J. W. GAMBLE.

VALVE.

APPLICATION FILED MAR. 19, 1912.

1,114,978.

Patented Oct. 27, 1914.

3 SHEETS—SHEET 1.

FIG. 1.

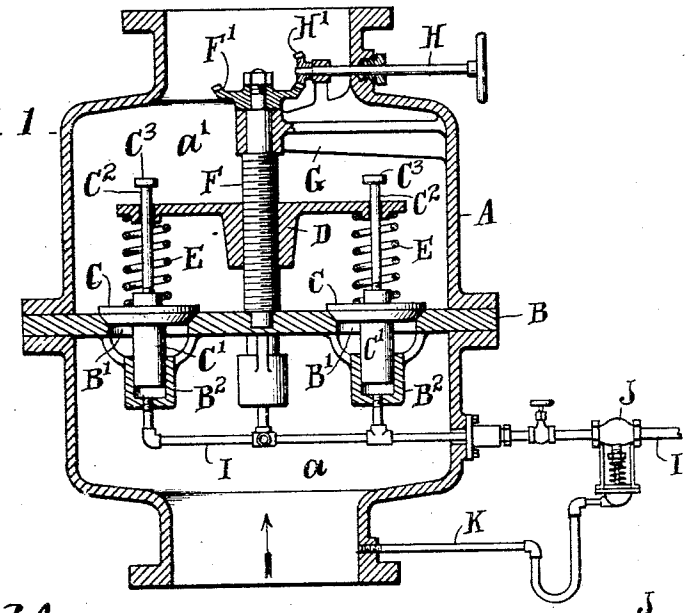


FIG. 3-A.

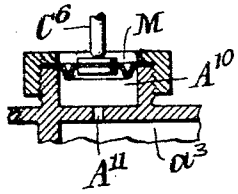


FIG. 2.

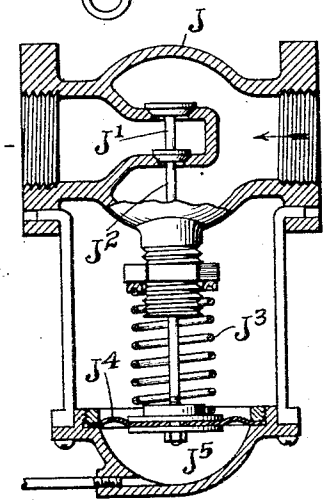


FIG. 3.

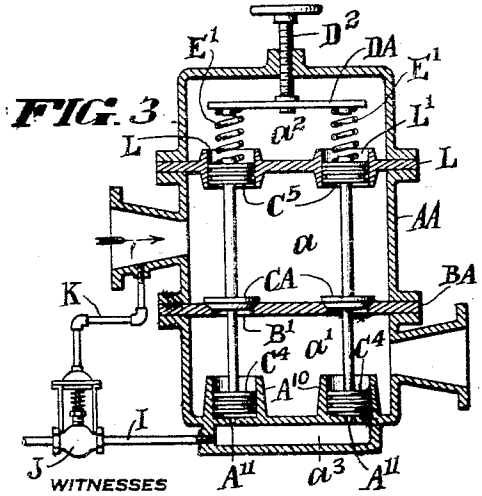
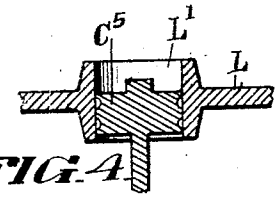


FIG. 4.



WITNESSES

Daniel Webster Jr.

Stewart

INVENTOR

Joseph W. Gamble

BY Francis J. Chamberlain

his ATTORNEY

J. W. GAMBLE.

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3 SHEETS—SHEET 2.

FIG. 5.

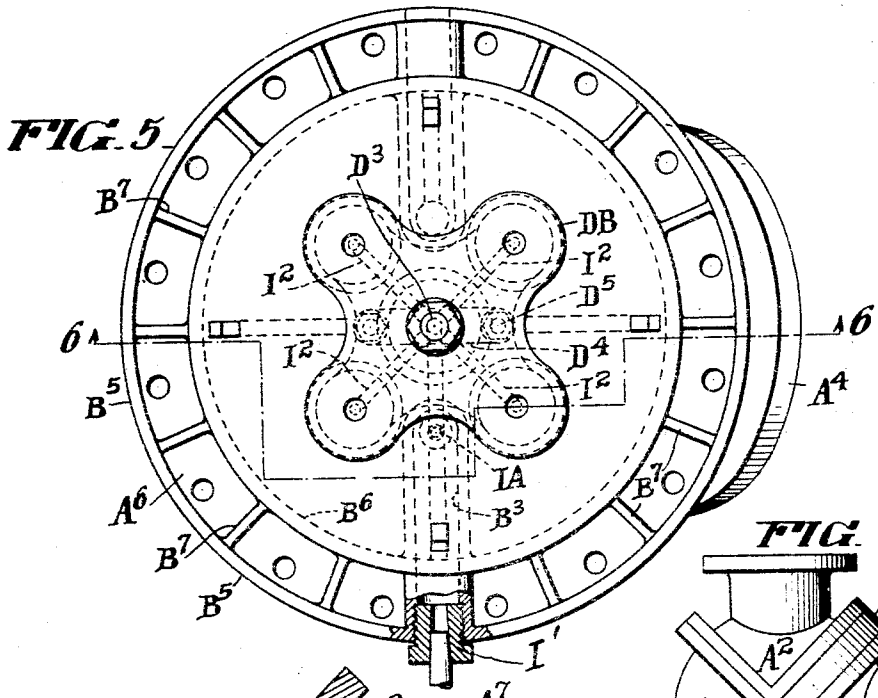


FIG. 7.

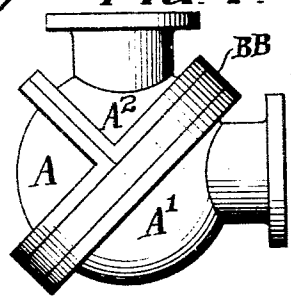
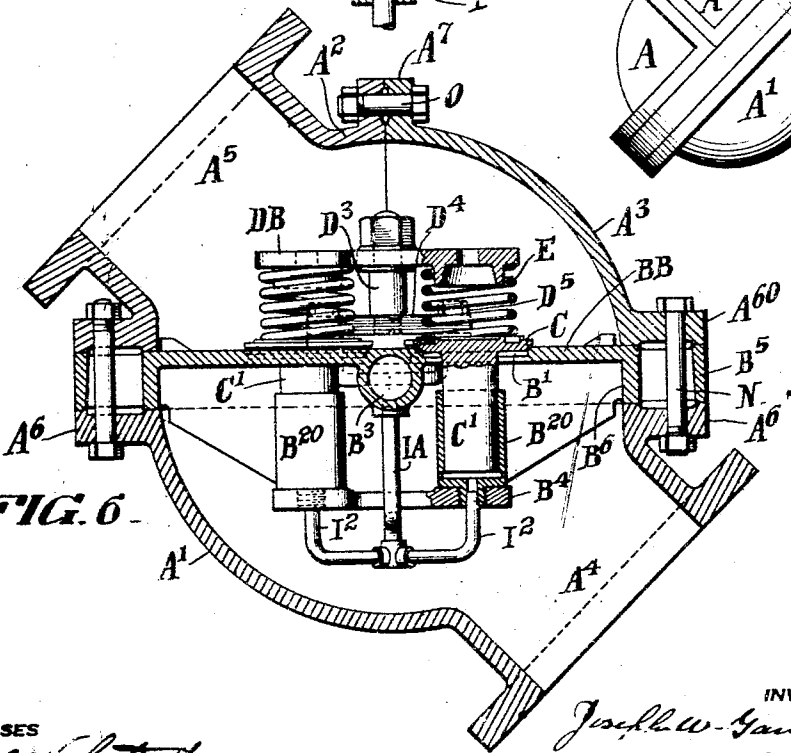


FIG. 6.



WITNESSES

Daniel W. Webster Jr.

Stuart

INVENTOR

Joseph W. Gamble

BY Francis J. Gamble

his ATTORNEY

J. W. GAMBLE.

VALVE.

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3 SHEETS—SHEET 3.

FIG. 8.

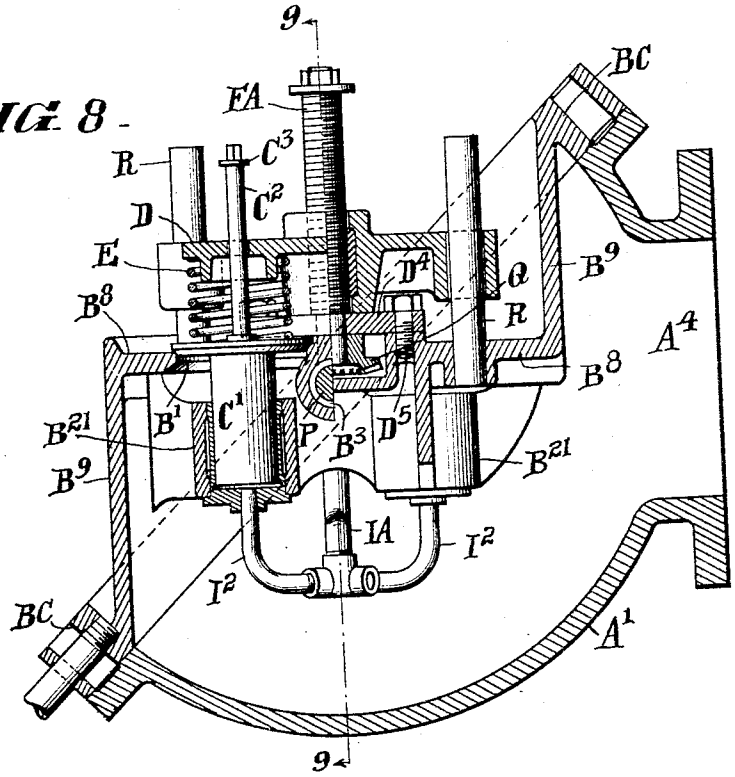
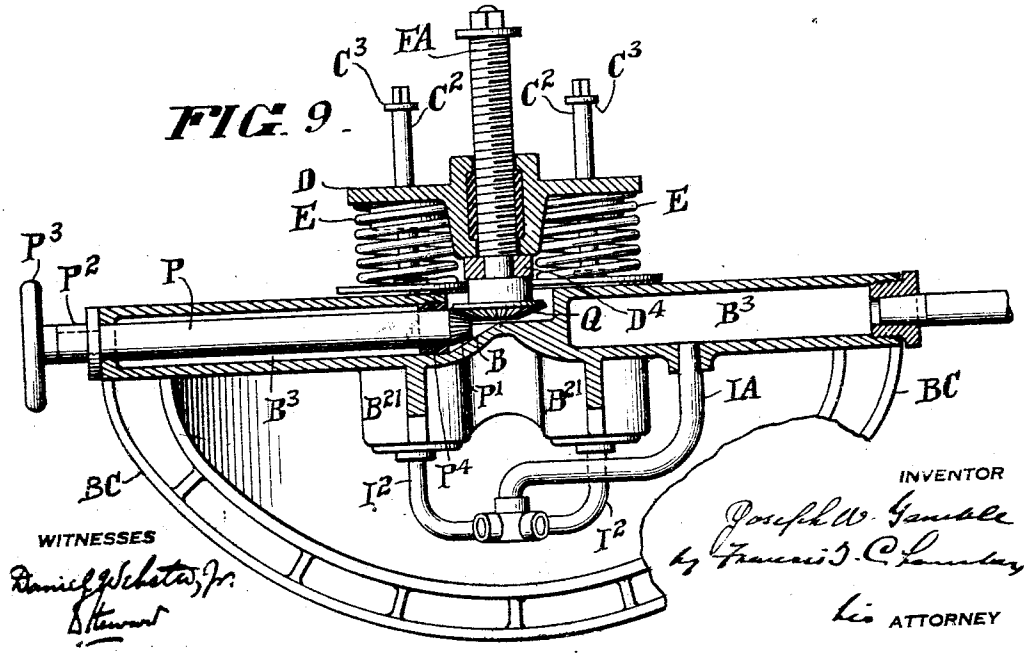


FIG. 9.



WITNESSES

Daniel G. Schatz, Jr.

S. Stewart

INVENTOR

Joseph W. Gamble

by Francis J. C. Lamboley

his ATTORNEY

UNITED STATES PATENT OFFICE.

JOSEPH W. GAMBLE, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO JOSEPH S. LOVERING WHARTON, WILLIAM S. HALLOWELL, AND JOHN C. JONES, ALL OF PHILADELPHIA, PENNSYLVANIA, AS FIRM OF HARRISON SAFETY BOILER WORKS, OF PHILADELPHIA, PENNSYLVANIA.

VALVE.

1,114,978. Specification of Letters Patent. Patented Oct. 27, 1914.

Application filed March 19, 1912. Serial No. 684,786.

To all whom it may concern:

Be it known that I, JOSEPH W. GAMBLE, a citizen of the United States of America, residing in the city and county of Philadelphia, in the State of Pennsylvania, have invented a certain new and useful Improvement in Valves, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

My present invention relates particularly to valves of the kind known as multi-port valves in which the inlet and outlet compartments of a single valve casing are connected by a plurality of valve seated ports, and individual valve disks or valve members proper are provided for each of these ports.

My invention comprises general features of construction and arrangement devised with the object of providing a simple and effective valve mechanism of the kind described comprising features of construction and arrangement whereby the separable sections of the valve mechanism may be assembled in different ways in order to change the relative location of different parts of the valve mechanism, and comprising provisions for automatically operating the movable valve members in response to fluid pressure variations. The last mentioned provisions are particularly adapted to insure positive movements of the movable valve members in response to slight differences in the pressure of the fluid passing through the valve casing, thus fitting the valve for use as a relief valve for a heater or condenser and for like uses in which the pressure of the fluid entering the valve casing fluctuates through a small range in the neighborhood of the pressure of the atmosphere and the movable valve members need to close when the pressure of the entering fluid becomes equal to or falls below the pressure of the atmosphere.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, and the advantages possessed by it, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described several forms in which my invention may be embodied.

Of the drawings, Figure 1 is an elevation partly in section of one form of valve mechanism constructed in accordance with the present invention, Fig. 2 is a section on a larger scale than Fig. 1 of a pilot valve employed in the mechanism shown in Fig. 1. Fig. 3 is a view taken similarly to Fig. 1 showing another form of valve mechanism; Fig. 3^A is a sectional elevation of a modified portion of the valve shown in Fig. 3. Fig. 4 is a sectional elevation of a portion of the mechanism shown in Fig. 3 taken on a larger scale than the latter figure. Fig. 5 is a plan view of a portion of another form of valve mechanism. Fig. 6 is a sectional elevation taken on the line 6—6 of Fig. 5. Fig. 7 is an elevation of the valve mechanism shown in Figs. 5 and 6 with the casing parts assembled differently. Fig. 8 is a sectional elevation of a modification of a portion of the valve mechanism shown in Figs. 5 and 6, and Fig. 9 is a section taken on the line 9—9 of Fig. 8.

The valve mechanism shown in Figs. 1 and 2 comprises a main valve casing A. The casing, as shown, is divided into two main parts separated by a diaphragm member B. The latter divides the interior of the valve casing into upper and lower compartments a' and a, respectively. The member B is formed with a plurality of valve seated ports B′ and supports the valve mechanism controlling these ports. This valve mechanism as shown comprises a valve disk or valve member proper, C, for each port, which is provided at its underside with a piston C′ working in a corresponding cylinder B^2 supported by the member B. Each valve member C is provided at its upper side with a stem C^2 having an enlarged head C^3 at its upper end. The stems C^2 of the various valve members C pass through a vertically movable crosshead D which is formed with a centrally threaded aperture receiving a screw spindle F. The latter is journaled at its lower end in the member B and at its upper end in a bracket G secured to the upper section of the valve casing. At its upper end above the bracket G, the valve member F has secured to it a bevel gear wheel F′ meshing with a bevel gear H′ car-

ried by an operating shaft H journaled in the upper section of the valve casing and provided externally of the valve casing with an operating handle. Surrounding each valve stem C^2 and extending between the corresponding valve disk and the crosshead D is a helical spring E, the function of which is to normally hold the corresponding valve disk against its seat. By rotating the shaft H the crosshead may be raised and lowered to correspondingly adjust the tension of all of the tension springs E. The crosshead may thus be lifted to engage the heads C^3 on the valve stem C^2 and thereby positively move the valve members C into their open positions when occasion requires. Normally, however, the valve members C are opened by the admission of pressure fluid to the lower ends of the various cylinders B^2, this pressure fluid being supplied by a pressure pipe I controlled by a fluid pressure motor valve J of known type. The valve J, in the form shown in Fig. 2, comprises a movable balanced valve member J' controlling the flow through the casing of the valve and having its stem J^2 urged in the valve closing direction by a spring J^3, and adapted to be moved in the opposite direction by a diaphragm J^4 when the pressure is sufficiently high in the chamber J^5 of which the diaphragm forms the upper wall. The chamber J^5 of the valve mechanism shown in Fig. 1 is connected to the compartment *a* of the main valve casing A by the pipe K.

With the mechanism described when the pressure in the compartment *a* of the main valve is insufficient to open the valve J, the valve disks C are held against their seats by the springs E, thus closing communication between the compartments *a* and *a'*. On a rise in the pressure in the chamber *a* such that the diaphragm J^4 moves the valve member J' into its open position, the pressure fluid admitted through the pipe I to the lower ends of the cylinders B^2 forces the pistons C' upward thus lifting the valve disks C and opening the ports B'. When, thereafter, the pressure in the compartment *a* falls to such an extent that the valve J closes, the valve disks return to their closed positions. To permit this closure of the valve disks C when the valve J closes, provisions should be made for then obtaining the desired reduction in pressure in the lower ends of the cylinder B^2. With the mechanism shown this reduction in the pressure is brought about by the leakage constantly taking place between the pistons C' and the walls of the surrounding cylinders B^2. Where, as is the case when the valve mechanism is used as a relief valve for condensers, heaters and the like, it is undesirable to permit air to leak into the main valve casing, I prefer to employ steam or water, rather than air, as the pressure fluid supplied through the pipe I. Compressed air may of course be employed as this pressure fluid when the leakage of air into the main valve casing A is not objectionable or where the parts are so arranged that such leakage cannot occur.

The valve mechanism disclosed may be made highly sensitive, as the simple and sensitive pilot valve mechanism J, can readily be made responsive to very slight variations in the pressure fluid admitted to the chamber J^5, and the pressure of the fluid supplied to the cylinders B^2, when the valve J opens, may be made ample to effect rapid and positive opening movements of the valve disks C. It is apparent moreover that if, for any cause, pressure fluid is not supplied to the cylinders B^2 to open the valve disks at the proper time, the valve disks will nevertheless be opened by the pressure in the chamber *a* as soon as that pressure rises high enough to overcome the weight of the valve disks and the action of the loading springs E. In such case the valve mechanism described will serve to limit the maximum pressure in the chamber *a* and of course will close as ordinary check valves to prevent a flow from the chamber *a'* back into the chamber *a*. The valve is thus admirably adapted for use as a flow valve where it is desired to maintain a low pressure or vacuum in the chamber *a'*. By making the valve seat and valve supporting member B separate from the valve casing, as in the preferred construction illustrated, it is possible to readily machine this member and to mount on it the valve mechanism supported by it prior to the assembly of the member B in the valve casing of which it forms a part.

In the modification shown in Fig. 3, the valve casing AA is divided into three sections and is internally separated into a central inlet compartment *a*, a lower outlet compartment *a'*, and an upper compartment a^2 by diaphragm members BA and L, the diaphragm BA being interposed between the lower and middle sections of the valve casing and the member L being interposed between the middle and upper sections. The member BA is formed with valve seated ports B' each controlled by an individual valve disk CA. Each valve disk CA has secured to its underside a piston C^4 which works in a corresponding cylinder A^{10} integrally formed as shown with the lower section of the valve casing AA. The lower section of the valve casing AA is formed with a pressure chamber a^3 communicating with the lower ends of the various cylinders A^{10} through corresponding ports A^{11}. The pressure fluid supply pipe I is connected to the chamber A^3 and is controlled by a valve J, the diaphragm chamber of which is connected by a pipe K to the inlet chamber *a*,

as in the construction first described. The member L is formed with cylindrical openings L′ coaxial with the ports B′ but somewhat greater in diameter than these ports. Each valve disk CA has connected to it a piston C^5 working in the corresponding cylindrical passage L′. The loading springs E′ for the valve disks CA are located within the chamber A^2 and extend each between the corresponding piston C^5 and the crosshead DA located within the chamber a^2 and adjustably connected through the threaded spindle D^2 to the valve casing.

The operation of the mechanism shown in Fig. 3 is similar to that of the mechanism shown in Figs. 1 and 2, as will be understood without further explanation. It is to be noted, however, that while in the mechanism shown in Fig. 3 the pressure of the fluid in the compartment *a* of the valve casing acting directly on the valve disks CA tends to hold the latter seated the pressure exerted on the somewhat larger connected pistons C^5 gives a resultant lifting effect on the valve disks CA which will open the ports B′ whenever this differential pressure effect exceeds the downward pressure of the springs E′. Inasmuch as the provision of the plurality of ports B′ in a multiport valve mechanism of the kind under consideration, makes it possible to open and close these ports with slight movements of the valve members controlling them, I may employ diaphragms in lieu of the piston and cylinder connections heretofore described. In Fig. 3^A for instance I have illustrated a modification of the mechanism shown in Fig. 3 in which the upper end of the valve disk operating cylinder A^{10} is closed by a diaphragm M against which the lower end of the valve stem C^6 of the corresponding valve disk CA bears.

The modification of my invention illustrated in Figs. 5, 6 and 7 does not differ in its mode of operation from the apparatus shown in Fig. 1 except that the spring abutment crosshead DB shown in Figs. 5 and 6, and corresponding generally to the crosshead D of Fig. 1 is not provided with external adjusting means but is fixed to the diaphragm member BB which correspond generally to the diaphragm member B of the constructions first described. As shown the crosshead DB is connected by a bolt D^3 to a yoke D^4 which is secured to the diaphragm member BB by the bolts D^5. The diaphragm member BB is formed with provisions whereby the pressure fluid supply pipe I may be attached to it, rather than to the body of the valve casing. As shown the member BB is provided with one or more radial chambers B^3. The pipe I is connected by bushing I′ into the outer end of one of the chambers B^3, and the latter is connected, within the valve casing, by a pipe IA and branch pipes I^2 to the lower ends of the cylinders B^{20}. The particular channel B^3, if there be more than one of these, which is most convenient is thus employed. The cylinders B^{20} are not integral with the diaphragm BB but are screwed into a flange portion B^4 of the latter. The valve disk C, pistons C′ and springs E may be identical with the correspondingly marked parts of Fig. 1.

The valve casing proper, shown in Figs. 5, 6 and 7 is formed in three parts A′, A^2 and A^3. The part A′ forms the portion of the casing at one side of the diaphragm member BB, and as shown, is substantially hemispherical in shape except for the tubular flanged pipe connection projection A^4. The portion of the valve casing at the other side of the diaphragm BB is substantially a counterpart of the casing part A′ except that it is formed of two sections A^2 and A^3. These parts are substantially similar spherical segments except that the part A^2 is provided with a tubular and flanged pipe connection projection A^5. The sections A^2 and A^3 are formed with meeting flanges A^7 connected together by bolts O and the two sections A^2 and A^3 are formed with flanges A^{60} which unite to form a circumferential flange between which and the similar flange A^6 on the part A′, the diaphragm BB is clamped by the bolts B^5. To reduce the weight of the diaphragm, and the machining required, the latter is formed at its rim with two concentric cylindrical flanges B^5 and B^6 connected together by integral radial ribs B^7. As shown in Fig. 6 the axes of the two tubular projections A^4 and A^5 are in line with each other but by rotating one half of the valve casing with respect to the other through an angle of 180° about an axis perpendicular to the plane of the diaphragm BB, these tubular passages may be arranged at right angles to one another as shown in Fig. 7. This capacity for adjustment of the inlet and outlet openings to the valve casing gives a desirable freedom in the manner in which the piping connected to the valve may be disposed. The provisions of the separable casing part A^3 makes it possible to open the valve casing and get at the mechanism located therein for adjustment or repairs without disturbing the pipe connections to the sections A′ and A^2 of the valve casing.

With the valve casing shown in Figs. 5 and 6 the axes of the valve disks are inclined to the horizontal at an angle of 45° when the inlet and outlet connections to the valve casing are horizontal or vertical as is usually the case. Under some conditions it may be desirable to have the axes of the valve members C vertical when the casing inlet and outlet connections are horizontally or vertically disposed. This may readily be accomplished by employing in lieu of the

diaphragm BB such a diaphragm member BC as is shown in Figs. 8 and 9. The diaphragm member BC differs from the diaphragm member BB primarily in the fact that it is formed with a central portion B^8 which contains the valve ports B′ and is inclined to the rim portion of the diaphragm member at an angle of 45° and is connected to the latter by the warped web portion B^9. With this construction the cylinders B^{21}, valves C, pistons C′, etc., extend transversely to the diaphragm portion B^8 and transversely or parallel to the inlet and outlet openings depending upon the manner in which the diaphragm and casing parts are assembled.

In Figs. 8 and 9 I have illustrated the manner in which a diaphragm such as that shown in these figures or that shown in Figs. 5 and 6 may be provided with means for regulating the tension of the springs E and positively opening the ports B′ in a manner similar to that in which this is accomplished with the valve mechanism of Fig. 1. In Figs. 8 and 9 a second channel B^3, in line with the channel B^3 to which the pipes I and IA are connected, is formed with an opening at its inner end to permit a gear wheel Q located beneath the yoke D^4 to be operated by a shaft P, axially disposed in said second channel B^3. This shaft is journaled adjacent its inner end in a bearing ring P^4 and passes through a stuffing box P^2 secured to the outer edge of the member BC. At its outer end the shaft P is provided with a handwheel P^3 by which the shaft may be rotated, and at its inner end the shaft is formed with gear teeth P′ which mesh with the teeth of the gear wheel Q. The latter is secured to the end of the threaded spindle FA journaled in the yoke D, and is in threaded engagement with the crosshead D which may be identical with the crosshead D′ of Fig. 1. R, R, represents guides for the crosshead D which are secured to the diaphragm portion B^8.

While in accordance with the provisions of the statutes I have illustrated and described the best form of my invention now known to me it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention, and that under some conditions certain features of my invention may be used with advantage without a corresponding use of other features.

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

1. In a valve, the combination of a valve casing comprising a diaphragm separating the interior of the casing into inlet and outlet chambers and formed with a plurality of valve seated ports connecting said chambers, an individual valve for and controlling each of said ports, a separate fluid operating device for each of said port controlling valves each device comprising coöperating piston and cylinder members secured one to the corresponding valve and the other to said diaphragm and projecting into one of said chambers, and means including a common controlling device located outside of said casing for supplying pressure fluid to the various valve actuating devices.

2. In a valve, the combination of a valve casing formed with a plurality of valve seated ports, an individual valve for each port, a separate fluid pressure operating device located within the valve casing for each of said valves, and means for supplying pressure fluid to the various devices comprising a supply pipe, a valve controlling said pipe, and fluid pressure operating mechanism for the last mentioned valve responsive to the pressure in the valve casing at one side of said ports.

3. In a valve, the combination of a casing divided into sections, a ported valve supporting member interposed between said sections and externally exposed at its outer edge, valves controlling the ports in said member, fluid pressure operating means for said valves mounted on said member within the casing, and a pressure fluid supply connection to said devices including an external pipe connected to said member and leading away from the exposed external edge thereof.

4. In a valve, the combination of a casing divided into sections, a valve supporting member interposed between said sections and externally exposed at its outer edge and formed with a plurality of ports, valves controlling the ports in said member and operating means therefor including a threaded operating member journaled in said valve supporting member and extending transversely thereto, and a second operating member journaled in said valve supporting member and geared to said threaded operating member and projecting externally of the valve casing from the exposed edge of said supporting member.

5. In a valve, the combination of a casing divided into sections, a ported valve supporting member interposed between said sections and externally exposed at its outer edge, valves controlling the ports in said member, spring loading mechanism for the valves, and an adjusting device therefor mounted in said member and projecting externally of the valve casing from the exposed outer edge of said member.

6. In a valve, the combination of a casing divided into sections, a ported valve supporting member interposed between said sections and externally exposed at its outer edge, valves controlling the ports in said

member, spring loading mechanism for said valves, an adjusting device therefor in said member and projecting externally of the valve casing from the exposed outer edge of said member, fluid pressure operating means for said valves mounted in said member and means for supplying pressure thereto including an external supply pipe connected to said valve supporting member and leading away from the exposed outer edge thereof.

JOSEPH W. GAMBLE.

Witnesses:
ROBERT G. CLIFTON,
JESSE E. HARRIS.