A. J. LOEPSINGER.

REGULATING VALVE.

APPLICATION FILED NOV. 11, 1911.

1,178,528.

Patented Apr. 11, 1916.

2 SHEETS—SHEET 1.

Fig. 1.

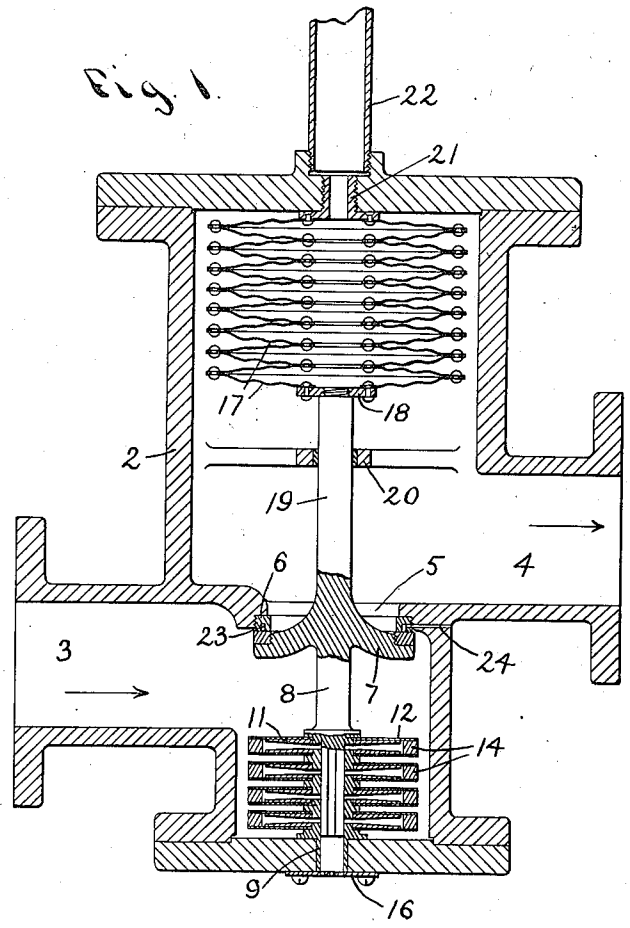


Fig. 3.

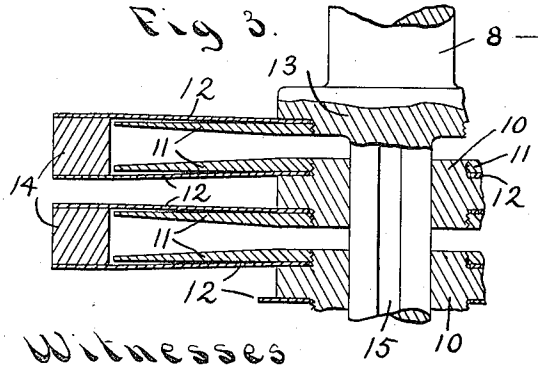
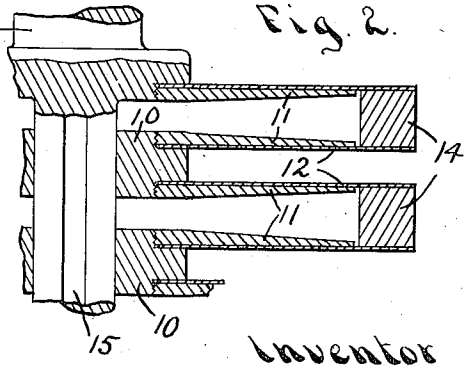


Fig. 2.



Witnesses

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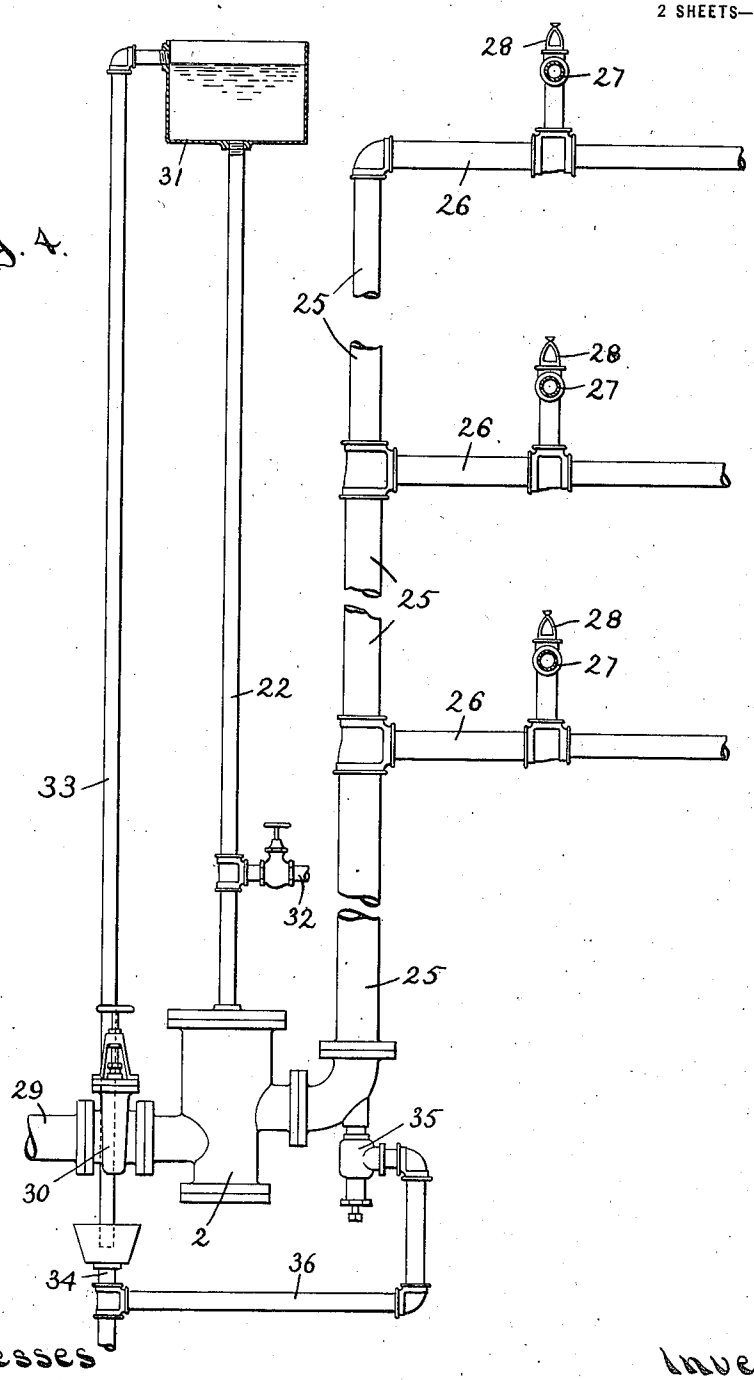
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2 SHEETS—SHEET 2.

Fig. 4.



Witnesses

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UNITED STATES PATENT OFFICE.

ALBERT JOHN LOEPSINGER, OF PROVIDENCE, RHODE ISLAND, ASSIGNOR TO GENERAL FIRE EXTINGUISHER COMPANY, OF PROVIDENCE, RHODE ISLAND, A CORPORATION OF NEW YORK.

REGULATING-VALVE.

1,178,528. Specification of Letters Patent. Patented Apr. 11, 1916.

Application filed November 11, 1911. Serial No. 659,709.

To all whom it may concern:

Be it known that I, ALBERT J. LOEPSINGER, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented new and useful Improvements in Regulating-Valves, of which the following is a specification.

In various localities in which automatic sprinkler systems are installed the normal pressure of the municipal water supply is so low as to be worthless for supplying water to such systems when installed in buildings of any considerable height, and in such cases the practice has been to rely on gravity or pressure tanks, or both, for supplying the sprinkler systems. In the case of many old buildings, however, it is impossible or undesirable to utilize such tanks because the buildings or their foundations are not strong enough to support the weight of the filled tanks, and therefore some other water supply must be available in order to make it possible to install automatic sprinkler systems in buildings of this character. Such a source of supply exists in some places, as in New York city, for example, where there is a special system of water pipes provided with fire pumps for giving high pressure fire service, the pressure developed being dependent upon the number of pumps put in operation to supply the demand at any given time, but it has not heretofore been feasible to utilize this service for supplying automatic sprinkler systems, for the reason that the pressure developed by the fire pumps is liable in case of a heavy demand to run up so high that if it were admitted to an automatic sprinkler system the latter would immediately be in danger. My invention is particularly intended to overcome this difficulty by providing a regulating valve which, if interposed between a sprinkler system and a high pressure water supply, will maintain a suitable predetermined pressure in the sprinkler system, regardless of any increase in pressure in the supply system, the features of construction and arrangement in which my invention resides being hereinafter set forth in connection with the accompanying drawings, in which—

Figure 1 is a central vertical section through my regulating valve as preferably constructed; Figs. 2 and 3 are sectional views on a larger scale, showing certain of the parts of the valve in different positions; and Fig. 4 is an elevation, largely diagrammatic in character, showing a sprinkler system equipped with the valve illustrated in Fig. 1.

Referring to Fig. 1 of the drawings, 2 indicates the valve casing, which is formed to provide an inlet or supply passage 3, an outlet or discharge passage 4, and an opening 5 affording communication between the passages 3 and 4. This opening 5 is surrounded by a suitable valve seat such as 6 and is controlled by the valve proper 7, which when closed rests against the seat 6 on that side of the latter which faces the inlet passage 3, so that said valve 7 is adapted to open away from the outlet passage 4.

The inlet side of the valve 7, which is its under side as represented in Fig. 1, is exposed to the supply pressure in the inlet passage 3, but this pressure is prevented from having any controlling effect upon the operation of the valve under normal conditions by means of a balancing arrangement, which is preferably so constructed as to permit a valve-opening movement of considerable extent in order to provide a free waterway through the valve casing when the valve is open, in accordance with the requirements of approved automatic sprinkler practice. The valve-balancing arrangement shown in Fig. 1, which I have devised for this purpose, is constructed as follows: A stem 8 is carried by the valve 7 on the inlet side thereof and extends in the direction of its opening movement, being guided by suitable means such as a fixed hub 9 in which the free end of the stem slides. On said stem 8 are mounted a number of hubs 10 adapted to slide longitudinally on the stem, and to each hub 10 are secured two rigid circular disks 11, which are of the same diameter and are concentric with each other and with the hub. Overlying the inner or opposed faces of the disks 11 on each hub 10 are circular flexible diaphragms 12, one for each disk, each diaphragm being preferably constructed of thin sheet metal such as phosphor bronze and being secured to its hub in such manner as to form a water-tight joint therewith, as by clamping the central portion of the diaphragm upon the hub by means of the corresponding disk 11, as shown in Figs. 2 and 3. A similar diaphragm 12 and disk 11 are secured to a fixed hub such as the hub

9, and another diaphragm 12 and disk 11 are similarly secured to a hub 13 on the valve stem 8. These diaphragms 12 are all of the same diameter and are connected in pairs by means of circular rings 14 to which the peripheries of the respective diaphragms are tightly secured, each ring serving to connect two diaphragms carried by adjacent hubs. There is thus provided a chamber which is compressible in the direction of the opening movement of the valve 7 and is closed so far as communication with the interior of the casing 2 is concerned, and since the bottom diaphragm 12 is secured to a fixed part, namely, the hub 9, while the external pressure on each intermediate diaphragm is balanced by the pressure on another intermediate diaphragm, the compressing force exerted on the chamber as a whole is measured by the supply pressure acting upon the topmost diaphragm 12, the interior of said chamber being subjected to the normal atmospheric pressure by providing the valve stem 8 below the hub 13 with longitudinally extending channels 15 opening through the end of the stem into the hollow interior of the hub 9, which in turn is in communication with the external air through a perforated cap plate 16 secured to the valve casing 2 at this point.

The parts associated with the valve stem 8 as above described are so proportioned and arranged that when the valve 7 is closed each of the flexible diaphragms 12 rests upon the adjacent disk 11, so that each disk serves as a rigid backing and support for its diaphragm and enables the latter to resist high pressures in the supply passage on the inlet side of the valve, each disk being of such diameter as to extend nearly across the hollow interior of the corresponding ring 14. Assuming that the effective area of the compressible chamber thus constructed is substantially equal to that of the valve 7 on its inlet side, the forces tending to hold said valve upon its seat will evidently be unaffected to any substantial extent by the pressure exerted by the water supply in the inlet passage 3, or by variations in such pressure. Whenever the valve 7 is opened, however, the resulting movement imparted to the valve stem 8 will be automatically distributed among all the movable hubs and diaphragms as indicated in Fig. 3, since if any diaphragm is separated from its supporting disk to a greater extent than the adjacent diaphragms are separated from their disks it will expose a greater area to the pressure tending to force it toward its disk, whereupon the corresponding hub will move on the stem 8 in such direction as to tend to equalize the pressure conditions. A considerable opening movement of the valve 7 is thus provided for without causing any one of the flexible diaphragms to be bent to an undesirable extent, thus securing the advantages of a sliding piston arrangement without the attendant disadvantages thereof.

From the preceding description it will be seen that if the flexible diaphragms 12 are each of the same diameter as the seating area of the valve 7, said valve will be exactly balanced as far as the pressure on its inlet side is concerned, but in practice I prefer to make these diaphragms enough larger than the valve 7 to result in a slight differential pressure tending to open the valve, in order that said valve may be automatically opened in case the arrangement for closing the valve should become inoperative for any reason, in which case, unless the valve were open, the water supply for the sprinkler system would be cut off. To all intents and purposes, however, the valve 7 is balanced so far as the effect of the supply pressure thereon is concerned, so long as the various parts are in condition to operate in the manner contemplated.

In order to control the opening and closing of the valve in such manner as to supply the sprinkler system and maintain a predetermined pressure therein under static conditions, this pressure is caused to exert a closing force on the valve but is partly balanced by an independently-applied force of constant amount, which will ordinarily vary with the height of the building in which the sprinkler system is installed. This independent force may be conveniently provided by a gravity tank located at a suitable elevation and connected to an arrangement for utilizing the static pressure due to the height of this tank, and in Fig. 1 I have shown a valve-controlling arrangement located on the outlet side of the valve 7 and exposed to the independent pressure above referred to and also to the pressure in the sprinkler pipe system. This valve-controlling arrangement, like the balancing device already described, should provide for a valve-opening movement of considerable extent, but since the pressures to which it is subjected are not liable to run up so high as the supply pressure on the inlet side of the valve, it is possible to employ a flexible diaphragm construction without rigid backings for the diaphragms. For example, the construction shown in Fig. 1 comprises a series of circular diaphragms 17 having open centers and arranged one above another, with the inner and outer edges of each intermediate diaphragm tightly secured to the adjacent edges of the next diaphragms in the series, thus forming a compressible and expansible chamber which is closed except at its ends. This chamber, which is contained in a suitable compartment in the valve casing 2, is secured at its lower end to and closed by a disk 18 carried by the top of a valve stem 19, which

extends upward from the valve 7 in alinement with the stem 8 and is guided by suitable means such as a spider 20 through which it passes. At its upper end said chamber is secured to a flanged bushing 21 carried by the valve casing and having a central opening which affords communication between the interior of the chamber and a pipe 22, which leads to the gravity tank above referred to. The diaphragms 17 are all equal in area, but since the intermediate diaphragms balance one another, so far as the effect of the pressures on them is concerned, the effective area of the chamber as a whole is that of a single diaphragm, and this area is somewhat greater than the effective area of the valve 7 on its outlet side. In order that the latter area may be defined with exactness the seat for said valve is preferably provided with an annular channel 23 connected through a passage 24 with the exterior of the casing 2, whereby any leakage into said channel from either side of the valve will be drained away.

In Fig. 4 I have illustrated the manner in which the regulating valve above described is preferably combined with a sprinkler system. In this figure, 25 indicates the supply riser of the sprinkler system, with cross pipes 26 leading therefrom and carrying sprinkler pipes 27 to which the sprinkler heads 28 are attached. The regulating valve, indicated at 2, is connected on its outlet side to the bottom of the supply riser 25 and on its inlet side to the supply main 29 which is usually provided with a gate-valve 30. The pipe 22, already referred to, leads upward from the regulating valve to the gravity tank 31, which is shown as provided with a valve-controlled pipe connection 32 through which it may be filled, and with an overflow pipe 33 discharging into an open drain pipe 34. As this tank is not utilized to hold a water supply to be drawn upon but merely to maintain a fixed pressure within the compressible chamber to which it is connected, it may be a small tank as compared with an ordinary gravity or pressure tank such as is used for supplying a sprinkler system, and may be connected to said chamber by a small pipe.

Since it is always conceivable that something might prevent the valve 7 from closing tightly, it is desirable to prevent any possibility of damage to the sprinkler pipes or sprinkler heads by the excessive pressure which might then be admitted to the sprinkler pipe system, and to this end said system may be provided with a safety valve of any suitable construction. Such a valve is indicated at 35 and is shown as discharging into a pipe 36 leading into the drain pipe 34.

As thus constructed and arranged, the mode of operation of the valve may be described as follows: Assuming that the sprinkler system is filled with water at the pressure which it is desired to maintain therein, so long as static conditions exist the valve 7 is subjected on its outlet side to the differential effect of said pressure on the valve itself and on the compressible chamber composed of the flexible diaphragms 17, and also to the pressure exerted in the interior of said compressible chamber by the water in the gravity tank 31, and this tank is located at such a height that the valve-opening force exerted thereby and by the sprinkler system pressure acting on the upper side of the valve 7 itself is slightly less than the valve-closing force exerted by the sprinkler system pressure on the exterior of said compressible chamber. On the inlet side of the valve 7 the forces acting on said valve are substantially balanced, as already explained, so that the supply pressure will not cause the valve 7 to open or otherwise affect its condition even though said pressure should be greatly increased, and therefore any such increase of pressure cannot affect the pressure in the sprinkler system. If a sprinkler opens, however, the pressure in the sprinkler system and in the valve casing 2 on the outlet side of the valve 7 is immediately reduced, and thereupon the pressure due to the gravity tank overbalances the sprinkler system pressure on the diaphragms 17 and opens the valve 7, whereupon the sprinkler system is supplied with water to whatever extent may be necessary to meet the demand, but whenever the sprinkler system pressure rises to the predetermined amount the force thereby exerted on the compressible chamber above the valve 7 becomes sufficient to cause said valve to close, the parts being thus restored to their normal condition.

It will be understood that the pressure which it is desirable to maintain in a sprinkler system under normal conditions will vary with the height of the uppermost sprinkler pipes in the system, the supply riser 25 being shown in Fig. 4 as broken away between various floor levels, and the valve-opening pressure exerted in the interior of the compressible chamber composed of the diaphragms 17 will therefore be varied accordingly, this being readily done in any given installation by locating the gravity tank 31 at a suitable elevation above the regulating valve.

If at any time the supply pressure is not greater than the pressure in the sprinkler pipes and the valve 7 is open, it will then cease to act as a regulating valve and will be continuously held open unless the supply pressure increases, whereupon it will close again and operate automatically thereafter as above described, while if the supply pres-

sure is less than that which is intended to be maintained in the sprinkler system the valve 7, if closed, will remain closed unless the pressure in the sprinkler system falls off, whereupon the valve will be opened by the pressure due to the gravity tank and will remain open after the sprinkler system pressure and the supply pressure have been equalized and so long as they continue to be equal, or so long as the sprinkler system pressure is less than the intended amount. In other words, the sprinkler system pressure is regulated wholly by the gravity tank, subject to the possibility that the supply pressure may sometimes be insufficient to keep up the desired pressure in the sprinkler system.

My invention thus provides a regulating valve which is particularly serviceable in situations of the character above described, in that it is unaffected by an increase in the supply pressure but is quickly responsive to a reduction of pressure in the sprinkler system, this being due to what may be called the distinctive characteristic of my broad invention, namely, the employment of means for balancing the supply pressure on one side of the valve, in combination with an arrangement for exerting on the valve an independent force which is of constant amount and tends to open the valve but is normally overcome by the pressure in the sprinkler system.

The particular construction above described also has the useful features that the valve is a single-seating valve, that it is capable of a wide opening movement, and that it may be readily adapted to a sprinkler system extending to any given height by so regulating the independent valve-opening pressure as to produce any desired pressure in the sprinkler system, so long as this pressure is not greater than the pressure in the supply main. The employment of a gravity tank and pressure-operated means connected thereto affords a very convenient way of securing this regulation of pressure, and the compressible chamber in which the diaphragms are rigidly supported under normal conditions also constitutes a useful feature of my improvements, but all these features and details of construction and arrangement may be variously modified without departing from my broad invention above characterized, and the valve may be employed in various situations in which the regulation of pressure is desirable.

I claim as my invention:—

1. A regulating valve comprising a casing having inlet and outlet passages and an opening connecting the same, a valve controlling said opening and exposed on opposite sides to the supply and discharge pressures respectively, means comprising a compressible chamber for substantially balancing the pressure on the inlet side of the valve, said chamber being exposed externally to the supply pressure and internally to a less pressure, and means for applying to the valve an independent valve-opening force which is normally overbalanced by the discharge pressure.

2. A regulating valve comprising a casing having inlet and outlet passages and an opening connecting the same, a single-seating valve controlling said opening and arranged to open toward the inlet passage, a compressible chamber connected to the valve for substantially balancing the pressure on the inlet side of the latter, said chamber being exposed externally to the supply pressure and internally to a less pressure, means for exerting on the valve a closing force varying with the discharge pressure, and means for applying to the valve an independent pressure of constant amount in a direction tending to open said valve.

3. A regulating valve comprising a casing having inlet and outlet passages and an opening connecting the same, a valve controlling said opening and exposed on one side to the pressure in the inlet passage, and a compressible chamber connected to the valve and comprising a series of flexible annular diaphragms connected at their outer and inner edges in alternation, and rigid supports for the respective diaphragms when in normal position.

4. A regulating valve comprising a casing having inlet and outlet passages and an opening connecting the same, a normally-closed valve controlling said opening and having a projecting stem, a series of hubs mounted to slide on said stem, each hub being provided with a pair of rigid disks, other disks connected respectively to the valve and the casing, a series of flexible diaphragms each overlying one of the disks and normally supported thereby, and a ring connecting the outer portions of each pair of diaphragms carried by adjacent hubs.

5. A regulating valve comprising a casing having inlet and outlet passages and an opening connecting the same, a valve controlling said opening and arranged to open toward the inlet passage, compressible chambers located on opposite sides of the valve and connected thereto, said chambers being exposed externally to the pressures in the inlet and outlet passages respectively, and means for maintaining a constant pressure in the interior of the compressible chamber located on the outlet side of said valve.

6. A regulating valve comprising a casing having inlet and outlet passages and an opening connecting the same, a valve controlling said opening and arranged to open toward the inlet passage, a compressible chamber located in the inlet passage and comprising a series of flexible diaphragms

connected to one another and each provided with a rigid support when in normal position, a compressible chamber located in the outlet passage and comprising a series of flexible diaphragms connected to one another and having a greater effective area than the valve, said chambers being each connected to the valve, and means for maintaining a constant pressure in the interior of the compressible chamber located on the outlet side of said valve.

7. A regulating valve comprising a casing having inlet and outlet passages and an opening connecting the same, a valve controlling said opening and arranged to open toward the inlet passage, compressible chambers connected to the valve and subjected externally to the pressures on the opposite sides of the latter, the effective area of the chamber on the inlet side being substantially equal to that of the valve and the effective area of the chamber on the outlet side being greater than that of the valve, a gravity tank located above the valve, and pipe connections between said tank and the interior of the latter chamber.

8. A regulating valve comprising a casing having inlet and outlet passages and an opening connecting the same, a single-seating valve controlling said opening and arranged to open toward the inlet passage, a compressible chamber connected to the valve and exposed externally to the pressure on the inlet side thereof, said chamber having substantially the same effective area as the valve, a compressible chamber connected to the valve and exposed externally to the pressure on the outlet side of the same, a gravity tank located above the valve, and pipe connections between said tank and the interior of the latter chamber.

In testimony whereof, I have hereunto subscribed my name this 8th day of November, 1911.

ALBERT JOHN LOEPSINGER.

Witnesses:

WILLIAM F. JOYCE,

JOSEPH FRANCES CONLEY.