2 Sheets—Sheet 1.

W. L. MARSHALL.

AUTOMATIC CANAL-LOCKS.

No. 194,922. Patented Sept. 4, 1877.

Fig. 1.

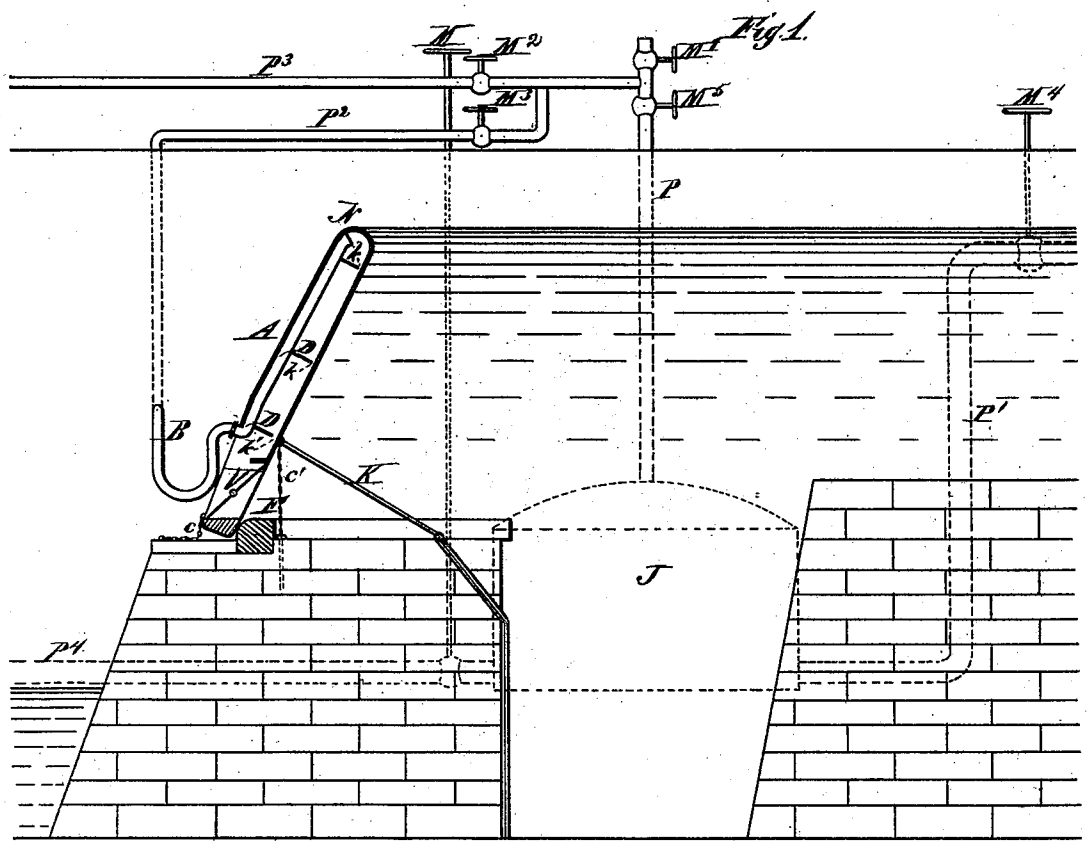
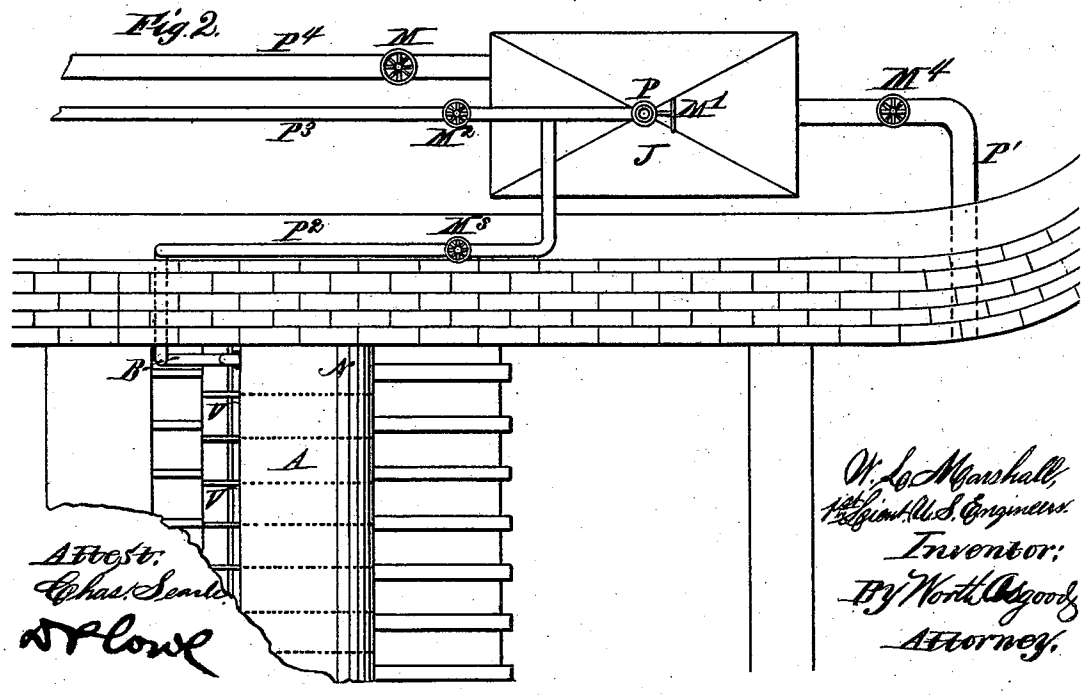


Fig. 2.



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2 Sheets—Sheet 2.

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Fig. 3.

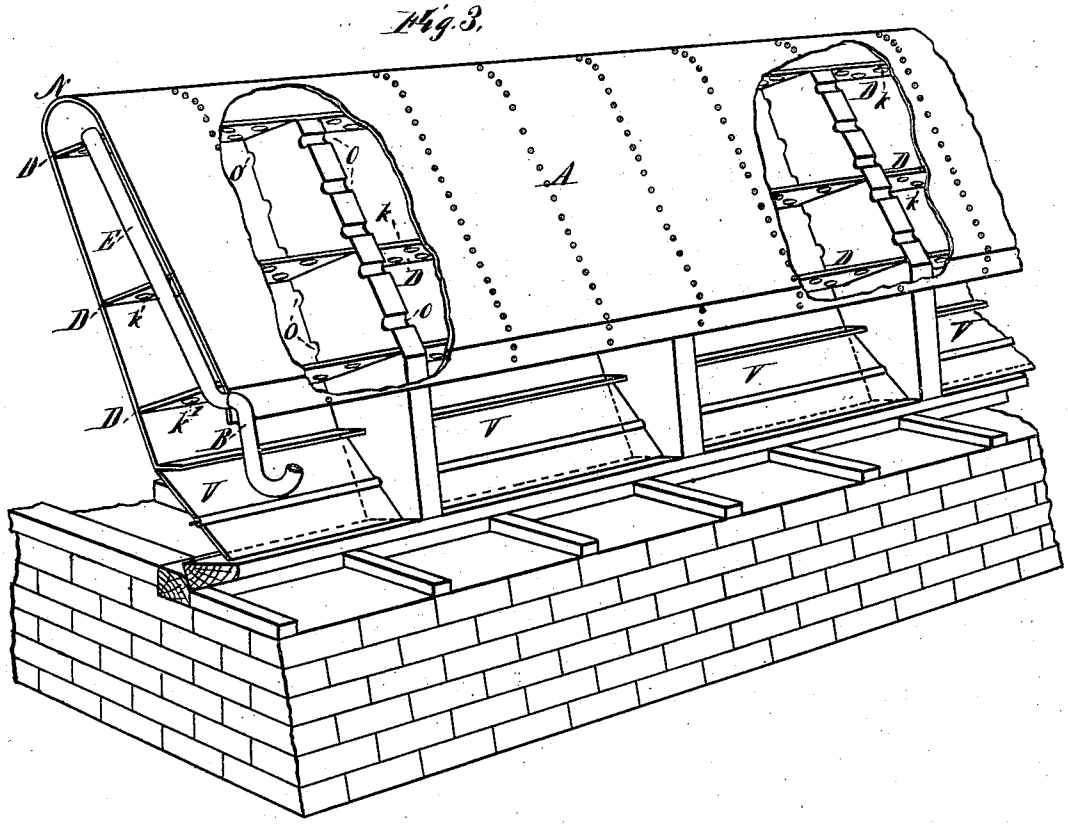
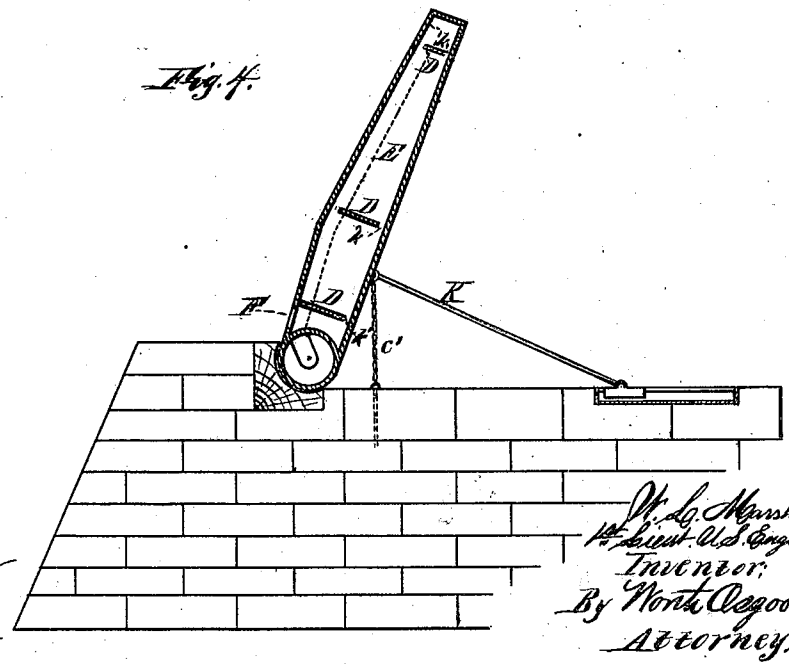


Fig. 4.



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UNITED STATES PATENT OFFICE.

WILLIAM L. MARSHALL, OF UNITED STATES ARMY.

IMPROVEMENT IN AUTOMATIC CANAL-LOCKS.

Specification forming part of Letters Patent No. 194,922, dated September 4, 1877; application filed August 15, 1877.

To all whom it may concern:

Be it known that I, WM. L. MARSHALL, a lieutenant in the Engineer Corps, United States Army, at present stationed at Rome, in the county of Floyd and State of Georgia, have invented certain new and useful Improvements in Automatic Canal-Locks, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

Figure 1 is an elevation showing a lock-gate in closed position, with means for operating said gate in accordance with the principles of my present invention. Fig. 2 is a plan view of a portion of a canal-lock illustrating a convenient arrangement of the air-compressing tank to correspond with Fig. 1. Fig. 3 is a perspective view of a lock-gate with portions thereof broken out the better to illustrate the details of interior construction and arrangement; and Fig. 4 is a sectional elevation of a modified form of gate, exhibiting the most approved manner of attaching the air-conducting pipe to such gates as are hinged to a rigid horizontal axis.

Like letters in all the figures refer to corresponding parts.

My invention has relation to that class of canal-lock gates wherein the gate is opened or closed by swinging it about a horizontal axis, and is in some respects an improvement upon devices shown in my patent of August 7, 1877.

The object of the invention is to simplify the means of operating and controlling the gates; and it consists in closing them by increasing their specific gravity, and in opening them by diminishing the same, thereby dispensing with exterior buoys, operating-chains, &c.; and it further consists in certain approved novel combinations of parts, as will be hereinafter fully described, and then pointed out in the claims.

The gate A is constructed either of wood or plate-iron, or a combination of the two, and its upper part is divided into suitable compartments. Its specific gravity is made such, by the distribution of material, or by loading the gate, that when the compartments are filled with water it will sink, and when filled with air it will float or rise up.

The general construction and operation of the gate are substantially the same as that shown in my aforesaid patent, except that an additional chain, *c'*, is introduced to prevent the gate from rising too high, and being from that cause pulled away from the sill F by heel-chain *c* when gate is raised, and except also the alterations necessary to adapt the gate to be operated in accordance with the principles of the present invention. The cap or top stringer, instead of a solid beam, is made of boiler-plate strengthened by cross-plate N, forming a continuous chamber or pipe the length of the gate. The compartments may be formed by continuing the boiler-plate covering the necessary distance, or they may be made by simply planking the back of the gate and calking the joints. The diaphragms D D may be of either material. The plate N at top of gate and diaphragms D D (if any are used) are pierced by holes *k k*, &c., sufficiently numerous to allow the passage of the air and water from one division or compartment to another. The bottom of the compartment formed by the lower diaphragm D is open only along a narrow crevice, *k'*, next to the front planking. By this arrangement it is evident that the air which, when forced into the gate, will be pressed by the water into the highest parts of the compartments, will be able to pass from one compartment to another throughout the gate, but will not be able to escape from the compartments until the water is expelled down to the level *k'*. To equalize the distribution of air and water throughout the gate in order that one compartment may not be freed from water or air much before another, and thus bring a twisting or tortional strain upon the gate, the vertical timbers, if of wood, are notched or pierced, as at *o o*, thus connecting the different compartments by small water-ways. The air throughout the gate being of the same tension, and the water being pressed up through *k'* by the same head on the outside of the gate, it (the water) will endeavor to assume the same level in the several chambers, and will do this by flowing from one chamber to the other through the

water-ways *o o*. Also, the air, if more of it flows into one compartment than into another, will, in this motion of the water, be driven from one to another chamber throughout the gate.

If the vertical braces be made of iron, they may be perforated at suitable places to effect the same result without materially weakening them.

When the air is allowed to escape from the top of the gate, the water, being above the opening *k'* on the outside, will gradually fill into the compartments, (the gate being heavier than water,) and it (the gate) will finally sink from its own weight when there is an equilibrium of pressure on both sides of it.

A flexible pipe, B, forms the connection between the gate and the air-forcing apparatus. It is preferably attached near one end of the gate and at the bottom thereof, to be out of the way of passing vessels, as well as to keep clear of the gate when it is being moved. It may, however, be attached at any desirable point, but should have such connection with the gate as that it will discharge at a point near the top thereof. As shown in the drawings, it is connected with an interior pipe, E, leading up to the upper compartment under the cap N.

The air may be supplied by any well-known device for forcing elastic fluids or gases into vessels against pressure, and the power employed may be of any description. The compressing power may be secured advantageously by inserting a turbine in a pipe or race from the upper to the lower level of the lock, which turbine may be connected with a suitable exhaust or condensing apparatus, and made to fill or empty the gate of air.

In locks where the lift exceeds the depth of navigation I propose the following apparatus for forcing air into the gate:

At any convenient point near the lock, preferably opposite the upper or lower gate, where the valves for filling the lock are situated, I place a large tank, J, of boiler-plate, airtight, and capable of withstanding with safety a pressure due a column of water equal to the lift of the lock. The bottom of this tank should be on a level with, or a little above, the level of the water in the lower reach, and its top should be below the surface of the upper level the same distance as the gate is under water when down.

Communicating with the upper and lower levels, and entering the tank at its lowermost points, I place water-pipes P^1 P^4, which are controlled by valves or cocks M^4 M. At the highest part of the tank I insert the pipe P, which leads to a favorable point for maneuvering the lock, where it is connected with the two pipes P^2 P^3, leading one to the interior and top of upper gate, and one to interior and top of lower gate compartments.

The pipe P, near the junction, has two air-cocks, one above, the other below, the junction, designated, respectively, M^1 and M^5. When M^1 is closed and M^5 opened, communication will be established, through pipes P^2 and P^3, with the compartments in either or both the upper and lower gates, accordingly as valves M^2 and M^3 are either or both opened, and by opening air-cock M^1 communication is established between interior of tank J and the external air, or between interior of gate and external air, as may be desired.

This arrangement of devices being understood, the method of operating the gates may be easily comprehended from a consideration of the following example of the condition of the lock:

Suppose the lock-chamber to be full, the lower gate up, (of course,) the upper one down, and its compartments filled with water, all the valves closed, and the tank J filled with air of the ordinary density. It is required to raise or close the upper gate, and to lower the lower one. The gate M^4 is opened, connecting tank with the upper level; the water will rush into the tank and compress the air therein. Valves M^5 and M^3 are then opened, and air passes along pipes P, P^2, B, and E to the compartment at top of upper gate, pressing against the water therein.

It is evident that the water is retained in the gate by the pressure above the exit *k'*, and will be pressed out by the air under a head equal to the distance from the level in the tank to the surface of the upper level. The latter being the greater, the water in the gate-compartments must give way to the air, which gradually presses out the water until bubbles escape through exit *k'*. The top of the gate then being buoyant, while the bottom is heavier than water, the gate will endeavor to take an upright position, but will be prevented by the chain *c'* and by its heel striking the sill F. The gate then is in its final position. The lower valves are then opened to empty the lock-chamber and the equilibrium of pressure upon the two sides of the upper gate will be destroyed and the gate pressed tightly into its position, retaining the upper level. The valve M^4 is then closed, valves and cocks M M^2 M^1 opened. The water will run out of the tank and the air out of lower gate-compartments, which will gradually fill with water, and the gate will sink. The tank J will fill with air and the cocks may again be closed.

The tank J may either be made of such capacity that it will suffice to fill one or both the gates with air, or it may be repeatedly filled and emptied of air and water to secure this result.

It is obvious, from its position, that the pressure of the water from the upper level upon the air in the tank can never be less than the pressure retaining the water in the gates; but, on the contrary, it will always be greater until the tank is emptied and water begins to rise in pipe P.

The same general operations may be effected

by use of steam from a conveniently-located steam-boiler instead of by use of compressed air. When the steam which has forced the water out of the gate-compartments has become condensed, the water will flow back in again, and thus the specific gravity or buoyancy of the gate be diminished. In the case of the upper gate the buoyancy may be increased by allowing the water to flow out and down to the lower level, suitable arrangements being provided for the inlet of air. To diminish the buoyancy it will then only be necessary to allow the gate to fill and to provide for the egress of air. And whatever mechanism or arrangements are adopted in connection with the gates, it should be observed that they are to be elevated or closed by increasing their buoyancy, and depressed or opened by forcing air or elastic fluid into them. This constitutes the distinctive feature of my present invention.

At Fig. 4 is shown a gate having a hollow axle, about which the gate swings, said axle having only a motion of rotation. In this event it is deemed most advantageous to attach the connecting air-pipe so that it shall pass from without the lock-wall to the center of the end of said axle, and from this point to carry the connection up to the upper compartments, as plainly indicated.

By the use of an elastic fluid as the transmitter of the power, none of its work is lost by the ordinary resistances of machines, all machinery about the canal-lock is avoided, and the most economical motor which could possibly be employed is secured.

The several valves and cocks should be so situated as to be most convenient for the operator, and could, with care in the location, be placed so that both gates could be maneuvered from the one standpoint. They are represented not in their necessary position in a lock, but so as not to interfere with each other, merely for the purpose of explaining the principles of the invention.

It has not been deemed necessary to show more than one of the gates in the drawings, or to describe the operation of the water-valves V therein. These valves and their connections are fully described in my previous patent.

I do not desire to be understood as claiming the mere loading of a gate to decrease its buoyancy, either by the introduction of water or otherwise, since the same has been mentioned in my aforesaid patent, as well as in other instances; but

Having now fully described my invention, what I do claim as new, and desire to secure by Letters Patent, is—

1. The method of opening and closing a canal-lock gate, substantially as herein indicated—that is to say, increasing its buoyancy to effect the raising and closing by displacing the water within it through the medium of an elastic fluid, and decreasing its buoyancy by allowing water to displace the elastic fluid to effect the reverse, as described.

2. A canal-lock gate divided into compartments, each having ports for the outlet of water, and inlet of air or other elastic fluid, substantially as set forth.

3. In combination with a canal-lock gate adapted to be opened and closed by varying its buoyancy, a conduit leading to the upper portion thereof, and adapted to convey a fluid under pressure to said portion, as and for the purposes explained.

4. In combination with a vertically-moving canal-lock gate, a section of elastic pipe forming the connection between said gate and the exterior pipe, which conveys a fluid under pressure, substantially as set forth.

5. The combination of an air or fluid compressing device, a hollow canal-lock gate, hinged below its center of pressure, and a pipe or conduit connecting the two, for the purposes explained.

6. In combination with a canal-lock gate adapted to be operated as hereinbefore set forth, a division-plate near the lower portion of said gate, arranged to afford a passage, *k'*, for water along its front, substantially as shown and described.

7. In combination with a canal-lock gate adapted to be operated as hereinbefore set forth, a series of perforated division-plates and vertical timbers or braces, serving to divide said gate into a number of compartments, between which there is free water and air communication, as and for the purposes explained.

8. In combination with a canal-lock gate, having a horizontal axis, a compartment at the top thereof, with outlet and inlet for air or fluid under pressure, and outlet and inlet for water, for the purposes described.

9. In combination with a canal-lock gate adapted to be operated substantially as herein shown and described, a series of conducting-pipes, with their valves and cocks arranged in close proximity to the fluid-compressing apparatus, in order that said apparatus and the gate may be operated or controlled from one standpoint, as explained.

10. In combination with an air-compressing tank located outside of the lock-chamber, and having an air-pipe leading to one or both gates, a water-pipe leading thereto from some convenient point of the upper level, and adapted to convey water to said tank, in the manner and for the purposes explained.

11. In combination with a canal-lock gate, an air-compressing apparatus, having two air-cocks, arranged one above and one below the connecting-pipe, as and for the purposes set forth.

12. In combination with a canal-lock gate, a series of pipes and valves connected therewith, substantially as described, so that the pipe which conducts the fluid under pressure

to said gate will also serve to convey this fluid from out the gate when water is admitted thereto, for the purposes explained.

13. The hollow gate A, provided with the perforated division-plates D D, substantially as shown and described.

14. The combination of the hollow gate A and the fluid-conducting pipes P^2, B, and E, substantially as shown and described.

15. The combination, as before set forth, of the hollow gate A, air-conducting pipes, tank J, and water-connections P^1 and P^4.

16. The combination, as before set forth, of the tank J, pipes P, P^3, and P^2, and cocks M^1 M^5.

In testimony that I claim the foregoing I have hereunto set my hand in the presence of two witnesses.

W. L. MARSHALL.

Witnesses:
JAMES M. JENKINS,
R. H. HERRICK.