(No Model.) 2 Sheets—Sheet 1.

D. E. MORAN.

AIR LOCK.

No. 500,149. Patented June 27, 1893.

Fig. 1

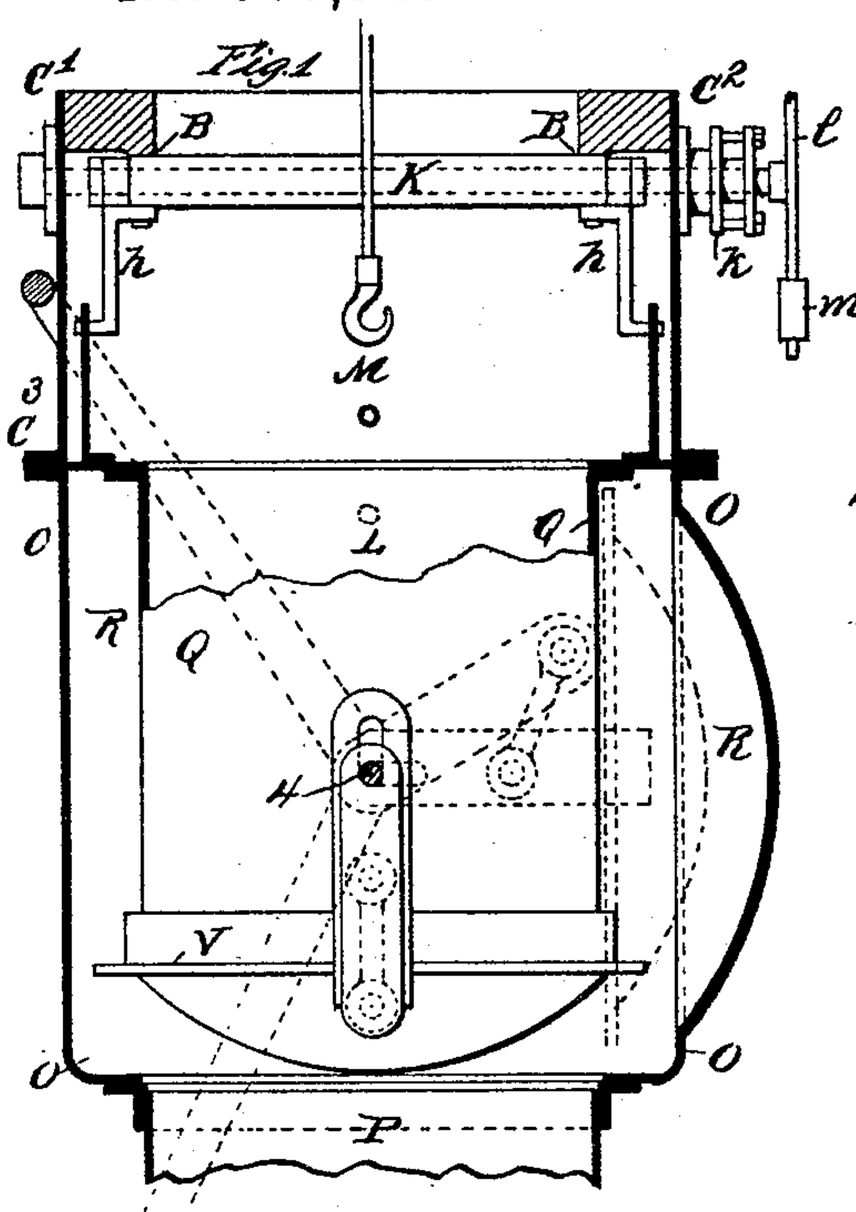


Fig. 2

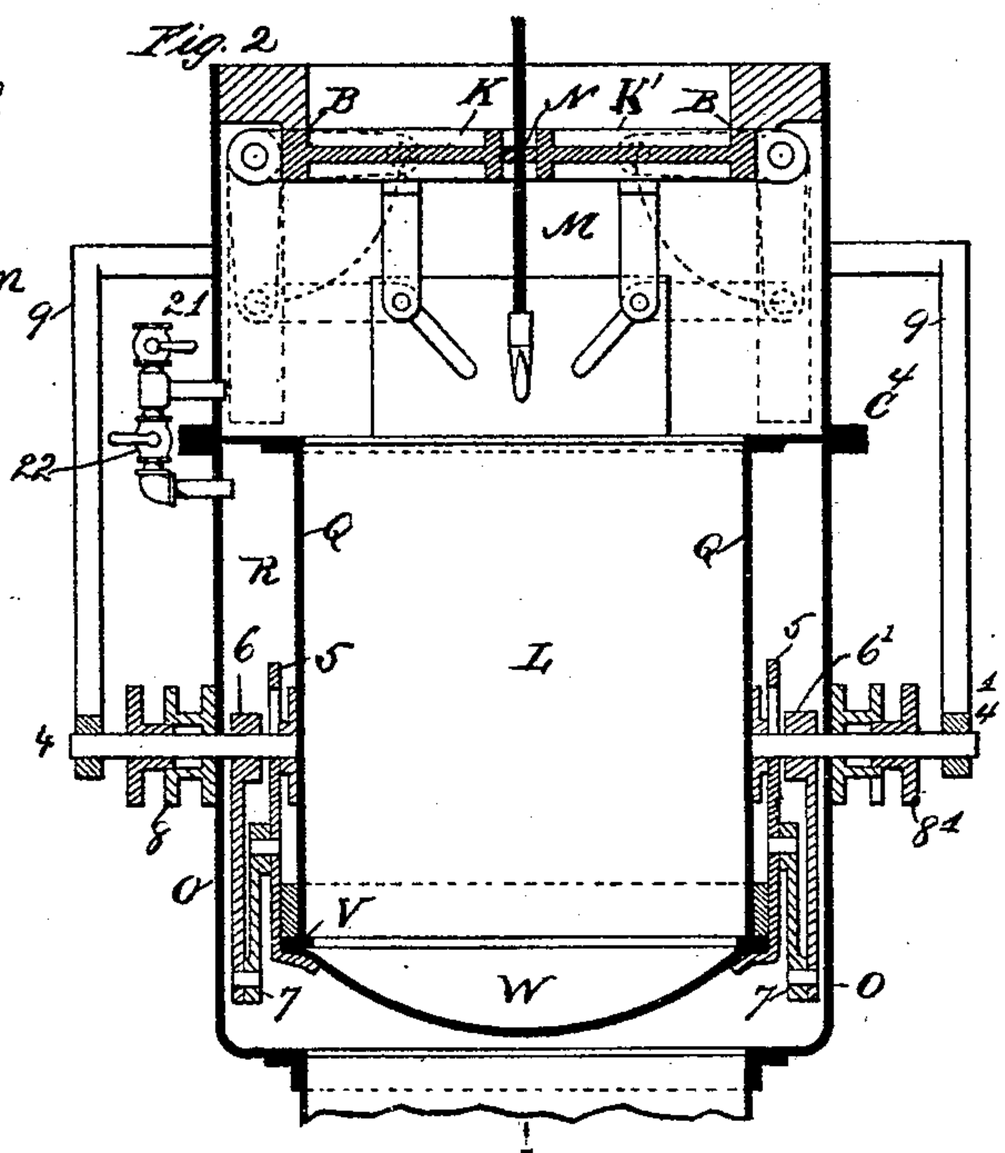


Fig. 3.

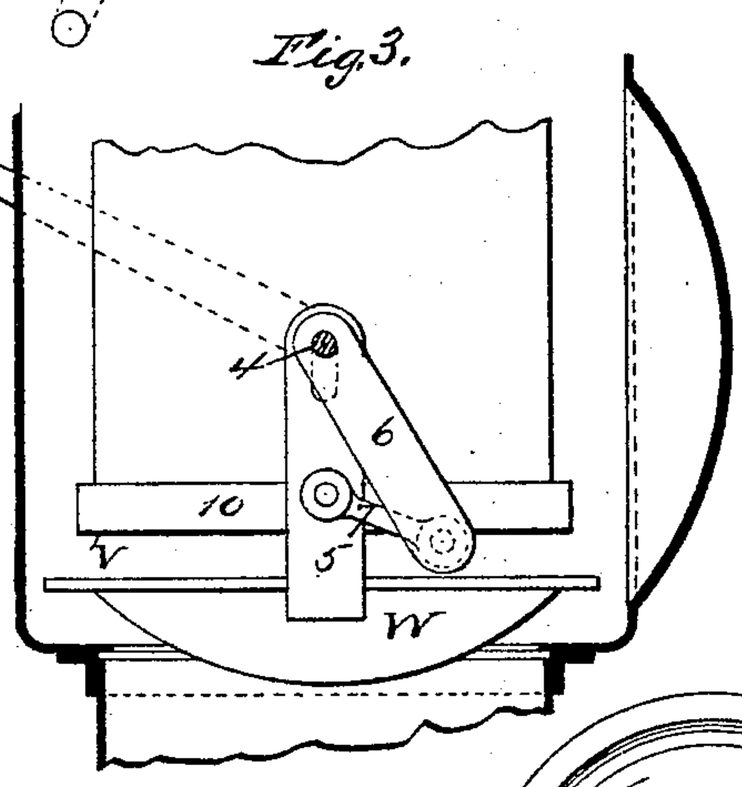


Fig. 4

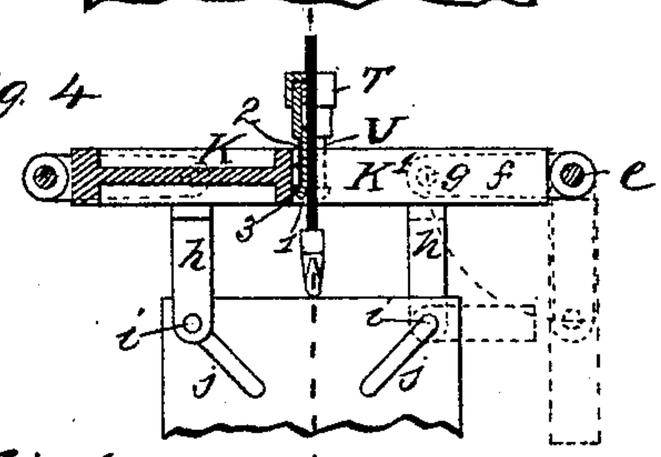


Fig. 6.

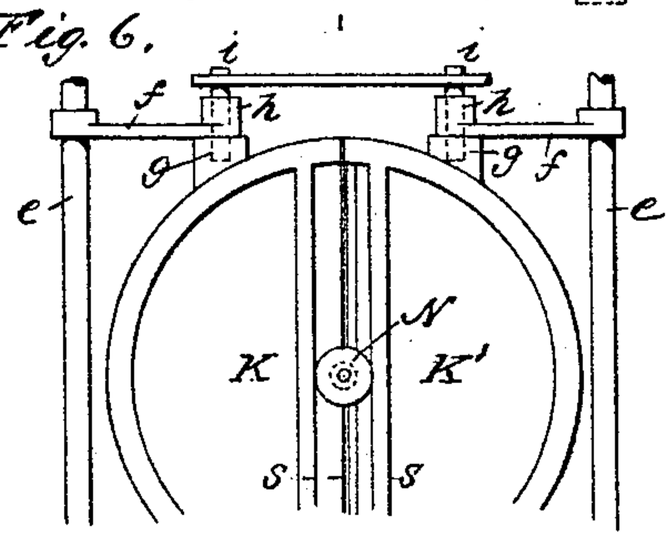


Fig. 12.

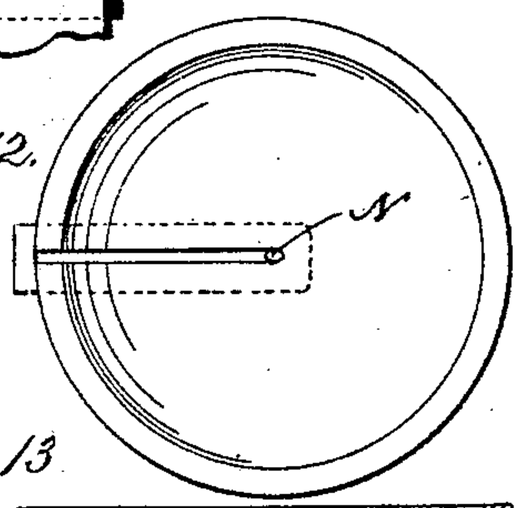
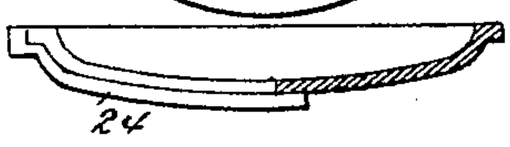


Fig. 7.

Fig. 8.

Fig. 13



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(No Model.) 2 Sheets—Sheet 2.

D. E. MORAN.

AIR LOCK.

No. 500,149. Patented June 27, 1893.

Fig. 10.

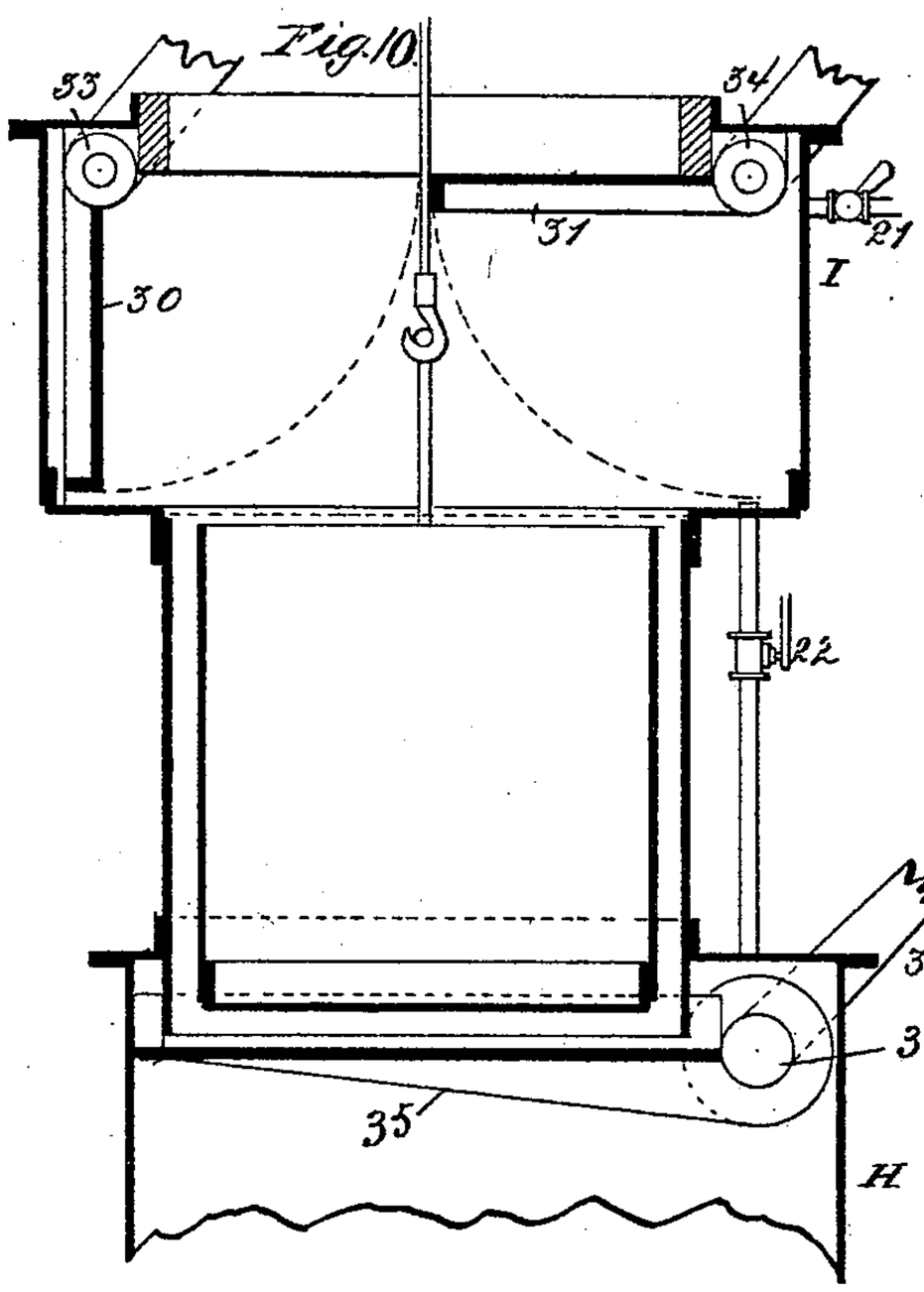


Fig. 11.

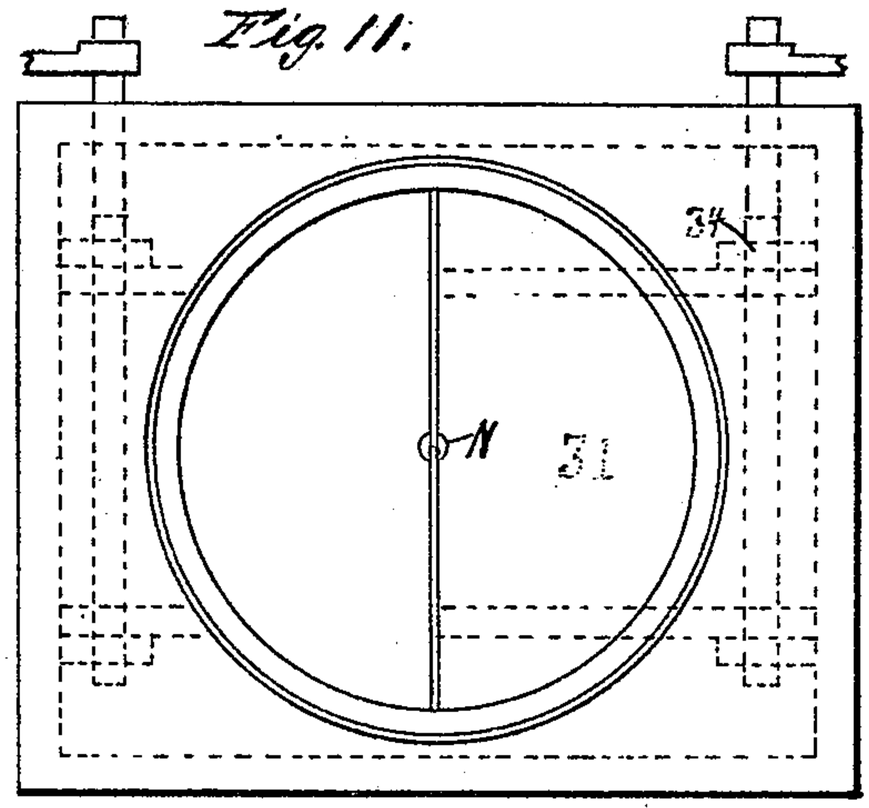


Fig. 9.

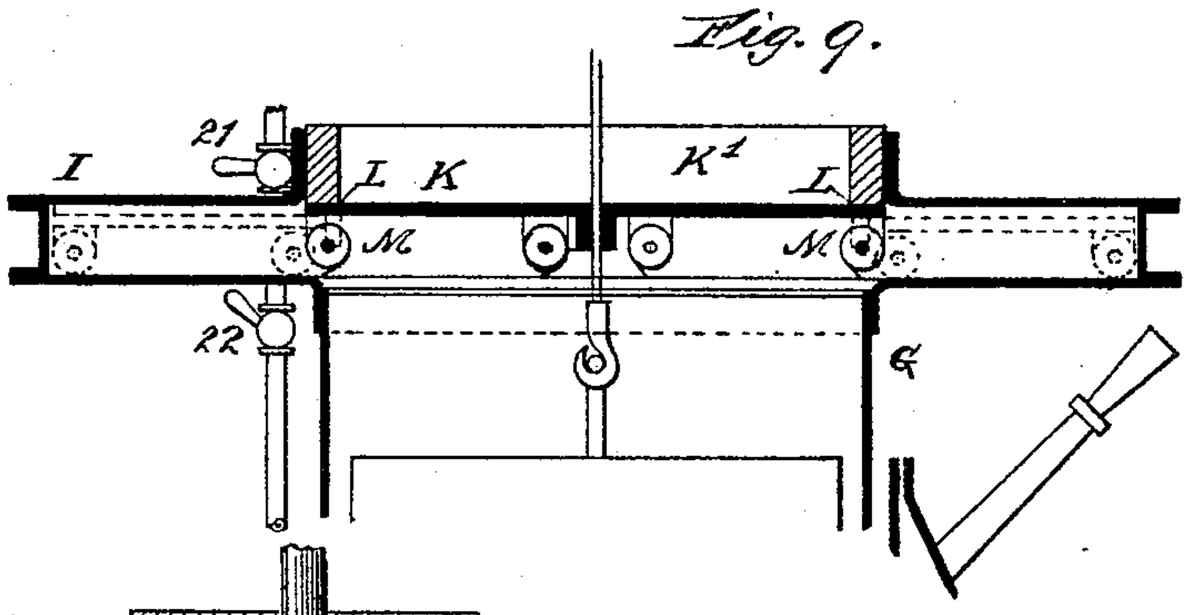
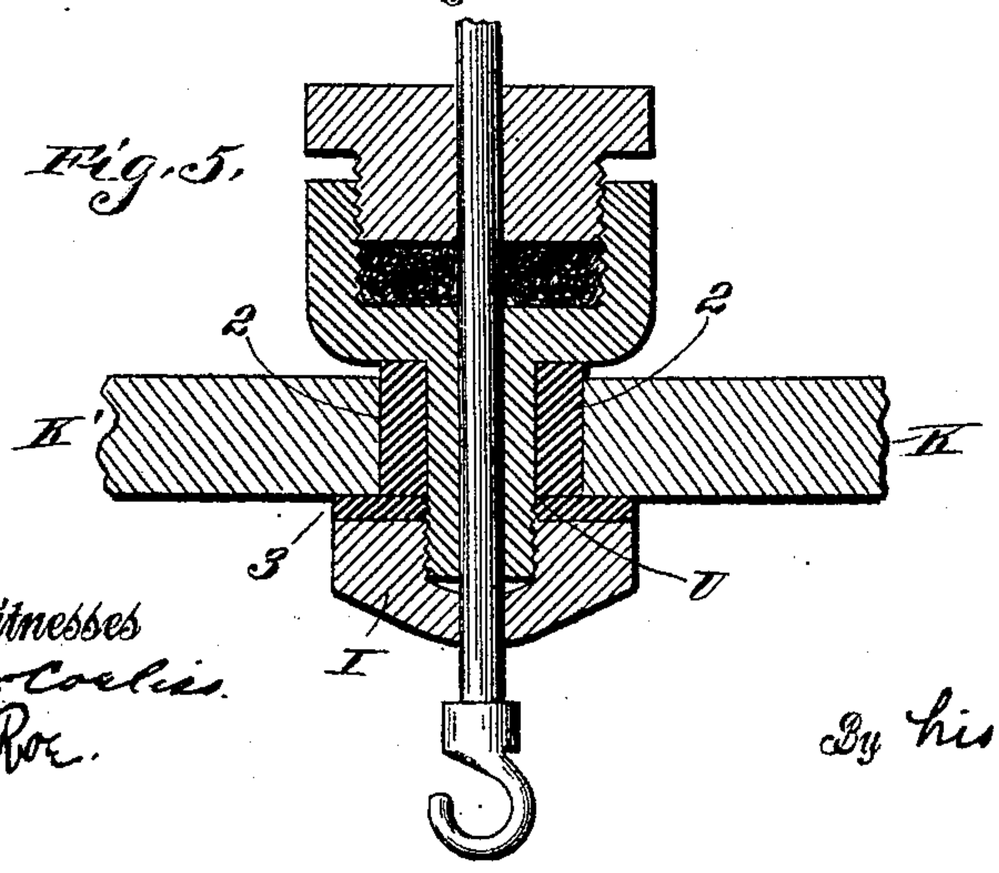


Fig. 5.



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UNITED STATES PATENT OFFICE.

DANIEL E. MORAN, OF NEW YORK, N. Y.

AIR-LOCK.

SPECIFICATION forming part of Letters Patent No. 500,149, dated June 27, 1893.

Application filed November 19, 1892. Serial No. 452,475. (No model.)

To all whom it may concern:

Be it known that I, DANIEL E. MORAN, of New York city, New York, have invented a new and useful Improvement in Air-Locks, whereof the following is such a full, clear, and exact description as will enable others skilled in the art to make and use the same when taken in connection with the accompanying drawings, in which—

Figure 1, is a vertical section through the center of the lock showing both valves closed, the open position of lower valve being shown in dotted lines. Fig. 2, is a vertical section through the center of the lock at right angles to section shown in Fig. 1 showing both valves closed, the open position of the upper valve being shown in dotted lines. Fig. 3 is a vertical section of the outer shell showing the inner shell lower valve-seat, valve and link motion in detail. Fig. 4 is a view of the upper valve in connection with a stuffing box, the half valve K and half the stuffing box being shown in section, and the other half valve K′ in side view with like view of the other half the stuffing box. Fig. 5 is a vertical section through the stuffing box. Fig. 6 is a top view of the valve when closed, the valve seat being removed to show the valve. Fig. 7 is a vertical section of valve on line S S showing manner of attaching gasket at joint. Fig. 8 is a vertical section through center of upper valve showing method of using packing around the hoisting rope. Fig. 9 is a vertical section of a modification of the upper valve, where the sections of valve roll to and from the seat. Fig. 10 is a vertical section of a modification of air lock in which all the valves are hinged so as to be turned to or away from the valve seats. Fig. 11 is a top view of the upper valve shown in Fig. 10 closed. Fig. 12 is a top view of another form of upper valve. Fig. 13 is a vertical section thereof.

This my invention relates to air-locks for use in work carried on under air pressure greater than that of the atmosphere, or what is known as the pneumatic method, and consists in the combination in an air-lock of a valve adapted to close around and open from a rope at or near the center of the valve while the rope is bearing a load, and the various combinations and modifications hereinafter specified and claimed.

In the construction of tunnels, piers and other underground or under water works, it is usual to connect the working chamber with the outer air by a tube or shaft having one end opening in the working chamber and the other end reaching to the outer air, through which access is had to and from the working chamber, tunnel heading or caisson.

In order to give access to and from the working chamber an air-lock is provided consisting usually of two doors one on the inner and the other on the outer side of an air chamber, connecting pipes and valves being arranged to equalize the pressure in the air chamber with the working chamber or outer air in accordance with which one the lock is to be opened into. In the use of such devices it is necessary in passing material from the working chamber to the outer air to close the outer door, open the inner door and move the material into the air chamber or lock, and rest it there, close the inner door, equalize the pressure with the outer air and again move the material to the outer air.

Where tackle is used in moving the material as is usually the case one tackle is used to bring the material in the air chamber or lock and a different tackle in moving it from the air chamber, making two handlings necessary in passing from the working chamber to the outer air.

The purpose of this my invention is to move the material from or to the working chamber in one continuous journey without the necessity of handling it or changing tackle in the air chamber or lock or of having special appliances on the bucket or carriage.

I usually place my air lock at the top of the shaft or end of the tunnel away from the working chamber, but it may be placed at any part of the shaft or tunnel without departing from my invention.

I will now proceed to describe my invention as applied at the outer or upper end of a shaft in connection with an ordinary dump bucket but it is manifest that it may be applied to tunnels, or other places where air locks are used or for locking through other objects than a bucket.

The upper part of the lock is in the form of a rectangular box C′, C², C³, C⁴, Figs. 1 and 2 having circular openings in the top and bot-

tom affording a passage way through the box. The opening in the top can be closed by the upper valve, K K′, Figs. 1, 2, 4, 5 and 6. This valve K K′ is in two halves and when not in use hangs in the space M Figs. 1 and 2 inclosed by the rectangular box but it is then so disposed as not to interfere with the passageway. The cylindrical shell Q Figs. 1 and 2 is attached to the bottom of the box C^3, C^4 so as to correspond with the opening through the bottom of the box. This shell Q is open at both ends but the lower end is reinforced so as to form a seat V Figs. 1 and 2 for the lower valve W Figs. 1 and 2. The space L within the shell Q is always open to the space M, and forms an extension of the passageway through the box C. The space so formed will hereinafter be referred to as the bucket space.

The box C′, C^2, C^3, C^4, is carried by an outer jacket O which connects at its lower end with the shaft proper "P" and makes a continuous air tight connection between the two. The annular space R between the cylindrical shell Q and the jacket O, accommodates the lower valve W and its moving parts when it is open. This space always has direct air communication with the shaft proper. The openings in the rectangular box and the cylindrical shell Q are all preferably approximately of the same diameter as the diameter of the shaft so that if both valves be opened a continuous passageway will be formed through the lock and in line with and equal in diameter to the shaft.

The upper valve K K′ fits against a continuous circular valve seat B arranged on the under side of the top-plate, of the rectangular box C′, C^2. The valve is in two equal or nearly equal halves so that each half is approximately a semi-circle. Each half or leaf of the valve is actuated as follows: The shafts *e* and *e* Figs. 1, 2, 5 and 6, each are held in bearings in the shell C′ C^2 one end of each shaft projects through the shell which is provided with a packing box at the place the shafts *e*, *e*, pass through. On the outer or projecting end of each shaft is a lever or other handle by which the shaft is to be turned, and a counterweight *m* to keep the valve in its place against the valve seat. Rigidly keyed to each shaft *e e*, within the shell are two arms *f f* which carry in bearings made for that purpose trunnions *g g* on the side of the half-valve. The trunnions should be about midway of the side of the half-valve, and turn freely in the arms *f f*. Rigidly attached to the under side of the half-valve, in line with the trunnions are two arms *h h*, projecting at right angles to the plane of the half-valves. At a point in each of the arms *h h* distant from the trunnions *g g* equal to the distance of the bearing for the trunnion in the arm *f* from the shaft *e* is a pin or projection *i* which rides in a groove *j* made in a plate provided for that purpose within the shell. The slot *j* is made at an angle of forty-five degrees from the valve seat and is sufficiently long to permit the pin *i* to move without being stopped by the length of the slot. I have shown two arms *h h* for each half-valve, but one for each is sufficient.

I will now describe the operation of one of the half-valves: The valve being closed against the seat as shown in Figs. 1 and 2, the shaft *e* is turned so as to throw the arms *f f* through the dotted quarter-circle shown in Fig. 4 to the position shown in dotted lines in that same figure; as the arms *f f* pass around, the pin *i* in the slot *j* is forced through the slot to its extreme lower end, the shaft *e*, trunnion *g* and pin *i* are in one straight line when the half-valve is midway between the closed position shown in solid lines, and the open position shown in dotted lines in Fig. 4. As the shaft *e* turns the half-valve moves toward the position shown in dotted lines, the pin *i* travels up through the slot *j* to its upper end as shown in dotted lines. Thus the half-valve is made to revolve a quarter-circle so that what is the upper face when closed against the valve seat is turned against the shell when the valve is open. The other half-valve is operated in the like manner. By this arrangement the valve is pressed against the valve seat more uniformly than if hinged. When it is removed it is stowed away out of the clear passage of the bucket space, and does not interfere with any bucket or other thing that may be in the bucket chamber. Where the edges of the two parts K K′ come together lips or flanges are made to give a more perfect joint and one part may be provided with dowel pins and the other with holes through the flange to receive the dowel pins and these flanges are made so that a gasket of rubber or other material may be carried by one of them as is shown in Fig. 7.

The valve K, K′ Fig. 2 has at its center an opening or hole N shown in Fig. 4 one-half the opening or hole being in one part K and the other half in K′. The lip or flange P Fig. 7 on the edges of the parts K K′ may follow around the opening N. The opening N is made to conform to the rope or cable which is to pass through it. About the hole N I may arrange a stuffing box in two halves as shown in Figs. 4, 5 and 6 or flexible packing arranged in some other way, so as to make a close joint with the cable, such device is shown in Fig. 8 where a circular groove is cut in the face of the edge of the hole N, and in each portion of the groove packing is secured, so that when the parts K K′ are brought together there will be a continuous packing about the cable between it and the half valves K K′. To make the joint about the cable more secure a stuffing box T Figs. 4 and 5 is placed on the cable and properly adjusted to make a close joint with it as shown in Figs. 4, 5 and 6. To the stuffing box is attached a thimble U preferably screwed into the stuffing box, but it may be formed as part of the stuffing box. The thimble has on the other end a projecting flange *l*. To the thimble is fitted a piece of hose or other packing 2 and about

the thimble and lying on the projecting flange *l* is a gasket or packing 3. The hose or packing 2 may be omitted and the gasket used alone, or the gasket may be omitted and the hose used, but I have found it advantageous to use both.

The valve K K′ closes against the thimble and hose 2 and makes a close joint with it, and the gasket forms a seal about the hole N when the air pressure is turned in the chamber of the air lock.

I will now describe the lower valve of my air-lock.

On the lower end of the body Q at V, I form a seat for the lower valve W to close against, Figs. 1 and 2. This seat is preferably circular and flat. The valve W is preferably circular and spherical, but has a flat circular edge which bears on the seat V when the valve is closed. Making the valve W spherical not only increases the strength, but makes it much easier to swing it in and out of position on its seat. The valve W is hung from the two axles or shafts 4 4′, one on either side of the shell Q by means of the slotted links 5, 5. The shafts 4, 4′ each passes through a stuffing box in the outer shell O each has one end supported in a step on the inner shell Q. These links are loose on the shafts 4, 4′ but are securely and rigidly attached to the valve W. To the shaft 4 is securely attached the arm 6, at one end and to the shaft 4′, is securely attached one end of the arm 6′. The extremities of these arms 6, 6′ are connected by floating links 7, 7 with the slotted links 5, 5′. All these parts are accommodated in the annular space R R between the inner and outer shells. The axles or shafts 4, 4′ pass through stuffing boxes 8, 8′ attached to the outer jacket O and are connected outside of the lock by a yoke lever 9. By means of this arrangement of links the lower valve may be opened or closed by moving the yoke lever, 9, as follows: Moving the yoke from the position shown in Fig. 1 where the valve is shown closed to the position shown in Fig. 3 permits the valve to fall by its own weight through a vertical distance sufficient to insure clearance between the valve and the valve seat V, during the motion next following. This vertical motion is permitted and limited by the slots in the links 5, 5′. Continuing the motion of the yoke and with it, of the shafts 4 and 4′ and fixed arm 6 and 6′, it is evident that the connecting links 7, 7′ will cause the slotted links 5, 5′ and the attached valve W to revolve with them using the axles 4 and 4′ as an axis. This is continued until the valve is swung completely out of the passageway into the annular space R as shown in Fig. 1 by dotted lines. In closing the valve the operation is reversed and the valve is rotated on the axles 4 and 4′ until in the position shown in Fig. 3 when the links engage with a roller stop at 10, Fig. 3. Further motion of the slotted links and valve around the axles 4 4′ being thereby prevented; continuing the motion of the yoke 9 and the arms 6 and 6′ causes the floating levers 7 7′ to act with a toggle joint motion and lift the valve until it comes to a bearing on its seat V. On the upper surface of the valve W, between it and the seat V I may arrange a gasket of rubber or other material.

I will now proceed to describe the operation of my lock. The lower valve *w* being closed and the upper valve K, K′ open as shown in dotted lines in Fig. 2, the bucket is lowered into the air lock and the upper valve K K′ closed so as to encircle the rope or cable and make a close joint at the meeting edges. The cock 21 which opens between the air chamber or lock and the outer air is closed and the cock 22 opening between the shaft and the air chamber or lock is opened thereby admitting air pressure under the valve K K′, which acts to keep it firmly on its seat B. When the air pressure in the air chamber and shaft have become equal, the valve W is lowered from its seat and swung to one side as shown in dotted lines in Fig. 1, the bucket is now lowered into shaft by the cable passing through the closed valve K K′. The bucket may now be lowered to the caisson, emptied of its contents or filled and raised again until the bucket is again in the bucket chamber, when the valve W is closed; the cock 22 closed and cock 21 opened thus relieving the air pressure in the air lock and freeing the valve K K′ when it may be readily opened and the bucket raised by the cable and emptied or filled ready for another descent. Thus the bucket is born by the cable continuously in its passage into, through and out of the air lock.

It is manifest that when the packing box shown in Figs. 4 and 5 is used the flange on the thimble is pressed by the air pressure in the air lock against the valve K K′ and by means of the interposed gasket a close joint made. When the bucket is raised away from the air chamber the packing box remains on the cable near the hook and swings with it until the packing box is again brought to its position in the valve *k k′*, where it is held during the descent of the cable through the air lock to the shaft.

I have described my invention as applied to a vertical shaft but it is manifest that I may apply it to tunnel or side hill operations or other places without departing from the nature of my invention.

When the air lock is applied to tunnels it should be outside the tunnel so that the lever 9 may be operated over the air-lock on a horizontal axis. It would be easier to operate the valve K K′ or upper valves with the shafts *e e′* also vertical, so that in their operation the valves K K′, would be turned rather than raised and lowered.

Fig. 9 shows a modification of the upper valve wherein the half valves K K′ are borne on rollers on tracks below the valve seat, so arranged that the valve will fall upon the tracks when the air pressure is removed from

the bucket space M when the half valves K K′ may be moved away by hand or appropriate instrument so as to leave a free passage through the opening in the air lock. When the cable is again in position the half valves are pushed together, the air pressure turned on to the space M, and the valve K K′ raised against the valve seat by the air pressure making a close joint.

Fig. 10 shows a section of a modification of which Fig. 11 is a top view. In this modification the upper shell I and lower shell H are each made of square cross-section and are higher than in the form last described. The upper valve is made in two parts, 30, 31, each being hinged within the shell I at 33, 34, to eyes provided for that purpose. The valves each have an eye or ring in the face by which they may be raised up against the seat L as 31 is shown in Fig. 10. The meeting edges of the valves 30 and 31 are provided with a flange and with the hole or perforation N, as in the before described valve. The air cocks 21 and 22 are arranged to equalize the pressure in the air lock. The lower valve may be made as an ordinary hinged valve if preferred, as shown in Figs. 10 and 11, where the valve 35 is hinged on the shaft 36 one end of which passes through the side of the shell H, the passage being sealed by a stuffing-box. The valve 35 is keyed to the shaft 36 as is the lever 37, so that movement of the lever will move the valve to or away from the seat provided for it. The valve 35 is so hung that it will swing clear of the opening in the air-lock when open. The shell for the valve is much larger in this form of construction than in that first described.

Another form of valve is shown in Fig. 12, where one continuous upper valve is used, through which from the edge farther from the hinge a slot is cut to the hole N in the center, the slot is provided with a slide 24 to close the slot, so as to leave passage only for the rope or cable. The slide rests in grooves on the under side of the valve and has a ring at or near the edge by which it may be moved, in and out over the slot, each side of the slot is provided a seat for the slide to make a close joint with when in position to close the slot. Fig. 13 is a cross section of the valve.

The valve shown in Fig. 12 is intended to be hinged at one side below the valve seat of the upper valve, so that when open it will swing in the bucket chamber M. which should be made sufficiently large to accommodate it. The bucket having been lowered into the bucket chamber M. the valve is swung up against the valve seat the rope passing through the slot in the valve until it reaches the center of the valve. The slide 24 is then inserted through an opening in the wall of the air chamber below the valve seat into the grooves on either side of the slot made to receive it, until the slot is closed excepting the hole N at the center.

There are other forms in which I may make the valves without departing from my invention, in which the valve will close around the rope and open from it while the rope is bearing a load.

What I claim as new, and desire to secure by Letters Patent, is—

1. The combination in an air lock of a two part valve opening from and closing toward the center, with a seat on the inner side of the air lock substantially as specified.

2. The combination in an air lock of a two part valve with a rope opening at the center with a seat on the inner side of the air lock and the rope at the center against which the valve closes substantially as specified.

3. The combination in an air lock of a two part valve opening in the air lock, closing against a seat on the inner side of the air lock, a central opening in the valve and stuffing box to close the same substantially as specified.

4. The combination in an air lock of a two part valve, the trunnions of each part held in arms *f. f.* on a shaft and each part provided with an arm *h.* having a pin *i.* and the groove *j.* to adjust the surface of the valve part to the valve seat when closed, and to turn it away when open substantially as specified.

5. The combination in an air lock of a two part valve, each part held in arms *f. f.* on a shaft passing through the shell of the air lock, and each part free to turn in the arms to adjust itself to the valve seat and the valve seat on the inner side of the air lock substantially as specified and set forth.

6. The combination in an air-lock of two valves, one provided with a rope opening at the center, and each closing against a valve seat on the side against which the air pressure is, so as to be pressed to its seat by the air pressure, substantially as specified.

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