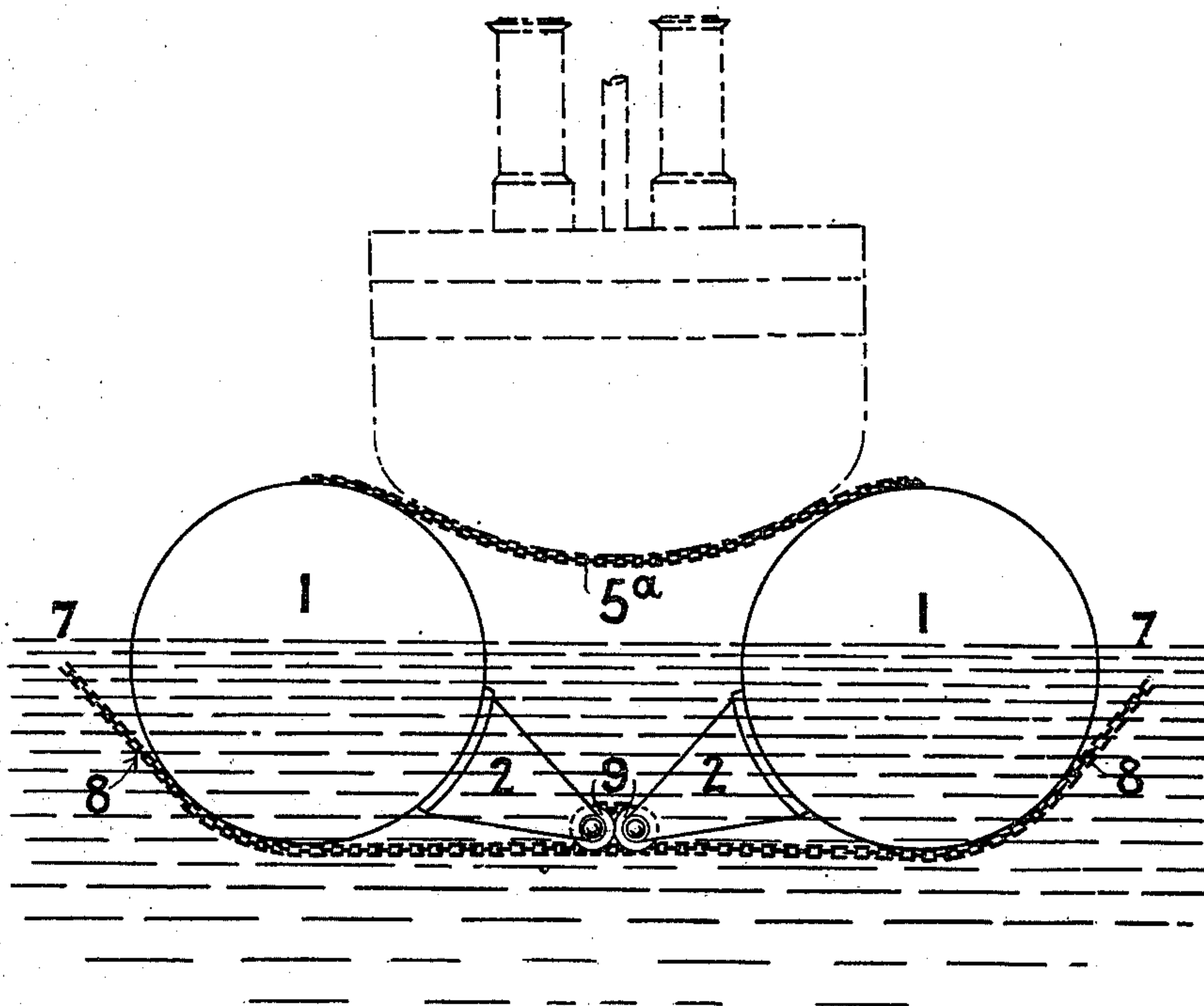


FIG. 6.



Witnesses

W. J. Simon
W. J. Conway

Inventor

M. M. J. O. O'Conor

No. 669,467.

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M. M. J. O. O'CONOR.

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(No Model.)

18 Sheets—Sheet 6.

FIG. 7.

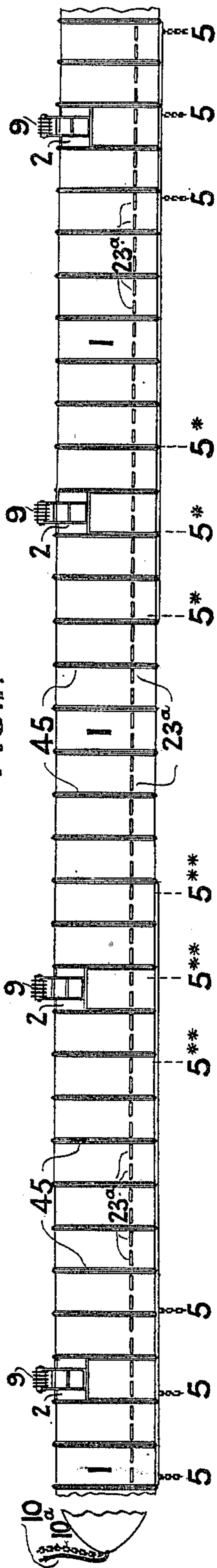
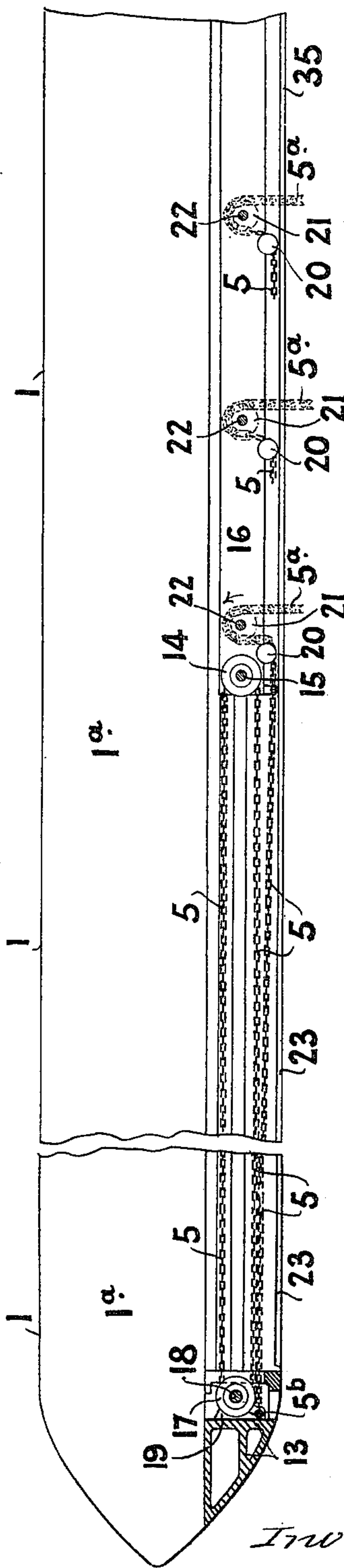


FIG. 18.



Witnesses.
W. H. Sumner
W. J. Conway

Inventor.
M. M. J. O. O'Conor

No. 669,467.

Patented Mar. 5, 1901.

M. M. J. O. O'CONOR.

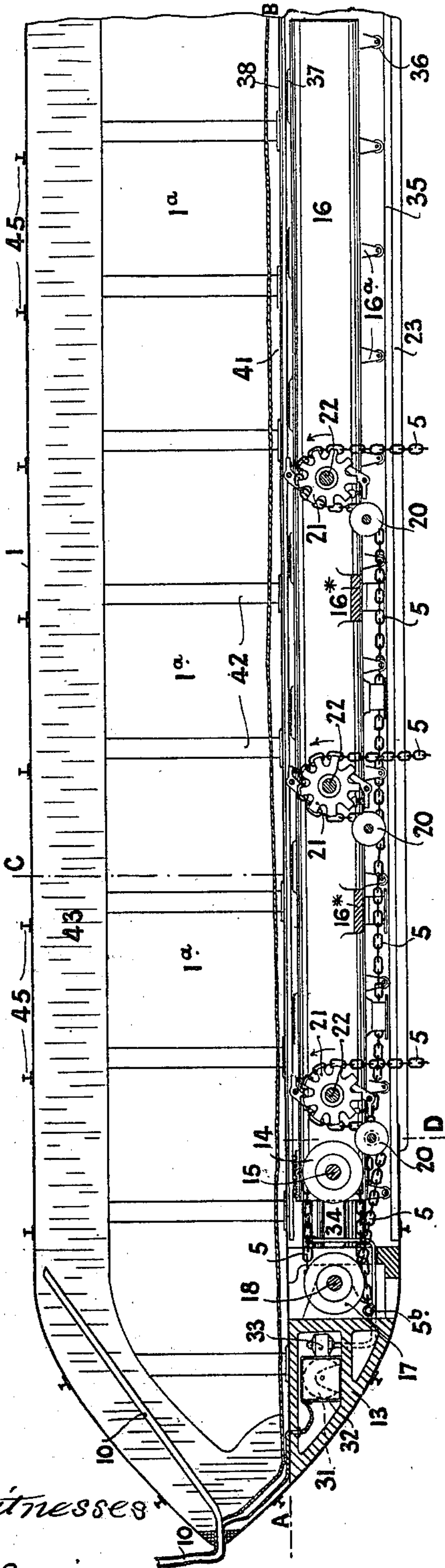
APPARATUS FOR RAISING AND CONVEYING SUNKEN BODIES.

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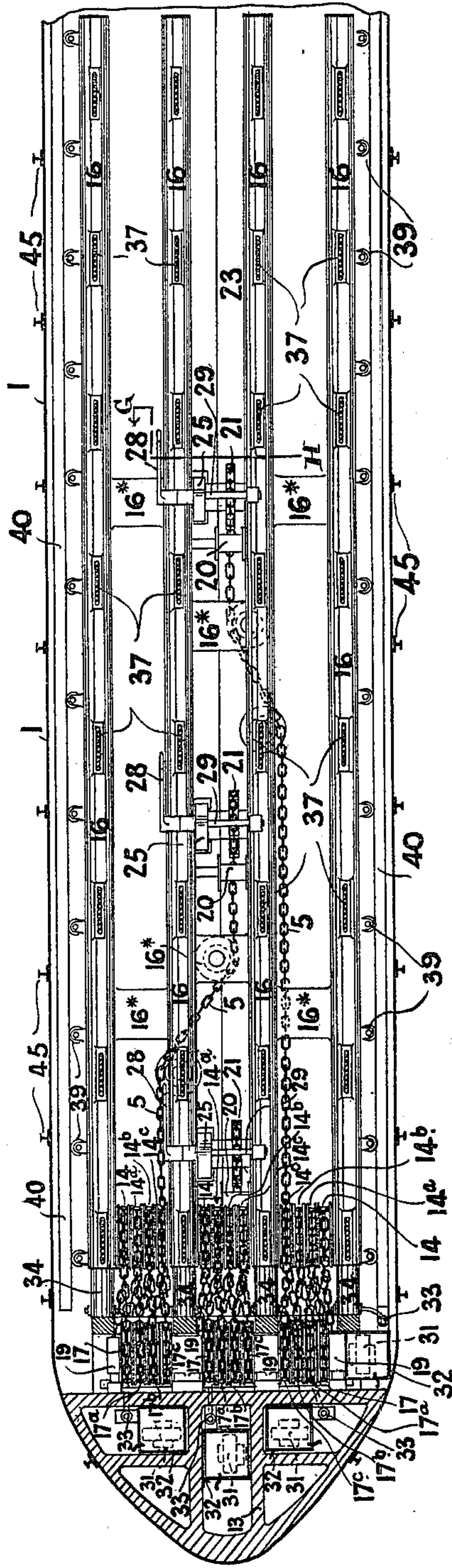
FIG. 8.



Witnesses

H. H. Sumner
W. J. Conway

FIG. 9.



Inventor

M. M. J. O. O'Conor

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M. M. J. O. O'CONOR.

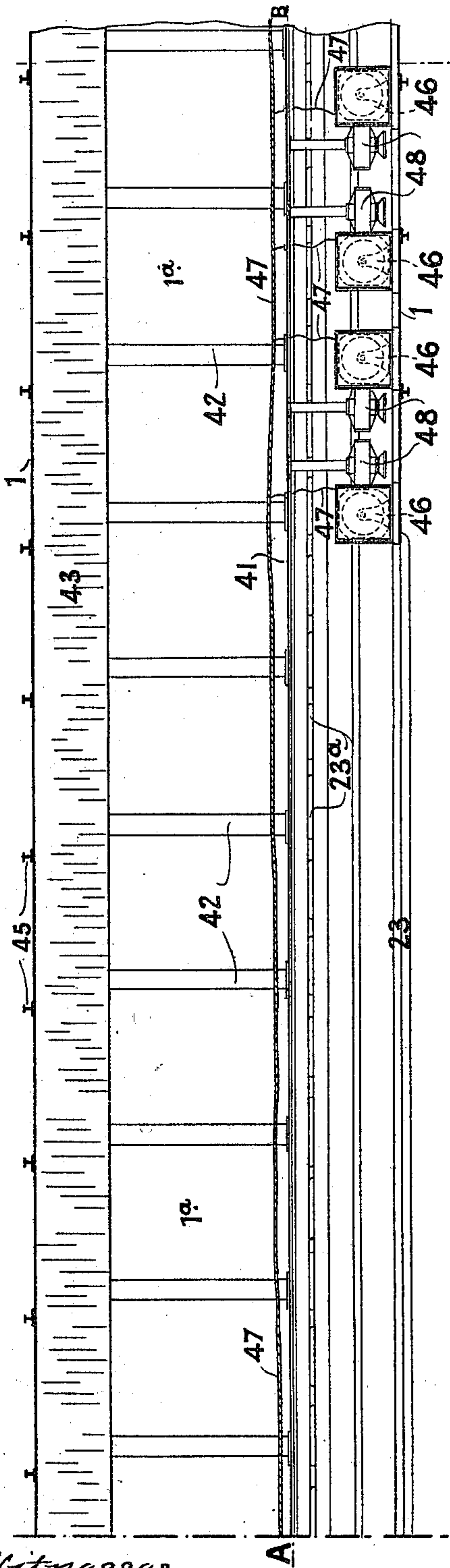
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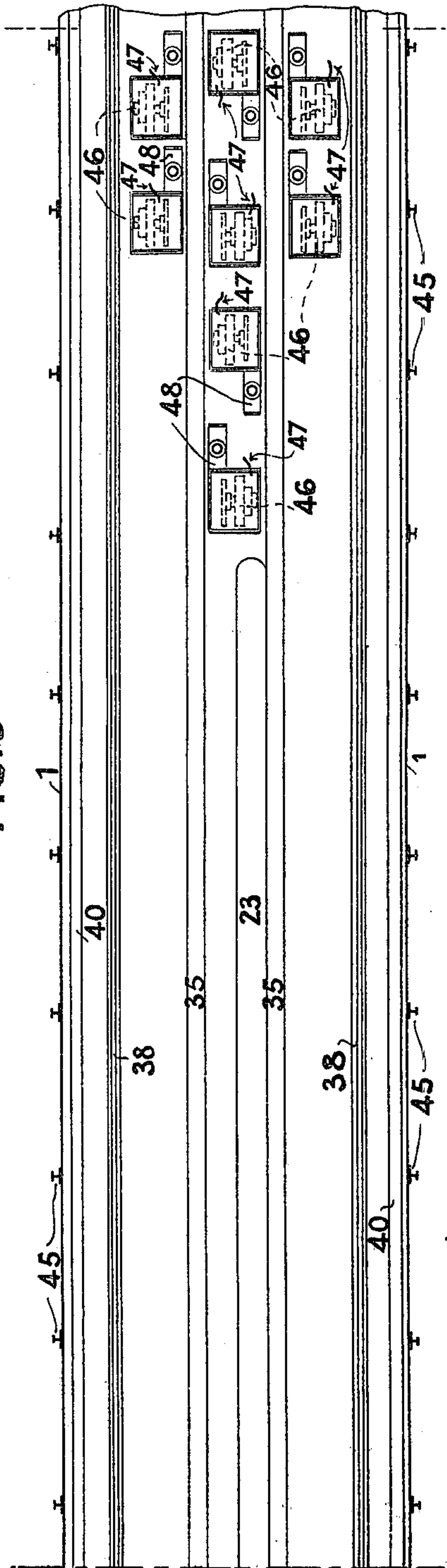
18 Sheets—Sheet 8.

FIG. 8^a.



Witnesses
W. P. Sumner
W. J. Conway

FIG. 9^a.



Inventor.
M. M. J. O. O'Conor

No. 669,467.

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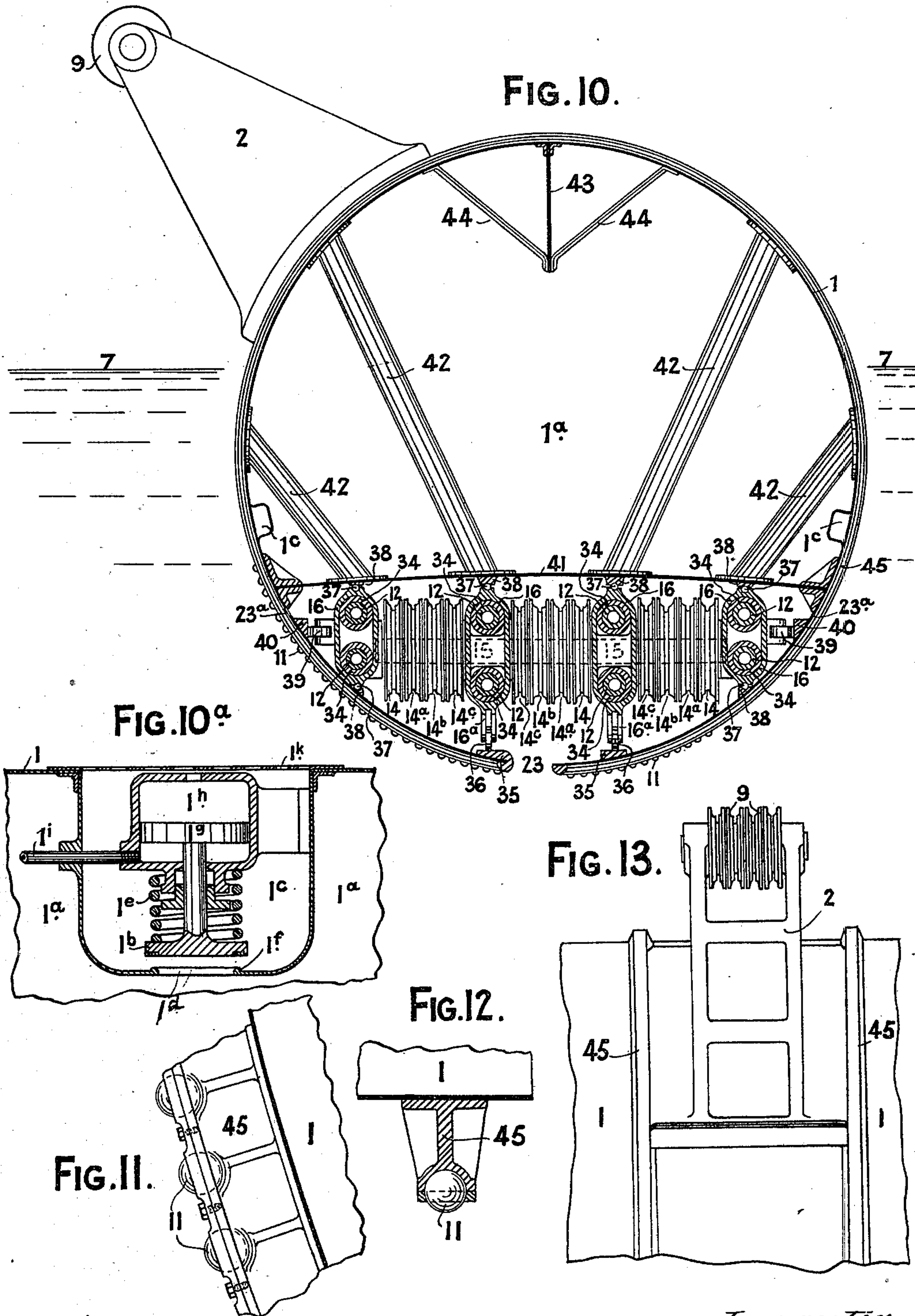
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W. H. Sumner
W. J. Conway

Inventor
M. M. J. O. O'Conor

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18 Sheets—Sheet 10.

FIG. 14.

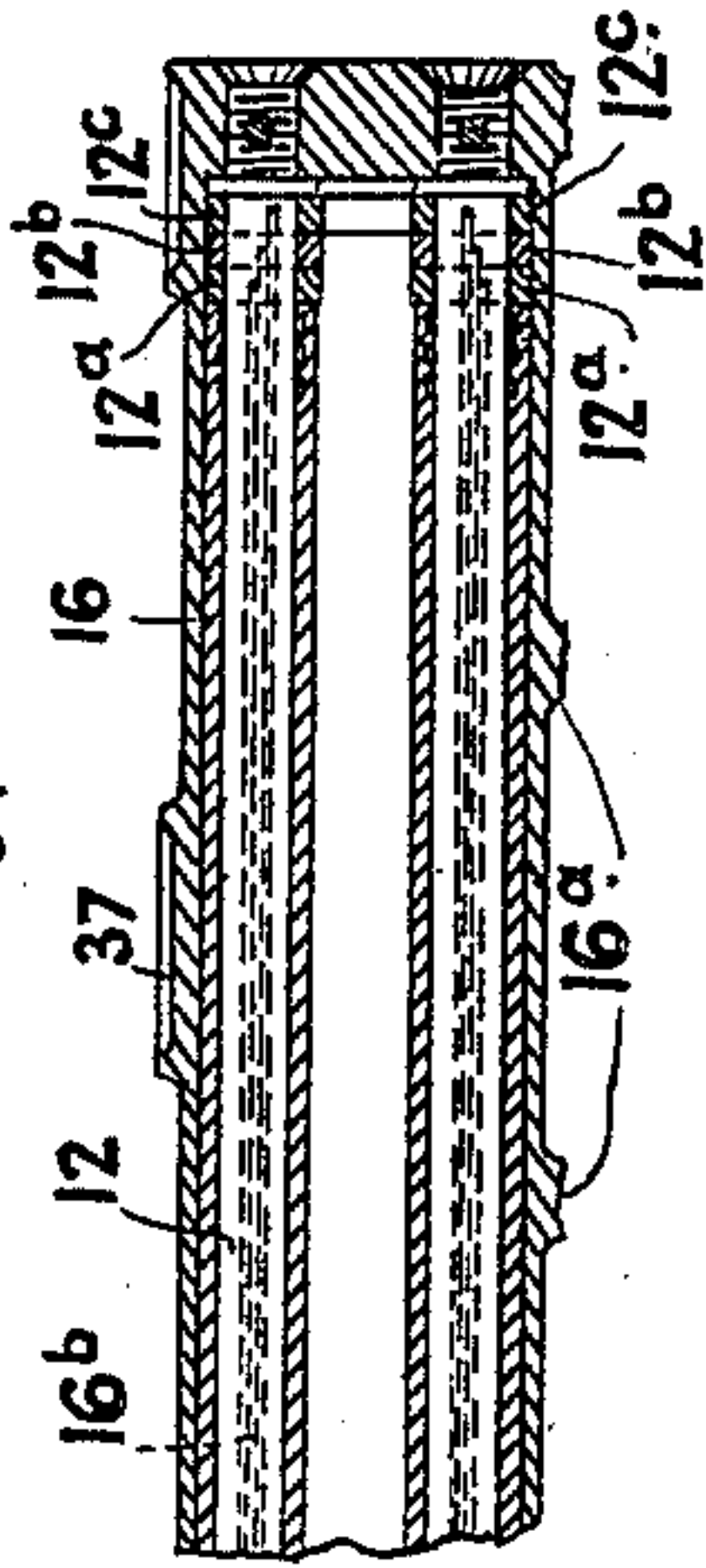
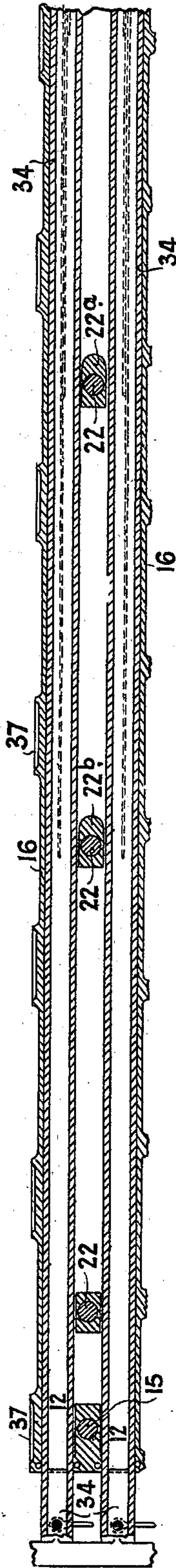
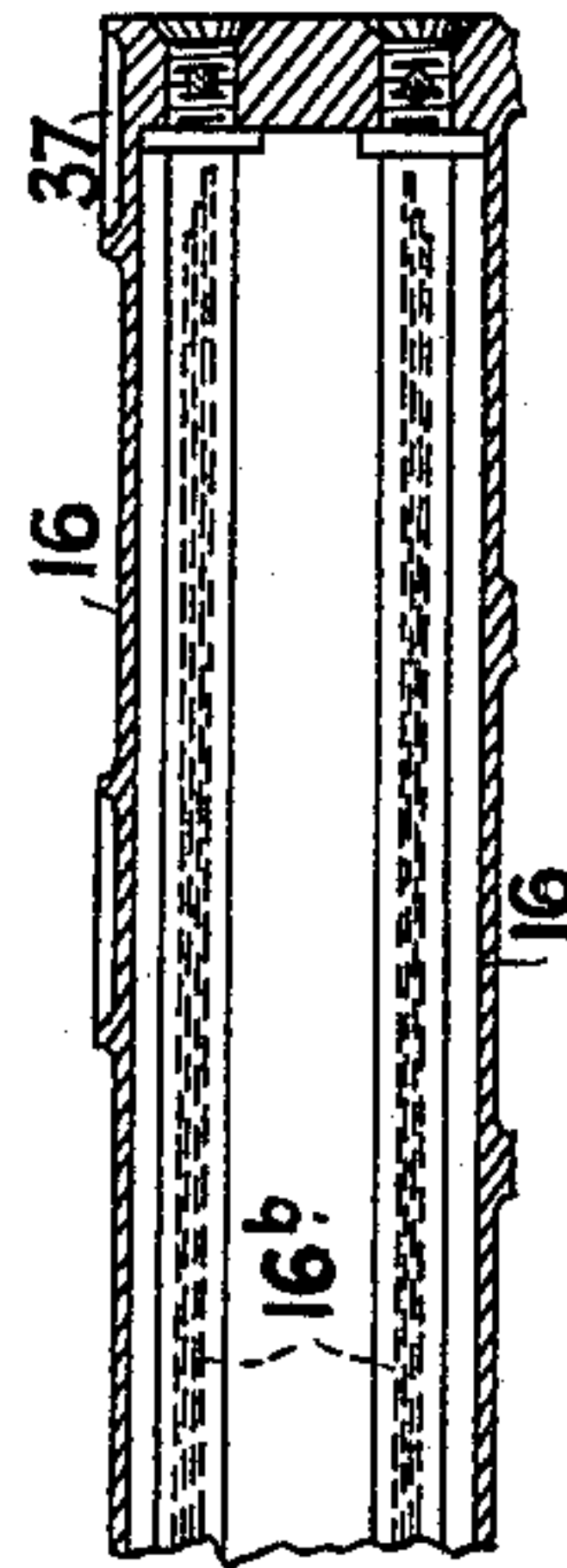
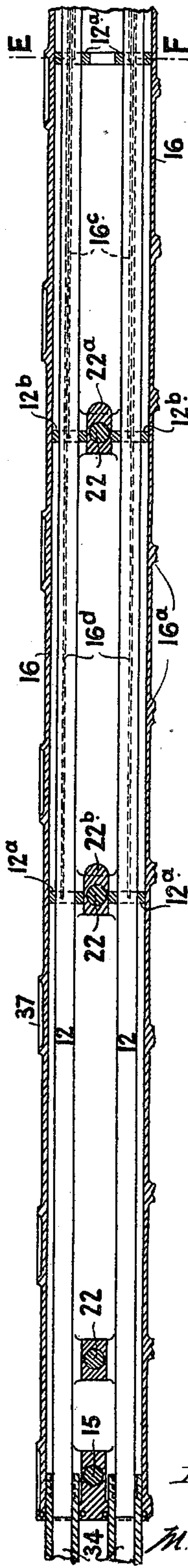


FIG. 15.



Witnesses
W. J. Sumner
W. J. Conway

Inventor.
M. M. J. O. O'Conor

No. 669,467.

Patented Mar. 5, 1901.

M. M. J. O. O'CONOR.

APPARATUS FOR RAISING AND CONVEYING SUNKEN BODIES.

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[3 Sheets—Sheet III.]

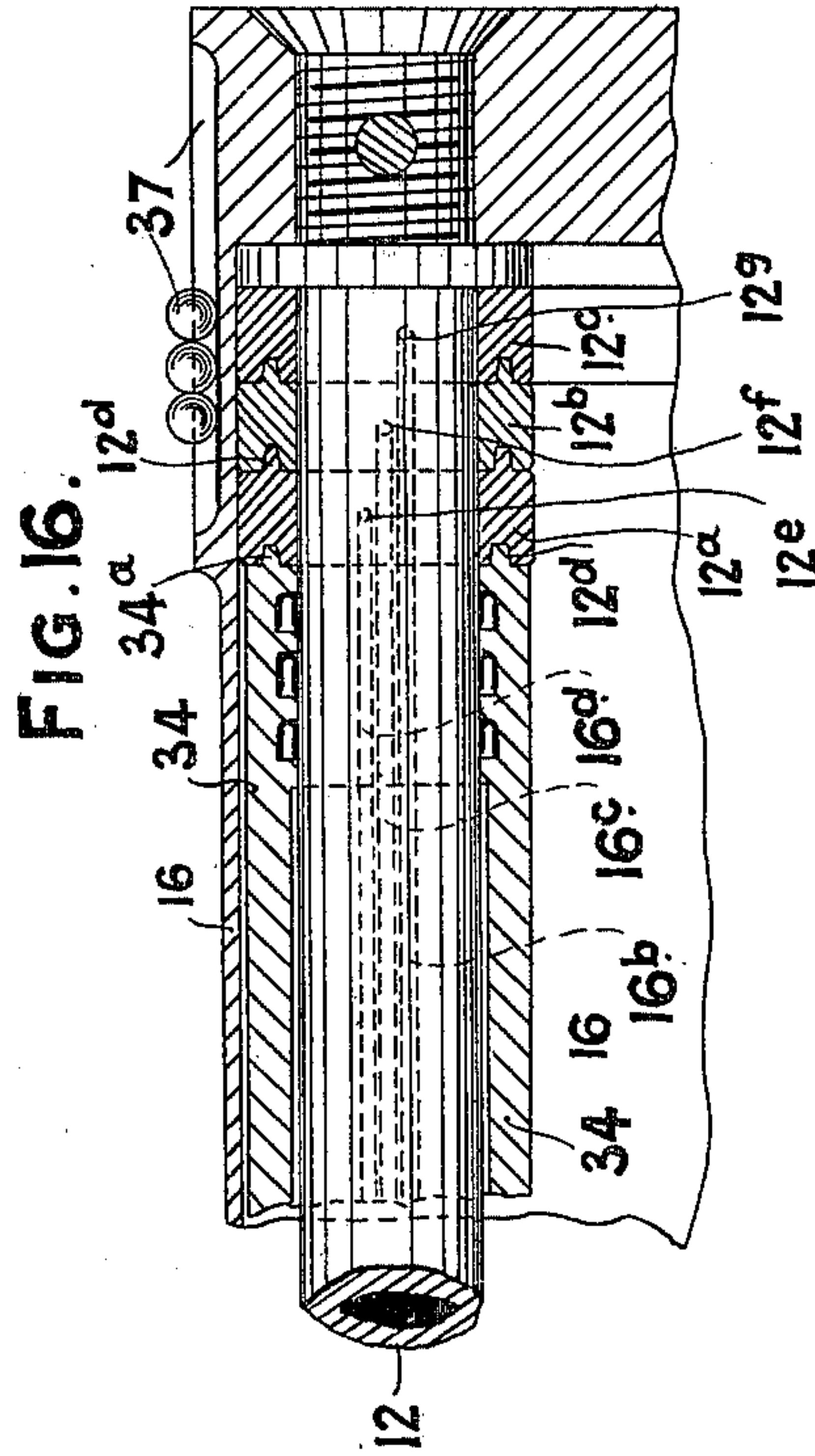
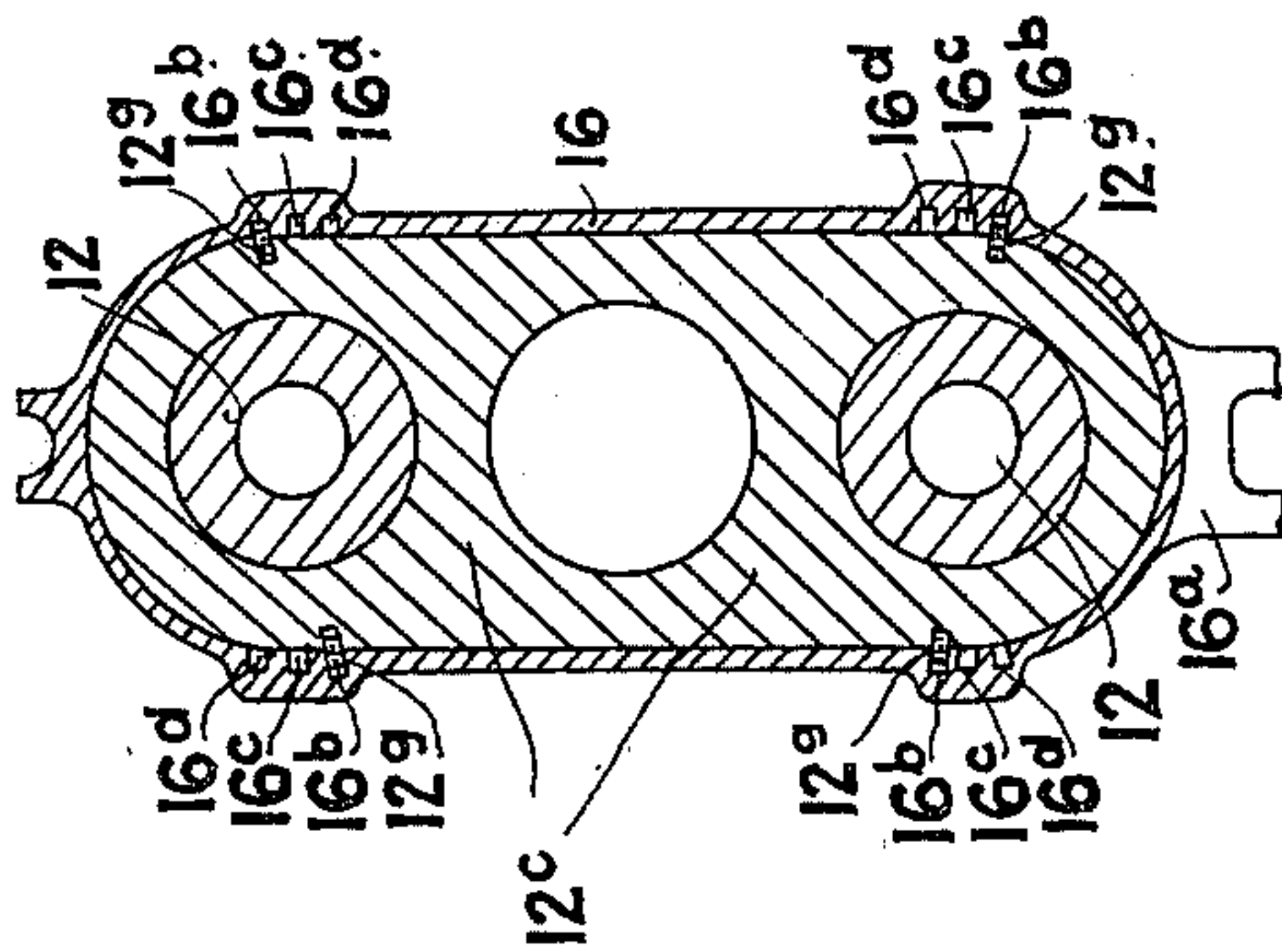


FIG. 17.



Witnesses
R. H. Simms
W. J. Conway

Inventor
M. M. J. O. O'Conor

No. 669,467.

Patented Mar. 5, 1901.

M. M. J. O. O'CONOR.

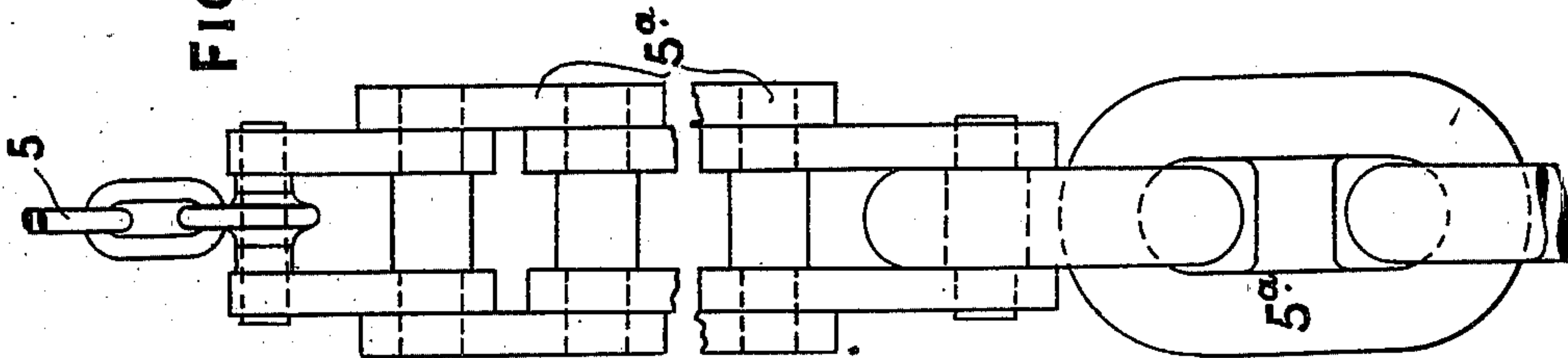
APPARATUS FOR RAISING AND CONVEYING SUNKEN BODIES.

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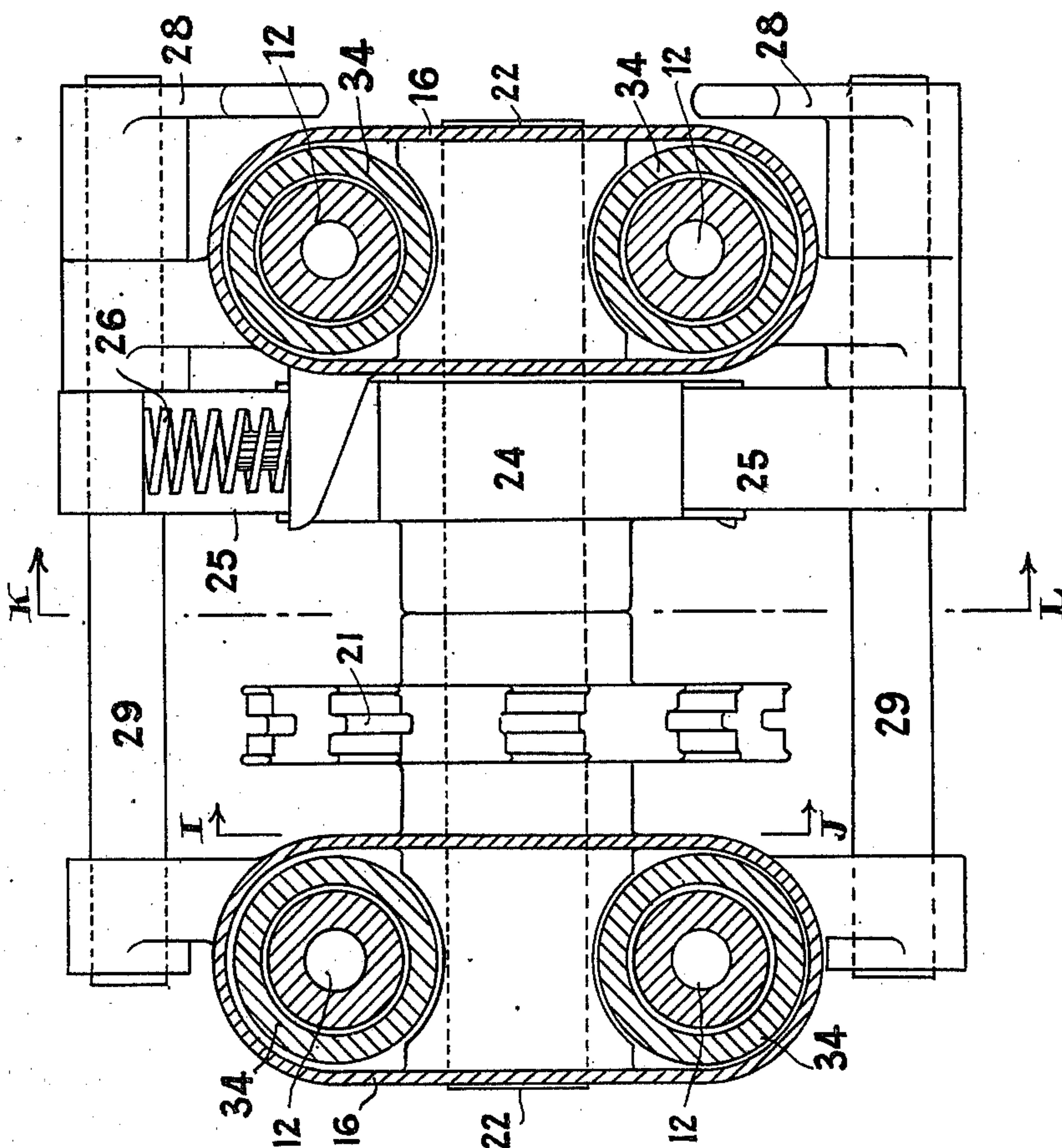
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18 Sheets—Sheet 12.

FIG. 22.



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Witnesses
W. H. Summs
W. J. Conway

Inventor.
M. M. J. O. O'Connor

No. 669,467.

Patented Mar. 5, 1901.

M. M. J. O. O'CONOR.

APPARATUS FOR RAISING AND CONVEYING SUNKEN BODIES.

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18 Sheets—Sheet 13.

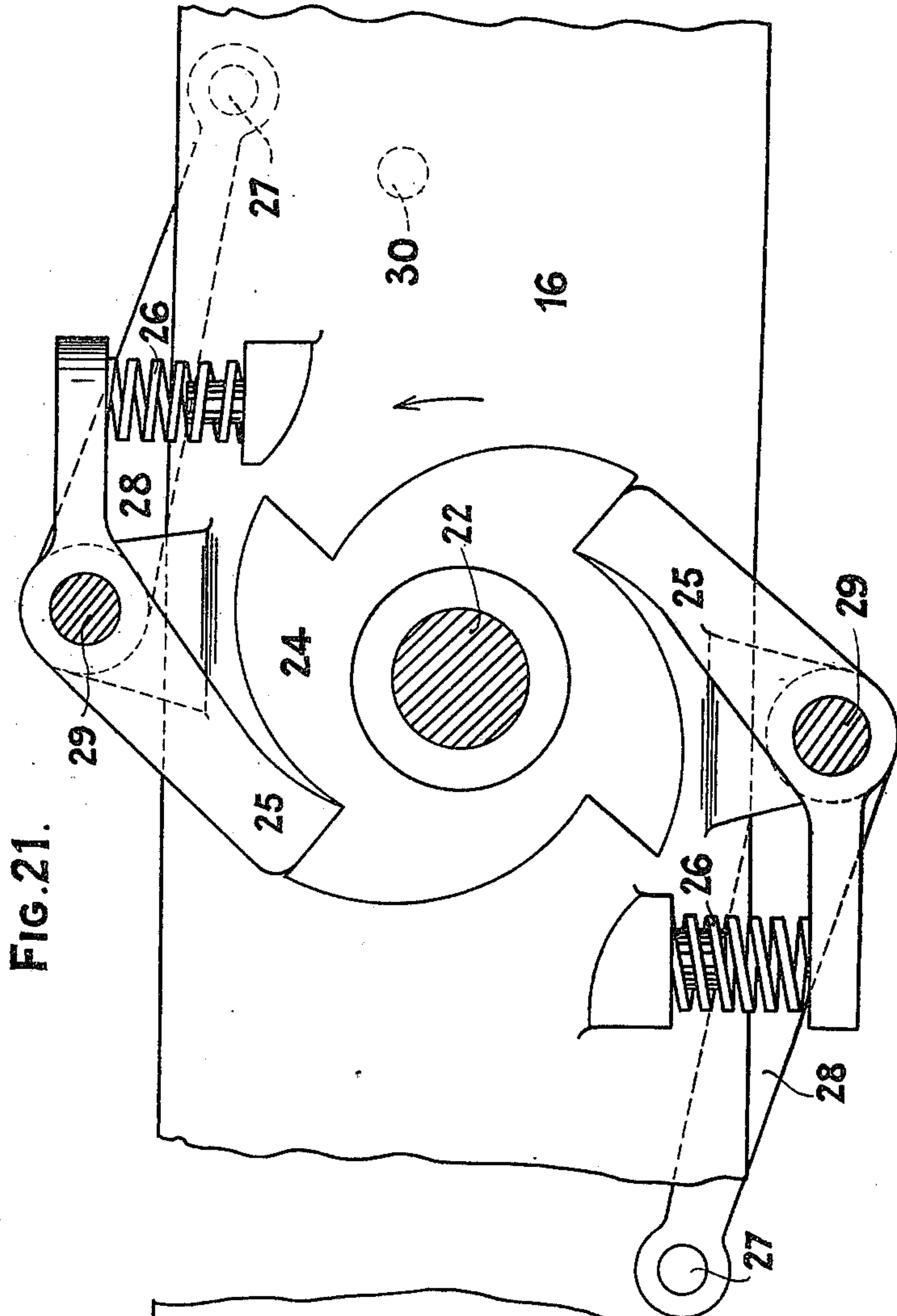
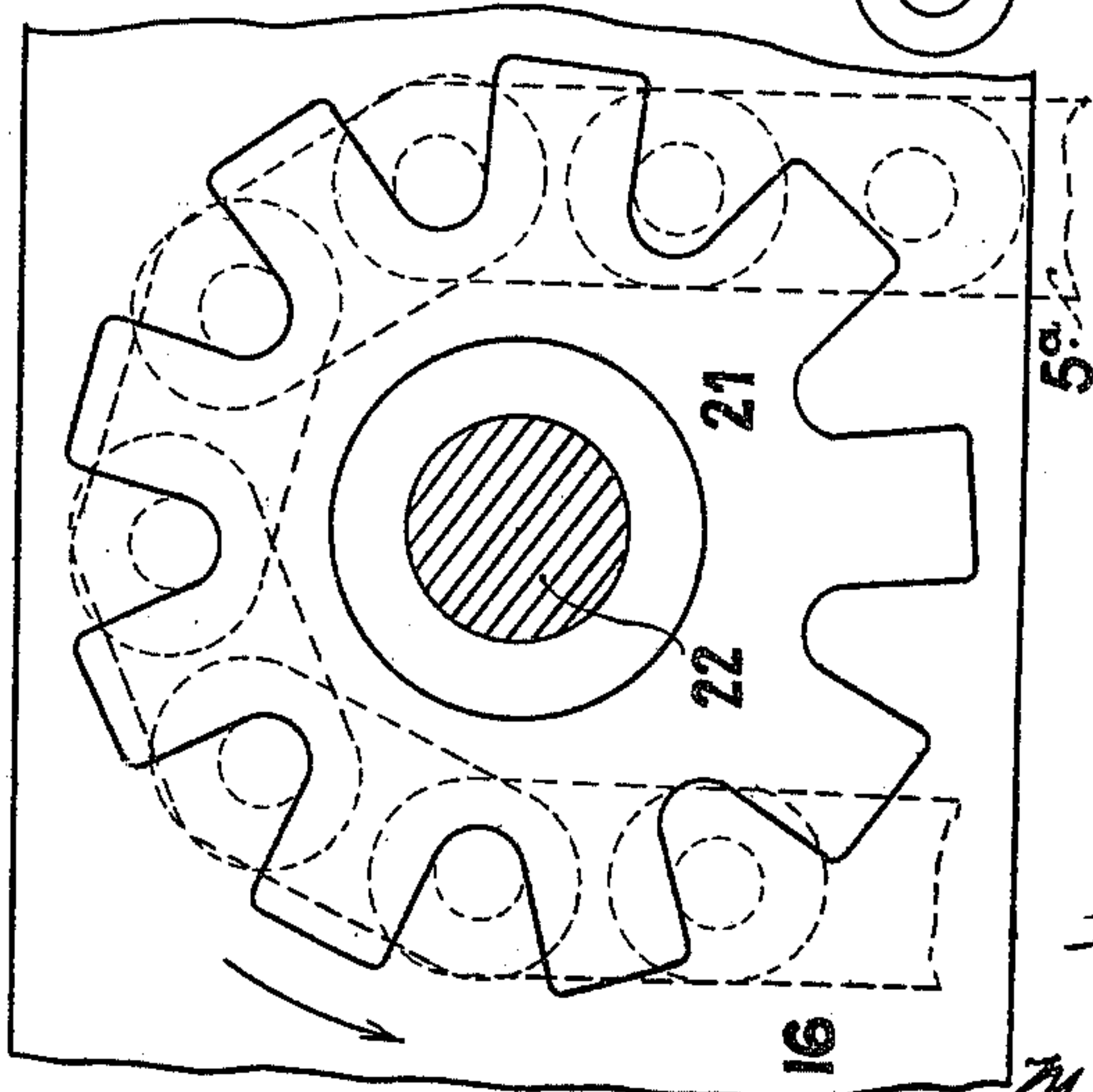


FIG. 20.



Witnesses
W. J. Sumner
W. J. Conway

Inventor.

M. M. J. O. O'Conor

No. 669,467.

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M. M. J. O. O'CONOR.

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18 Sheets—Sheet 14.

FIG. 23.

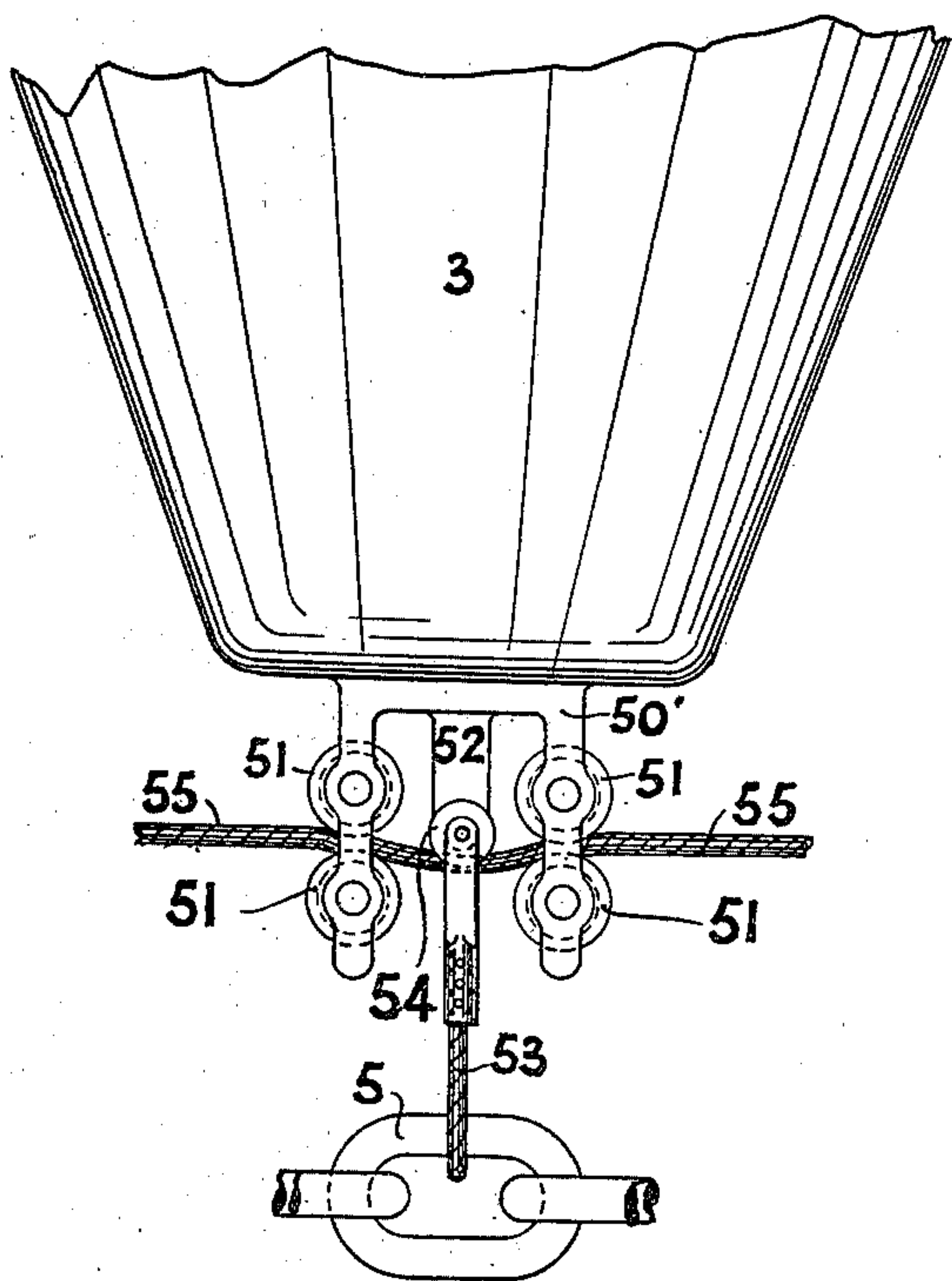
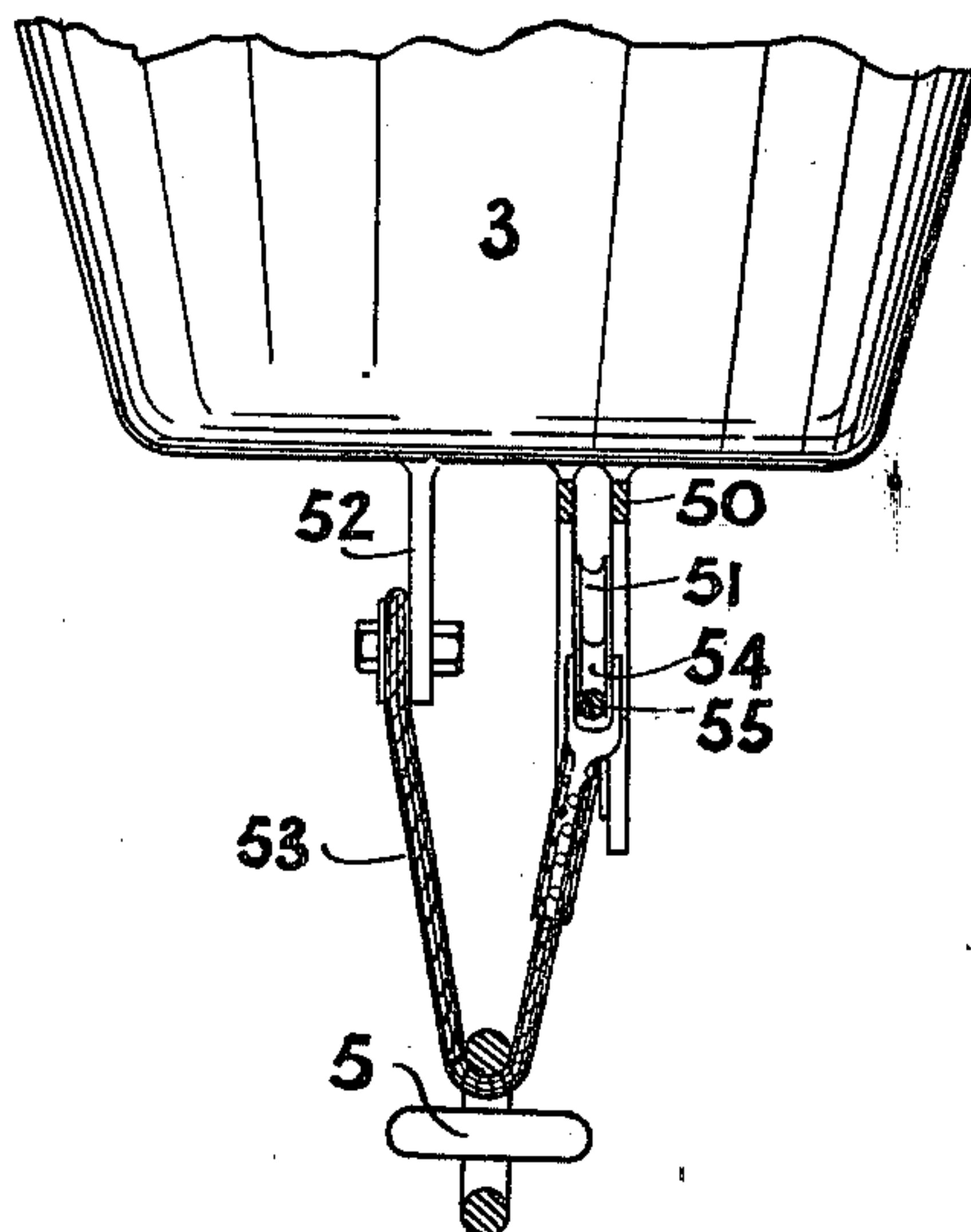


FIG. 24.



Witnesses
W. J. Symms
W. J. Conway

Inventor.
M. M. J. O. O'Conor

No. 669,467.

Patented Mar. 5, 1901.

M. M. J. O. O'CONOR.

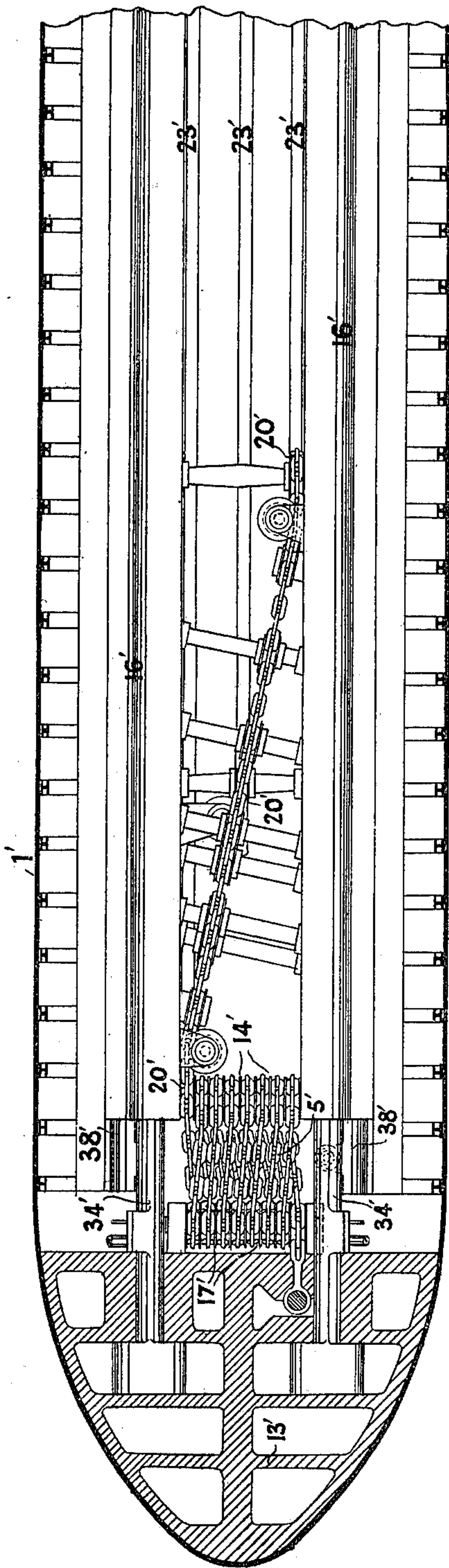
APPARATUS FOR RAISING AND CONVEYING SUNKEN BODIES.

(No Model.)

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18 Sheets—Sheet 15.

FIG. 25.



Witnesses.
W. H. Sumner
W. J. Conway

Inventor.
M. M. J. O'Conor

No. 669,467.

Patented Mar. 5, 1901.

M. M. J. O. O'CONOR.

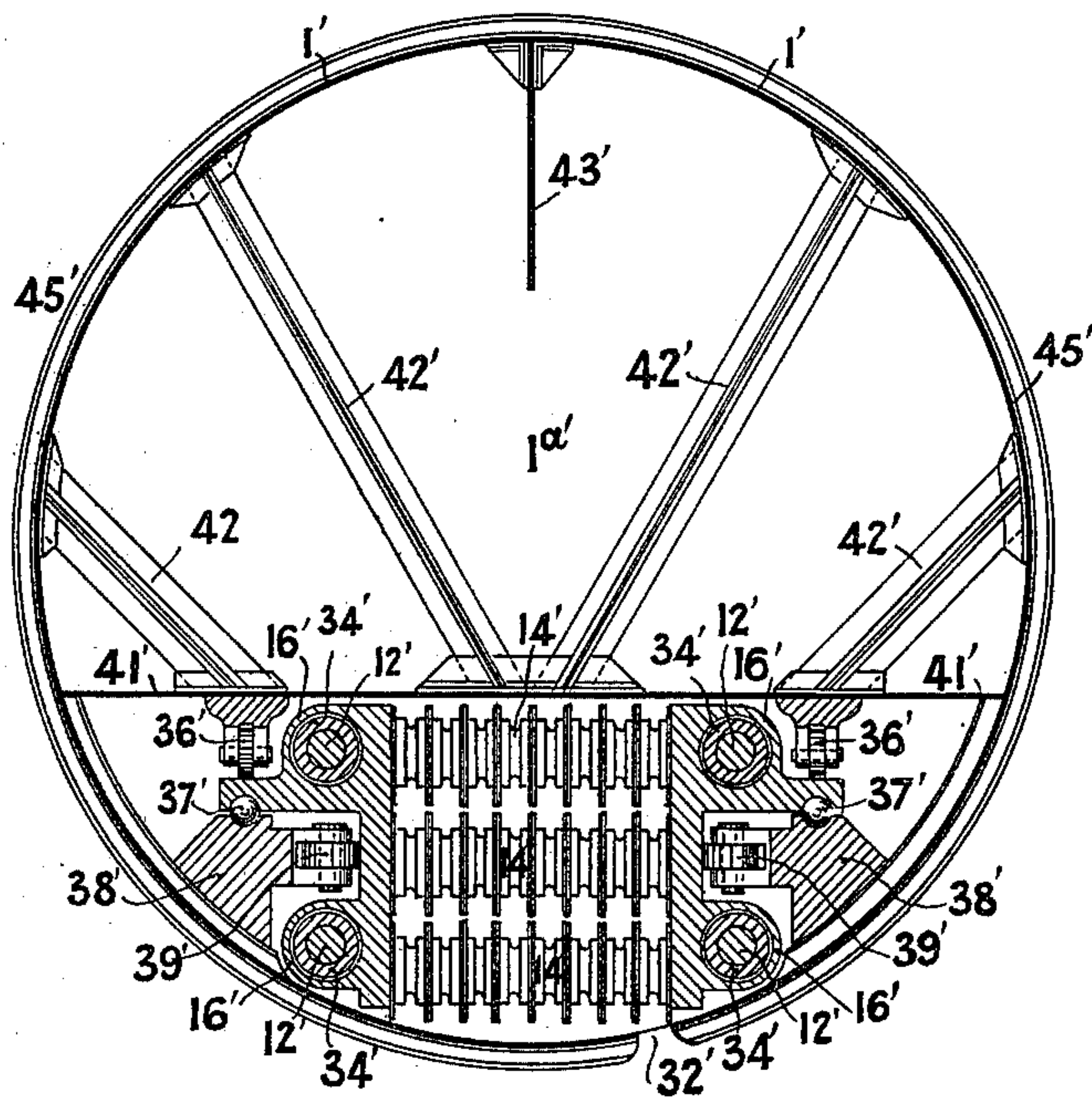
APPARATUS FOR RAISING AND CONVEYING SUNKEN BODIES.

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(Application filed June 6, 1898.)

18 Sheets—Sheet 16.

FIG. 26.



Witnesses
W. H. Sumner
W. J. Conway

Inventor
M. M. J. O. O'Conor

No. 669,467.

Patented Mar. 5, 1901.

M. M. J. O. O'CONOR.

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(No Model.)

18 Sheets—Sheet 17.

Fig. 27. Q

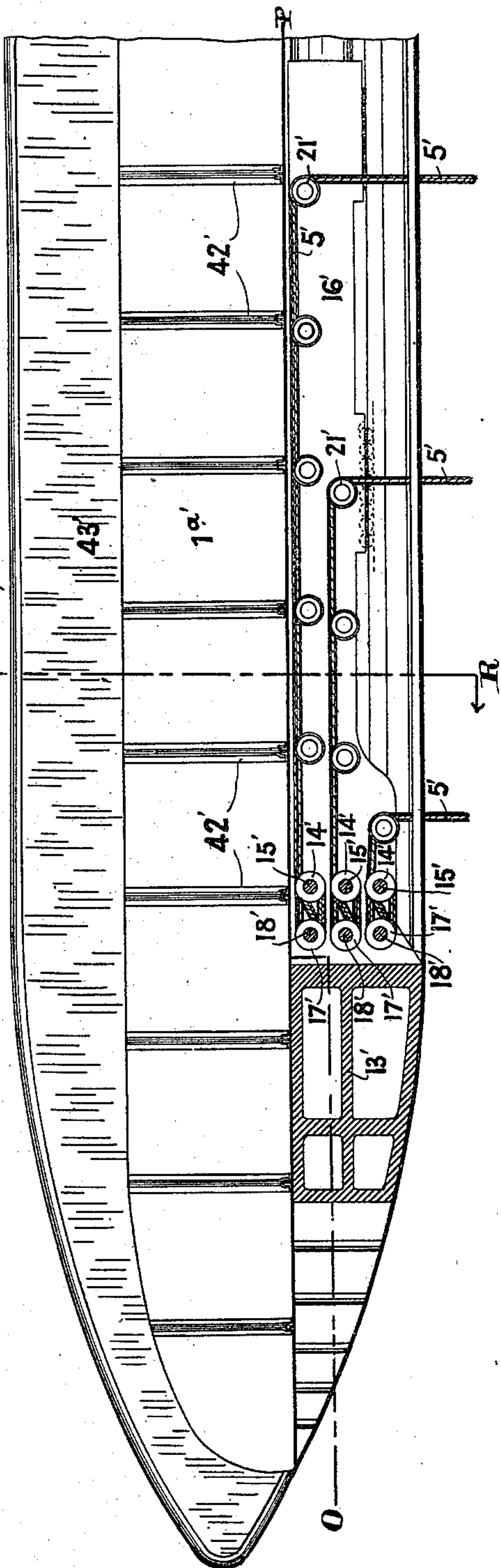
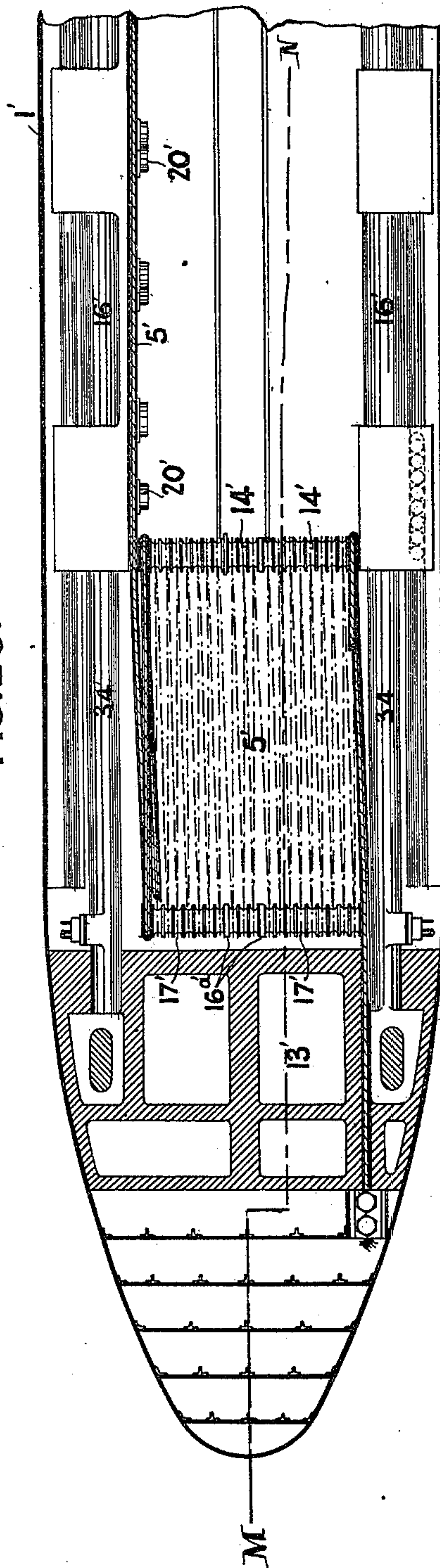


Fig. 28.



Witnesses
W. H. Summa
W. J. Conway

Inventor,
M. M. J. O'Connor

No. 669,467.

Patented Mar. 5, 1901.

M. M. J. O. O'CONOR.

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18 Sheets—Sheet 18.

FIG. 30.

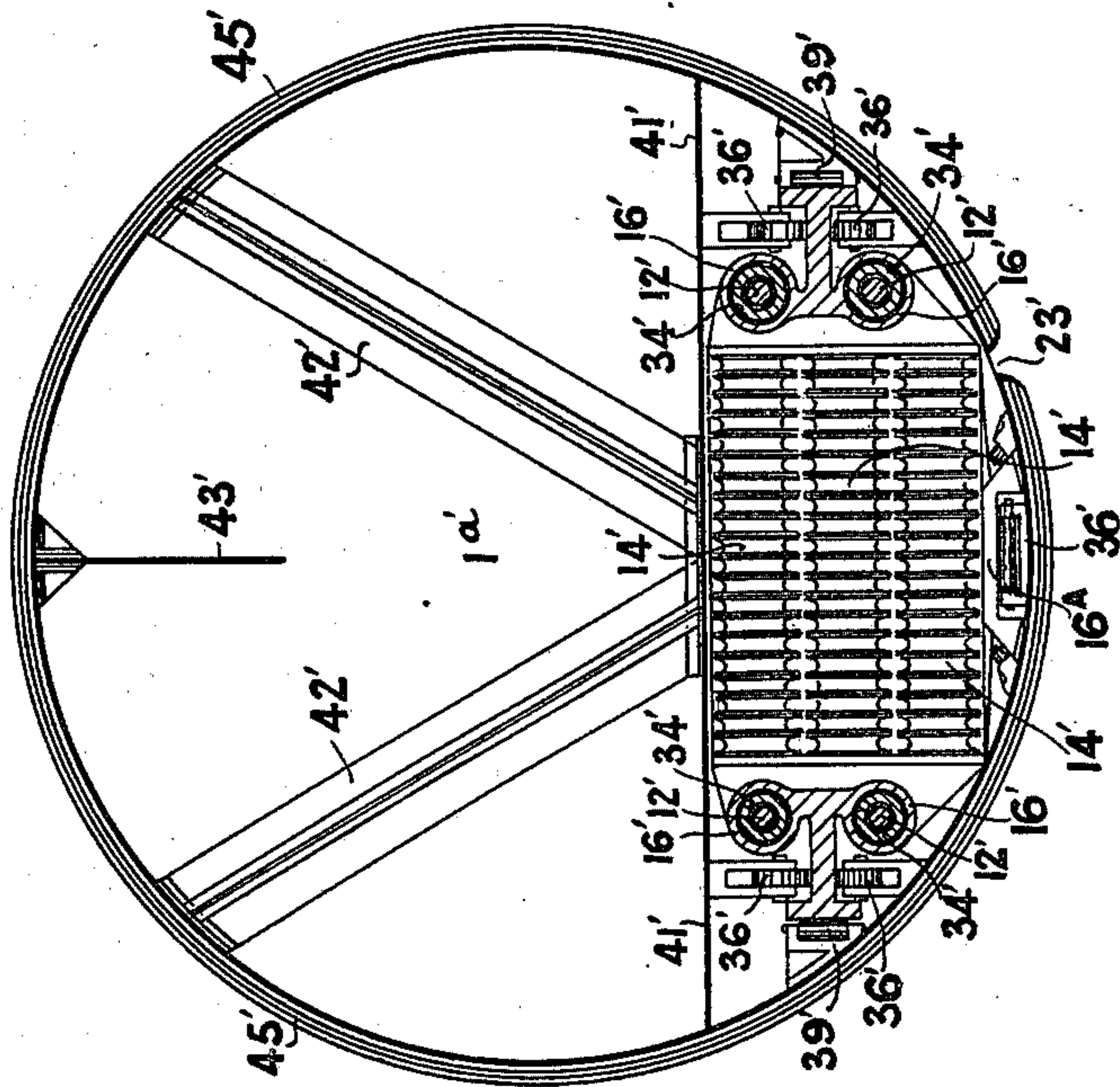
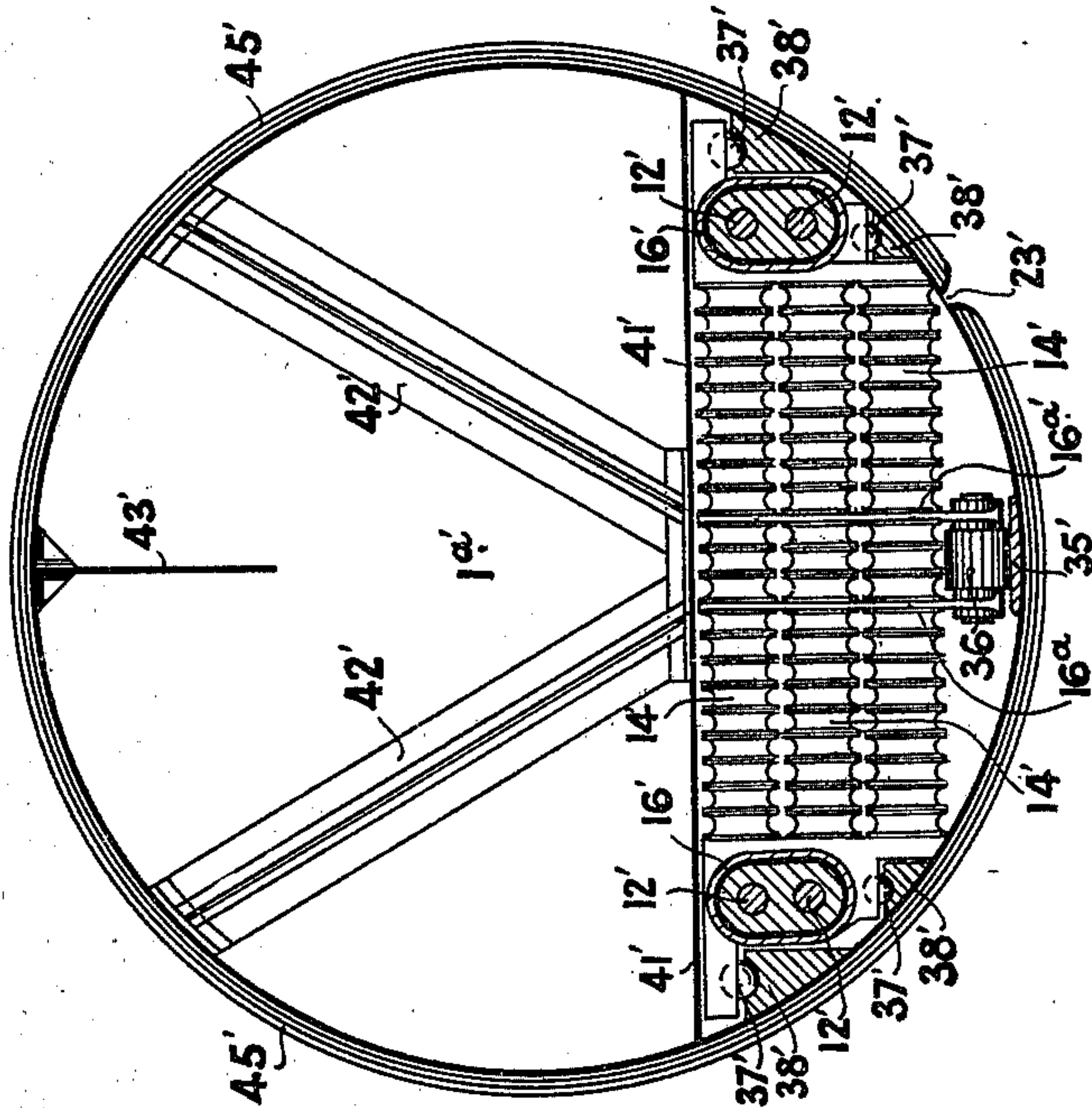


FIG. 29.



WITNESSES
W. H. Simms
W. J. Conway

INVENTOR
M. M. J. O. O'Conor

UNITED STATES PATENT OFFICE.

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

APPARATUS FOR RAISING AND CONVEYING SUNKEN BODIES.

SPECIFICATION forming part of Letters Patent No. 669,467, dated March 5, 1901.

Application filed June 6, 1898. Serial No. 682,709. (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 county of Leitrim, Ireland, have invented Apparatus for Finding, Raising, and Conveying Sunken Bodies, of which the following is a specification.

10 The object of this invention is to provide apparatus by which submerged ships or other bodies (hereinafter referred to as "ships") may be searched for and found, secured, raised, conveyed to any desired place, and there be
15 raised and supported above the surface of the water by the apparatus while being examined or repaired or for any other purpose, or else be discharged according to requirement, such apparatus being also suitable for
20 refloating ships that may have gone aground, for raising ships in the water, and thus reducing their draft sufficiently to enable them to pass over sand banks, bars, and other shallows, and to enter and leave tide-bound harbors, estuaries, bays, rivers, and other waterways too shallow for them to traverse in the ordinary way at their full draft, and to raise ships above the surface of the water for dry-docking them for examination and repair.
25 An apparatus for the above-mentioned purposes according to this invention comprises the following features: (a) two cylindrical or other vessels of suitable strength and usually of greater length than any submerged or other ship they are intended to find or raise, these vessels being of such displacement that with their contained (or attached) machinery they can themselves float and also raise and support (in addition to their connecting-gear) a
35 ship or other body to be raised, supported, and removed; (b) chains or other flexible connections whereby the two cylindrical or other vessels are connected, whereby the said vessels can be caused to move toward one another, and whereby, also, a ship can be supported during and after the raising operation; (c) machinery carried by the cylindrical or other vessels and adapted to be controlled from the surface of the water, such
45 machinery being adapted for hauling in the said chains or other flexible connections in

such a manner as to, first, cause the said vessels to be drawn toward one another laterally and so to approach any ship or other body located within the area inclosed or surrounded
55 by the vessels and their chains or other flexible connections, and also, second, to simultaneously alter the positions of the chains or other flexible connections relatively to the ends of the vessels at the points where they
60 enter the vessels in such a way as to force them to travel in an inward direction and away from both ends of the vessels, so that the apparatus will be caused to contract or converge simultaneously on all sides toward
65 a given center and cause the chains or other flexible connections to pass under the said ship or other body and bring the vessels close against the said ship or other body, and (d) arms or projections securely fixed to and projecting laterally from the exteriors of the said
70 cylindrical or other vessels and adapted to enable those vessels to be moved in a rotary sense, so as by altering their displacement in the water to raise a ship sufficiently to bring
75 its bottom above the bottoms of the cylindrical or other vessels of the apparatus and so that the raised ship may be supported with its lowermost part above the surface of the water on which the cylindrical or other vessels
80 are for the time being floating, or to enable a ship to pass through shallow water, or to refloat a ship if it has gone aground, the said arms or projections serving also to steady the vessels and prevent them rolling or turning
85 when on the bed of the sea, and to maintain the chains or other flexible connections on the bed of the sea at the points where they enter the vessels, and (e) means whereby water can be admitted to the interiors of the
90 cylindrical or other vessels for the purpose of causing them to sink, and whereby water can be afterward withdrawn from and air admitted to the interiors of the said vessels in order to cause them to rise.

95 In order that my said invention may be clearly understood, I hereunto annex drawings, in which I illustrate (as examples) several modifications of apparatus embodying, in combination, the features hereinabove enumerated; but it is to be understood that I reserve the right to vary the forms, proportions,
100

dimensions, and materials employed in carrying out my invention as may be found desirable to meet the requirements of all cases.

Figures 1, 2, 3, and 4 are perspective views, 5 to different scales, showing the apparatus in various positions preparatory and during use. Fig. 5 is a diagrammatic view showing the apparatus with a ship to be raised thereby, and Fig. 6 is a similar view showing the ship raised 10 above the water-level by the apparatus. Fig. 7 shows in side elevation one of the cylindrical vessels with the parts carried thereby. Figs. 8 and 8^a together show in central vertical longitudinal section, to a larger scale, approximately one-half of one of the cylindrical vessels with contained machinery. To facilitate 15 description I call this view a "vertical section" and will treat other views accordingly, because, regard being had to the location of the machinery within the cylindrical vessel, if that vessel were afloat the portion containing the machinery would naturally be the lower portion. Figs. 9 and 9^a together show a longitudinal sectional view in the line A B of Figs. 8 25 and 8^a. Fig. 10 shows a transverse sectional view in two planes, approximately according to the line C D of Fig. 8, but to a larger scale. Fig. 10^a is a sectional detail view. Figs. 11 and 12 are views at right angles to one another, to a larger scale than Fig. 10, illustrating an 30 antifriction-ball arrangement. Fig. 13 shows in side elevation part of one of the cylindrical vessels with one of the arms or brackets and pulleys carried thereby. Fig. 14 shows, to a slightly different scale from Fig. 10, a longitudinal sectional view of hydraulic apparatus for drawing in the chains or connections between the vessels. In this view the parts occupying the relative positions which 40 obtain before the hydraulic rams have commenced their operative strokes. Fig. 15 is a view corresponding to Fig. 14, but showing the other extreme or outward position of the hydraulic rams. Fig. 16 is a view, to a larger scale than Figs. 14 and 15, showing more clearly the construction of that portion of the apparatus which is shown in the upper right-hand portion of Fig. 14. Fig. 17 shows, to the same scale as Fig. 16, a cross-sectional 50 view corresponding, except as to scale, to a transverse section on the line E F of Fig. 15. Fig. 18 is a diagrammatic view to a reduced scale and illustrating the action of the hydraulic apparatus in drawing in the chains or connections between the vessels. Fig. 19 is a cross-section corresponding, except as to scale, to the line G H of Fig. 9. Figs. 20 and 21 are cross-sections corresponding to the lines I J and K L, respectively, of Fig. 19. 60 Fig. 22 shows in elevation part of one of the chains or connections. Figs. 23 and 24 are two views at right angles to one another, showing the lower part of a buoy with a device for readily securing a chain thereto and for readily releasing such chain. Figs. 25 and 26 are similar views to Figs. 9 and 10, respectively, showing a modification. Fig. 27 is a

vertical section on the line M N of Fig. 28; Fig. 28, a horizontal section on the line O P of Fig. 27, but with some of the parts in a 70 different position; and Fig. 29, a cross-section on the line Q R of Fig. 27, showing another modified construction. Fig. 30 is a similar view to Fig. 29, showing a further modification. 75

Fig. 1 is a general view in which there is shown afloat an apparatus according to this invention, 1 1 being the two vessels, which are of cylindrical form, with their ends tapered; 2 2, arms or projections securely fixed to 80 and projecting laterally from the exteriors of the said vessels and adapted to enable these vessels to be moved in a rotary sense and also to steady and hold the vessels in position, as already referred to; 3 3, rows of buoys where- 85 by chains or other flexible connections (not seen in this view) that connect the two cylindrical vessels 1 1 are supported, the several buoys in each row being held apart by rods of rigid material, and 4 4 steamships where- 90 by the apparatus is being towed into position preparatory to being sunk. Fig. 2 is a similar view, to a somewhat larger scale, in which the apparatus is represented as lying upon the bed of the sea preparatory to the ma- 95 chinery contained in the cylindrical vessels 1 1 being operated so as to haul onto the flexible connections 5, (which in this example are chains having the central or intermediate portion 5^a of their lengths of much greater 100 strength than the remainder,) so as to cause the two cylindrical vessels 1 1 to move toward the sunken ship 6 and simultaneously to cause the chains to pass under the ship 6, the stronger portions 5^a of the chains occu- 105 pying positions beneath the ship when the vessels 1 have been brought close against her sides. The thin dotted lines 10 10 indicate strong armored flexible air-tubes, to which are secured electric cables in suchwise that 110 through the tubes air may, according to requirement, enter or leave the cylindrical vessels 1, (air entering as water is discharged and leaving as water is admitted,) and through the electric cables the necessary electric cur- 115 rents are conducted for the purpose of operating the electric motors whereby to work, when required, the pumps for discharging water from within the cylindrical vessels, as also to work the machinery for drawing the cy- 120 lindrical vessels toward one another through the media of the flexible connections 5. To obviate liability of fracture of the air-tubes and electric cables, (indicated at 10,) chains 10^a may be used in conjunction therewith for 125 taking the strain between the steamships 4 and cylinders 1. The other ends of the vessels 1 are also provided with strong armored flexible air-pipes and electric cables, as indicated at 10, for use in the event of the other 130 ones becoming damaged. The upper ends of these duplicate tubes and cables may be buoyed or connected with the ships 4.

Fig. 3 shows generally from a slightly-dif-

ferent point of view the apparatus afloat with the raised ship 6 supported between the cylindrical vessels 1 1 of the apparatus by means of the connections 5, (not seen in this view,) 4 4 and 4^a 4^a being steamships in attendance.

Fig. 4 is a view, to a still larger scale, in which there is shown so much of the apparatus as is necessary to illustrate how it supports the raised ship 6 by means of the stronger portions 5^a of the connecting-chains after the cylindrical vessels 1 1 have been partly rotated by hauling onto powerful connections attached to the arms or projections 2 of the respective cylindrical vessels 1.

Fig. 5 illustrates, diagrammatically, relative positions of the cylindrical vessels 1, their arms or projections 2, the stronger portions 5^a of the flexible connections or chains, and the ship 6. These relative positions would obtain (or approximately so) just before commencing to raise the apparatus, with the ship 6, from the bed of the sea and also during the raising and until the apparatus and ship 6 had attained, approximately speaking, the position indicated in the upper part of the view in relation to the water-level 7. When the vessels are in the latter position, light flexible connections are reeved by divers over and around the pulleys 9, carried by the arms or brackets 2. By means of these connections stronger chains or flexible connections 8 are pulled into place over and around the pulleys 9 from the attendant steamships 4 4^a. By pulling on the ends of these chains or flexible connections by means of powerful winches on the ships 4 4^a the vessels 1 can be partly rotated, so as to alter their displacement. Fig. 6 is a similar diagrammatic view indicating approximately the relative positions of the cylindrical vessels 1, their arms or projections 2, connections 5^a, and the ship 6 after the cylindrical vessels 1 have been partially rotated by means of the chains 8, passing over the pulleys 9, carried by the said arms or projections 2, thereby raising the ship 6 into a position well above the water-level 7, so as to permit of inspection, repairs, &c., such as might be effected if the ship 6 were in a dry dock.

Fig. 7 shows in side elevation one of the cylindrical vessels 1, with its arms or projections 2, portions 5 of the flexible connections, as also at 10 10 portions of the air-tubes, with electric cables secured thereto, and portions of the chains 10^a. As will be seen, the arms or projections 2, with pulleys 9, are arranged so that, in addition in serving as a convenient means whereby the cylindrical or other vessels 1 can be turned in a rotary sense for the purpose herein set forth, they also serve when the apparatus is resting on the bed of the sea, as shown in Figs. 2 and 5, to steady the said vessels and prevent them from rolling or turning on the said bed, and so maintain the chains 5 or other flexible connections in their proper positions, resting on the bed

of the sea at the points where they enter the said vessel through the longitudinal slots or openings 23, which at this time will be at the lower sides of the vessels. In this way the chains or other flexible connections will be maintained in the best positions for being drawn below the bottom of a sunken ship. Furthermore, the rollers 9 serve to facilitate the movement of the vessels 1 over the bed of the sea when they are being drawn together.

I have already indicated that as the cylindrical vessels 1 are caused to approach one another the chains or flexible connections 5 are caused to approach one another from both ends of the cylindrical vessels and also to pass under the sunken ship 6. To illustrate this, I have in the view under notice, Fig. 7, illustrated by dotted lines 5* 5* 5* the extreme inward positions that may be assumed by portions of the three connecting-chains indicated at 5 5 5 to the right of the figure, while at 5** 5** 5** I have indicated the extreme inward positions that may be assumed by the connecting-chains indicated at 5 5 5 to the left of the figure.

Figs. 8 and 8^a together show in central longitudinal section (to a larger scale) approximately one-half of one of the cylindrical vessels with contained machinery. To facilitate description, I call this view a "vertical section" and will treat other views accordingly, because, regard being had to the location of the machinery within the cylindrical vessel, if that vessel were afloat the portion containing the machinery would naturally be the lower portion.

Figs. 9 and 9^a together show a longitudinal sectional view in the line A B of Figs. 8 and 8^a.

Fig. 10 shows a transverse sectional view in two planes approximately according to the line C D of Fig. 8. At 11 11 there are arranged partly around the cylindrical vessel 1 and for a considerable portion of its length antifriction-balls adapted to bear against the side of a sunken ship or other body when the cylindrical vessels 1 have been brought into juxtaposition with it for raising it.

Figs. 11 and 12 are views at right angles to one another, (to a larger scale than Fig. 10,) illustrating the antifriction-ball arrangement just above referred to.

Fig. 13 shows in side elevation part of one of the cylindrical vessels 1, with one of the arms or brackets 2 and pulleys 9 carried thereby.

Fig. 14 shows, to a slightly different scale from Fig. 10, a longitudinal sectional view of hydraulic apparatus, hereinafter described, for drawing in the chains or connections 5 with the aid of wheels whose axles are moved lengthwise of the cylindrical vessels 1 by means of such hydraulic apparatus as will be hereinafter explained. In this view the parts occupy the relative positions which obtain before the rams 12 have commenced their operative strokes.

Fig. 15 is a view corresponding to Fig. 14,

but showing the other extreme (or outward) positions of the rams 12.

Fig. 16 is a view to a larger scale than Figs. 14 and 15 and shows more clearly the construction of that portion of the apparatus which is shown in the upper right-hand part of Fig. 14.

Fig. 17 shows, to the same scale as Fig. 16, a cross-sectional view corresponding (except as to scale) to a transverse section in the line E F of Fig. 15.

Fig. 18 is a diagrammatic view to a reduced scale and illustrates the action of the hydraulic apparatus in drawing in the chains or connections 5. The chain 5 shown to the left of the figure has one of its ends secured at 5^b to a strong framework or casting 13, which is fixed within the cylindrical vessel 1, and from 5^b the chain 5 passes to and half around the pulley 14, which is free to rotate on the axle 15, which latter is carried by the casing 16 of the hydraulic apparatus. From the pulley 14 the chain 5 returns to and passes half around a pulley 17, which is free to rotate on an axle 18, carried in brackets 19, formed with or fixed to the casting 13. From the pulley 17 the chain passes to and half around a second pulley 14^a, which is free to rotate on the axle 15, Figs. 8, 9, and 10. Then the chain passes back to and half around a second pulley 17^a on the axle 18, thence back to and half around a third pulley 14^b on the axle 15, thence back to and half around a third pulley 17^b on the axle 18, thence back to and half around a fourth pulley 14^c on the axle 15, thence back to and half around a fourth pulley 17^c on the axle 18, and thence back to and under a guide-roller 20 and upward and over a chain-wheel 21, which wheel is fast on the axle 22 and is free to rotate in the direction of the arrow, (so as to allow the chain 5 5^a to be drawn in through the longitudinal slot or opening 23, formed in the external wall of the cylindrical vessel 1,) but is prevented from rotating (unless specially released) in the contrary direction, as will be hereinafter explained.

Hydraulic gear, pulleys, and other parts similar to those just above described are provided for each of the other chains, (two of which are indicated to the right of the one just described;) but, as will be seen on reference to Figs. 8 and 9, additional guide-pulleys are provided to direct the course of the second and third chains, as distinguished from that chain whose course has been fully explained, it being understood that the arrangement at each end of each cylindrical vessel 1 is similar to that above described.

Although I have shown for each chain four pulleys on each of the axles 15 and 18, the number of such pulleys may be varied to suit the requirements of particular cases.

Figs. 19, 20, and 21 show, to a larger scale, one of the chain-wheels 21, also a ratchet-wheel 24, which is fast on the same axle 22, and a couple of pawls 25, whereby the ratchet-wheel, while permitted to rotate freely in the

direction of the arrow for taking in chain, is prevented from rotating in the contrary direction until specially released, which release is effected by moving the pawls 25 in opposition to the springs 26 until the said pawls are out of gear with the ratchet-wheel 24. The pawls can be locked out of gear by means of pins, which for that purpose are passed through eyes 27 in the ends of the lever-arms 28 (which are fast on the pawl-axes 29) and into holes 30, formed in the outer casing 16 of the hydraulic apparatus, which casing carries the chain-wheel 21, the ratchet-wheel 24, the pawls 25, and other parts, as will be readily understood from the drawings.

Referring now again to Figs. 8 and 9, the general arrangement of the apparatus will be readily understood from the description that has been already given. 31 31 31 31 indicate electric motors, which may be of any suitable description and are to be of adequate power and such as can through suitable conductors, such as already referred to, be set in operation from attendant ships, such as 4 4^a, which are intended to carry suitable electric generators or storage batteries, (preferring electric generators with, of course, adequate driving power and appliances.) The electric motors 31 are to be carefully located in strongly-constructed water-tight compartments or chambers, (indicated at 32,) suitable provision being made to afford access when necessary to the said compartments or chambers and also for strongly closing them air-tight at other times. 33 33 33 33 indicate pumps whereby water can be supplied under pressure to the hydraulic cylinders 34 34. The pumps may be of any suitable construction, such as can be suitably worked through appropriate gear from the particular motors employed; but care must be taken that all the connections between the electric motors and the pumps they are to operate shall be so inclosed as to prevent the entry of water into the chambers or compartments in which the electric motors are located. As will be seen in Figs. 8, 9, and 10, eight of these hydraulic cylinders 34 are in this particular example arranged in pairs. Each cylinder contains a ram 12, (see Figs. 10, 14, 15, 16, and 17,) and the two rams of each pair of cylinders have secured to them at their outer ends the strong end of the outer casing 16, which incloses the pair of cylinders and travels along the same.

For supporting the pairs of rams at intervals of their length as they leave the cylinders 34 they may be provided with sets of blocks or bearings 12^a 12^b 12^c. The forward end of each cylinder of each pair is provided with an annular projection 34^a, which fits tightly within a corresponding recess 12^d in the corresponding bearing 12^a next it, and this bearing is provided with a similar projection taking into a corresponding recess in the next bearing 12^b, which is also provided with a projection taking into a recess in the third bearing 12^c, as shown in Fig. 16. Projecting from

the sides of the bearings 12^a 12^b 12^c are pins 12^e 12^f 12^g, that extend, respectively, into slots or grooves 16^b, 16^c, and 16^d of different lengths formed on the inner side of the casing 16. The arrangement is such that on the outstroke of the rams the bearings 12^a 12^b 12^c remain close to the forward ends of the cylinders 34 until the rear ends of the slots or grooves 16^b come into contact with the pins 12^e on the forward set of bearings 12^c, whereupon those bearings are caused to travel forward with the rams and corresponding outer casing 16 and support the parts of the rams they surround by such casing. Upon the rear ends of the second set of slots or grooves 16^c coming into contact with the pins 12^f of the second set of bearings 12^b these bearings are also caused to travel forward with the rams and outer casing, such bearings then resting against the bearing 22^a of the adjacent pulley-axle 22 and supporting the parts of the rams they surround, and upon the rear ends of the slots or grooves 16^d coming into contact with the pins 12^g on bearings 12^a these bearings are caused to bear against the bearings 22^b of the next pulley-axle 22 and are also caused to travel forward with the rams, the various parts finally assuming the positions shown in Fig. 15. Two of the casings 16 (see Fig. 10) are supported by longitudinal rails or ways 35, on which there travel antifriction balls or rollers 36, whose axles are carried by cheeks or brackets 16^a, formed with or secured to the under sides of the inner or center casings 16, which at their upper sides are furnished with antifriction-balls 37, which travel against suitable ways 38. (See Figs. 8, 9, and 10.) The other two or outer casings 16 are supported and guided each by upper and lower rows of antifriction-balls 37, traveling against suitable ways 38. (See Fig. 10.)

The axle 15 at each end of each cylindrical vessel 1 is carried by and secured to and aids in tying together the whole of the casings 16 at that end. 16* represents stays serving to further tie the casings 16 together. The two outside casings 16 are furnished with lateral antifriction-wheels 39, traveling along rails or ways 40, so as to guide laterally the whole arrangement.

Although in the particular example I have shown four pairs of hydraulic rams and cylinders and four casings, it is to be understood that, not only as to the number of those parts, but also as to their proportions, dimensions, and general arrangement, variations may be made, as circumstances may render desirable, to suit the requirements of different cases.

A strong longitudinal curved bulkhead partition or deck 41 with suitable stays 42 separates in an air-tight and water-tight manner the compartment or compartments containing the machinery from the compartment or compartments 1^a, intended to receive water for sinking the apparatus and to contain air when the apparatus is to be caused to rise.

Any suitable arrangement may be provided

for admitting water to the compartment 1^a of each cylinder 1 for the purpose of sinking the apparatus. For this purpose each cylindrical vessel may, for example, be provided with a number of valves, one of which, 1^b, is shown in Fig. 10^a. This valve is arranged within a pocket 1^c, open to the water, and controls an opening 1^d to the chamber 1^a. 1^e is a spring that tends to press the valve against its seat 1^f. 1^g is a piston connected to the stem of the valve and arranged to work in a cylinder 1^h, and 1ⁱ is a pipe for supplying fluid under pressure to the cylinder. The arrangement is such that by admitting fluid under pressure to the cylinder 1^h the valve 1^b can be opened against the action of its spring 1^e and water allowed to enter the compartment 1^a to sink the vessel 1, and upon exhausting the cylinder 1^h the valve will be closed against its seat 1^f and be held there by the external pressure of the water in which the vessel is submerged. 1^k is a screen to prevent the entrance of foreign matter to the pocket 1^c. The air-pipe 1^l may be common to all the water-inlet valves and be led to the surface of the water with the air-tube and electric cables, (shown at 10.) Any other suitable arrangement of water-inlet valves may, however, be employed. Water or air can enter and leave the compartment containing the machinery through the longitudinal slot or opening 23.

23^a represents additional openings through which water or air can enter and leave the machinery-compartment as the same is turned by moving the cylindrical vessel in a rotary sense upward or downward.

43, Figs. 8 and 10, is a longitudinal plate-girder with numerous inclined stays 44.

45 45 are strong circumferential hoops or strengthening-belts. These may be suitably covered with wood or other material, (or the annular spaces between them may be filled up,) so as to obviate risk of injury to a ship or other body to be raised, such as might result from the pressure against it of the unprotected hoops or belts 45. Furthermore, it will be evident that the details of construction and arrangement of the devices for strengthening the cylindrical vessels 1 (as well as the forms and proportions of these vessels themselves) may be more or less varied, as may be found desirable, without departure from the essential characteristics of my invention.

It will be understood that the cylindrical vessels 1 are caused to approach one another by forcing liquid under pressure into the hydraulic cylinders 34, thereby forcing their rams 12 and casings 16 outward and so moving the pulleys 14 14^a 14^b 14^c away from the pulleys 17 17^a 17^b 17^c, and consequently drawing in the chains or flexible connections 5. When this has been done, the cylindrical vessels are in a sunken condition, due to the presence of water previously admitted to the water-tight compartments thereof. After the cylindrical vessels have reached the ship or body to be raised the raising is to be effected

by discharging the water from the compartments 1^a and simultaneously admitting air.

46 46, Figs. 8^a and 9^a, indicate, in a general way, electric motors, which may be of any
5 suitable construction, which receive current through suitable conductors 47, which are connected with suitable sources of supply of electric current on board ship, or in some cases the source of supply might even be on land
10 where the distance was not great.

The electric motors are arranged to drive pumps of any suitable construction, (indicated in a general way at 48,) care being taken that the connections between the motors and
15 the pumps are so arranged and that the motors are so inclosed as to prevent access of water to the motors, while at the same time enabling access to be gained, when required, to the motors. Such details may obviously
20 be variously arranged. Fig. 22 shows a part of the heavier length of chains 5^a for directly supporting the ship to be raised. A portion of each end of such heavier length is formed of flat links that work over and gear with the
25 corresponding chain-wheel 21, (see Fig. 20,) the small portion of the chain 5 to which such flat link portion is connected simply working over the top of the teeth of such chain-wheel 21 without gearing therewith.

30 I have already referred to the buoys, (marked 3 in Fig. 1.)

Figs. 23 and 24 are two views at right angles to one another, showing the lower part of a buoy with a device for readily securing
35 a chain 5 thereto and readily releasing it. The bracket 50 projects from the lower end of the buoy and carries between its forks anti-friction-wheels 51. Another bracket 52 is secured to the lower end of the buoy and has
40 attached to it one end of a loop 53, which passes through a link of the chain 5 and at its other end is furnished with an anti-friction-wheel 54. A rope 55, which is common to a series of buoys, is passed between the upper
45 and lower anti-friction-wheels 51 and under the anti-friction-wheel 54, thus holding up the chain 5 until the rope 55 is drawn away, whereupon the chain 5 will be released. In some cases, as in shallow water, the buoys
50 may be dispensed with. In such a case the vessels 1 would be near together at starting and before being sunk would be drawn apart by ships 4, the chains paying out, sinking, and resting on the bed of the sea.

55 Figs. 25 and 26 illustrate a modification in which a larger number of pulleys 14' and 17' are employed than in the previous arrangement, and the sets of pulleys instead of being arranged with their axes in a common
60 plane are arranged in planes one above the other. The several chains 5' from the separate sets of pulleys pass through separate slots or openings 23' and are made uniform throughout their length and of sufficient
65 strength to collectively support the ship to be raised and do not pass over and engage with chain-wheels arranged to rotate in one

direction only and hold the chains, as in the arrangement hereinbefore described, but only over guide-pulleys that take the place of the
70 chain-wheels. In this case there are two casings 16, inclosing four rams 12 and cylinders 34', arranged as shown, the casings being supported and guided by balls 37', working on ways 38', and also guided laterally by horizontal
75 rollers 39'.

Figs. 27, 28, and 29 show, respectively, in vertical section, horizontal section, and cross-section, a further modified arrangement, in
80 which wire ropes are used instead of chains, a still greater number of pulleys 14' and 17' being employed, arranged with their axes in different planes and the several ropes being led through a common slot or opening 23'. In this arrangement there are two casings 16', in-
85 closing two pairs of rams 12', and two pairs of cylinders 34', each pair of cylinders being cast in one piece. The casings 16' are supported by ball-bearings 37' and ways 38', as shown, a roller 36' running on a way 35', be-
90 ing provided to support, through bearing plates or cheeks 16^a, the central portions of the axles carrying the pulleys 14.

Fig. 30 shows a further modified arrangement in which there are two casings 16', each
95 of which incloses a pair of separate rams 12' and cylinders 34' and is arranged to work between vertical sets of rollers 36'. The casings 16 are connected together by the axles of the pulleys 14' and are guided laterally by ver-
100 tical rollers 39' and are supported vertically by horizontal rollers 36', that bear against a block 16^a, secured to the said casings 16'.

Instead of making the hydraulic cylinders 34 stationary and the rams 12' movable the
105 rams may be made stationary and the cylinders 34' movable. In this case the casings 16' would be dispensed with, and the movable pulleys 17', chain and guide pulleys 21', and other parts carried by the casings in the other
110 arrangements hereinbefore described would be carried by the said movable cylinders. In this case the fluid under pressure may be admitted to the cylinders through the rams.

To refloat a grounded ship, or to reduce the
115 draft of a ship, or to raise a ship above the surface of the water to examine or repair it, the vessels 1' are moved apart sufficiently to enable the chains 5' hanging between them to be passed under the ship and are then
120 hauled in sufficiently to effect the object in view, the cylindrical vessels being also partly rotated about their axes to alter their displacement when it is designed to raise the ship above the surface of the water. In this
125 application of my apparatus the chains or other flexible connections 5', connecting the vessels 1, may be much shorter than when the apparatus is designed to search for and find submerged ships or other bodies. In order
130 that all the portions 5^a of the chains or flexible connections shall aid in supporting a raised vessel, means, such as a hydraulic drawing-up device, may be employed for taking up any

slack there may be found to exist in any of such portions of chain after the ship has been raised to the surface of the water and before the cylindrical vessels 1 have been rotated.

5 These devices can be applied by divers.

The pumps for withdrawing water from the compartments 1^a of the cylindrical vessels 1' may be so operated from the hydraulic hauling-in apparatus that they or other pumps
10 shall displace from the compartment or compartments 1^a a weight of water equal to that of the chain or other flexible connection hauled in, so that the weight or buoyancy of the vessels 1 shall remain practically constant.

15 I claim—

1. Apparatus of the character herein described comprising vessels capable of being sunk and afterward refloated, flexible connections between said vessels, and mechanism located within said vessels and whereby
20 the flexible connections can be hauled in and the vessels caused to approach one another in a lateral direction.

2. Apparatus of the character herein described comprising vessels capable of being sunk and afterward refloated, flexible connections between the end portions of said vessels, and mechanism located within said vessels and adapted to simultaneously haul in
30 the flexible connections and alter their positions relatively to the ends of the vessels at the points where they enter the same, whereby the vessels and connections will be caused to converge upon an object bounded by them.

3. Apparatus of the character herein described comprising vessels capable of being sunk and afterward refloated, flexible connections between said vessels, and mechanism located within said vessels and whereby
40 the flexible connections can be hauled in and the vessels caused to approach one another in a lateral direction, said mechanism being adapted to be controlled from the surface of the water.

4. Apparatus of the character herein described comprising vessels capable of being sunk and afterward refloated, flexible connections between the end portions of said vessels, mechanism located within said vessels
50 and whereby said flexible connections can be simultaneously hauled in and caused to move away from the ends of said vessels at the points where they enter the same, and means for partly rotating said vessels and thereby
55 altering their displacement.

5. Apparatus of the character herein described comprising vessels capable of being sunk and afterward refloated, flexible connections between said vessels, mechanism located within said vessels and whereby said
60 flexible connections can be simultaneously hauled in and caused to move away from the ends of said vessels at the points where they enter the same, and means for preventing withdrawal of said flexible connections from
65 said vessels until desired.

6. Apparatus of the character herein de-

scribed comprising vessels capable of being sunk and afterward refloated, flexible connections between said vessels, mechanism located within said vessels and whereby said
70 flexible connections can be simultaneously hauled in and caused to move away from the ends of said vessels at the points where they enter the same, means for preventing withdrawal of said flexible connections from said
75 vessels until desired, and means for partly rotating said vessels when refloated.

7. Apparatus of the character herein described comprising elongated vessels, means whereby water can be admitted to said vessels, means whereby water can be withdrawn from said vessels, means whereby air can be
80 admitted to said vessels to replace the air withdrawn therefrom, flexible connections between said vessels, and mechanism located within said vessels, and whereby said connections can be hauled in and simultaneously
85 caused to move along said vessels toward the central portions thereof.

8. Apparatus of the character herein described comprising elongated vessels capable of being sunk and afterward refloated and provided with arms or projections extending laterally from said vessels and so arranged
95 that while the vessels are upon the bed of the sea or other waterway they can bear upon said bed and prevent said vessels rolling or turning thereon, flexible connections between said vessels, and mechanism located within said
100 vessels and whereby said connections can be hauled in and simultaneously caused to move along said vessels toward the central portions thereof.

9. Apparatus of the character herein referred to comprising two elongated vessels each capable of being sunk and afterward refloated and provided with longitudinal slots and with arms or projections arranged to extend in a backward direction from the vessel
110 when the same is in use and to then bear upon the bed of the sea or other waterway, flexible connections extending between said vessels and entering the longitudinal slots therein, and hauling-in mechanism located within
115 said vessels and whereby said connections can be hauled in and simultaneously caused to move along said slots away from the ends of said vessels substantially as described for the purpose specified.

10. Apparatus of the character herein referred to comprising two elongated vessels each capable of being sunk and afterward refloated and provided with longitudinal slots and with arms or projections arranged to extend in a backward direction from the vessel
120 when the same is in use and to then bear upon the bed of the sea or other waterway, flexible connections extending between said vessels and entering the longitudinal slots therein, hauling-in mechanism located within said
125 vessels and whereby said connections can be hauled in and simultaneously caused to move along said slots away from the ends of said
130

vessels, and means whereby said vessels can be partly rotated about a horizontal axis after being refloated, substantially as described.

11. Apparatus of the character herein described comprising two elongated vessels arranged parallel to one another and capable of being sunk and afterward refloated, and each divided into an air and water compartment and a machinery-compartment and provided with longitudinal slots communicating with the machinery-compartment and with laterally-extending arms or projections, hauling-in mechanism located within each vessel, two sets of flexible connections extending between said vessels, extending through the slots therethrough and connected to the hauling-in mechanism therein, guide-wheels spaced apart and carried by the movable portions of said hauling-in mechanism and around which said flexible connections are led and by which they are moved relatively to the ends of said vessels when said mechanism is in operation, and means for preventing withdrawal of said flexible connections until desired.

12. Apparatus of the character herein described comprising two elongated vessels arranged parallel to one another and capable of being sunk and afterward refloated, and each divided into an air and water compartment and a machinery-compartment and provided with longitudinal slots communicating with the machinery-compartment and with laterally-extending arms or projections, hauling-in mechanism located within each vessel, two sets of flexible connections extending between said vessels, extending through the slots therethrough and connected to the hauling-in mechanism therein, guide-wheels spaced apart and carried by the movable portions of said hauling-in mechanism and around which said flexible connections are led and by which they are moved relatively to the ends of said vessels when said mechanism is in operation, means for preventing withdrawal of said flexible connections until desired, and means whereby said vessels can be partly rotated after being refloated.

13. In apparatus of the character herein described, an elongated vessel divided internally so as to form an air and water compartment and a machinery-compartment and provided with one or more longitudinal slots leading into the machinery-compartment and with laterally-extending arms or projections, an air-tube whereby air can enter the air and water compartment from above the surface of the water in which said vessel is placed, means whereby water can be admitted to and shut off from said air and water compartment, means whereby water can be withdrawn from said air and water compartment, and means whereby the vessel, when sunk upon the bed of the sea or other waterway can be drawn over said bed.

14. In apparatus of the character herein described, an elongated vessel divided internally

so as to form an air and water compartment and a machinery-compartment and provided with one or more longitudinal slots leading into the machinery-compartment and with laterally-extending arms or projections, an air-tube whereby air can enter the air and water compartment from above the surface of the water in which said vessel is placed means whereby water can be admitted to and shut off from said air and water compartment, means whereby water can be withdrawn from said air and water compartment, means whereby the vessel, when sunk upon the bed of the sea or other waterway can be drawn over said bed, and means whereby said vessel when floating can be rotated about its axis.

15. Apparatus of the character herein described comprising two elongated vessels, flexible connections between said vessels and mechanism located within said vessels and whereby said connections can be hauled in and simultaneously caused to move from the ends of said vessels toward the center thereof, each of said vessels being divided internally so as to form an air and water compartment and a machinery-compartment and provided with one or more longitudinal slots through which said connections enter the machinery-compartment and with laterally-extending arms or projections, an air-tube whereby air can enter the air and water compartment from above the surface of the water in which said vessel is placed, means whereby water can be admitted to and shut off from said air and water compartment, and means whereby water can be withdrawn from said air and water compartment.

16. Apparatus of the character herein described comprising vessels capable of being sunk and afterward refloated, flexible connections between the end portions of said vessels, mechanism located within said vessels and whereby said flexible connections can be simultaneously hauled in and caused to move away from the ends of said vessels at the points where they enter the same, arms or projections extending from said vessels in opposite directions when said vessels are in use and provided with rollers, flexible connections arranged to extend under said vessels and around the rollers on said arms or projections when the vessels are brought near together, and means for hauling up said connections and thereby partly rotating said vessels about their axes.

17. In apparatus of the character herein described, an elongated vessel made of cylindrical shape, divided internally by a longitudinal bulkhead into an air and water compartment and a machinery-compartment and provided with longitudinal slots in its wall communicating with the machinery-compartment, and with laterally-extending arms or projections, 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 the air and

water compartment, an air-tube leading to the said air and water compartment, hydraulic hauling-in mechanism arranged longitudinally within said vessel at each end portion thereof, flexible connections connected to said hauling-in mechanism and extending through said slots, guide-wheels for said flexible connections, and pumps and electric motors for driving the same located in said machinery-compartment, one or some of said pumps being adapted to withdraw water from the air and water compartment and another or others for supplying water under pressure to said hydraulic hauling-in mechanism, substantially as described.

18. In apparatus of the character herein described, an elongated vessel capable of being sunk and refloated and divided internally by a longitudinal bulkhead into an air and water compartment and a machinery-compartment the wall of which is formed with longitudinal slots; a set of hydraulic rams arranged longitudinally within said machinery-compartment at each end thereof, guide-wheels spaced apart upon the longitudinally-movable portion of each set of hydraulic rams and around which flexible connections attached to the movable portions of said rams are led through said slots, and means for pre-

venting withdrawal of said flexible connections, substantially as described.

19. In apparatus of the character herein described, an elongated vessel capable of being sunk and refloated, two sets of hydraulic hauling-in mechanism arranged within said vessel and each comprising a series of hydraulic rams and cylinders arranged longitudinally of the vessel, a series of pulleys carried by the fixed part of said hydraulic mechanism, a series of pulleys carried by the longitudinally-movable part of said mechanism, chain-wheels spaced apart and carried by said longitudinally-movable portions of the hydraulic mechanism, and means for preventing backward rotation of said chain-wheels, substantially as described.

20. In apparatus of the character herein described, an elongated vessel capable of being sunk and refloated at will and provided with hauling-in mechanism constructed arranged and operating substantially as described and shown.

Signed at 2 Popes Head Alley, Cornhill, London, England, this 25th day of May, 1898.

MAURICE MARY JOSEPH OWEN O'CONOR.

Witnesses:

PERCY E. MATTOCKS,
WM. O. BROWN.