No. 686,703. Patented Nov. 19, 1901.

J. H. BICKFORD.

GATE VALVE.

(Application filed Mar. 13, 1901.)

(No Model.) 3 Sheets—Sheet 1.

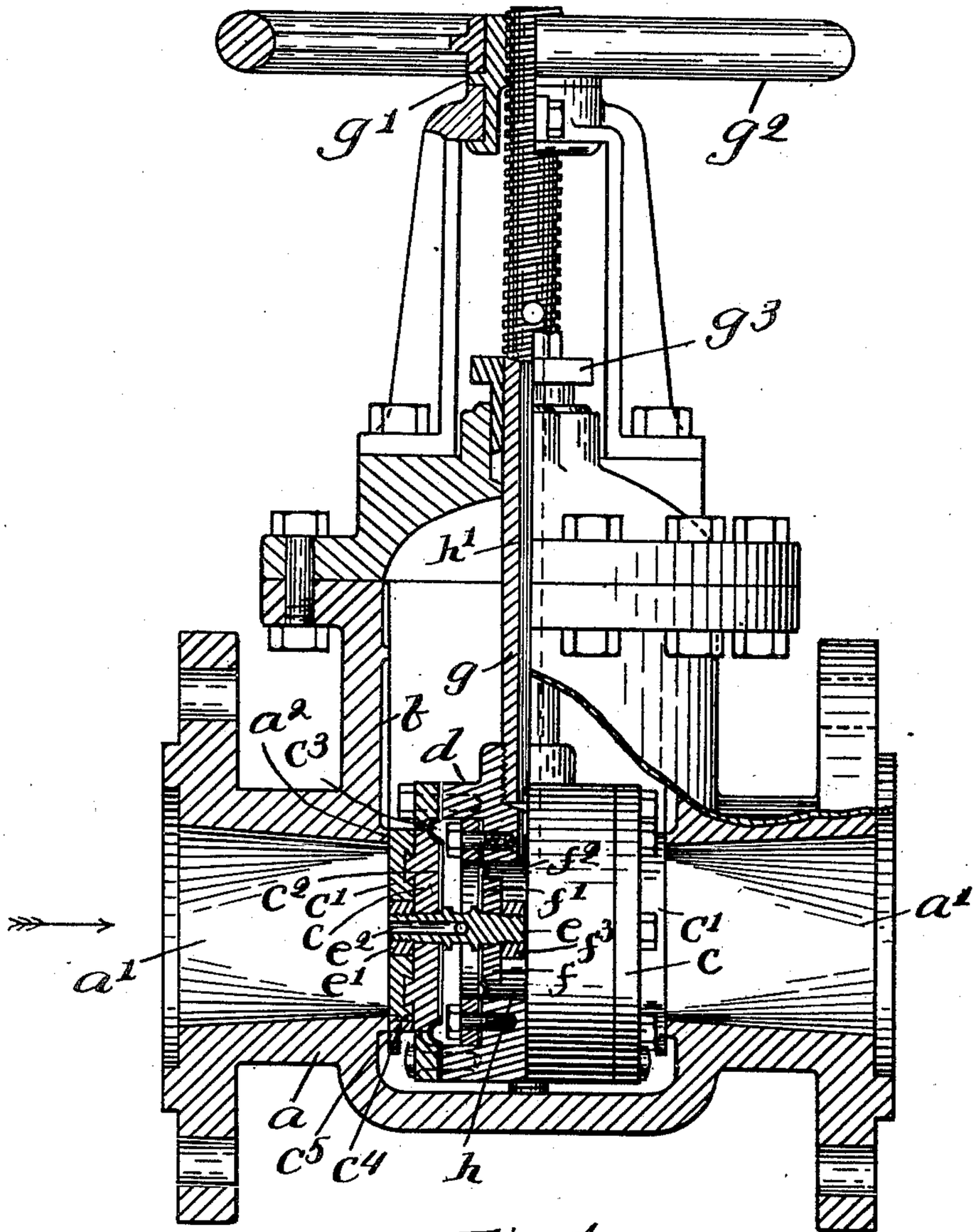

Fig. 1.

Witnesses;
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Inventor;
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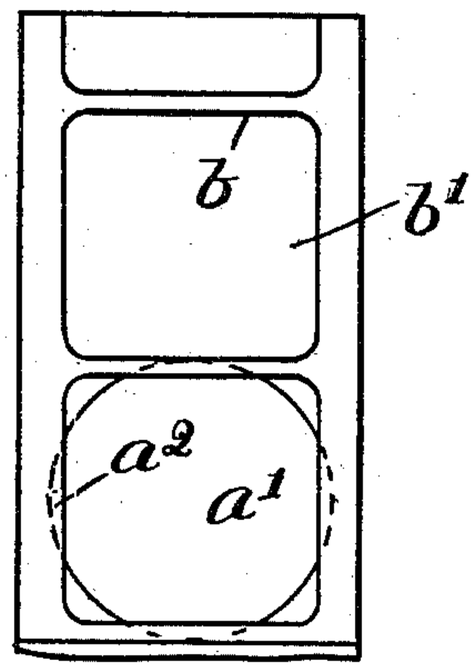


Fig. 2.

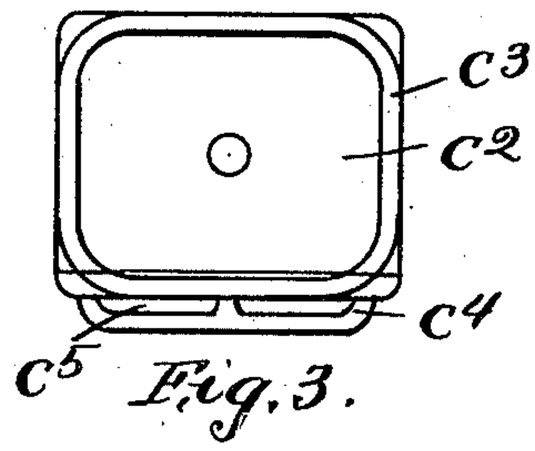
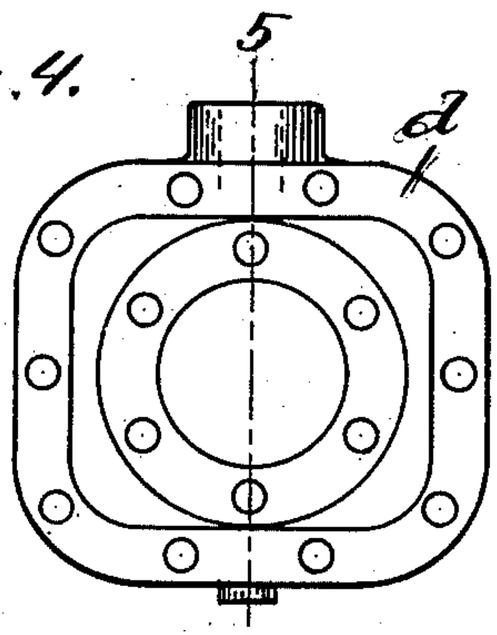


Fig. 3.

Fig. 4.



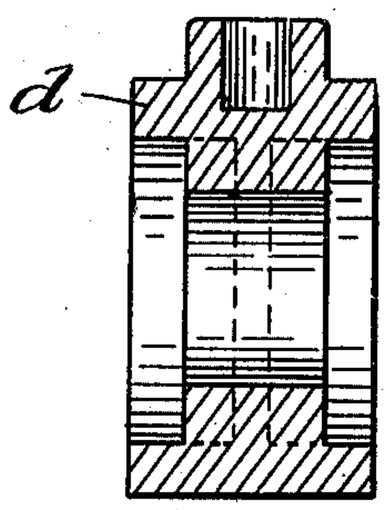


Fig. 5.

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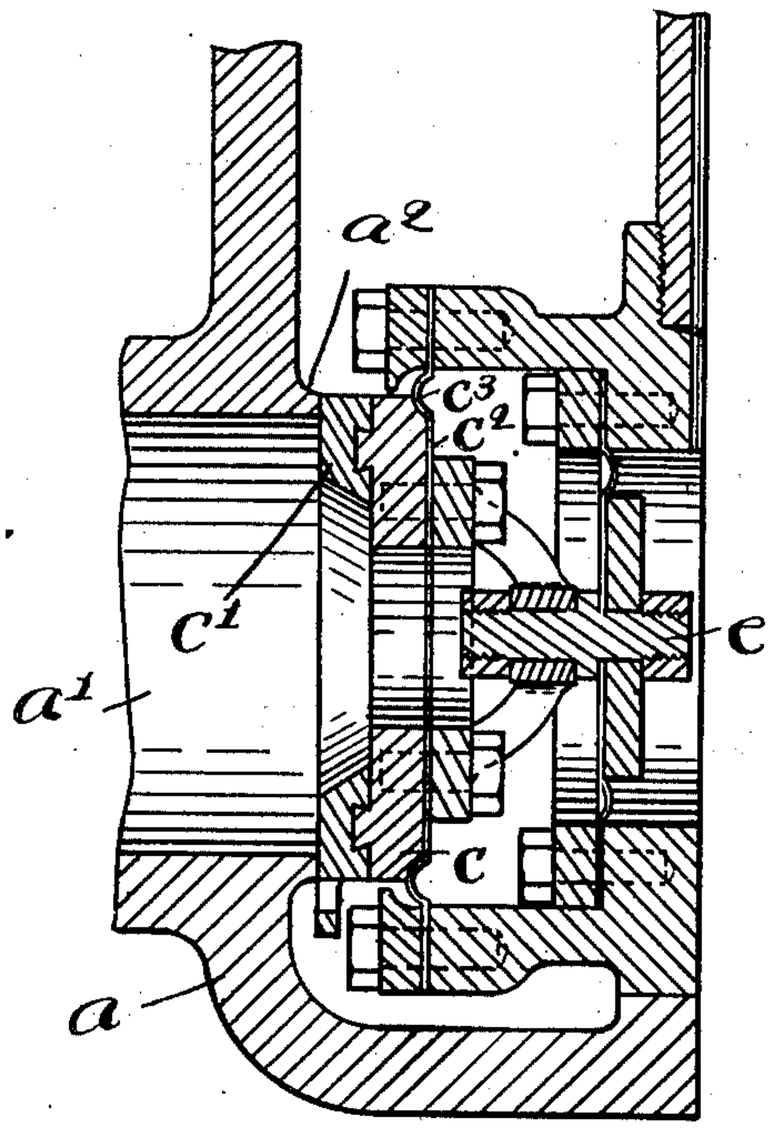
GATE VALVE.

(Application filed Mar. 13, 1901.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 6.



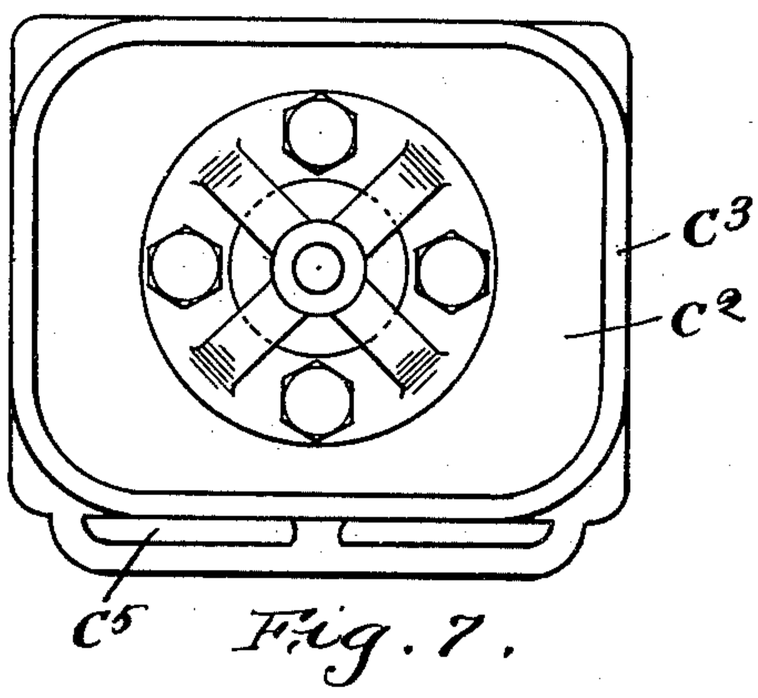


Fig. 7.

Witnesses:
H. B Davis
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Inventor:
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UNITED STATES PATENT OFFICE.

JOHN H. BICKFORD, OF SALEM, MASSACHUSETTS.

GATE-VALVE.

SPECIFICATION forming part of Letters Patent No. 686,703, dated November 19, 1901.

Application filed March 13, 1901. Serial No. 50,940. (No model.)

To all whom it may concern:

Be it known that I, JOHN H. BICKFORD, of Salem, in the county of Essex and State of Massachusetts, have invented an Improvement in Gate-Valves, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention has for its object to improve the construction of valves, to the end that the valve-plate borne by a suitable carrier may be held upon and in sliding contact with its seat by the pressure; also, that that valve-plate borne by a carrier may be held upon and in sliding contact with its seat by the pressure against the action of an opposing force produced by the same pressure which holds the valve-plate upon its seat, said opposing force thereby tending to partially or wholly balance the valve, and also has for its object to improve the construction of the valve in many particulars.

The invention consists, essentially, in a valve having a valve-plate supported by a carrier and movable laterally relative thereto against its seat by the pressure and also in means for exerting an opposing force upon said valve-plate, consisting of a diaphragm which is connected with said valve-plate and which is acted upon by the same pressure which holds the valve-plate upon its seat. The valve-plate is movable in a direction at substantially right angles to the movement of its carrier and independently thereof and is flexibly connected to said carrier—as, for instance, by a yielding metallic connection. A diaphragm is employed as the means for exerting an opposing force upon the valve-plate, and said diaphragm is connected to the carrier and is adapted to be acted upon by the said pressure which holds the valve-plate on its seat, and the area of said diaphragm is less or at least no greater than the area of contact of the valve-plate with its seat, so as to exert an opposing force which partially or wholly balances the thrust of the valve-plate, said force, however, varying according to the relative area of the diaphragm to the area of contact of the valve-plate with its seat.

The invention also consists in providing a chamber back of the diaphragm in open communication with the atmosphere, which provides for a relief of any pressure upon the back side of the diaphragm in case of leakage.

The invention also consists in making certain wearing parts, as will be described, detachable, in order that new parts may be substituted whenever desired.

The invention also consists in providing a valve-plate with a passage which establishes communication between the port and the interior of the valve-case when said valve-plate is moved by its carrier a short distance in a direction to open said port, yet said communication is established while the valve-plate is still in contact with all sides of its seat.

Figure 1 shows in side elevation and partial section a valve embodying this invention. Fig. 2 is a detail of one of the valve-seats. Fig. 3 is a detail of one of the valve-plates. Fig. 4 is a view of the carrier with the valve-plate removed. Fig. 5 is a vertical section of the carrier shown in Fig. 4, taken on the dotted line 5 5. Fig. 6 is a sectional detail of a modified form of valve to be referred to, and Fig. 7 is a detail of the valve-plate of the modified form of valve.

a represents the valve-case, which is made of any suitable shape, having ports a' a', which are preferably made circular.

The valve-case *a* is formed or provided interiorly with valve-seats a^2 a^2, surrounding or inclosing the ports. The valve-seats are made quadrangular, for purposes to be described, the four sides thereof together inclosing the ports, and two opposite sides of each valve-seat are made wider than the other two sides, as shown in Fig. 2. Also formed or provided within the valve-case are mock valve-seats *b b*, which are located above the valve-seats a^2 a^2 and in the same plane, and said mock valve-seats *b b* are also made quadrangular and surround or inclose mock ports b' b'. The lower side of the mock valve-seat is the upper side of the valve-seat a^2 and is the "divide" between the two. Two opposite sides of the mock valve-seat *b* are made wider than the other sides, like unto the valve-seats a^2. The mock valve-seats are also the same size as the valve-seats a^2. A carrier is provided bearing two valve-plates, one for each valve-seat a^2, and as said valve-plates and the means for connecting them with the carrier and the ports coöperating therewith

are alike, or substantially so, but one need be described.

The valve-plate shown in Fig. 1 consists of a supporting-disk c and a contact-disk c', detachably connected to said supporting-disk. The disk c' is detachably connected to the supporting-disk, so that it may be removed and another substituted whenever desired. As a simple means of detachably connecting said disk c' it may be formed with dovetailed recesses, which receive dovetailed projections on the disk c. The valve-plate is also made quadrangular, substantially like the valve-seat. It is obvious that the valve-plate may be made in one piece, if desired.

The valve-plate is flexibly connected to the shell d of the carrier by a metallic or other diaphragm c^2, having a roll c^3, any suitable means being provided for securing said diaphragm to the shell d. The disks c c' and the diaphragm c^2 are rigidly connected together, all being mounted upon a stud e, on which a nut is turned to hold said parts assembled.

I do not desire to limit my invention to flexibly connecting the valve-plate to the carrier by a diaphragm, as any other suitable flexible connection may be substituted therefor.

By flexibly connecting the valve-plate to the shell d it will be seen that said plate is free to move laterally independently of and relative to its carrier in a direction toward its seat. To thus move said valve-plate, means are provided whereby the pressure is admitted to the back side of it, and for this purpose a passage e^2 is formed or provided in the stud e, (see Fig. 1,) one end of which is in open communication with the port a' and the other end of which is in open communication with the interior of the shell d. Thus it will be seen that the pressure will act upon the valve-plate and thrust it outwardly or laterally relative to its carrier into firm contact or engagement with its seat, upon which it is constantly held. In large valves or high pressures it will be seen that the valve-plate thus held upon its seat by the pressure will be held so hard that there is liability of injuring the plate or its seat when said plate is moved along on its seat to open the port, and consequently means are provided for opposing the thrust of the valve-plate on its seat, which, as herein shown, consists of a diaphragm f', mounted upon the stud e and suitably reinforced by a plate f, said parts being rigidly connected by a nut f^3, and said diaphragm has a roll f^2 and is connected to the shell d of the carrier by any suitable means. The stud e therefore rigidly connects together the valve-plate and diaphragm f' and holds them a predetermined distance apart, and as both are flexibly connected to the carrier it will be seen that they will both move together laterally independently of the carrier in a direction toward the valve-seat. The area of the diaphragm f' is less or at least no greater than the area of contact of the valve-plate with its seat, and as it is exposed directly to the same pressure which acts upon said valve-plate it will serve to relieve the thrust of said valve-plate upon its seat.

The shell d of the carrier is attached to the lower end of a spindle or stem g, a portion of which is threaded and works in a threaded bushing g', secured to a hand-wheel g^2. A suitable gland g^3 will be provided in the valve-case for said spindle or stem. As the hand-wheel is turned the carrier will be moved up or down, and suitable guides will be provided for guiding the up-and-down movement of said carrier. It will be seen that as the carrier is moved up or down the valve-plate, which is held upon its seat by the pressure, will remain in sliding contact therewith during the entire movement of the carrier, said valve-plate resting upon either the valve-seat a^2 or upon the mock valve-seat b or intermediate thereof. The lower portion or edge c^4 of the valve-plate is also preferably made detachable in order that it may be removed and another substituted whenever desired, it being understood that the wear due to the passage of the fluid is taken primarily upon this piece when the passage is open. This provides for relieving the wear upon the seat. The lower portion or edge c^4 is cut away at one side to provide an opening into the interior of the valve-case, and a passage c^5 is formed or provided through said lower edge or portion which opens into the cut-away portion, and when the valve-plate is raised a short distance the passage c^5 will be brought into position to establish a communicating passage between the port a' and the interior of the valve-case. Back of the diaphragm f' a chamber h is formed or provided within the shell d of the carrier, which is in open communication with the atmosphere through a passage h' in the spindle or stem, which obviates back pressure upon the diaphragm in case of leakage.

Referring to Fig. 6, the valve-plate is made as open quadrangular rings connected to a spider, which is rigidly connected to the stud e, and in such modified form of my valve an unobstructed way is provided to the back side of the valve-plate in order that the pressure may act directly upon it, said open rings being used in lieu of the disks shown in Fig. 1, which are attached to the stud e, having a passage e' through it. Substantially the same results, however, will be obtained by either form.

By forming valve-seats and valve-plates as herein shown the valve-seats will have substantially double the area of the valve-plates in contact therewith. This is desirable, for as the valve-plate moves upward it should, through its entire movement, cover substantially the same area of seat as when in its closed position in order that its thrust upon the seat due to the pressure may be substantially the same, regardless of the relative

position of the valve-plate to its seat. The corners of the valve-plate are rounded, so that the roll of the flexible metallic connection will be free to work at all points. To allow for these rounded corners is why two sides of the seats are made wider, it not being desirable to increase the width of the other two sides.

The entrances to the ports from the interior of the valve-case are quadrangular in shape, as such shape only will serve to keep substantially a uniform area of contact between the valve-plate and the seats as the valve-plate moves upward—that is, there will be the least variation with such a shaped port. If the entrances to the ports and also the valve plates and seats were circular, it is obvious that a wide variation would occur as the valve-plate moved upward.

Recesses are formed or provided through the walls of the mock valve-seat to admit the pressure to the mock port, so that as the valve-plate is moved upward the pressure upon it will remain the same, or substantially so.

In the drawings the valve is represented as closed and the pressure upon only one side, said pressure entering a port a' in the direction of the arrow. The fluid passes through the passage e^2 and fills the chamber or space back of the valve-plate, and as the area of the valve-plate in contact with the pressure is greater on the back side than on the front side the tendency is for said valve-plate to move laterally relative to its carrier and bear hard upon its seat, although normally it is in light contact with its seat, the flexible metallic connection yielding to provide for such movement of the valve-plate, and the thrust of said valve-plate upon its seat is relieved by the diaphragm f', which is exposed to the same pressure as before stated. To open the valve, the hand-wheel will be turned and the carrier will be raised, and as it is raised the passage at the lower edge of the valve-plate first comes opposite the port a', admitting the fluid to the valve-case, which, continuing, passes out through a similar passage at the lower edge of the other valve-plate. This continues until the pressure is substantially equal in both ports a'. In the meantime the pressure has entered the chamber back of the other valve-plate, causing it to bear on its seat with substantially an equal pressure, and then the valve-plates and also the carrier are in equilibrium and free to be opened as far as desired, the valve-plates maintaining substantially the same pressure upon their respective seats as before the carriage was raised.

I claim—

1. In a valve, a carrier, a valve-plate flexibly connected thereto and movable laterally against its seat by the pressure, and thereby held in sliding contact therewith while moved by its carrier, substantially as described.

2. In a valve, a valve-plate supported by a carrier and movable laterally relative thereto against its seat by the pressure, and means for exerting an opposing force upon said valve-plate consisting of a diaphragm connected with said valve-plate which is acted upon by the same pressure, substantially as described.

3. In a valve, a valve-plate supported by a carrier and movable independently thereof against its seat by the pressure in a direction at substantially right angles to the movement of its carrier, and means for exerting an opposing force upon said valve-plate consisting of a diaphragm connected with said valve-plate, which is acted upon by the same pressure, substantially as described.

4. In a valve, a valve-plate carrier, means for moving it, a valve-plate supported by said carrier, movable laterally independently thereof against its seat by the pressure, upon which it slides while being moved by the carrier, and means operated by the same pressure for exerting an opposing force upon said valve-plate consisting of a diaphragm connected with said valve-plate, substantially as described.

5. In a valve, a valve-case having a valve-seat and a mock valve-seat, a valve-plate carrier, means for moving it, a valve-plate supported by said carrier, movable laterally independently thereof against its seat by the pressure, upon which it constantly bears while the carrier is moved, and means for exerting an opposing force upon said valve-plate consisting of a diaphragm connected with said valve-plate, which is acted upon by the same pressure, substantially as described.

6. In a valve, a valve-case having a port, a quadrangular valve-seat inclosing it, two opposite sides of which are greater in area than the other two sides, and a valve-plate flexibly connected to its carrier, substantially as described.

7. In a valve, a valve-plate flexibly connected to its carrier, and movable laterally relative thereto against its seat by the pressure and means for exerting an opposing force upon said valve-plate consisting of a diaphragm connected with said valve-plate, which is acted upon by the same pressure, substantially as described.

8. In a valve, a valve-plate held upon its seat by the pressure and means for exerting an opposing force upon said valve-plate consisting of a diaphragm connected with said valve-plate which is acted upon by the same pressure, and a chamber back of said diaphragm in open communication with the atmosphere, substantially as described.

9. In a valve, a valve-plate supported by a carrier and movable independently thereof against its seat by the pressure, means for exerting an opposing force upon said valve-plate consisting of a diaphragm connected with said valve-plate, which is acted upon by the same pressure, and a chamber back of said diaphragm in open communication with

the atmosphere through a passage in the stem of said carrier, substantially as described.

10. In a valve, a valve-plate flexibly connected to its carrier and movable laterally relative thereto against its seat by the pressure and having a detachable engaging face, and means for exerting an opposing force upon said valve-plate consisting of a diaphragm connected with said valve-plate, which is acted upon by the same pressure, substantially as described.

11. In a valve, a valve-case having a valve-seat, a valve-plate held upon its seat by the pressure, said valve-plate having a passage which establishes communication between the port and the interior of the valve-case when moved by its carrier a short distance in a direction to open the port, and while said plate is still in contact with all sides of its seat, substantially as described.

12. In a valve, a valve-plate held upon its seat by the pressure, a diaphragm connected with said valve-plate which is acted upon by the same pressure and which exerts an opposing force upon said valve-plate, the area of said diaphragm being less than the area of contact of the valve-plate with its seat, substantially as described.

13. In a valve, a valve-case having a valve-seat inclosing a port, a mock valve-seat inclosing a mock port, a valve-plate carrier, means for moving it, a valve-plate supported by said carrier, movable laterally independently thereof against said seats by the pressure, upon which it constantly bears while the carrier is moved, and means for exerting an opposing force upon said valve-plate consisting of a diaphragm connected with said valve-plate which is acted upon by the same pressure, substantially as described.

14. In a valve, a valve-case having two valve-seats, a carrier, means for moving it, two valve-plates supported by said carrier between said seats, and movable independently of each other and of the carrier against their respective valve-seats by the pressure, and two diaphragms connected respectively with said valve-plates which are acted upon by the same pressure, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN H. BICKFORD.

Witnesses:
ALBERT W. TOWNE,
HARRY M. WILKINS.