W. L. MARSHALL.
Canal-Lock Gate.

No. 196,686. Patented Oct. 30, 1877.

Fig. 1.

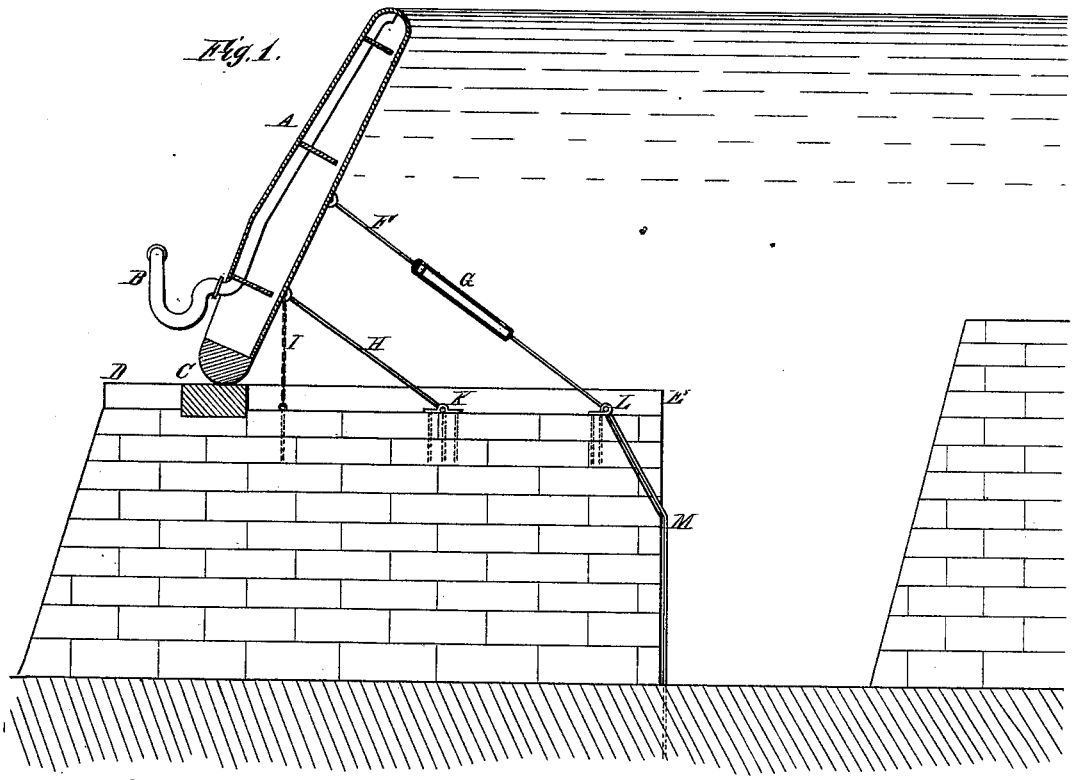

Fig. 2.

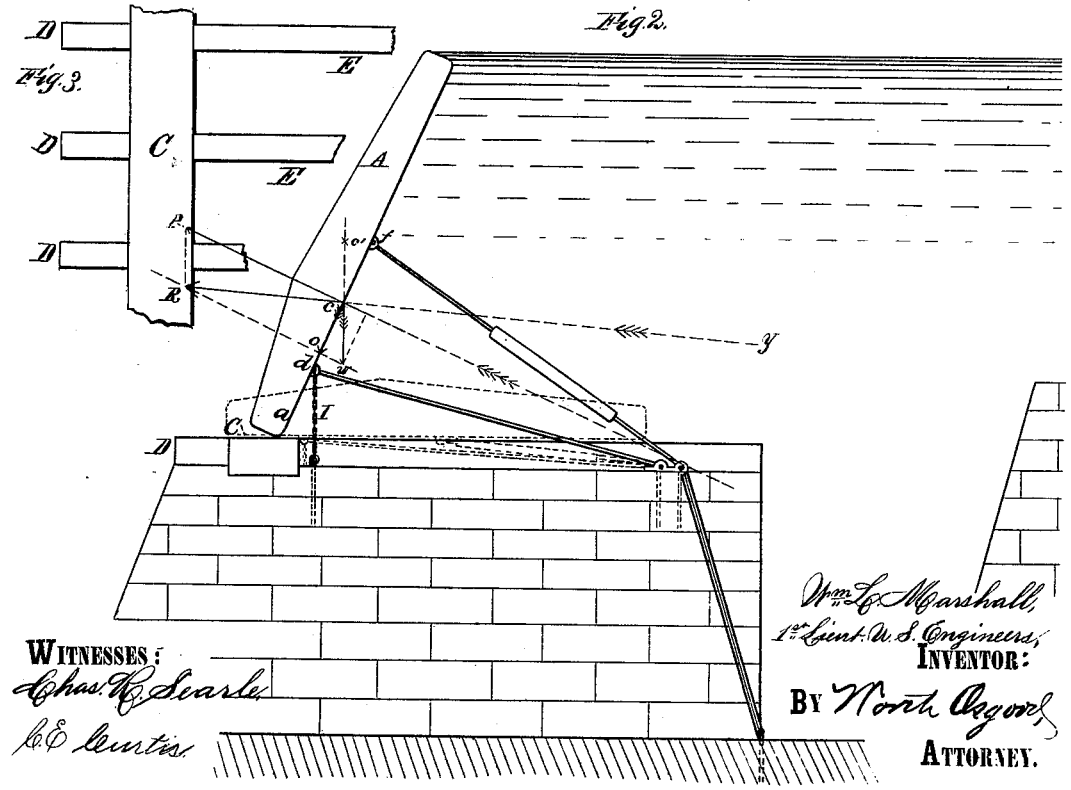

Fig. 3.

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UNITED STATES PATENT OFFICE.

WILLIAM L. MARSHALL, FIRST LIEUTENANT OF ENGINEERS, UNITED STATES ARMY.

IMPROVEMENT IN CANAL-LOCK GATES.

Specification forming part of Letters Patent No. **196,686,** dated October 30, 1877; application filed September 26, 1877.

To all whom it may concern:

Be it known that I, WILLIAM L. MARSHALL, first lieutenant of engineers in the 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 Canal-Lock Gates, 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 a sectional elevation of a portion of a canal-lock, the gate being represented in an elevated or closed position and secured by hinged tie-rods lying substantially in the same vertical plane, but which are anchored to the masonry or foundation at points considerably separated from each other. Fig. 2 is a similar view, showing the tie-rods anchored, two and two, at the same, or substantially the same, distance from the heel of the gate. Fig. 3 is a fragmental plan view, showing the arrangement of the sleepers, the gate-sill, and the slide-bars over which the gate is maneuvered.

Like letters in all the figures indicate corresponding parts.

For purposes of illustration, the upper gate is alone shown, but it is to be understood that the principles of the invention are applicable to the lower gate as well.

My invention has relation to that class of canal-lock gates which move about a horizontal instead of a vertical axis, and is, in some respects, an improvement upon devices heretofore secured by Letters Patent granted me.

It consists, chiefly, in forming the water-joint beneath or at the lower edge of the gate by so arranging the sill and the tie-rods as that said gate shall be forced down upon the upper surface of the sill when the gate is up, instead of being crowded against the side of the sill, as shown in my before-mentioned patents.

A is the gate, of wood or boiler-iron, preferably made hollow, and caused to revolve about its movable horizontal axis by gravity, which, for all purposes of the present invention, may be made available either by increasing or diminishing the buoyancy or specific gravity of the gate by forcing air or water into or from the several compartments, or by the employment of buoys located without the lock, but connected with the gate, which is lighter than water, so as to drag the same under water by their buoyancy or weight, either in their upward or downward movements.

In Fig. 1, B represents a pipe leading from an elastic fluid-compressing device to the upper compartments in the gate, through which the fluid under pressure may be conducted for the purpose of displacing the water.

The sill C has a flat upper surface, which is located in practically the same level as the tops of the sleepers E E and the slide-bars D D.

The gate is slightly rounded off at its lower edge, and this edge is forced hard down upon the top of the sill when the gate is up or closed, thereby forming a perfect water-joint beneath the gate.

By placing the tops of sill and slide-bars in the same plane, the heel of the gate is gradually led up to its final position without shock, and is crowded down tighter and tighter as this position is gradually approached. The arrangement, moreover, lessens strain on the gate-supports, and simplifies their construction.

A series of hinged or jointed tie-rods are shown as attached to the gate in pairs at suitable intervals, for the purpose of maintaining it against the water-pressure, and the gate is prevented from rising by a series of chains, one of which is represented at I.

Under certain circumstances the rods may be increased in number, and in one instance the upper rod may, if desired, be replaced by a chain, as will be explained hereinafter.

Both gates (the upper and lower) we will suppose to be provided with a double series of tie-rods, (represented at H and F,) the series F having a water-brake, G, consisting of a cylinder and piston, the operation and purpose of which are well understood and need not now be described.

The forces acting upon the gate when in position are two: First, the weight of the gate acting vertically downward through its center

of gravity; and, second, the pressure of the water upon its exposed face, and perpendicular to it, acting through the center of pressure or two-thirds the depth of the bottom of gate below the upper surface of the water in the canal.

In Fig. 2, for illustration, the weight of the gate is supposed to act vertically through the center of pressure, to allow me to represent graphically without confusion the action of the forces upon the gate.

The weight of the gate may be resolved into two components, one of which acts in a direction perpendicular to the face of the gate in opposition to the pressure, and the other in the direction of the length of the gate, pressing it against the sill; and the resultant of all the forces acting upon the gate may be represented in intensity and direction by the line *c* R, the line *c w* representing the weight of the gate, and the line *c* P the intensity and direction of the pressure of the water upon it.

From the figure it is evident that, if the tie-rods are so placed as that the line of direction of the resultant R Y passes above point of hinge H, the gate will be pressed down upon the sill, and form a close joint. If, however, this line passes below H the gate will be pressed upward.

In general, the conditions to be observed in placing the ties, whatever be their number, will be that at least one shall be below any possible center of pressure of the water upon gate, and at least one shall be above this center, and that the angles *a d* H and *a f* H shall be less than *a c* Y made by resultant of forces acting upon the gate, and this whether ties or chains are hinged at the same or unequal distances from the heel of the gate when raised.

In the above I have said "any possible center of pressure." This term is used because the centers of pressure upon both gates shift as the water in the lock-chamber rises. In the case of the upper gate, this point varies from two-thirds the depth of gate when lock-chamber is empty to one-half the depth when lock is full. In the case of lower gate, there are also corresponding changes, though the centers of pressure are found between different limits than in the upper gate, because there is always a reverse pressure from water in lower level.

If the tie-rods, properly placed with reference to the center of pressure, make an angle of ninety degrees with the face of the gate when raised, this required condition will always be fulfilled; or if the hinge common to both ties be placed in the line of direction of the resultant water-pressure upon the gate surface, the same will follow; for in such arrangements the gate will be pressed down upon sill by a force equal in intensity to the weight of the gate itself (less the weight of the water displaced by it) multiplied by the sin. 2 of the inclination of the gate to the horizon. If the hinge is placed nearer the gate than this, or if the ties make a less angle with the lower part of gate than ninety degrees, one component of the pressure will also act in the direction of the gate, and it will be pressed against sill with a greater force; and by diminishing the angle made by the ties with face of gate, we may have gate pressed against sill with any force we may desire, (having due regard to the limit of strength of ties,) and thus, by increasing the friction at the heel, prevent the gate moving suddenly into position, and avoid the ramming action of the water upon gate and fastenings. It is preferable, however, in order to avoid wear upon sill and heel of gate, to diminish pressure at heel of gate to the least amount consistent with a tight joint, and interpose a brake to check its too rapid motion into position.

By increasing the number of tie-rods and dispensing with the projecting sill, I am enabled to support the water-pressure at two or more points along each section of the gate, instead of at but one point, as in my former patents, so that both gate timbers and ties may be made considerably lighter, with the same strength and stiffness, and to throw all strains where strains due to the weight of bodies properly should be thrown—*i. e.*, upon the foundation.

It may be observed that the lower tie-rod may be placed as near the bottom of the gate as may be considered desirable, so as to limit the sliding motion of the heel of the gate, and, in connection with the short chain I, reduce the possible opening between heel of gate and sill to a small area.

In the upper gate the upper tie-rod may be replaced by a chain, since the strain thereon only takes place after the gate is up, and when the water upon the lower side commences to recede. The brake may be advantageously used, however, so that the gate will be caused to approach its final position (either up or down) without shock.

In the lower gate it may be found desirable to use more than two tie-rods or chains, since this gate is much wider than the upper one, and is subjected to greater strain. The distribution of the rods will, of course, depend upon the length and width of the gate.

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

1. In combination with a lock-gate having a movable or shifting axis, a flat sill, against the top of which said gate is forced, substantially in the manner described.

2. In combination with a sill having a flat top, against which the lock-gate is forced when elevated, a series of slide-bars the tops of which are practically in the same horizontal plane, substantially as and for the purposes set forth.

3. The combination of the flat sill, the slide-bars, and the sleepers, the tops of all being located practically in the same horizontal plane, affording a bed for the gate when down, substantially as shown and described.

4. In combination with a canal-lock gate adapted to be operated by the buoyant effort of the water, a multiple series of tie-rods attached to said gate, at least one rod being located below, and at least another above, any possible center of pressure, substantially as and for the purposes explained.

5. In combination with a canal-lock gate, a flat horizontal sill and two or more tie-rods, arranged, with respect to said gate, substantially as described, so as to cause the retained water to maintain the gate in an elevated position, and its weight to force it downwardly upon the top of the sill to form the water-joint, as explained.

6. In combination with a canal-lock gate having a movable or shifting horizontal axis, a double series of tie-rods, or their equivalents, hinged two and two, at about the same distance from the heel of the gate, substantially as shown and described.

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

W. L. MARSHALL.

Witnesses:
R. H. HERRICK,
H. RAWLINS.