(No Model.)

3 Sheets—Sheet 1.

J. F. O'ROURKE.

AIR LOCK FOR CAISSONS.

No. 591,633. Patented Oct. 12, 1897.

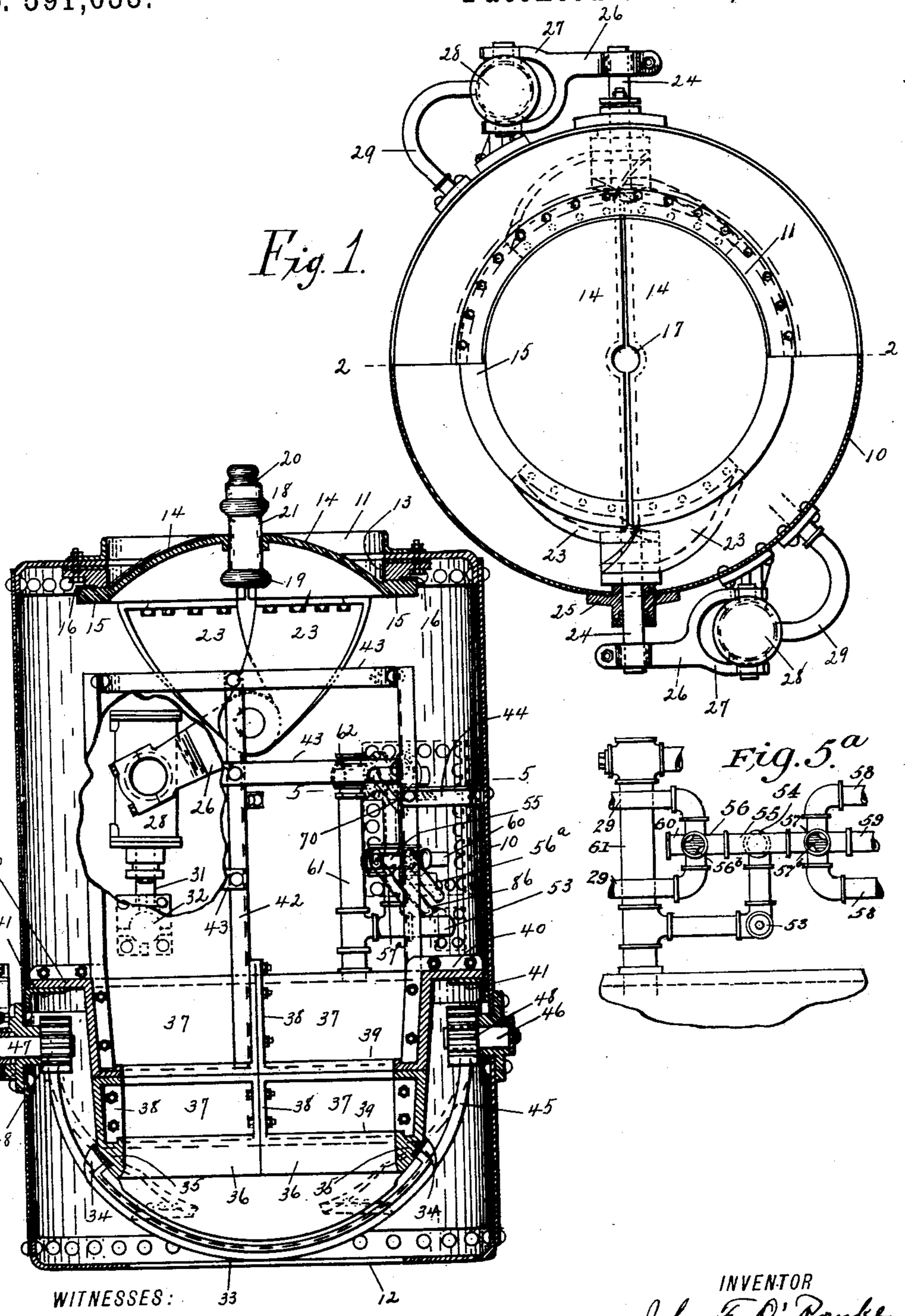

Fig. 1.

Fig. 5a

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Fig. 2.

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(No Model.)

3 Sheets—Sheet 2.

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AIR LOCK FOR CAISSONS.

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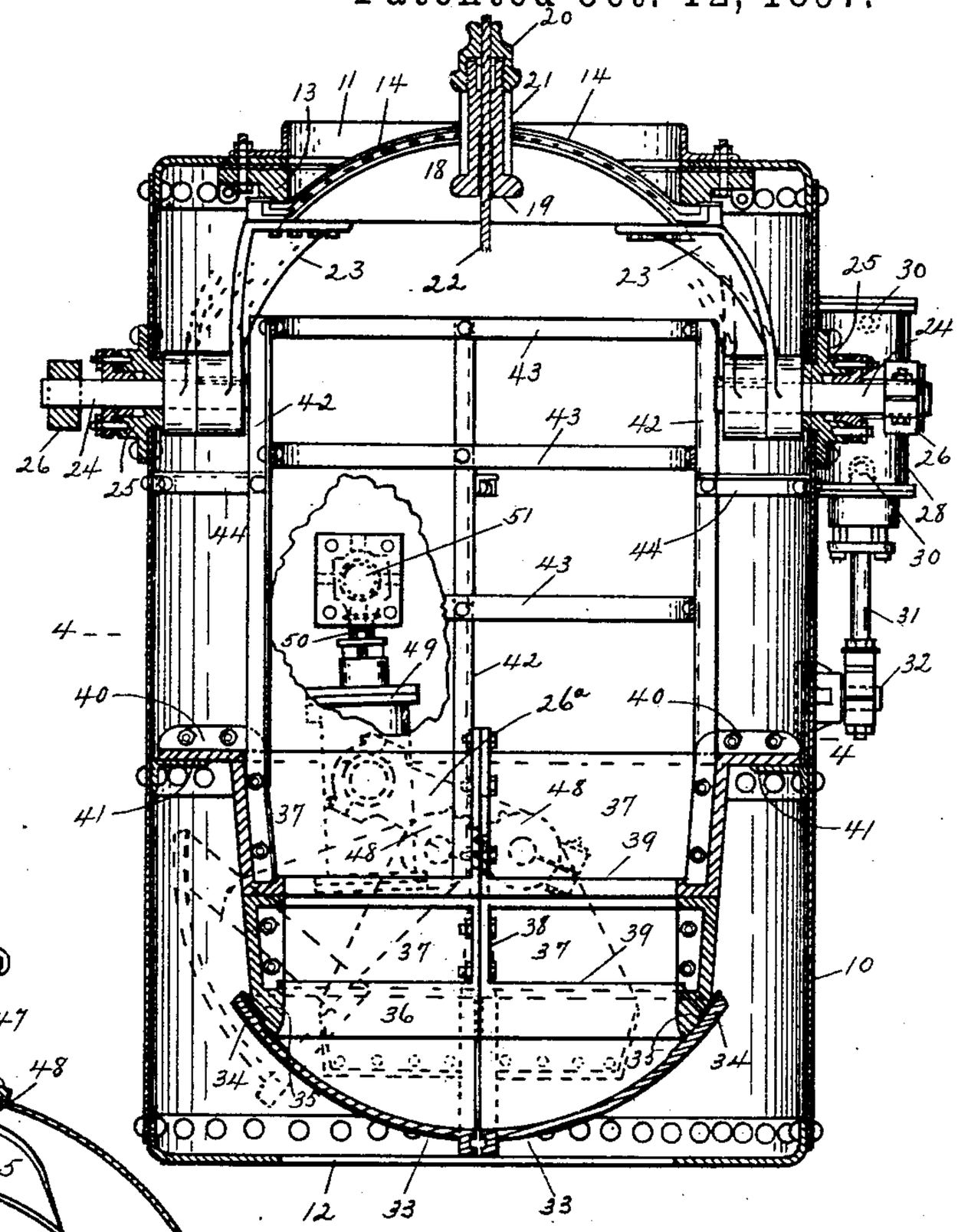

Fig. 3.

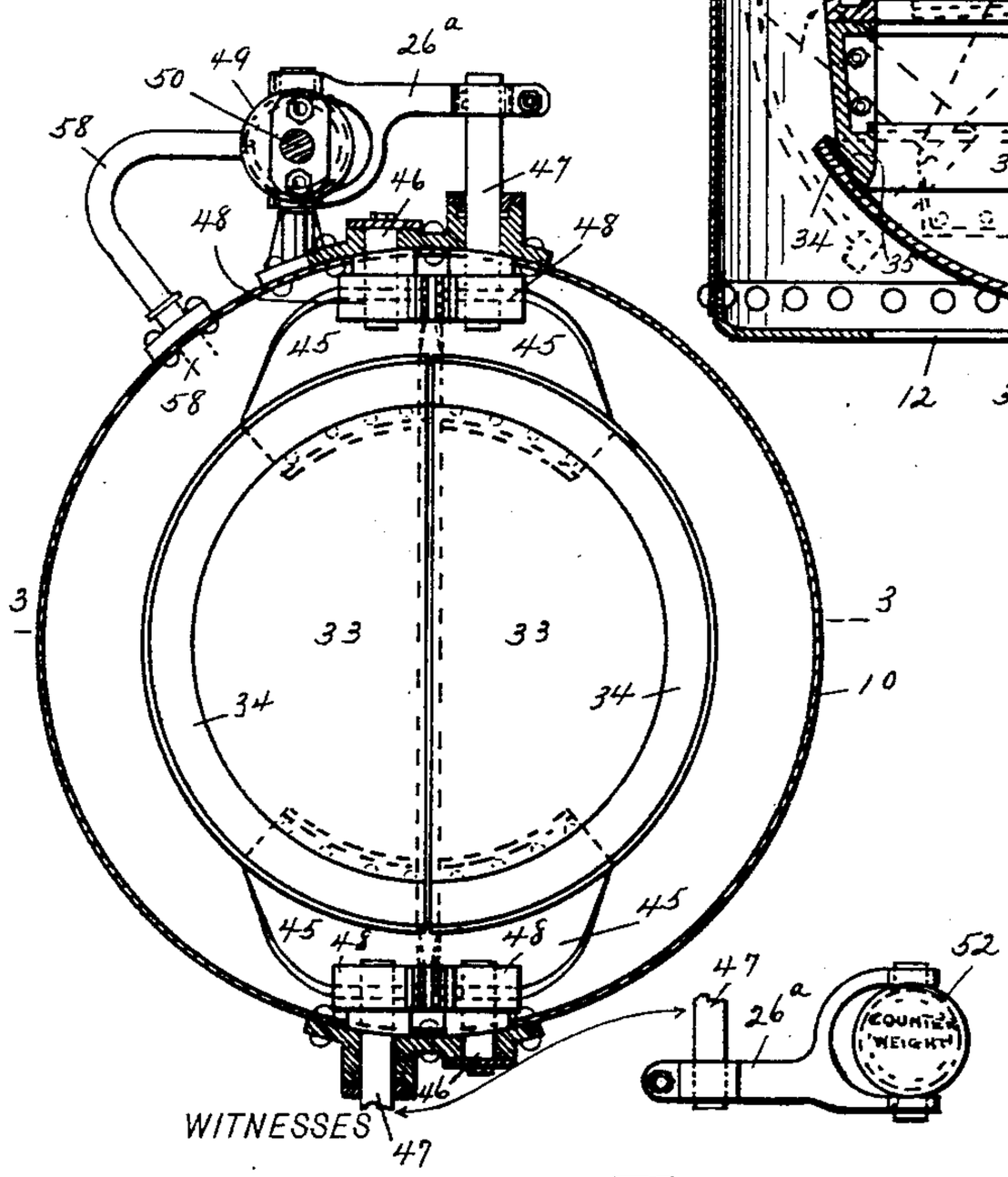

Fig. 4.

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(No Model.) 3 Sheets—Sheet 3.

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AIR LOCK FOR CAISSONS.

No. 591,633. Patented Oct. 12, 1897.

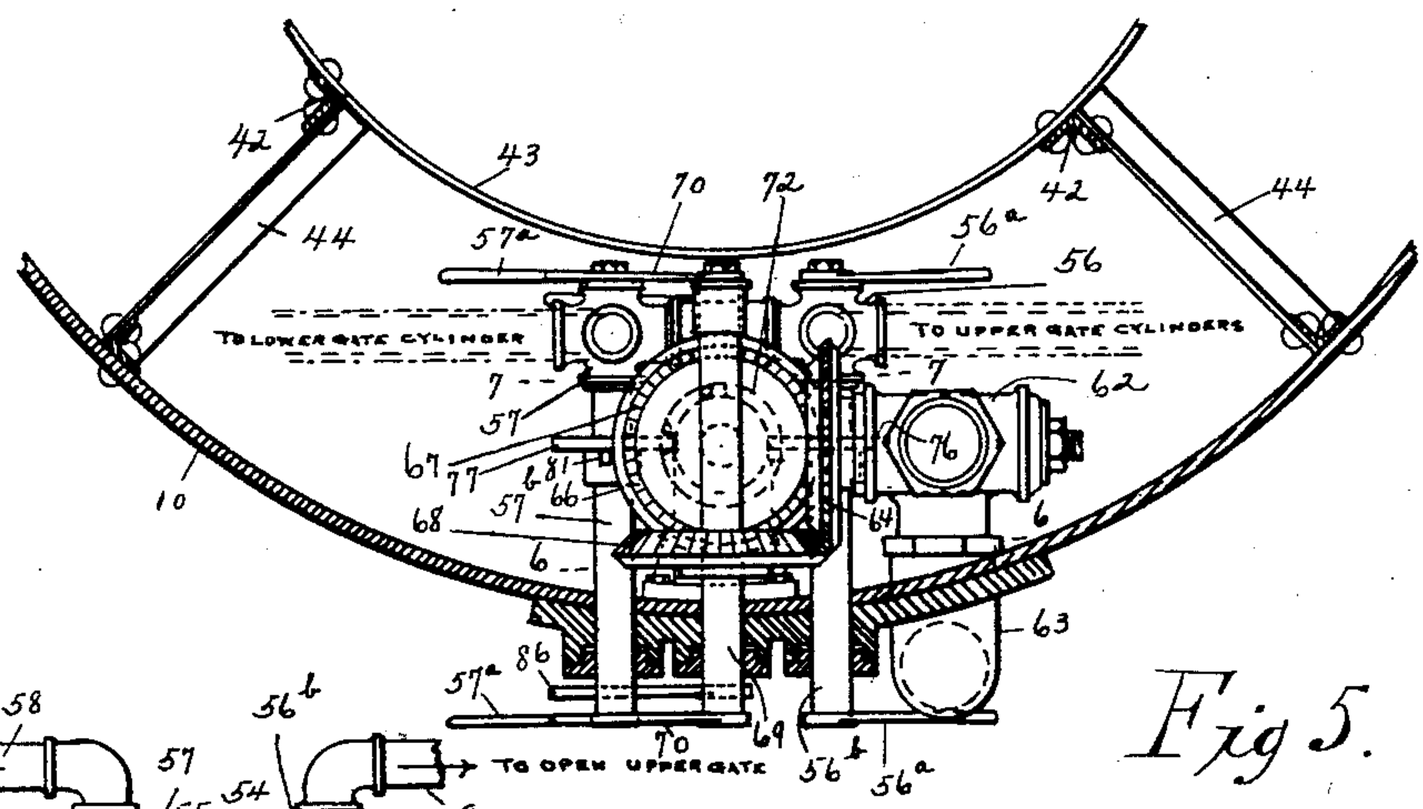

Fig 5.

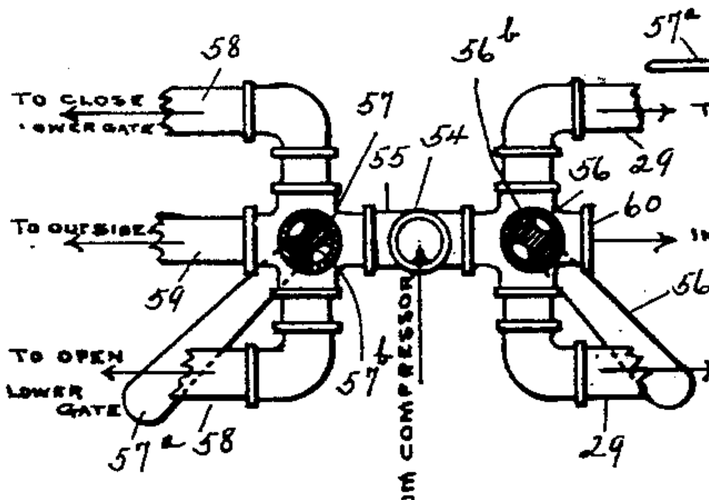

Fig. 7.

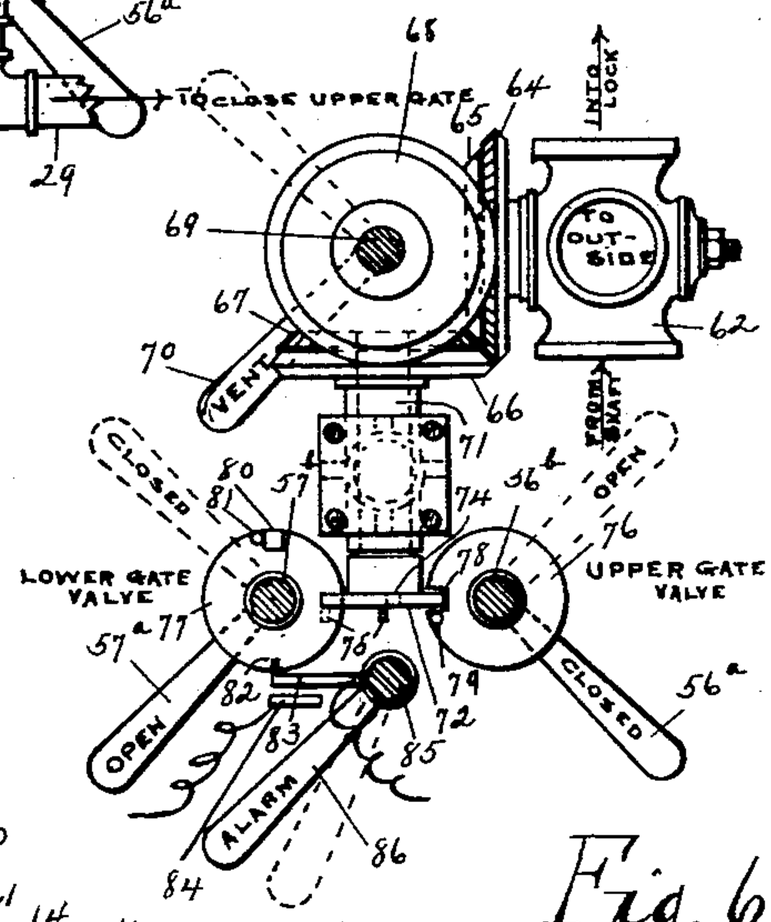

Fig. 6.

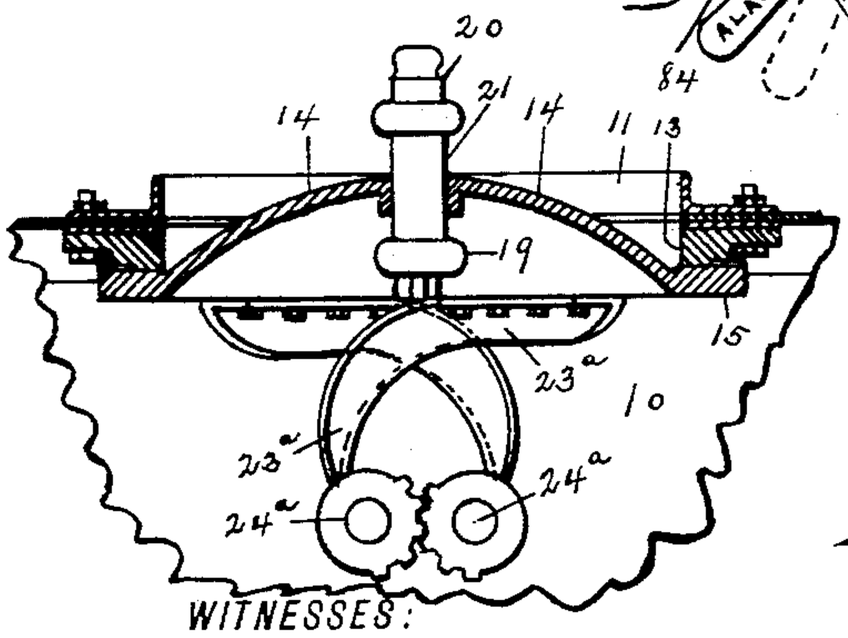

Fig. 8.

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UNITED STATES PATENT OFFICE.

JOHN F. O'ROURKE, OF NEW YORK, N. Y., ASSIGNOR TO STEPHENS & O'ROURKE, OF SAME PLACE.

AIR-LOCK FOR CAISSONS.

SPECIFICATION forming part of Letters Patent No. 591,633, dated October 12, 1897.

Application filed May 6, 1897. Serial No. 635,316. (No model.)

To all whom it may concern:

Be it known that I, JOHN F. O'ROURKE, of New York, in the county and State of New York, have invented certain new and useful Improvements in Air-Locks for Caissons, of which the following is a full, clear, and exact description.

My invention relates to improvements in air-locks for pneumatic caissons; and the object of my invention is to produce a comparatively simple and thoroughly efficient lock which has at the upper and lower ends gates arranged to make air-tight closures and to operate very easily; to provide the lock with an internal-ladder arrangement which enables workmen or others to easily ascend or descend through the lock without depending on the bucket or cage; to provide a convenient means for working the gates or valves of the lock by steam or air pressure, and to produce a system of valve-operating mechanism by which the valves can only be operated progressively or successively so as to permit the air to enter the appropriate cylinders to work the gates or to supply or relieve the air-pressure in the lock at the proper intervals, thus rendering accidents or inefficient working practically impossible.

To these ends my invention consists of certain features of construction and combinations of parts, which will be hereinafter described and claimed.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar figures of reference indicate corresponding parts in all the views.

Figure 1 is a plan view, partly in section, of the air-lock embodying my invention, a part of the external mechanism being removed. Fig. 2 is a vertical section on the line 2 2 of Fig. 1. Fig. 3 is a vertical section on the line 3 3 of Fig. 4, a portion being broken away to show the cylinder for operating the lower gates. Fig. 4 is a sectional plan on the line 4 4 of Fig. 3, but with the steps removed. Fig. 5 is an enlarged detail sectional plan of the valve mechanism controlling the air-supply to the air-lock and to the cylinders which work the gates, and Fig. 5ª is a detail of the air-pipe connections. Fig. 6 is a sectional elevation on the line 6 6 of Fig. 5. Fig. 7 is a detail section on the line 7 7 of Fig. 5, showing the air-pipe connections; and Fig. 8 is a detail sectional view showing a modified means of hanging the doors to cause the ready separation from their seats.

The lock has an essentially cylindrical body 10, which has a top opening 11 and bottom opening 12, these being of the usual size to permit the passage of a bucket or cage, and around the top opening 11 is a circular ring 13, which is arranged on the inner wall of the body or shell, and the opening 11 is closed by the oppositely-arranged convex swinging gates 14, the meeting edges of which are packed, so as to make an air-tight closure, said gates having at their outer edge flanges 15, adapted to close opposite the ring 13, above referred to, and the flanges 15 have flap-gaskets 16, which close against the ring 13 and protrude into the air-lock, so that the air-pressure will strike the gaskets and make an air-tight seal. It is obvious that the flap-gaskets 16 can be applied either to the ring 13 or flanges 15 with the same result, the only necessary thing being to bring the flaps into the air, so that the pressure will press them against the opposite part and make an air-tight closure. The ring 13 will therefore act only as an emergency seat against which the flanges 15 can close tightly in case of an accident; but ordinarily the strain on the doors will be taken by the journals, and the top of the air-lock will be more likely to buckle than the doors themselves, and the actual closure is effected by gaskets 16, which, as above stated, close down against the flanges 15.

The gates 14 are cut away at the center and at the meeting edges, as shown at 17 in Fig. 1, to receive and fit snugly upon the stuffing-box 18, which comprises two meeting parts 19 and 20, screwed together in the ordinary way, as shown in Fig. 3, and the part 19 is inclosed by a packing-band 21, against which the gates 14 close. The hoisting-rope 22 runs through the stuffing-box, and the stuffing-box is relatively long, so that it can be easily adjusted in relation to the gates. The doors will therefore close tightly against the stuffing-box even if the latter is not very nicely adjusted.

The gates 14 have depending arms 23 at the ends which overlap, as shown best in Figs. 1

and 2, and the arms are hung on shafts 24, which are journaled in suitable stuffing-boxes 25 on the shell 10. The overlapping of the arms makes it possible to hang both gates on the same center, and one arm of each gate is fixed to its shaft, while the opposite arm is loose on its shaft, and so by the simple rotation of the shafts both gates are moved in unison, and if the shafts are oppositely moved it follows that the gates are opened or closed thereby, as the case may be. This hanging of the opposite gates on a single center is important, as it obviates the necessity of piercing the shell in more than two places, and therefore reduces the liability of leakage, and it also simplifies the construction.

It will be noticed that the doors as soon as they start swing clear of their seats and are entirely unobstructed. This is an important matter and it can be accomplished in other ways—for instance, as in Fig. 8, where the arms 23ª, carrying the doors 14, cross and are journaled on parallel shafts which are geared together. This arrangement brings the centers of the doors—that is, the centers of the circles which they describe—in such position that the doors swing clear as soon as they start. This prevents any possible wear or friction on either the doors or the opposite parts of the shell.

To the outer ends of the shafts 24 are secured cranks 26, which are forked, as shown at 27, and each fork is pivoted to a cylinder 28, which is supplied with air by flexible pipes 29, the connection being at opposite ends of the cylinders, as shown at 30 in Fig. 3. The cylinder has the usual piston, and the piston-rod 31 is pivoted to a fixed support on the shell 10, as shown at 32. The cylinders 28 counterbalance the gates 14, and when air is admitted to the cylinders the cylinders move up or down, as the case may be, and so actuate the gates. This arrangement of cylinders I do not claim, as I have claimed it in my application for Letters Patent of the United States for an improvement in air-locks for caissons, Serial No. 617,437, filed December 30, 1896.

The air-lock has at its lower end oppositely-arranged convex swinging gates 33, which near their outer edges have seats 34, which when the gates are closed fit closely against the seats 35 on the sectional ring 36, forming the lower terminus of the lower step-sections 37, and the meeting points of the fixed and movable seats are suitably packed, as shown in Fig. 3, the packing being substantially like that of the upper gates already described. These step-sections 37 have meeting flanges 38, which can be readily bolted together, and when the sections are fastened they form a tubular structure, as the drawings clearly show, and at intervals are flange-like steps 39, which are formed on the lower and inner sides of the sections 37, and these flanges or steps can be grasped like the rungs of an ordinary ladder, and the workman may therefore clamber easily up through the air-lock. This step-like arrangement, which in connection with the parts to be described below forms an internal tubular ladder, is particularly adapted for use in connection with the caisson-shaft shown in my application for Letters Patent of the United States, Serial No. 620,996, filed January 28, 1897; but I do not limit my invention to use in connection with the caisson-shaft referred to. When, however, it is so used, one can climb up the ladder of the shaft and then continue on through the ladder-like structure within the air-lock. The step-like arrangement referred to can be carried up to any necessary height, but it is better to carry it to the height shown, and the upper sections 37 have outwardly-extending flanges 40, which are supported on angle-irons 41, bolted to the shell 10 of the air-lock. To form a continuation of this ladder-like structure-uprights 42 are bolted to the flanges 38, and the uprights are connected by circular cross-pieces 43, which form ladder-rungs, and the whole affair is braced by the laterally-extending braces 44, which are bolted to the uprights 42 and to the shell 10 of the air-lock. The top of the internal ladder comes nearly to the top of the air-lock, so that one can clamber from the ladder through the top of the air-lock, and while I have shown a particular form of structure adapted for easy application to the interior of the air-lock I do not by any means limit my invention to this precise form.

The lower gates 33, already referred to, are suspended by arms 45, which are rigidly secured to the gates, and the arms are journaled on shafts 46 and 47, which are mounted in stuffing-boxes on the shell 10, the shafts being connected by gears 48, so that they will turn in unison and oppositely. One of the shafts 47 has a crank 26ª similar to the crank 26 already described, secured to it, and the crank is pivoted to an oscillating cylinder 49, which has its piston-rod 50 pivoted to a fixed support 51, as shown clearly in Fig. 3, and so the admission of air to the cylinder ends causes the cylinder to move on its piston and so work the gates. The opposite shaft 47 is also provided with a crank 26ª, to which is attached a counterweight 52, which assists in counterbalancing the gates.

It will be observed that the arrangement of the cylinders for operating the gates is similar to that described for working the upper gates and described in my former application, as referred to above; but in this connection I wish it distinctly understood that I do not limit my invention to the use of any arrangement of cylinders, as it is perfectly obvious that any equivalents in the way of levers, hand-wheels, or other well-known devices can be applied to either the upper or lower gate-shafts to work the gates.

The air to supply the air-lock, work the cylinders, and also supply the caisson is admitted in the usual way through a pipe 53,

move forward, tipping the cranks 26 and turning the shaft 24, so as to swing open the gates 14. The bucket is then free to pass out through the upper opening of the air-lock.

When the bucket is to be returned to the caisson, the above operation is simply reversed, the disks 72, 76, and 77 serving to successively lock and release the several valves, and the valves are operated so as to first lock the upper gates, then turn the air into the air-lock, and then open the lower gates.

It will be observed that when either the upper or lower gates are moved they swing clear from their seats as soon as they start, and are therefore entirely unobstructed, and it will be observed that when they are closed an hermetical seal is effected.

From the foregoing description it will be observed that the gates at both ends of the air-lock can be very easily operated either by the ordinary levers or handles or by the cylinder mechanism described; that when the latter mechanism is used the valves can only be worked, and consequently the several parts can only be worked in proper sequence, and that the air-lock is easy of access and can be conveniently traversed in either direction without recourse to the usual way—to wit, the bucket or cage.

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

1. The combination of the shell, the opposite swinging gates, the crossing arms secured to the gates and independently journaled, and gears connecting the adjacent arms, substantially as described.

2. The combination with the shell, and the opposite and alining gate-shafts therein, of means for turning the shafts or gates to close the shell-opening, and the overlapping arms secured to opposite sides of the gates, one arm of each gate being secured to one shaft and the opposite arm loose on the opposite shaft, substantially as described.

3. The combination with the shell having a bucket-opening and the ring encircling said opening, of the swinging gates having flanges adapted to come to rest opposite the ring, and a flap-gasket held to effect a closure between the ring and flanges, said gasket being pressed to its seat by the air-pressure in the shell, substantially as described.

4. The combination with the shell, of the essentially-tubular ladder therein.

5. The combination with the shell, of an internal tubular structure held rigidly to the walls of the shell, said structure having inwardly-projecting flanges forming steps, substantially as described.

6. The combination with the shell, of the internal tubular structure having steps thereon, the said structure having its lower end formed into a seat against which the lower closure of the shell can abut, substantially as described.

7. The combination with the shell, of the internal tubular structure formed of ring-sections secured together, said sections having inwardly-projecting step-forming flanges thereon, substantially as described.

8. The combination with the air-lock having suitable end closures, of the internal ladder secured to the lock, the lower end of the ladder carrying a valve-seat, substantially as described.

9. The combination with the shell and the internal essentially-tubular structure having steps thereon, of the skeleton ladder projecting upward from the said tubular structure, substantially as described.

10. The combination with the shell and the ring-sections with steps thereon held within the shell, of the uprights secured to the ring-sections, and the cross-pieces forming rungs secured to the uprights, substantially as described.

11. The combination with the air-lock and the cylinders or motors constructed to work the moving parts of the lock, of a valve mechanism controlling the cylinder or motor air-supply, and an automatic locking device whereby the valves operate in regular sequence, substantially as described.

12. The combination with the air-lock having its movable parts worked by cylinders or motors, of a valve mechanism controlling the air-supply of the cylinders or motors and air-lock, and an automatic locking device for the valve mechanism constructed to cause the movement of the first valve to unlock the next, and so on in sequence through the whole series of valves.

13. The combination with the air-lock and the cylinders or motors constructed to work the moving parts of the air-lock, of an automatic locking device constructed to permit the operation of the valve mechanism only in regular sequence, and a movable latch locking the valve mechanism, and serving as a circuit-closer for an alarm-circuit, substantially as described.

14. The combination with the air-lock and the cylinders or motors working the removable parts of the air-lock, of a series of valves controlling the air-supply to the cylinders or motors and lock, a gear mechanism connecting the several valves, and interlocking disks connected to the valve-stems and constructed to move successively, the movement of one disk unlocking the next, substantially as described.

15. The combination with the air-lock and the cylinders or motors constructed to work the moving parts of the air-lock, of the air-supply pipe, valve-controlled connections between the air-supply pipe, the cylinders or motors, and the inner and outer sides of the air-lock, a gear mechanism connecting the several valve-stems, and interlocking disks

which connects, as shown at 54 in Fig. 7, with a cross-pipe 55, and at one end of the pipe is an ordinary two-way cock 56, operated by handles 56[a] on opposite ends of its valve-stem 56[b], and the cock can be turned so as to let air into either of the pipes 29 and so to either end of the cylinders 28, and when the air is admitted to one end of the cylinder it exhausts from the other end through the valve 56 and through the vent 60 into the lock. The details of this and the other valves or cocks to be immediately described are not illustrated, as the valves are not new in themselves and any usual valves capable of fulfilling the necessary functions can be used. This of course will be understood. The opposite end of the pipe 55 connects by a cock or valve 57 with the branch pipes 58, leading to the lower cylinder 49, and the valve-stem 57[b] has handles 57[a] at the ends, these handles, as seen in Fig. 5, being placed at the ends of the several valve-stems, which are journaled in the wall of the shell 10, so that the valve mechanism can be operated either from within or without the shell. The valve 57 also connects with a pipe 59, leading outside the shell 10, so that when air is admitted to one end of the cylinder 49 it exhausts from the other end and out through the pipe 59. This is necessary, because it cannot exhaust into into the shell 10 when working the gates one way, because the air-pressure in the shell would prevent it.

The inlet-pipe 53 connects directly with a pipe 61, leading to the caisson-shaft in the ordinary way, and the pipe 61 connects at the top with a valve 62, (shown best in Fig. 6,) which is adapted to permit the air to enter the lock or to permit the air to exhaust from the lock outward through a connection 63, leading outside the shell. The stem of the valve 62 is provided with a double beveled gear 64, one half of the face being plain, as shown at 65, and the toothed half of the gear registering with the plain face 66, while the plain face 65 registers with the toothed face 67 of the second gear. The gears 64 65 and 66 67 do not therefore work each other, but they engage and are worked by the beveled gear-wheel 68 on the shaft 69, which is operated by a handle 70, and thus by moving the handle 70 the shaft of the valve 62 can be moved. The connection between the gear 68 and the gear 66 67 is simply to permit the locking of the gear 68 and the valve connected with it, and to this end the gear 66 67 is secured to a properly-journaled vertical shaft 71, which has thereon a disk 72, with notches 74 in the edge thereof, and stop-pins 75 adjacent to the notches, these pins and notches registering, as described more particularly below, with the disks 76 and 77, which are secured to the valve-stems 56[b] and 57[b], the former having a notch 78 and an adjacent stop-pin 79 thereon, and the latter a notch 80 and stop-pin 81.

By reference to Figs. 5 and 6, more particularly the latter, it will be seen that when one of the notches 74 registers with one of the disks 76 or 77 the latter can be moved a limited distance, the distance being limited by the stop-pins 75, 79, or 81, but that when the said parts are not in registry the disks and consequently the valve-stems cannot be moved, and it will be further observed that when the disk 72 is engaged by either of the notches 78 or 80 the shaft 71, gear 66 67, gear 68, and the valve-stem of the valve 72 are locked. The object of this arrangement is to provide against accidents and make it possible to only operate the appropriate valves in regular sequence. To carry out this idea still further, the disk 77 is normally locked by a latch 83, which engages a notch in the disk, as shown at 82 in Fig. 6, and the latch 83 forms one terminal of an electric circuit and is adapted to close the circuit by engaging an opposite contact 84, which forms the other terminal of the circuit. This circuit can include any necessary number of alarms or signals which can be located in the caisson or at desired points, and in order that the circuit may be conveniently opened or closed the latch 83 is fastened to a shaft 85, which is suitably journaled and turned by a handle 86.

We will suppose now that the bucket is in the air-lock and the lower gates 33 are opened and the upper gates 14 closed. The alarm-handle 86 is turned so as to bring the latch 83 into engagement with the contact 84, which closes the circuit and sounds the alarms. This action also releases the disk 77, which is held in one of the notches 74 of the disk 72. The handle 57[a] is then turned to the position shown by dotted lines in Fig. 6, and this admits air through the valve 57 and one of the pipes 58 to the upper end of the cylinder 49. The cylinder then moves upward and acting on the crank 26[a] and gears 48[a] swings the gates 33 to closed position, the seats 34 and 35 coming into close contact, so as to make an air-tight seal. The movement of the handle 57[a] will have brought the notch 80 into registry with the disk 72, the pin 81 making this registry certain, and the operator can then swing the vent-handle 70 to the position shown by dotted lines in Fig. 6, because the disk 72 and the handle 70, which is indirectly connected, as already described, will by the first movement be unlocked, the handle 70 being moved, as described. The gear 68 turns the gear-wheel 64 65 and moves the stem of the valve 62, so as to permit the air to exhaust from the air-lock. The above movement will turn the disk 72 so as to lock the disk 77 and will bring one of the notches 74 into registry with the disk 76, so as to permit the latter to be turned. The operator then turns the handle 56[a] to the position shown by dotted lines in Fig. 6, and this turns the cock or valve 56, so as to permit the air to pass through one set of pipes 29 to the lower ends of the cylinders 28, whereupon the cylinders

connected to the stems and constructed so that the movement of one disk releases the next, and so on in sequence, substantially as described.

16. The combination with the shell and the internal tubular structure terminating at its lower end in a fixed seat or ring, of a lower closure adapted to close opposite the said ring, and the flap-gasket arranged to be pressed by air so as to effect a closure between the said ring and the said lower closure, substantially as described.

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