No. 662,559. Patented Nov. 27, 1900.

W. B. ERB.

DRY PIPE VALVE.

(Application filed July 31, 1896. Renewed June 16, 1899.)

(No Model.)

Fig. 1.

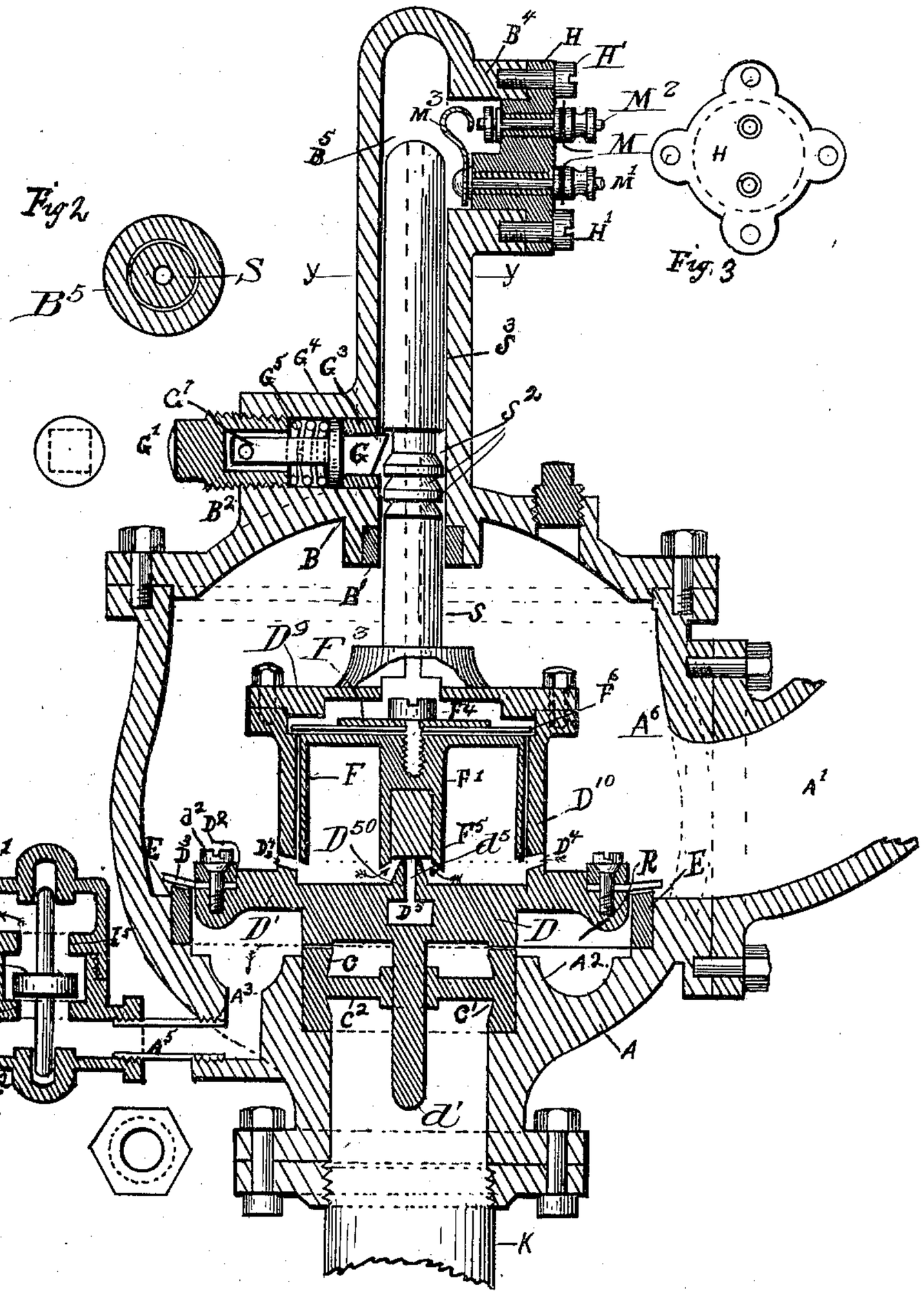

Fig. 2.

Fig. 3.

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DRY-PIPE VALVE.

SPECIFICATION forming part of Letters Patent No. 662,559, dated November 27, 1900.

Application filed July 31, 1896. Renewed June 16, 1899. Serial No. 720,845. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM B. ERB, a citizen of the United States, residing at Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Dry-Pipe Valves and Alarms, which are fully set forth in the following specification, reference being had to the accompanying drawings, forming a part thereof.

My invention relates to a so-called "dry-pipe valve," being a valve which operates in a dry-pipe fire-extinguisher system to control admission of water into the system of pipes upon the release of air from the system which results upon the burning out of the fuse of any sprinkler-head of the system.

In the drawings, Figure 1 is a central vertical section of my dry-pipe valve. Fig. 2 is a section at the line *y y* on Fig. 1. Fig. 3 is a side view of the electrical alarm.

A is the valve-body. B is the cap of the same.

K is the water-supply pipe, to whose terminal flange the valve-body is attached by means of a base-flange on the latter. The valve-body has a side outlet to which an elbow A′ is attached in a customary manner and affords the connection of the valve with the pipe system. The valve-body is provided with two seats concentric about the supply-pipe—to wit, the inner seat C, which is let into the body about the margin of the inlet-neck, and the outer seat E, which is an annular ring of considerably greater diameter than the seat C, let into the body concentric therewith. Both of these seats are preferably made of brass or similar metal, which may be faced and fitted accurately. The central seat C has a bridge C^2, which affords at its center a guide for the lower spindle d' of the valve. Its cavity or opening is enlarged at the plane of the bridge, as indicated at C′, to compensate for the space occupied by the bridge and preserve a practical uniform waterway. Between the two valve-seats the body of the valve is hollowed out in an annular cavity A^2 to increase the interseat-space R, and this space has communication through a port A^3 with the body of a valve which controls the drainage of said interseat-space, as will be more particularly hereinafter described.

D is the main valve, located within the chamber A. It is suitably faced to match the seat C, and from the central portion, which is thus seated, the flange D′ extends almost to the annular seat E, within which it is adapted to enter, and to said flange there is secured the flexible ring or washer D^3, which is adapted to seat on the annular seat E, said washer being secured to the valve-flange D′ by means of the screws d^2, set through the ring D^2, which binds the washer to the flange of the valve. The valve D has a coaxial upward extension D^{10}, which constitutes a cylindrical chamber which has a cap D^9. Said chamber communicates with a chamber of the valve-body by ports D^4 D^4, &c., at the lower part of the cylindrical chamber, and from the cap a stem S extends up through the cap B of the valve-body and into the hollow stem B^5, with which said cap is provided. In the valve D there is formed a transverse passage D^5, extending diametrically through the valve and opening at the ends below the flange into the interseat-space R. At the center of the valve on the upper side there is formed a small nipple D^{50}, through which a duct d^5 extends into said passage D^5, thereby completing communication from the cavity of the chamber D^{10} into the interseat-space R. Within the chamber D^{10} there is an inverted cup F, adapted to operate as a float or buoy, having a central stem F′, connected with and extending down from the upper diaphragm or head of said buoy a little lower than the lower margin of the latter. In the lower end of this stem F′ there is inserted a rubber plug F^5, which constitutes a valve which seats upon the top of the nipple to close the duct d^5, the seating-surface of the valve F^5 being above the level of the margin of the buoy and somewhat more above the level of the lower end of the stem in which said valve is secured. At the upper end the cavity of the chamber D^{10} is slightly enlarged immediately under the cap D^9, and on top of the cylindrical valve F a flexible washer F^6 is secured at the center by a rigid washer F^3 and bolt F^4, said flexible washer being of such diameter as to extend beyond the periphery of the cylindrical valve into the enlarged portion of the chamber D^{10} and to lodge or seat upon the shoulder or offset which constitutes

the lower boundary of said enlargement. The cap D^9 is recessed on the under side at the center to admit the head of the bolt F^4 and the washer F^3, so that when the cylindrical valve rises slightly the flexible washer F^6 seats against the under side of the cap. The stem S of the cap, which constitutes the upper spindle of the valve D, is axially apertured from end to end, said aperture S^3 constituting a communicating-duct between the cavity of the chamber D^{10} above the valve F and the space in the stem B^5 beyond the spindle S. Near the upper end of said spindle at one side there is formed an apertured boss B^4, whose aperture leads into the cavity of the stem B^5, said aperture being closed by the insulating plug or cover H, secured by bolts H', and through said insulating-plug are set binding-posts M' and M^2, to which are secured the electric-alarm circuit-wires M. To the inner end of the binding-post M' there is secured a spring M^3, which is bowed into the cavity of the stem B^5, so that the bow stands in the path of the upper end of the spindle S, while the return end of the bow stands opposite the inner end of the other binding-post M^2, but normally out of contact. The bow, however, protrudes so far into the path of the spindle S that when said spindle encounters it and forces it back contact is established between the free end of the spring and the binding-post M^2, and the electric circuit is completed. The spindle S at the lower end of the stem B^5 is guided in a suitable bushing B', let into the under side of the cap B, where a boss is provided for that purpose; but the spindle is at no point air-tight in its guideway. Above the guide-bearing thus provided the spindle S is encircled by a plurality of grooves S^2, forming ratchet-shaped teeth, and a catch-bolt G, adapted to engage said teeth when the bolt is pushed upward and to prevent its return until the bolt is withdrawn, is lodged in a chambered boss B^2, formed on the upper side of the cover at the base of the stem B^5, said bolt having a flange G^4, by which it is stopped between an inner sleeve G^3 and an outer cap-plug G', the spring G^5 being interposed between the flange G^4 and the cap-plug and adapted to throw the bolt inward. The bolt has a stem which extends into the cavity of the cap-plug, and said stem is provided with transverse projections G^7, by which when the cap-plug is screwed out the bolt may be engaged to withdraw its inner end from engagement with the annular ratchet-teeth of the spindle S.

The drainage-valve I for the interseat-space has its body made of two pieces I and I', the former being connected by a nipple A^5 to the drainage-port A^3 and the latter having suitable sewer connection by means of the pipe I^6. The valve I^3 is adapted to play between the seats I^4 and I^5, which are formed on the two parts of the valve-body, respectively, so that the valve is retained between said seats when the two parts of the valve-body are screwed together. The valve seats downwardly by gravity on the seat I^4 and is adapted to be lifted from its seat to permit a slow drainage of the interseat-space; but the sewer connection I^6 being between the levels of the valve-seats C and E it will be seen that the interseat-space will not be drained below the lower seat C, and when the valve D is lifted from its seat and the supply is admitted the pressure will immediately seat the valve I^3 upwardly against the upper seat I^5 and prevent overflow.

The operation of this structure, in connection with a dry-pipe system of fire-extinguishers, is as follows: Before the water is admitted through the pipe K, any suitable controlling-valve being interposed in such pipe, (not shown,) air will be pumped into the system until the pressure operating over the larger area of the valve to the limit of the outer diameter of the outer seat E will be sufficient to overbalance the water-pressure operating over the smaller area defined by the inner diameter of the seat C. In this condition the water will be held back from entering the system until by the melting of the fuse in any one of the sprinkler-heads of the system the air-pressure is relieved, whereupon water-pressure operating against the under side of the valve D, although over the limited area exposed to such pressure, will lift the valve from the inner and smaller seat C, the elastic washer D^3, which constitutes the seating-surface of the valve at the larger outer seat, permitting a slight movement away from the inner seat before it will leave the outer seat; but the water-pressure thus admitted to the interseat-space R operates first to close the valve I^3 and then immediately to lift the main valve against which it operates over the entire larger area defined by the diameter of the seat E. The valve thus lifted is engaged and latched open by the spring-bolt G, so that it is not liable to close by any changes in the pressure which may occur afterward until it is released by the withdrawal of the spring-bolt, which may be done by unscrewing the cap G' and pulling back the bolt, as above described. When the valve is thus lifted from its seat, the upper end of the spindle S operates against the contact-spring M^3 and closes the alarm-circuit, causing the alarm to be sounded simultaneously with the entrance of the water in the system. It will be observed that the water will rise in the valve-chamber A only slightly above the point A^6, because the air contained above that point has not escaped and the water can rise no farther than it can compress the air. It will be observed that as soon as the water rises high enough to pass through the ports D^4 into the chamber of the main valve it will seal the mouth of the inverted cup F, which thereby becomes a float and is lifted by the head of water outside the valve until the washer F^6 seats against the lower or inner side of the cap D^9 and prevents the water from ris-

ing any higher in the annular space between the valve and the cup or float, (except as the air in said space may be slightly compressed,) thus keeping the duct S^3 and the chamber B^5 above the valve-stem free from water, which, if it should occupy said spaces, would close the alarm-circuit without regard to the movement of the main valve. The construction described, therefore, while permitting free air communication through the spindle S between the cavity of the chamber A and the cavity above the spindle in the stem B^5 nevertheless preserves the advantage of a substantially hollow valve, which may thereby be made very much lighter than would be otherwise possible consistently with its volume of water displaced. This is very greatly to the advantage of the device, making it very much more sensitive than it would otherwise be, and for the same purpose I prefer to make the entire valve D of aluminium or other very light metal.

One of the difficulties experienced in the use of dry-pipe valves in sprinkler systems is the liability to accumulation of water by drip or drainage from the system of pipes after they have been once filled and substantially emptied, but not absolutely dried in their inner surfaces, such drainage being often sufficient not only to cover the valve, but to accumulate a column of water in the system, this result being commonly spoken of as "columning" the valve. When this occurs, it is evident that to the extent of the weight of such water column on the valve the sensitiveness of the device is destroyed, and it may easily happen that the valve might be entirely prevented from opening even upon the relief of the air-pressure by the melting of the fuses in the sprinkler-heads, and thus the automatic action of the system would be prevented. To overcome this difficulty is one of the purposes of the present invention, and it is effected in the operation of the device in the manner which will now be described. The valve being closed and the dry-pipe system charged with air under pressure as in use, the position of the parts will be as shown in Fig. 1. If under these circumstances water accumulates in the valve-chamber by drainage from the system, it will pass through the port D^4 into the chamber D^{10}, accumulating therein until it rises to the lower edge of the inverted cup F, and it will further rise in this cup only to such an extent as the pressure of the accumulated water in the system may operate to compress the air under the inverted cup. The first effect of such compression will be to cause the cup to rise, lifting the valve F^5 off of its seat at the upper end of the nipple D^{50} and uncovering thus the mouth of the duct d^5, which leads into the passage D^5, and thereupon if the water rises higher than the top of the nipple the excess will pass out through said duct and passage into the inter-seat-space R, and if it accumulates therein to the height of the pipe connection I^6 it will be drained off, passing the valve I^3, into the sewer. The mouth of the duct d^5 at the top of the nipple D^{50} being substantially at the level of the lower outer margin of the cup or float at the position occupied by the latter when the valve is seated and the range of movement of such cup or float until it is stopped by the seating of the washer F^6 against the under side of the cap D^9 being only such as to bring the lower edge of the stem approximately to the level of the top of the nipple, it will be seen that the cavity under the cup or float will always remain substantially water-sealed, because before the cup is lifted the level of water outside it must have reached a point a little above the lower outer margin of the cup in order to produce the compression of air under the cup which measures the weight of the latter, and that as the water flows out through the nipple the float will descend as the level is lowered and the lower end of the stem F′ will pass the level of the nipple in such descending movement before the valve becomes seated and while the water-level still extends up in the cup the distance which measures the compression of the air therein due to the weight of the cup, and this condition will continue until the valve F^5 seats upon the top of the nipple. The descent of the float being thus arrested, the valve at first rests without sensible pressure upon its seat, and the water will be still forced out slightly past it by the reaction of the air under the cup until the pressure of the valve on its seat, due to the relief of the air-tension and consequent operation of the unsupported weight of the cup, stops the escape of the water. The reaction of the air compressed under the cup may continue until the water-level is forced back to the level of the outer margin of the cup before the flow into the nipple will entirely cease; but on account of the extension of the margin of the stem F′ below the level of the outer margin of the cup the air is effectively retained in the chamber and prevented from passing out through the nipple. This is essential. Otherwise the compressed air, whose presence in the system holds the main valve seated so long as the sprinkler-heads are closed, would be lost and the water-pressure through the pipe K would open the main valve and flood the system.

It will be seen that the height of the apertures D^4 determines the depth to which water will be retained in the globe, and these apertures are located above the level of the seat E and valve-flange D^3, which rests thereon, in order that said seat may be water-sealed, thus insuring more perfect sealing than could be maintained between dry surfaces. It will be noticed also that the height of the nipple D^{50} determines the height at which the water will be retained in the chamber of the valve, and this is therefore made, as stated, about the

level of the lower margin of the inverted cup at its lowest position, so that that cup may always be kept substantially water-sealed, as above described, in order that the slightest accumulation of water above the normal level will tend to lift the float and uncover the mouth of the duct d^5 to permit the water to escape. This prevents any large accumulation of water occurring before the opening of the valve and so causes the flow through the duct d^5 to be never any more rapid than the drip or drainage of the water from the wet walls of the system. The amount of water thus passing through the system is never sufficient to lift the valve I^3 to its upper seat in the casing I, and the escape of the water thus drained off is therefore never prevented by this valve. The same result is aimed at by making the duct d^5 so small relatively to the aperture in the valve-seat I^4 and around the valve I^3 that even with a considerable head of water accumulated in the system the flow through said duct d^5 would not be sufficient to carry up the valve I^3 to its upper seat.

It will be noticed that in order to obtain the result above described, consisting in the drainage of water out of the system by way of the interseat-space below the main valve in a manner to prevent columning of the water, it is necessary that the final overflow point—to wit, the port I^6, beyond the valve I^3—shall not be higher than the level to which it is necessary to reduce the water in the system in order to prevent such columning effect and practically it is desirable that it should be not higher than the upper surface of the valve, so that so far as the location of this port is concerned it may be possible to draw all the water from above the valve, the only purpose of retaining any water being to seal the seats and prevent them from becoming dry, which tends to prevent perfect seating. It is also necessary evidently for the result sought that the float device which opens the drainage-passage should be located so as to be operated by a head of water not greater than it is safe to allow to accumulate above the valve. If the first precaution is overlooked, the back pressure of the water retained in the passage between the interseat-space and the discharge-orifice I^6 may counterbalance the air-pressure and cause the valve to open and permit the system to be flooded. If the second precaution is overlooked, the head of water which would accumulate before the float operates might be sufficient to cause so rapid an outflow as to seat the valve I^3 upward and in this manner cause the water-pressure of the accumulated column to operate upon the under side of the main valve between the seats and open said valve and admit the water to flood the system. Both these results, contrary to the intention of my invention, are prevented by the structure shown, in which the float is located in a position to be operated by a very slight accumulation of water and in which not only is the final discharge-orifice I^6 below the level of the seat E, but also the duct d^5, by which accumulated water must reach the valve I^3, is so restricted that except in case of a very great head of water in the system not enough could pass said duct to lift the valve I^3.

I claim—

1. In combination with a dry-pipe fire-extinguisher system, a valve which controls the same comprising a body or chamber; a differential or two-seated main valve controlling entrance of the water to the chamber, the valve having a passage leading from its inner or discharge side into said interseat-space; a valve which controls said passage, and a buoy or float operatively connected to said valve to open the same when the buoy rises, and adapted to be lifted by accumulation of water in the main-valve chamber, the interseat-space having a drainage passage and outlet; a drainage-valve therein which is normally open, but adapted to be seated by a rapid discharge of water through such drainage-passage, the first-mentioned passage being restricted relatively to such drainage passage or outlet, whereby the valve in the latter passage is not closed by flow of water derived through the first-mentioned passage.

2. In combination with a dry-pipe fire-extinguisher system, a valve which controls the same comprising a body or chamber; a differential or two-seated main valve controlling entrance of water to the chamber, said valve having a passage leading from its inner or discharge side into said interseat-space; a drainage-passage from said interseat-space having a final outlet at a level between the two seats of the main valve; the passage from the main-valve chamber to the interseat-space being at its entrance and also at its highest point, slightly above the level of the outer seat, whereby said seat is kept water-sealed with slight pressure of water thereon; a subsidiary valve which controls said passage, and a float which operates it; said float being located near the level of said entrance and being adapted to be lifted by slight accumulation of water above said level; whereby the outflow through said passage due to accumulation in the chamber when the main valve is closed is feeble.

3. In a valve for controlling a dry-pipe fire-extinguisher system, the body or chamber; a differential or two-seated main valve controlling entrance to the chamber; the interseat-space having a drainage-outlet near the level of the upper seat, said main valve having a hollow chamber D^{10}, immediately above the level of said upper seat; ports leading into said chamber slightly above said level; a drainage-passage leading from within said chamber to the interseat-space; a float in said chamber, and a subsidiary valve operated thereby to control said drainage-passage, the outlet from the interseat-space being free when the main valve is closed.

4. In a dry-pipe fire-extinguisher, in com-

bination with a valve-casing having bottom outlet and differential valve-seats encompassing the same and one encompassing the other, and a drainage-outlet from the interseat-space; the differential main valve adapted to seat on both seats and having above the outer seat and within the valve-chamber a chamber D^{10}, having ports D^4, leading into it from the main-valve chamber; a drainage-passage leading from it through the body of the valve to the interseat-space, the inverted cup F within said chamber D^{10} adapted to operate as a buoy having the stem F′ recessed at the end and carrying the valve F^5 at the limit of said recess, the outer lower margin of said stem being slightly lower than the lower outer margin of the cup; the nipple D^5 having the mouth of said drainage-passage in its upper end arranged to intrude into the recess in the stem of the float and to afford the seat for said valve.

5. In an automatic fire-extinguisher system, the water-controlling valve comprising a body or casing having discharge for water leading to the system, and having an upwardly-extending hollow stem for the guidance of the main-valve spindle, closed at the upper end, a differential or two-seated main valve within the casing, having its stem or spindle guided in the hollow stem of the body; drainage-passages from the cavity of the body leading into the cavity of the hollow main valve and thence into the interseat-space; a subsidiary valve within the main valve controlling said drainage-passages, the main-valve spindle having a duct affording air communication from the cavity of the hollow main valve above the subsidiary valve to the upper part of the cavity of the hollow guide-stem of the body.

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