

Dec. 23, 1958

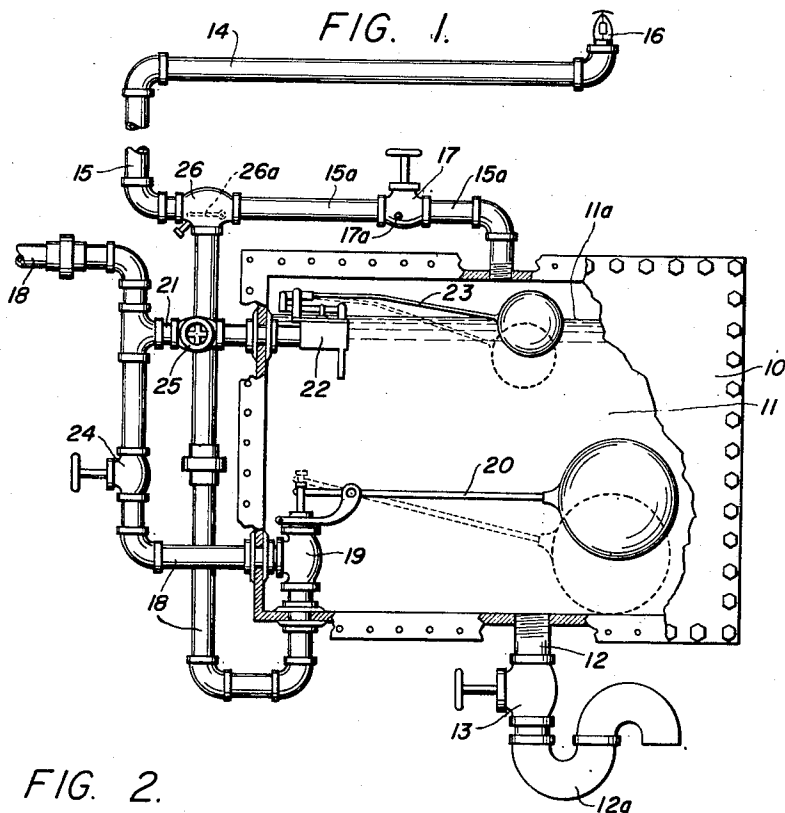
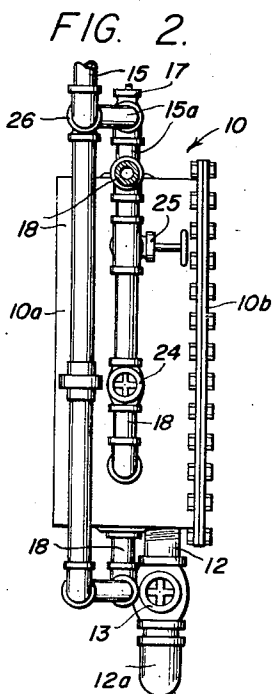
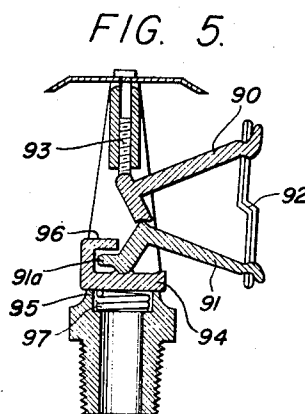
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2,865,457

FIRE EXTINGUISHING SPRINKLER SYSTEM OF DRY-PIPE TYPE

Filed Aug. 8, 1957

4 Sheets-Sheet 1



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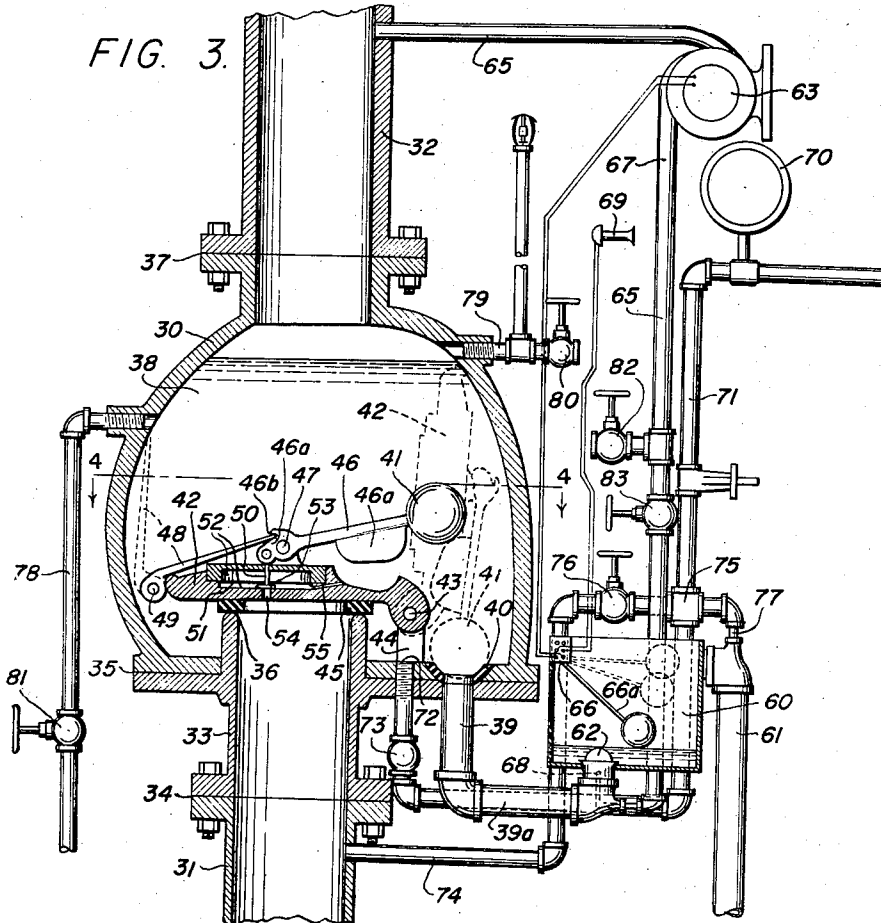
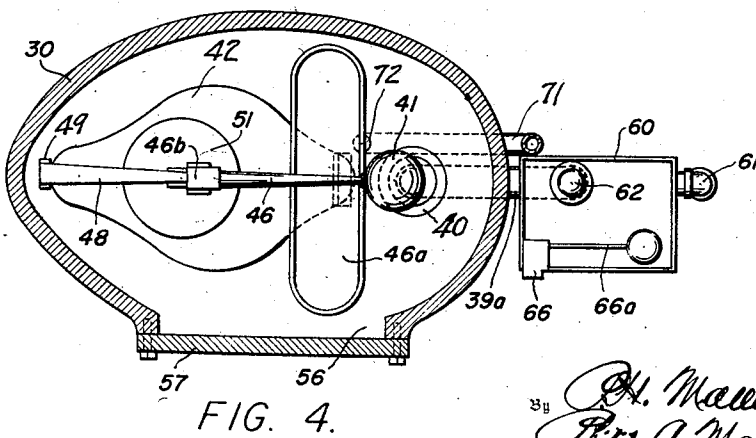
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FIRE EXTINGUISHING SPRINKLER SYSTEM OF DRY-PIPE TYPE

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4 Sheets-Sheet 2



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FIRE EXTINGUISHING SPRINKLER SYSTEM OF DRY-PIPE TYPE

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4 Sheets-Sheet 3

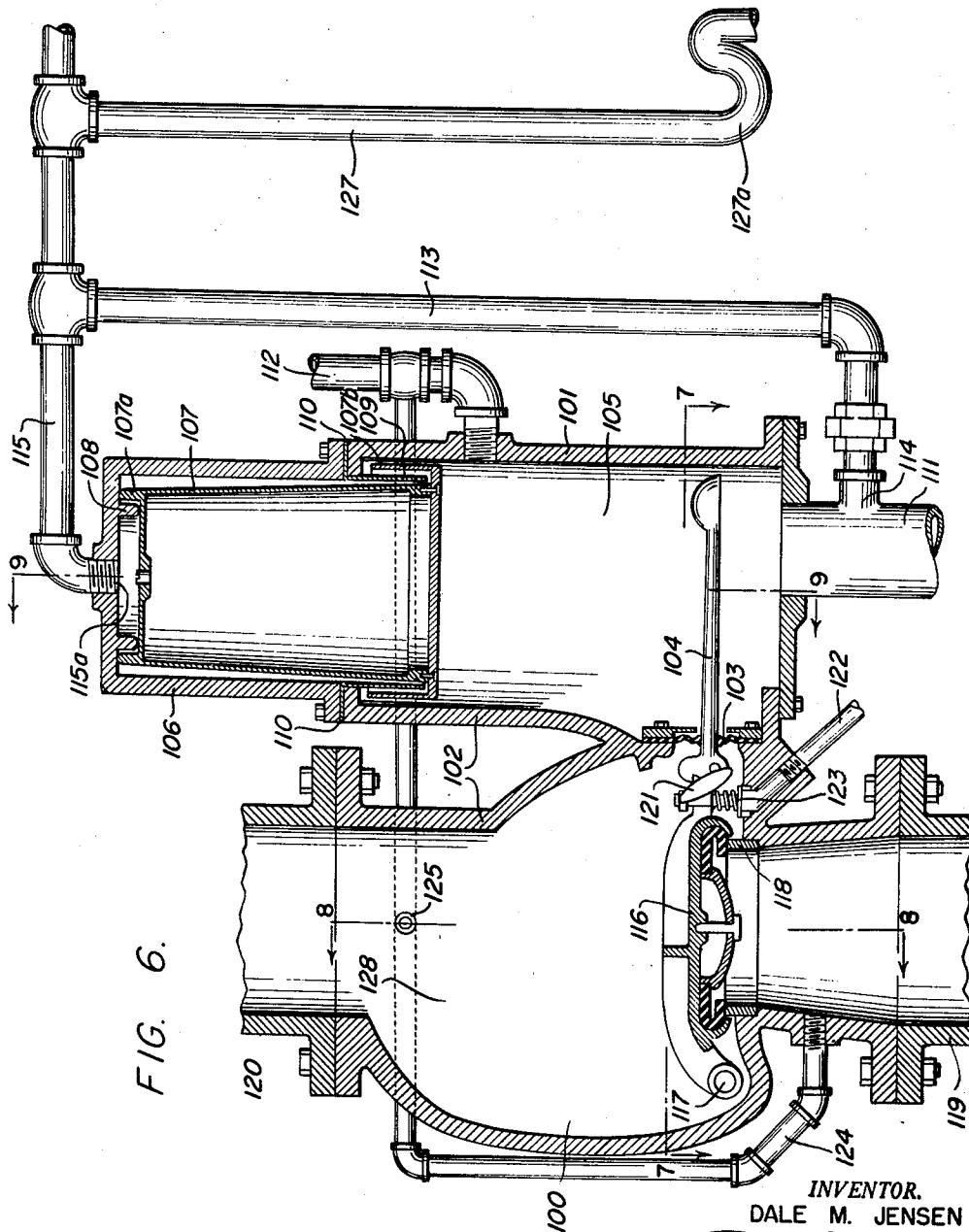


FIG. 6.

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2,865,457

FIRE EXTINGUISHING SPRINKLER SYSTEM OF DRY-PIPE TYPE

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22 Claims. (Cl. 169—17)

This invention relates to automatic sprinkler systems as installed in buildings and other structures for the purpose of extinguishing fires. It relates particularly to so-called dry-pipe systems, wherein the sprinkler-equipped, water distribution piping is normally maintained free of water.

Many automatic sprinkler systems for fire extinguishing purposes are installed in unheated warehouses and industrial establishments where at least portions of the distribution piping leading to the numerous sprinkler heads are likely to be exposed to freezing temperatures. Under such circumstances, it is undesirable to have such distribution piping constantly filled with water.

In order to take care of this condition, fire sprinkler systems have been designed to have the distribution piping thereof normally maintained empty, this being accomplished by providing for the introduction of compressed air into such distribution piping. When undue heat opens one or more of the sprinkler heads in conventional fashion, the air pressure is dissipated, causing a control valve to open and pass water into the distribution piping from the water supply main.

These compressed air systems are in use extensively, but have numerous disadvantages, both from the standpoint of cost and of operation. The pressure of the compressed air in the distribution piping must drop from a normally maintained 30 pounds per square inch to approximately 12 pounds per square inch before the water release valve will open and permit water to flow into the distribution piping and out through the particular sprinkler heads which have been opened. Accordingly, complicated and expensive accelerator mechanisms are customarily included in such systems to open the water release valve in advance of the above-mentioned pressure drop, that is to say, when there is a pressure drop of only approximately 5 pounds per square inch from that normally maintained.

Furthermore, not only are there bothersome leakage problems by reason of the relatively high pressure which must be normally maintained in the distribution piping, but there is often condensation of moisture, which can and often has in practice accumulated at low points in the system, thereby rendering these dry-pipe systems susceptible to the very danger they are designed to avoid, namely, stoppage or breakage of portions of the system by reason of freezing of water in the distribution lines.

An additional disadvantage of these compressed air, dry-pipe systems is that the air escaping in advance of the water can be a very real menace, in that such air supplies needed oxygen to smoldering materials, and often fans fires into activity which would otherwise not occur.

In accordance with the present invention, these disadvantages are overcome by maintaining the interior of the distribution piping at or somewhat below atmospheric pressure, rather than above, as in conventional compressed air systems.

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While so-called vacuum dry-pipe systems have been proposed heretofore, they have not had any significant commercial use, largely because of various impractical structural and functional features involved in the systems as proposed.

Accordingly, the principal object of the present invention is to provide a practical and commercially satisfactory automatic fire sprinkling system of dry-pipe character, wherein the water distribution piping leading directly to the sprinklers is normally maintained below atmospheric pressure.

An outstanding feature of the invention resides in the fact that a body of water is normally maintained in static condition relative to an open drain by means of a simple water trap, such body of water serving as the control agency with respect to valve mechanism governing flow of water from the water supply system into such water distribution system.

In operation, the opening of one or more of the sprinkler heads will immediately expose the upper surface of the control body of water to atmospheric pressure, and will, thereby, cause it to rapidly descend through the drain. Lowering the water level of this normally maintained body of water will, by suitable means provided for the purpose, result in opening the valve mechanism that normally closes off flow of water between the water supply piping and the water distribution piping of the system.

It should be noted that, in the operation of this system of the invention, there is no intensive expelling of air through the open sprinkler heads in advance of the water, as there is in compressed air systems. Even though some air be present in the dry distribution piping, it is not under high pressure. In fact, it is usually at less than atmospheric pressure, and the water will actually be accelerated in its flow, rather than retarded, thereby attaining at least as great speed of travel to the sprinkler head as is attained by the use in conventional compressed air systems, of expensive accelerators and related equipment.

Further advantages of the system of the invention reside in the fact that, if anything, a relatively inexpensive vacuum pump is utilized, as against an expensive air compressor, to maintain the dry condition of the sprinkler piping; that the system is less expensive to maintain than conventional compressed air systems; that there is no danger of tripping the system by reason of surges in water pressure in the water supply piping; and, especially significant, that the system may be recharged in a matter of approximately 30 seconds as compared to approximately 30 minutes or more for compressed air systems.

Further objects and features of the invention will become apparent from the following detailed description of the preferred specific embodiments illustrated in the accompanying drawings.

In the drawings:

Fig. 1 represents an elevation, shown partly in vertical section, of one form of dry-pipe system in accordance with the invention, the valve mechanism being illustrated in its normally closed position, but the opened position thereof being indicated by dotted lines;

Fig. 2, an end elevation of the same, looking from the left in Fig. 1;

Fig. 3, a view corresponding to that of Fig. 1, but illustrating a more preferred form of the system for most industrial installations;

Fig. 4, a horizontal section taken approximately on the line 4—4 of Fig. 3;

Fig. 5, a central vertical section through a type of sprinkler head adapted for use with the dry-pipe system of the invention;

Fig. 6, a vertical section through another construction

of control valve and tripping mechanism therefor as installed in a pilot line type of system, the section being taken on the line 6—6 of Fig. 7;

Fig. 7, a horizontal section taken on the line 7—7 of Fig. 6;

Fig. 8, a vertical section taken on the line 8—8 of Fig. 6;

Fig. 9, a vertical section taken on the line 9—9 of Fig. 6; and

Fig. 10, an elevation partly in vertical section and somewhat diagrammatic in character representing an alarm system for indicating a break in the sprinkler distribution lines.

Referring to the drawings:

In the embodiment of Fig. 1, a closed tank 10, having a removable cover 10b tightly sealed thereto, is adapted to contain a body of water 11, which is normally maintained in static condition relative to a normally open drain 12 by means of a water trap 12a.

While, for convenience of maintenance, a manual shut-off valve 13 is interposed in the drain piping 12, such valve is normally maintained open, so that, in use, the body of water 11 is constantly subject to drainage from the tank 10, given only the required atmospheric pressure at the surface 11a of the body of water 11.

Sprinkler distribution piping, which is usually extensive for any given installation, is here represented by the single branch 14, extending from a main distribution line 15 and equipped with one or more sprinkler heads 16. The main distribution line 15 has a pilot portion 15a leading from the top of the tank 10 above the top surface 11a of the body of water 11, and both the main and the pilot portions are normally maintained in open communication with the several sprinkler branches of the system, but, for convenience of maintenance, there is provided a manually controlled shut-off valve 17 in the pilot portion 15.

The distribution piping, including all of the sprinkler branches 14, the main line 15, and the pilot line 15a, represents a system which is normally closed off from the atmosphere, so that atmospheric pressure is not exerted therethrough. Accordingly, the body of water 11 normally remains suspended within the tank 10, regardless of the open drain 12.

Water supply piping 18 leads into and out of the tank 10 at a low level therein, and has a float-actuated valve 19 interposed therein within the confines of the tank, the float 20 of such valve 19 being normally submerged below the surface of the body of water 11 and in position maintaining the valve closed.

The water supply piping 18 connects with the water supply system of the building within which the fire sprinkler system is installed, and advantageously has a branch 21 leading into the tank 10 at a high level therein for filling the tank originally, as well as following each discharge of the body of water 11 therefrom. A float-actuated valve 22 of conventional construction normally maintains the branch supply piping 21 closed by reason of the action of the body of water 11 on its float 23.

A manually operated shut-off valve 24 is provided in the water supply piping 18, and a similar valve 25 in the branch piping 21.

The water supply piping 18 connects with the distribution line 13, conveniently through the body of a check valve 26, provided for the purpose of cutting off the pilot line 15a from communication with the sprinkler distribution piping during the time that water is flowing into the sprinkler system. It should be noted that the check valve is normally maintained open by the action of gravity on its swinging valve flapper 26a.

In the operation of this embodiment of the invention, the shut-off valve 13 in the drain 12 is closed and the shut-off valve 25 opened for initially introducing the body of water 11 into the tank 10, the flow of water through branch pipe 21 being shut off automatically by the float valve 22 when the proper level has been reached. Shut-

off valve 24 is also closed during this initial filling period, as a matter of convenience.

When the level of water in the tank 10 has reached that normally maintained, and the supply of water has been shut off by float valve 22, the valve 25 is closed and the valves 13 and 24 opened, it being understood that the stop and waste valve 17 in the pilot line 15a is now opened, it having been closed during the filling period, and its waste cock 17a having been opened, for the purpose of eliminating, from the system, air displaced from the tank 10.

The system is now in the static, though constantly ready, condition normally maintained to insure substantially immediate operation of such sprinklers 16 as may be opened upon occurrence of fire in the vicinity thereof or of sufficiently elevated temperatures to cause them to open. Since the dry distribution piping 14, 15, and 15a of the system are normally closed against the atmosphere, the pressure exerted on the surface of the body of water 11 in the tank 10 will be appreciably less than atmospheric. Accordingly, there will be no run off of water from the body 11 through the open drain 12, and float valve 19 will effectively close off water flow through water supply piping 16.

When, however, one or more of the sprinkler heads 16 is opened, atmospheric pressure, communicated through the dry distribution piping 14, 15, and 15a to the upper part of the interior of tank 10, causes the body of water 11 to discharge through the open drain 12. The rapidity of such discharge will, of course, be determined by the quantity of water involved and by the size of the drain passage. Ordinarily, these are predetermined to give maximum rapidity of discharge.

As the body of water 11 passes from the tank, the float 20 drops, and valve 19 opens to permit water from the main lines 18 to flow into and through the distribution piping and out of those sprinkler heads 16 which may be open, it being noted that check valve 26 prevents back flow into tank 10. This flow will continue, of course, until shut-off valve 24 is manually closed.

While it is not always necessary to provide a vacuum pump in communication with the distribution piping 14 and 15, it is advantageous to do so in order to reduce any pressure therein which may be caused by minute leaks in such piping. The provision of same is not illustrated in this embodiment, though a convenient way of doing so is illustrated and described with respect to the more preferred embodiment illustrated in Figs. 3 and 4.

In the system of Figs. 3 and 4, the equivalent of the tank is provided by a special pipe fitting 30 interposed between the water supply piping 31 and the main distribution line 32 leading to the several sprinkler branches.

The special pipe fitting 30 is utilized in conjunction with a second special fitting 33 which is secured directly to the water supply piping 31, as by means of the flanged connection 34, and which is secured to the bottom of fitting 30 as by means of the flange connection 35, so that an annular valve seat formation 36 thereof projects into the hollow interior of the fitting 30 somewhat above the floor thereof.

The special fitting 30 advantageously connects with the distribution piping 32 by means of a flange connection 37, thereby providing a compact and conveniently installed structure capable of retaining a body of water 38 required for effectuating the purposes of the invention.

A drain pipe 39 enters the fitting 30 through the floor thereof at one side of the valve seat 36, and, for the purpose of closing off the drain at such times as water is being supplied to the distribution line 32 from the water supply line 31 by way of the interior of the fitting 30, the floor surrounding the entry of drain pipe 39 into the fitting 30 is formed to receive a resilient valve seat 40, which, in turn, is formed to receive and seat a ball valve 41.

The arrangement of structure in this embodiment is

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such that the valve structure utilized to normally close off flow through the water supply line 31 is also utilized, when opened, to close off the drain line 39, and that such valve mechanism is float-operated in response to the presence of the body of water 38 within the hollow interior of the fitting 30, or of the discharge thereof through the drain 39.

As here illustrated, such valve mechanism comprises a movable cap valve member 42 hinged on a pin 43 to swing relative to the valve seat 36. The pin 43 may be conveniently journaled in a pair of ears 44 projecting outwardly from the valve seat structure below the seat proper and immediately above the drain valve seat 40.

A sealing ring 45 is attached to the lower face of the valve cap 42 for seating directly upon the annular valve seat 36.

As above mentioned, the valve cap 42 is float operated, so as to close and to be maintained closed by the buoyant action of the body of water 38 normally maintained in static condition in the hollow interior of the fitting 30.

For this purpose, and also for providing the movable valve member for the drain valve, namely, the ball 41, such ball, serving both as a float and a valve member, is fastened to the top of the valve cap 42 by means of an arm 46 pivoted centrally of the cap as by means of a pin 47 journaled in spaced upstanding ears 48. For aiding the valve-closing action of the float 41, such arm 46 is advantageously cupped, as at 46a.

The free end of pivoted arm 46 is formed as a latch keeper 46b, and normally engages a latch arm 48 pivoted at 49 diametrically opposite hinge 43 of the valve cap.

Thus, the valve cap 42 is securely latched in closed position under the buoyant action of float 41.

The placement of the ball float 41 in its mounting on the top of valve cap 42, as described above, is such that, when the valve cap 42 is swung forcibly back from its valve seat by the pressure of water flowing through the supply piping 31 and the fitting 33, it seats firmly upon the drain valve seat 40, and closes off drainage from the interior of the fitting 30.

In order to make the opening action of the valve cap 42 more positive, and to utilize the pressure in the water supply line as an aid to unlatching the float-locked valve cap at the appropriate time (when the level of the body of water 38 drops below the ball float 41), the free end of arm 46 is articulatively attached to a stem 50, which extends through and is secured to a diaphragm 51 stretched across a normally closed chamber 52 provided within the body of the valve cap 42. Such stem carries a valve disk 53 at its free end for seating over and closing a passage 54 leading from the under-face of the valve cap 42 into the chamber 52 below the diaphragm 51. A bleeder passage 55 extends from the chamber 52, below the diaphragm, to the top of the valve cap, so that water pressure cannot build up below the diaphragm.

In this embodiment, the trap 39a of the drain 39 leads into a tank 60 at a low level therein, while auxiliary drain piping 61 leads from such tank at a relatively high level therein. A float check valve 62 is advantageously provided across the inlet of trap piping 39a to the tank 60, for the purpose of preventing back flow from tank 60 under conditions of thermal contraction of the system.

The tank 60 serves as a control agency for a vacuum pump 63, which has its intake line 65 connected into the distribution line 32 at some convenient location, for example, that shown.

Starting and stopping of the vacuum pump 63 is effected by an electrical switch 66 having a float-carrying actuating arm 66a positioned for being raised and lowered in accordance with the level of water in the tank 60, it being realized that, normally, the water in such tank is at a low level, but that the level is raised at such times as leakage in the dry-pipe distribution line 32 leading

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to the sprinklers causes discharge of a portion of the body of water 38 normally maintained in the fitting 30. A discharge of sufficient water to fill tank 60 to a level causing switch arm 66a to close the switch 66 will start vacuum pump 63 operating, thereby evacuating such distribution line 32 of the air introduced by the leakage.

The discharge line 67 from the vacuum pump 63 advantageously connects into the trap portion 39a of the drain piping 39, and terminates in a restricted discharge orifice 68 disposed immediately below the float check valve 62. This means that the vacuum pump and its connecting lines are sealed off from the atmosphere at all times. The restricted nature of the discharge orifice 68 permits air evacuated from the distribution lines by the vacuum pump to bubble through the water in tank 60 without disrupting the system.

In order to give an audible alarm when there is a break or other leakage in the distribution line of so serious a character that the vacuum pump 63 cannot take care of it, the switch 66 is provided with a second pair of contacts arranged to be closed when the float arm 66a is raised to a predetermined higher level than is necessary to initiate operation of the vacuum pump. A low-pressure air horn 69 may be electrically connected with such second pair of contacts, so as to be actuated when the float arm reaches such predetermined higher level. This arrangement also provides for the giving of an alarm in the event of failure of the vacuum pump 63. A third pair of contacts may be provided at a higher level, for the purpose of shutting off the vacuum pump when the system is tripped.

The horn 69 is merely for the purpose of issuing an audible warning in the vicinity of the building where the system is installed. The customary electric alarm, indicated 70, for transmitting a fire alarm to a fire station is here provided in an auxiliary water pressure line 71 leading from open communication, at 72, with the interior of the fitting 30 to communication with the usual water bell (not shown). A float check valve 73 is interposed in such line 71 immediately below its inlet 72, so as to normally prevent back flow, into fitting 30, of water from the water bell and from lines interconnected therewith.

In order to provide a way for testing the alarm 70, a pressure line 74 is conveniently provided from communication with the water supply piping 31 to communication, as indicated at 75, with the alarm control line 71, a manually operated shut-off valve 76 being interposed in such line 74 to normally shut off flow therethrough, but to permit testing when desired.

Such test line 74 and the main alarm line 71 conveniently connect to drainage by means of the restricted flow passage 77.

In order to fill the fitting 30 with water initially and following each emptying thereof, a water supply pipe 78 advantageously leads into such fitting 30, and similarly, for predetermining the level of the body of water 38 introduced into the fitting 30 by such piping 78, an overflow 79 is provided, discharge through the same being controlled by the manual shut-off valve 80, and the inflow of water to the fitting 30 being controlled by the manual shut-off valve 81.

In connection with the exhausting of the air from the closed, dry pipe, distribution lines, it is advantageous to provide a manually controlled exhaust valve 82 in the discharge line 67 leading from the vacuum pump 63, and, also in this connection, to provide a shut-off valve 83 at a point in such line lying more remote from the vacuum pump than the exhaust valve.

This second embodiment of the invention operates in much the same manner as that first described, it being possible here, however, to obtain any desired partial evacuation of the dry-pipe distribution lines, within practical limits, because of the vacuum pump 63.

When opening of one or more sprinkler heads (not shown here), introduces atmospheric pressure to the in-

terior of fitting 30 above the normally maintained body of water 38 therein, drainage of such body of water will immediately occur through the open drain 39, whereupon ball valve 41, following the lowering level of the receding water, and positively urged by the supply water pressure manifested on valve disk 56 and diaphragm 51, will unlatch the latch arrangement 46b—48, and will permit the pressure of the water supply in line 31 to forcibly displace valve cap 42 into the dotted line position indicated in Fig. 3, with the ball float 41 seating firmly over the drain opening, at 40.

This means that the full force and volume of water supplied through line 31 will pass through fitting 30 and into the sprinkler distribution system by way of line 32.

At the same time, this water flow will be manifested, through piping 71 by way of inlet 72, at the electric alarm 70 and at the water bell, so that the alarm will be given at station headquarters and at the proper valve box. Also, drainage of the body of water 38 through tank 60 will raise float arm 66a to the predetermined high level required to actuate the horn 69, thereby giving an audible alarm in the vicinity of the system. Float arm 66a will also be raised to the higher level required to break the vacuum pump circuit.

Following the extinguishing of the fire, the main water supply through line 31 will be shut off by any suitable valve provided for the purpose (not shown), and the valve cap 42 will be re-locked into its closed position by manually resetting the latch members 48 and 46b by way of access opening 56. It should be here noted that such access opening is normally closed by a suitable cover 57.

In all embodiments of the invention, special sprinkler heads or special installation of conventional sprinkler heads will be required, considering the evacuated nature of the dry-pipe distribution system.

Thus, in the special sprinkler head illustrated in Fig. 5, release arms 90 and 91 maintain a heat-fusible link 92 in tension, as is customary, by reason of force exerted by set screw 93, thereby pressing closure plate 94 tightly against the nozzle opening 95. Here, however, the closure plate is provided with a raised and intumed lip 96, which overhangs an extended foot member 91a of the lower arm 91, so that the latter will effectively kick the closure plate from its seat over the nozzle opening when link 92 is fused.

While the provision of a kicker spring 97 is also illustrated in the sprinkler head installation of Fig. 5, such spring is usually necessary only when a conventional sprinkler head (without kicker foot and lip) is employed.

Installers of fire sprinkler equipment are going more and more to systems wherein one or more rate-of-rise temperature devices for releasing the water control valve are incorporated in a pilot line strategically extended throughout the structure to be protected from fire. These systems may be of either preaction or deluge type.

The embodiment of Figs. 6-9 shows such a pilot line system conforming to the present invention.

For this purpose, the body of liquid utilized for valve control is maintained in a receptacle whose interior is closed off from the valve chamber. Such receptacle is normally closed to the atmosphere, and the pilot line communicates therewith. Within the receptacle are means for controlling the opening of the normally closed valve mechanism in the valve chamber upon drainage of the body of liquid from the receptacle.

As illustrated, the valve chamber 100 and receptacle 101 are disposed side by side in a duplex valve body 102, and are partitioned off from each other in a water-tight manner by means of a flexible diaphragm 103 that accommodates passage of a valve-latching trip lever 104 from the interior of the receptacle into engagement with the valve mechanism proper in the valve chamber.

The receptacle 101 normally contains a body of water 105, and is extended upwardly by means of an inverted cup cover 106 to accommodate a buoyant weight 107 that

is normally supported therein by reason of the buoyancy of the body of water 105. As illustrated, the buoyant weight is fabricated from a cup-shaped member provided with annular water-retaining flanges 107a and 107b at its opposite ends.

Water seals for air are effected at both the upper and lower ends of such buoyant weight by reason of annular members 108 and 109 depending within the receptacle and into the troughs provided by the flanges 107a and 107b.

The annular member 108 is advantageously provided as a rib depending from the inner face of the upper end of cover 106, while annular member 109 is advantageously provided by a separate ferrule 110 held in place between receptacle 101 and its aforesaid cover 106.

Valve-tripping lever 104 is disposed directly below buoyant weight 107, so as to be actuated by dropping of the latter when the body of water 105 drains from the receptacle through drain piping 111. As in the embodiment previously described, this occurs when such body of water is exposed to atmospheric pressure, here by the opening of pilot line 112 to the atmosphere due to excessive heat acting on the rate of rise and/or fixed temperature devices thereof (not shown). Such devices are well known, and need not be described here in detail.

Pilot line 112 enters receptacle 101 below the buoyant weight 107, so that, as the body of water 105 drains out of the receptacle, the afore-described water seals prevent passage of air upwardly about such buoyant weight. Inasmuch as the upper part of the receptacle is closed to the atmosphere, the buoyant weight is maintained in its elevated position as the water drains away from beneath it. Until released, it remains so poised for dropping forcefully upon the valve-latching trip lever 104.

To release the buoyant weight, provision is made for opening the upper part of the receptacle above the water seals to the atmosphere when the body of water 105 has dropped from the receptacle.

This is conveniently accomplished by a pipe line 113, which establishes communication between the bottom and the top interior of the receptacle. In the construction shown, pipe line 113 opens into drain pipe 111 immediately below the receptacle, at 114, and interconnects with a vacuum pipe line 115 that opens into the receptacle at 115a through the top of cover 106.

Air from pilot line 112 cannot pass through pipe line 113 until the body of water 105 drains past the lower open end 114 thereof, and, by that time, buoyant weight 107 is free to drop forcefully upon valve-latching trip lever 104. This happens, of course, when the atmospheric pressure of the air suddenly releases such buoyant weight by breaking the vacuum otherwise holding it in elevated position.

Vacuum pipe line 115 extends to a vacuum pump (not shown) corresponding to 63 of the embodiment of Fig. 5.

Such pump is used to suck air through the water seals for normally maintaining pilot line 112 under a slight vacuum. It also insures a vacuum condition within the receptacle above buoyant weight 107.

The valve mechanism in valve chamber 100 is essentially of conventional type. It comprises a valve closure cap 116, pivoted at 117 to swing upon and away from stationary valve seat 118 and normally held in tightly closed position, sealing the inflow port of water supply line 119, by means of the latching heel 104a of valve-latching trip lever 104. When such trip lever is suddenly and forcefully pushed downwardly by the dropping of buoyant weight 107 thereupon, valve closure cap 116 is released and is pushed open by the force of the supply water rushing from line 119 toward distribution sprinkler system 120.

As is customary in valves of this type, a latch 121 is provided to prevent re-seating of the valve closure cap 116 until such latch is manually released.

It will be noted that an alarm line 122, corresponding to the alarm line 71-73 of the embodiment of Fig. 3,

is normally closed by a spring-pressed valve 123, which opens upon the opening of valve closure cap 116.

A water supply line 124 conveniently extends from connection with the main water supply in the lower part of valve body 102 to a valved (not shown) connection 125 with the upper part of chamber 100 above the valve mechanism and to a valved (not shown) connection 126 with pilot line 112, for introducing water into valve chamber 100 and into receptacle 101, respectively, under independent manual control as and when necessary.

Thus, following any tripping of the valve-latching trip lever 104 for test purposes or otherwise, receptacle 101 may be easily refilled with water. As a safeguard against damage to the vacuum pump in the event too much replacement water is permitted to flow into receptacle 101 and to rise into vacuum line 115, an overflow drainage line 127 is connected to such vacuum line. Drainage line 127 corresponds to 61 in the embodiment of Fig. 3, and has a trap 127a.

It should be noted that, where a pilot line is employed, as in this embodiment, the distribution sprinkler system may be either of pre-action or deluge type. Where of pre-action type, it is preferred that a body of water 128 normally be maintained in valve chamber 100 for alarm purposes, this being introduced through supply line 124.

In Fig. 10 is illustrated an alarm system operated by such body of water 128. As shown, a tank 130 is disposed within the bend of a U-pipe arrangement extending below valve body 102 and having upstanding legs 131 and 132.

Leg 131 of the U-pipe connects tank 130 with the bottom of valve chamber 100, while leg 132 connects such tank with an elevated and open water storage reservoir 133. Flap valves 134 and 135 hang in permanently unseated and partially open condition over the openings of legs 131 and 132 into tank 130, so that water may normally trickle slowly from one leg to the other by way of the tank.

During night coolness, the air in distribution sprinkler piping 120 contracts and water passes slowly from reservoir 133 and through tank 130 into valve chamber 100, to compensate for such contraction. The quantity of water in reservoir 133 is so proportioned relative to the volumetric capacity of distribution system 120 that atmospheric air follows the water, thereby more or less regularly supplementing the air in the system. During the warmth of the day, the movement of water is reversed and air exhausts through the reservoir.

Tank 130 is provided with a tight cover 136 in which is a plug 137 having a small orifice therethrough for the escape of air. The ebb and flow of water and air from day to night and vice versa keeps a body of air 138 trapped in the tank above a body of water 139.

A float 140 rises on the surface of the water 139 and serves to close a normally open electric switch 141 if and when such float rises beyond a predetermined level within tank 130. Flap valves 134 and 135 are provided with normally open electrical switches 142 and 143, respectively, which are subject to being closed when the respective flap valves are pushed open by water discharging suddenly and voluminously from the respective legs of the U-pipe. The several switches are connected in an alarm circuit (not shown) of any desired type for giving audible and/or visual alarm when any one of the switches is closed.

Breakage in distribution sprinkler system 120 will open valve chamber 100 to the atmosphere, whereby water in either one leg or the other of the U-pipe, as the case may be, will be released and descend suddenly and voluminously into tank 130, opening either flap valve 134 or 135, and giving an alarm by reason of the closing of its switch contacts, either 142 or 143.

If the water is so proportioned between the two legs of the U-pipe when the breakage occurs that no vo-

luminous descent of water is effected from either leg, disturbance of the normal ebb and flow of water in the system by its being opened to atmospheric pressure will result in the filling of tank 130 with water, due to hydrostatic pressure, and in the forcing of the air 138 out of tank 130 through the orifice in plug 137. The rising water in tank 130 will close float switch 141, giving the alarm.

Thus, under any circumstances, an alarm will be given should breakage occur in the distribution sprinkler system.

A construction which is now preferred makes use of the vacuum-breaking pipe 113 as a guide for the descent of buoyant weight 107. Such presently preferred construction also utilizes a liquid which is heavier than water, for example, carbon tetrachloride or mercury, to seal off the air at the upper and lower ends of the buoyant weight.

Thus, buoyant weight 107 is modified by thickening the central area of its top wall to a height somewhat short of the top of flange 107a, so as to define, together with such flange 107a, an annular trough into which annular rib 108 depends. Such trough and the lower trough defined between lower flange 107b and the body of the buoyant weight are filled with carbon tetrachloride, mercury, or other sealing liquid heavier than water, rather than with water as in the immediately preceding embodiment. This has been found to provide a more positive seal under all conditions than does ordinary water.

Pipe 113 is removed from the position shown in Fig. 6, and is positioned within the receptacle 101 and through buoyant weight 107, advantageously along the longitudinal central axis thereof.

As so arranged, the upper end of pipe 113 extends through the top wall of buoyant weight 107 and opens thereat into the upper portion of the interior of receptacle or container 101. To accommodate the lower end of such pipe 113, trip lever 104 desirably has the interfering portion of its length offset and drain piping 111 is desirably centered with respect to the longitudinal central axis of receptacle 101. Obviously, there are other ways in which the lower end of such re-positioned pipe 113 can be accommodated without interfering with its function as a central guide upon which buoyant float 107 slides.

The lower end of pipe 113 preferably extends down into drain piping 111 sufficiently to enable it to be anchored in place by a supporting spider within and secured to such drain piping.

Arranged in this way, pipe 113, not only serves as a guide for buoyant weight 107, but its open lower end is more advantageously placed for the exertion, with respect thereto, of an injector action by the body of water descending from the receptacle or container 101 through drain pipe 111. This tends to insure maintenance of a vacuum condition above buoyant weight 107 until complete drainage of the body of water from below the buoyant weight and past the lower open end of re-positioned pipe 113 releases such buoyant weight by exposing such lower open end of pipe 113 to the atmosphere.

While re-positioned pipe 113 extends snugly through appropriate receiving openings provided through the top and bottom walls of buoyant weight 107, the fit is not so snug as to exercise any restriction against free sliding action of such buoyant weight with respect to the pipe.

Whereas this invention is here illustrated and described with respect to certain preferred forms thereof, it should be understood that various changes may be made within the scope of the claims thereof, without departing from the essential inventive concepts here taught.

The present application constitutes a continuation-in-part of my formerly allowed and co-pending application Serial Number 587,535, filed May 28, 1956, which is itself a continuation-in-part of my previously allowed application Serial Number 400,708, filed December 28, 1953,

entitled "Dry-Pipe, Automatic, Fire Extinguishing, Sprinkler System," both of which are now abandoned.

I claim:

1. In a dry-pipe fire extinguishing sprinkler system having water distribution sprinkler lines which are normally maintained dry, and water supply piping in communication with said water distribution lines, the combination of a closed container for a body of water, normally sealed against the atmosphere; a normally open drain leading from said container at a low level thereof; water trap means interposed in said drain below said container; valve means interposed in said water supply piping for opening and shutting off flow through said piping; valve control means disposed within said container for maintaining said valve means closed when a body of water is maintained within said container and for opening said valve means when the said body of water drains from said container; and means normally closed to the atmosphere but in open communication with the interior of said container, said means opening to the atmosphere under conditions of extreme heat for causing said body of water to drain from said container.

2. The combination recited in claim 1, additionally including a vacuum pump; and means establishing fluid flow interconnection between said vacuum pump and the water distribution sprinkler lines.

3. The combination recited in claim 2, additionally including a tank into which the water trap discharges; and control means within said tank and connected with the vacuum pump for starting and stopping the latter in accordance with the level of water in said tank.

4. The combination recited in claim 3, wherein the water trap opens into the tank through the bottom thereof; and wherein a check valve is provided thereat, for normally preventing back flow from the tank into the water trap, while permitting free flow from the water trap into the tank.

5. The combination recited in claim 4, wherein there is provided an air conduit from the discharge of the vacuum pump into the water trap, said line having a restricted discharge orifice disposed below the check valve.

6. The combination recited in claim 1, additionally including a vacuum pump; means establishing fluid flow interconnection between said vacuum pump and the water distribution sprinkler lines; a tank into which the water trap discharges; control means disposed within said tank and connected with said vacuum pump for starting and stopping the latter in accordance with the level of water in the tank; and signal control means associated with said vacuum pump control means for actuation at a level of water in the tank above that required to start the vacuum pump operating, said signal control means being connected with an alarm device, for actuating the latter.

7. The combination recited in claim 1, wherein the closed container is a pipe fitting of the nature of valve body interposed substantially vertically between the water supply piping and the water distribution lines, with its lower part connected to the water supply piping and its upper part to the water distribution lines; wherein the valve means comprises a valve seat within said valve body and extending about the opening of said water supply piping into the valve body, and a movable valve element normally seated over said valve seat to close off the supply of water; and wherein means are provided within said valve body for closing the drain when said valve is open.

8. The combination recited in claim 7, wherein the movable valve element is a closure cap pivoted to swing between the valve seat and the drain opening; wherein the means for maintaining the valve closed and for opening the valve comprises a latch member carried by the said cap and pivoted on the upper face of the latter, and a keeper for said latch member, said keeper being pivotally attached to the valve body; and wherein the means for closing the drain comprises a float member secured to

said latch member for normally maintaining it in latched engagement with said keeper member by reason of the buoyancy of the static body of water normally contained by the valve body, and for seating across the drain opening at such time as drainage of said static body of water unlatches said valve cap and releases flow of water from said water supply piping.

9. The combination recited in claim 8, wherein the latch member includes an elongate arm, to the free end of which the float is secured; and wherein there is additionally included an open-topped vessel attached to said arm between said float and the latch proper.

10. The combination recited in claim 9, additionally including means defining a closed chamber within the valve cap; a diaphragm dividing said chamber horizontally; a plunger secured to said latch member and extending through said diaphragm; and a restricted passage leading from the underside of said valve cap to the lower part of said chamber in alignment with said plunger, so as to be normally closed by the latter.

11. The combination recited in claim 1, wherein a water-pressure-actuated alarm system connects with the interior of the valve body, for actuation at such times as the valve means is open.

12. The combination recited in claim 1, wherein the closed container is a tank, through the lower portion of which the water supply piping passes; wherein the valve means is interposed in the portion of said water supply piping located within said tank, and is of float-actuated type; wherein auxiliary water supply piping communicates with the interior of said tank at an upper level therein; and wherein a float-actuated valve is associated with said auxiliary water supply piping within said tank, for controlling inflow of water to said tank.

13. The combination recited in claim 12, wherein a main distribution pipe extends from communication with the top of the interior of the tank to communication with the sprinkler lines; wherein the water supply piping connects with said main distribution pipe following passage of the former through the tank; and wherein a check valve is interposed in said main distribution pipe to prevent flow of sprinkler water into said tank.

14. The combination recited in claim 1, wherein the closed container is provided by one section of a duplex valve body; the water supply piping communicates with the water distribution lines through the other section of said valve body; the valve means is disposed within said other section of the valve body; and means are provided sealing said one section of the valve body from said other section thereof.

15. The combination recited in claim 14, wherein the closing means comprises a flexible, waterproof diaphragm; and the valve control means comprises a valve-latching trip lever extending from the container, at a low level thereof, into the said other section of the duplex valve body and into latching relationship with said valve means through and in sealed engagement with said diaphragm, a buoyant weight within said container, and means maintaining said buoyant weight spaced upwardly from said trip lever until the body of water drains from said container.

16. The combination recited in claim 15, wherein the last-named means comprises liquid seal means between the buoyant weight and the upper portion of the container, and means defining an air-flow passageway extending from the drain above the water trap means to the interior of the container above said water seal means.

17. The combination recited in claim 16, wherein the air-flow passageway defining means comprises an open-ended pipe disposed vertically within the container and upon which the buoyant weight is mounted for vertical sliding movement, the open upper end of said pipe communicating with the container above said buoyant weight and the open lower end of said pipe communicating with the container below the valve-latching trip lever.

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18. The combination recited in claim 17, wherein the liquid means is of a type heavier than water.

19. The combination recited in claim 1, wherein the distribution sprinkler lines include the last-named means in direct association therewith.

20. The combination recited in claim 1, wherein a pilot pipe line embodying at least one rate-of-rise temperature device constitutes the last-named means.

21. The combination recited in claim 1, wherein there is additionally provided a breakage alarm system comprising a vertically positioned U-pipe having the upper end of one of its legs connected in flow communication with the water distribution lines in proximity to the valve means; a closed tank interposed in the bend portion of said U-pipe; a reservoir open to the atmosphere at the upper end of the other leg of said U-pipe and in flow communication therewith; normally slightly open valves interposed between the respective legs of said U-pipe and said tank, each of said valves being openable by the weight of a column of water within its corresponding leg of the U-pipe; respective alarm means associated with said valves and actuated by the opening of the latter, respectively; means defining a restricted outflow passage for air in the top of said tank; and float actuated alarm means at a high level in said tank.

22. A water supply control valve for dry-pipe fire extinguishing sprinkler systems, comprising a valve body

having mutually spaced ports for the connection of a water supply pipe line and a sprinkler pipe line, respectively; valve mechanism within said valve body normally closing off flow of water between said ports; means for opening said valve mechanism to permit water to flow from said water supply pipe line into said sprinkler pipe line; container means normally closed off from the atmosphere for normally confining a body of water about the valve-opening means; water-buoyant means associated with said valve-opening means and adapted to be normally maintained in buoyantly elevated position in said body of water; means defining a drain at a low point in said container means, for connection with drain piping; and means normally closed to the atmosphere but in open communication with the interior of said container means, said normally closed means opening to the atmosphere under conditions of extreme heat for causing said body of water to drain from said container.

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