Jan. 23, 1951 J. H. BADEAUX 2,539,221

MULTIPLE CONTROL VALVE

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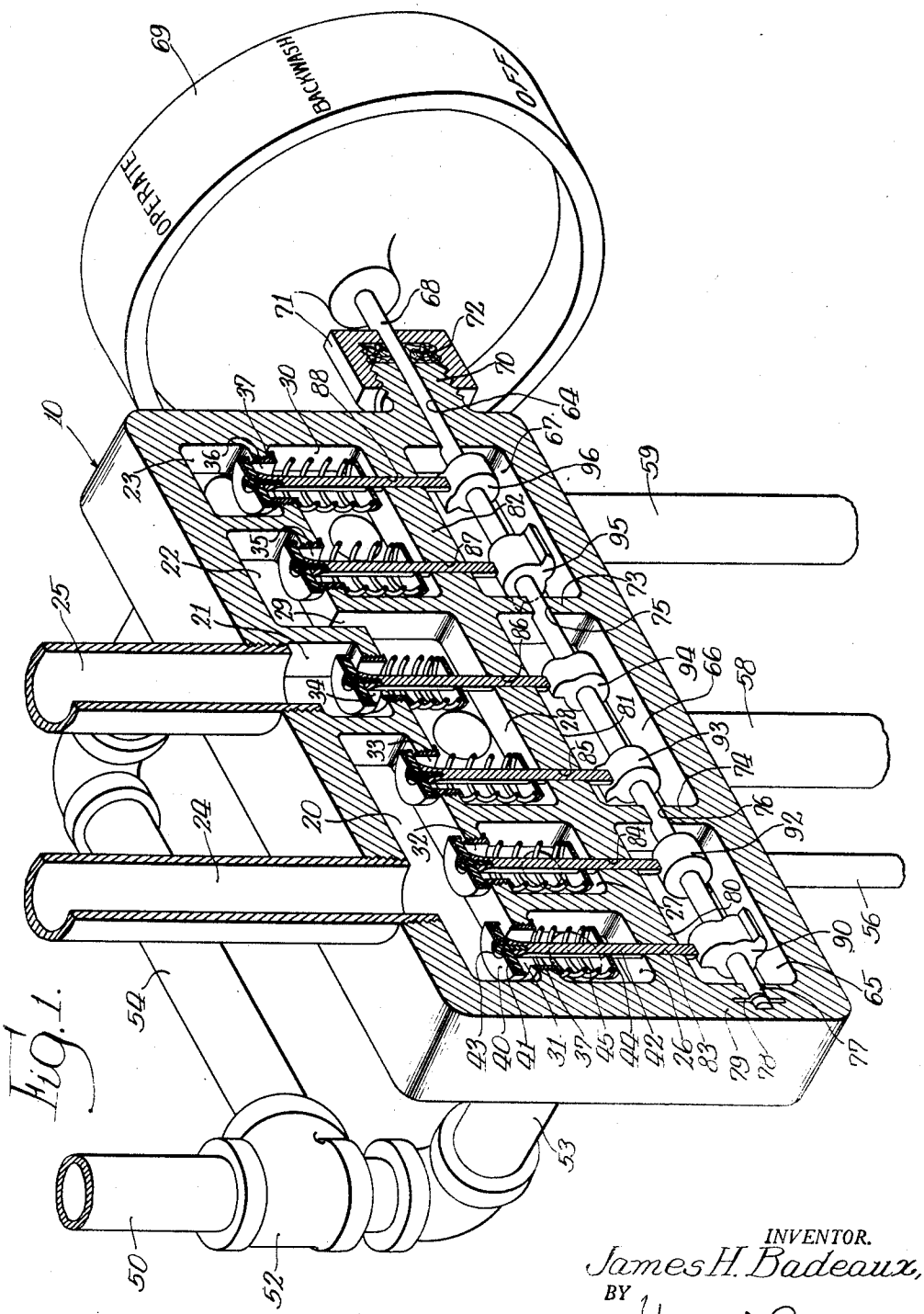

Fig. 1.

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Fig. 5.

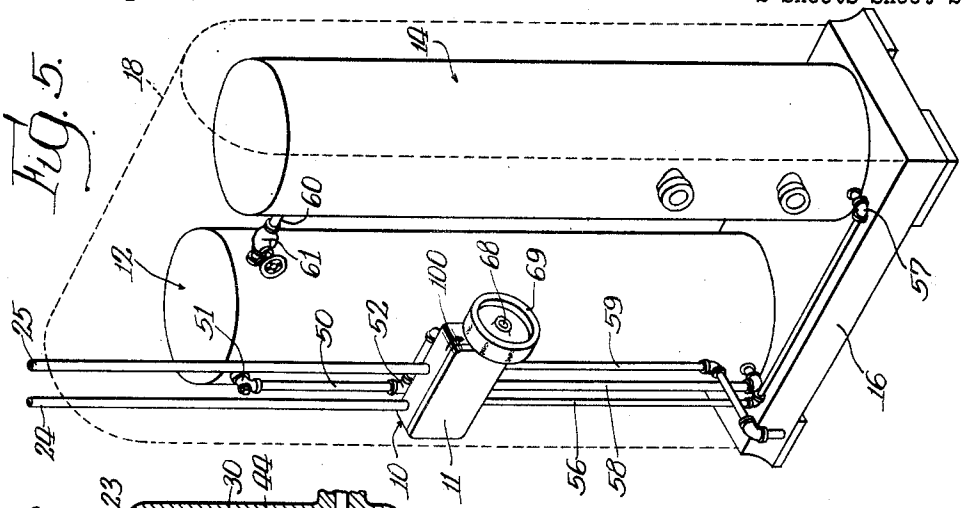


Fig. 3.

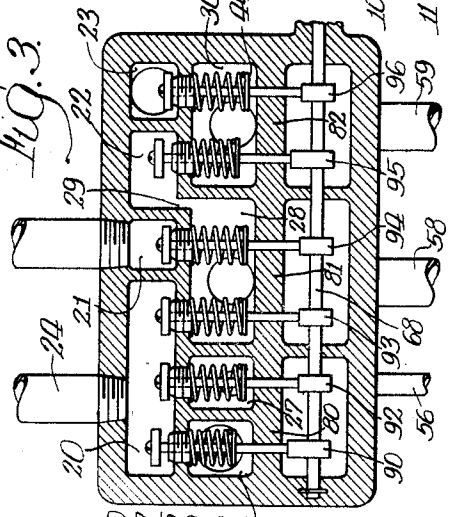


Fig. 2.

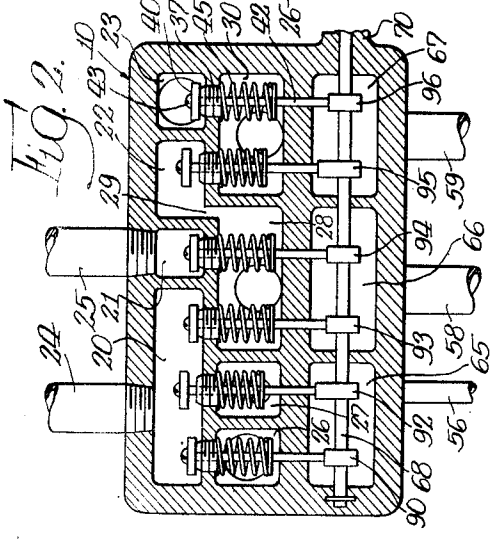
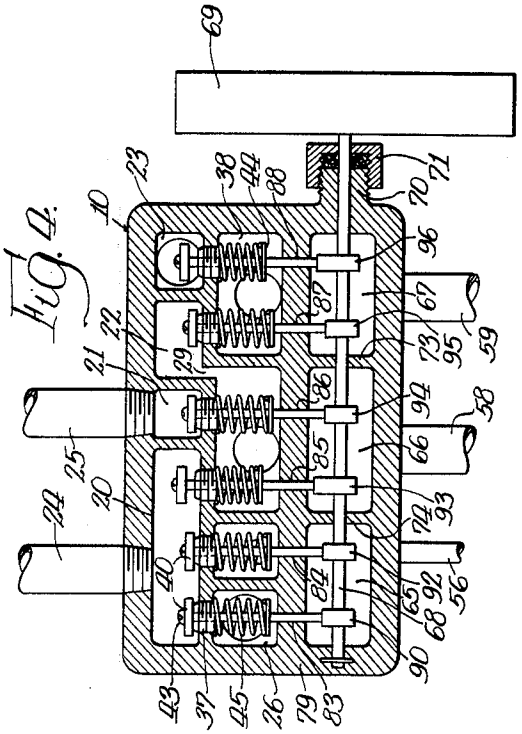


Fig. 4.



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MULTIPLE CONTROL VALVE

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2 Claims. (Cl. 277—20)

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My invention relates to valves for water softener devices which use a mineral for softening the water, a brine for regeneration of the mineral and valve for controlling the flow of water and brine in order to make possible different stages of operation.

Among the objects of my invention is to provide a new and improved multiple control valve designed for hand operation which is relatively simple in construction and easy to service.

Another object of my invention is to provide a new and improved multiple control valve which is so constructed that the number of working parts is held to a relative minimum so that the device is inexpensive both from the point of view of construction and operation.

Another object of my invention is to provide a new and improved multiple control valve incorporating a relatively large number of valve chambers and valves which are all housed within a single valve casing.

Still another object is to provide a multiple control valve which houses within a single casing two separate sets of valve chambers separated respectively by a set of valves and a set of auxiliary chambers adapted to contain means for operating the valve wherein only one element thereof need extend through the outside casing wall in such a manner as to require a packing.

A further object of my invention is to provide a relatively simple multiple control valve in which the valve casing can be separated into two sections and the parts readily removed and then reassembled with such new parts added as may be necessary.

A still further object is to provide a unitary multiple control valve with chambers having such sizes with relation to the pipes connected thereto that there will be no restriction in the flow of water through the valve.

With these and other objects in view, my invention consists in the construction, arrangement and combination of the various parts of my device whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims and illustrated in the accompanying drawings, in which:

Figure 1 is a perspective view of my valve device showing a longitudinal section of the mid portion or the valve with the valves having the position normally occupied when the device is set up for delivery of softened water.

Figure 2 is a side elevational view of my device similar to the view in Figure 1 showing the relative position of the valves for a brining operation.

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Figure 3 is a longitudinal sectional view similar to Figure 2 showing the valves in the position occupied when the mineral tank is being regenerated.

Figure 4 is a longitudinal elevation view showing the relative positions of the valves when the mineral bed is being backwashed.

Figure 5 is a perspective view of a softening apparatus showing a mineral tank, a brine tank and a control valve of my design attached adjacent the mineral tank.

It has been common practice in the past to supply a water softening apparatus which utilizes mineral softening materials of the nature of zeolite. When this sort of material is used its water softening potentiality becomes spent as the apparatus continues in operation. After the material is no longer capable of softening water it is washed with brine to renew its softening effect, then washed and subsequently backwashed before the device is again ready for further use. Because of the fact that all of these operations involve the passage of water or liquids in one direction or another it becomes necessary to control their flow by means of valves so that the flow will be directed to the proper places and in proper sequence.

While it has been possible to control the operation of water-softening apparatus with different sets of individual valves coupled with a cam or other operation mechanism it has become desirable for efficient operation to produce a compact, efficient valve wherein all of the parts are in a single casing and adapted to control at one point all of the various operations required of the separate valves.

This invention is devoted to the preparation and building of a compact valve to which all liquid lines are led so that a unitary control may be produced which will operate properly at all times. It is desirable also in a valve of this kind to direct the flow of fresh hard water under pressure through all of the several chambers without there being likelihood of a leak between valve chambers filled with water and other valve chambers which are not being utilized at some particular phase of operation.

In water softening devices of this general description which have been in use in the past it has been the custom to employ separate valves individually operated. In a few rare instances where all of the valves have been grouped together their separate identity has been maintained so that each and every valve member acts separately without advantage being taken of the fact that

part of one valve may at the same time serve equally well as part of another valve. As a result valves which have heretofore been employed for the control of water softening devices have been cumbersome, complicated and inefficient and as a result of these characteristics have been quite generally expensive.

In the embodiment chosen to illustrate the principles of my invention there is shown a multiple control valve designed for manual operation comprising a body 10 having a cover plate 11 connected by means of a system of pipes to a mineral water softening tank 12 and a brine tank 14. The tanks normally rest upon a base 16 and are customarily encased within a cover, suggested by the dotted lines 18.

In the perspective view of the casing shown in Figure 1 the multiple valve device has been sectioned through the mid portion longitudinally so as to reveal all of the internal working parts. Mechanical details illustrating attachment of the cover plate have been omitted for the sake of simplicity.

Within the valve casing there is provided a set of primary valve chambers comprising a triple chamber 20 and individual chambers 21, 22 and 23. A fresh hard water supply pipe 24 connected to a source of supply communicates with the chamber 20. A soft water discharge pipe 25 communicates with the chamber 21 and is designed to conduct water softened by the device to a place where it will be utilized.

Within the casing there is likewise provided a set of secondary valve chambers comprising a pair of single chambers 26 and 27 both located immediately adjacent the triple chamber 20. A double chamber 28 lies adjacent one end of the chamber 20 and the chamber 21 and is connected to the chamber 22 by a short aperture 29. A second double chamber 30 completes the set of secondary valve chambers and lies immediately adjacent both primary chambers 22 and 23.

For connecting the primary chambers with the secondary chambers there is provided a set of passages comprising a plurality of apertures 31, 32, 33, 34, 35 and 36 each provided with a sleeve 37 threadedly engaging the aperture and forming a valve seat in the primary chamber in each case.

A set of valve members is provided which are uniform in size and construction. Each member includes a valve element 40 formed in the shape of an inverted cup within which is positioned a relatively soft seat 41. The cup-shaped member together with the seat is attached in each case to a valve stem 42 by means of a screw 43. In order that the valves may be normally held in closed position there is provided a spring keeper 44 attached to the valve stem upon which is positioned a coiled spring 45 which is compressed between the spring keeper and the top of the respective secondary chamber in which it is located.

A pipe 50 leads from a fitting 51 at the top of the mineral tank to a T fitting 52 at the rear of the multiple contral valve from which one branch line 53 is in constant open communication with the secondary valve chamber 26. Another branch line 54 from the T fitting is in constant open communication with the primary valve chamber 23.

A pipe line 56 of relatively smaller size leads from the secondary chamber 27 downwardly to an L fitting 57 from which it is directed into the bottom of the brine tank. Still another pipe 58 communicates between the bottom of the mineral tank and the secondary chamber 28. A drain pipe 59 is in constant open communication with the secondary valve chamber 30 and leads downwardly to a convenient point.

The top of the brine tank is connected by a means of a short pipe 60 to the top of the mineral tank, there being provided a hand operated shut-off valve 61 in the short pipe line to shut off the line when desired.

Beneath the set of secondary valve chambers, as viewed especially in Figure 1, there is provided a set of cam chambers comprising respectively the chambers 65, 66 and 67. These cam chambers are closed pockets when the valve casing is closed by the plate 11 and have no means of communication between each other or with any of the other chambers within the valve casing.

For positioning the valves for different phases of operation there is provided a cam shaft 68 which has a hand wheel 69 attached on one end to provide for manual rotation. The shaft extends through an aperture 64 located partially within a threaded boss 70 at one end of the valve casing. A packing nut 71 serves to confine a mass of packing 72 around the cam shaft thereby providing the only packed aperture in the valve casing.

The cam shaft extends from the boss laterally through all of the cam chambers passing through apertures 75 and 76 in the walls 73 and 74 which separate the cam chambers. At the opposite end 77 the cam shaft is rotatably secured by means of a key 78 in an end wall 79 of the valve casing. A snug rotating fit is provided wherever the shaft is supported within the valve casing. Partition walls, 80, 81 and 82 separate respectively the cam chambers 65, 66 and 67 from the adjacent secondary valve chambers. These partition walls have respectively a series of apertures 83, 84, 85, 86, 87 and 88 within which the valve stems 44 are snugly but slidably mounted. The valve stems in each case extend clear through the apertures into the cam chambers. So that the valve stems may be suitably sealed against passage of liquid in the valve chambers, which is seldom under any appreciable pressure, the apertures may be sealed with a heavy grease or by some similar means which will resist the flow of liquid through them.

For lifting the valve adjacent the secondary chamber 26 there is provided a cam 90 having two cam faces thereon angularly spaced one with respect to the other so that when the cam shaft is rotated there will be two points within a 360° rotation at which the cam will bear against the valve stem and press it upwardly in order to open the valve against its spring pressure. A second cam 92 on the cam shaft is also positioned within the cam chamber 65 and has a single cam face thereon designed to lift the valve adjacent the secondary valve chamber 27.

Within the cam chamber 66 are two cams 93 and 94 having a single cam face on each so positioned that they respectively lift and open the valves adjacent the secondary valve chamber 28 at the proper intervals. Within the cam chamber 67 there is provided a cam 95 having two faces here shown spaced at approximately 180° intervals for lifting and opening the valve in primary chamber 22. A single cam 96 in the same cam chamber operates to open the valve in primary chamber 23. It is contemplated that in each of the apertures which extend into the cam chambers wherein a moving part either rotates or re-

ciprocates the apertures will be suitably packed or the moving part will be suitably fitted so that there will be no appreciable passage of liquid through those apertures.

In operation the multiple control valve is initially set in a soft-operating position. This is the position illustrated in Figure 1. With the valve in this position a fresh hard water supply is drawn from the water main and passed through the valve and thence into the top of the mineral tank wherein it passes through a bed of water softening mineral to the bottom of the tank from which it is withdrawn, passes again through the valve, and thence is passed outwardly through a pipe to the point of consumption.

Specifically when it is desired to set the control valve in soft-operating position the hand wheel 69 is rotated to a point where a designation "Operate" on the rim of the wheel is located opposite a pointer 100 on the casing. In this position one face of the cam 90 bears against the valve stem in chamber 26 opening the valve so as to permit passage of fresh hard water from the pipe 24 through the primary chamber 20, the secondary chamber 26 and thence outwardly to the branch line 53, the T 52 and the pipe 50 into the top of the mineral tank. From here the water passes down through the mineral bed, outwardly at the bottom into the pipe 58 from which it is led back to the valve casing where it enters the secondary valve chamber 28. At the same time the cam 94 is positioned as shown in Figure 1 so that the cam face lifts the valve in primary chamber 21 and, since the valve in chamber 22 is closed, water thus softened by passage through the mineral bed passes upwardly from the chamber 28 into the chamber 21 and thence outwardly from the casing through the discharge pipe 25 to a point where it will be used. It will be noted that all of the remaining valves stand in closed position.

When it becomes necessary to pass brine through the mineral bed the hand wheel is rotated until the appropriate designation on the hand wheel is opposite the indicator 100. This will place the cams on the cam shaft in the positions shown in Figure 2, at which brine induction takes place.

As there illustrated cam 92 is rotated so that the cam face lifts the valve adjacent the secondary chamber 27 to open position. Meanwhile cam 90 has rotated past its respective valve stem permitting the valve to close. Fresh hard water will then pass from the pipe 24 into the primary chamber 20 and thence through the valve into the secondary chamber 27 from which it passes outwardly through the pipe 56 and L 57 into the bottom of the brine tank. The liquid contents of the brine tank will then be subject to pressure of water in the hard water supply line. The pressure of water thus introduced into the bottom of the brine tank causes the brine within the tank to pass outwardly at the top through the connection 60 into the top of the mineral tank, the valve 61 having been opened.

Brine then passes downwardly through the mineral bed and outwardly at the bottom through the pipe 58 into the secondary valve chamber 28. In the position of the cam shaft illustrated in Figure 2 the valve to the soft water discharge pipe 25 is closed but through action of the cam 95 the valve in the chamber 22 is opened. Brine will therefore pass through the chamber 28, upwardly through the aperture 29 into the chamber 22 and thence downwardly into the chamber 30 from which it flows outwardly and downwardly through the drain pipe 59. After an ample amount of brine has been introduced this operation is complete.

In the next regeneration phase of operation water is flushed through the mineral bed to wash out the brine. For this operation the hand wheel is rotated to "regeneration" position and in so doing the second face of the cam 90 lifts the valve opposite secondary chamber 26 again to open position. Again fresh hard water from the pipe 24 flows through the chamber 20 into the chamber 26 and thence outwardly through the branch line 53 and pipe 50 into the top of the mineral tank. This fresh water then passes down through the mineral bed washing out the brine and emerges at the bottom from which it is conducted through the pipe 58 into the chamber 28 thence upward through the aperture 29 into the chamber 22. In this position a second face on the cam 95 has lifted the valve in chamber 22 to open position thereby permitting the water used in washing out the brine to pass into the chamber 30 from which it is discharged outwardly through the drain pipe 59. This continues until all salt brine has been washed out of the mineral bed.

In order to provide a backwash operation the hand wheel is rotated to a "backwash" position which sets the cams and valves in the relative positions indicated in Figure 4 of the drawings. As there shown cam 93 has been rotated so that the cam face lifts the third valve from the left in primary chamber 20 to open position. By the same operation cam 95 lifts the valve in chamber 23 to open position, all of the remaining valves being automatically closed by spring action. With the valves thus set fresh hard water from the supply pipe 24 passes into the chamber 20 and thence downwardly into the secondary chamber 28 and thence outwardly through the pipe 58 into the bottom of the mineral tank. The fresh water supply being under line pressure water is forced upwardly through the bed of mineral in the softening tank thus loosening up the particles of the mineral substance. During this phase of operation the water passes upwardly and outwardly through the pipe 58 which communicates between the top of the mineral tank and the valve casing. Water which passes through the pipe 58 is then routed through the branch line 54 into the primary chamber 23. No water passes through the branch line 53 because the valve opposite chamber 26 is in closed position as shown in Figure 4.

Backwashing water which flows into the chamber 23 as just described passes downwardly into the chamber 30 and thence outwardly through the drain pipe 59. After this operation has been completed the hand wheel is rotated to the original soft-operating position and the water softening device then proceeds to operate as described in connection with Figure 1 so that the fresh hard water supply is softened and passed again to the point of consumption.

There has thus been provided a compact unitary multiple control valve wherein certain valve chambers serve a double or triple purpose. All of the moving parts are contained within the valve casing so that extra packing for moving parts is reduced substantially to a minimum. The valve parts including removable seats have been kept to a uniform size, are easily accessible by removal of the cover plate 11 and can be readily taken out and replaced. With this novel arrangement of valve elements operation of the device is further facilitated by having brine in

the brine tank placed under pressure present in the supply line for the brining operation so that the device is positive acting during this phase of operation.

Some changes may be made in the construction and arrangement of the parts of my device without departing from the real spirit and purpose of my invention, and it is my intention to cover by my claims any modified forms of structure, or use of mechanical equivalents, which may be reasonably included within their scope.

I claim as my invention:

1. A multiple valve device comprising, in combination, a casing having a first, a second, a third and a fourth primary chamber; a first, a second, a third and a fourth secondary chamber; a port for each the first, the second and the fourth of said primary chambers and for each of said secondary chambers, opening externally of said casing; six internal passages providing communication respectively between said first primary chamber and the first, the second and the third of said secondary chambers, between the second of said primary chambers and the third of said secondary chambers, and between the third and the fourth of said primary chambers and the fourth of said secondary chambers; and a seventh permanently open passage providing communication between the third of said primary chambers and the third of said secondary chambers; tappet valve means controlling each of said first six passages having valve heads located in said primary chambers and valve stems projecting through and beyond said secondary chambers; means for urging said valves to closed position; a cam shaft rotatably mounted within said casing and projecting at one end from said casing for operation; and a cam for each of said valves fast on said cam shaft and engaging said valve stems to determine the open or closed position of said valves, said cams in a first position of said cam shaft causing the first and the fourth named valve controlled passages only to be opened, in a second position causing the second and the fifth named valve controlled passages only to be opened, in a third position causing the first and the fifth named valve controlled passages only to be opened, and in a fourth position causing the third and the sixth named valve controlled passages only to be opened.

2. A multiple valve device comprising, in combination, a shallow rectangular casing having a first and a second longitudinally extending partition wall dividing the interior of the casing into a middle and two outside tiers; a plurality of transverse partition walls extending between the first longitudinal partition wall and an external casing wall dividing the one outside tier into a triple primary chamber and three single primary chambers; a second pluraliy of transverse walls extending between said longitudinal partition walls dividing the middle tier into two single secondary chambers opposite said triple primary chamber; a first double secondary chamber opposite the triple primary chamber and one of the single primary chambers and a second double secondary chamber opposite the remaining two single primary chambers; six passages opening through said first longitudinal division wall to provide communication respectively between the primary chambers and the secondary chambers directly opposite; a tappet valve controlling each of said passages having a valve head located in said primary chamber and a valve stem projecting through the passage, a secondary chamber and said second longitudinally extending partition wall; means for urging each of said valves to closed position; a seventh uncontrolled and permanently open passage formed in said first longitudinally extending partition wall providing communication between the third primary chamber and the third secondary chamber; a cam shaft rotatably mounted in said casing in the remaining outside tier and projecting at one end outwardly through the casing for actuation by external means; and a cam for each of said valves fast on said cam shaft and engaging said valve stems to determine the open or closed position of said valves in accordance with the position of said cam shaft.

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