United States Patent

[11] **3,548,860**

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[45] Patented **Dec. 22, 1970**

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[54] **SELF-DRAINING VALVE FOR FLUID DISTRIBUTION SYSTEMS**
12 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **137/289,** 137/307, 137/525, 137/596.2, 137/625.68, 251/231
[51] **Int. Cl.** **E03b 9/14**
[50] **Field of Search** ..... 137/272, 281, 289, 301—303, 307, 308, 525U.S., 625.67, 625.68, 596.2(Inquired); 251/147

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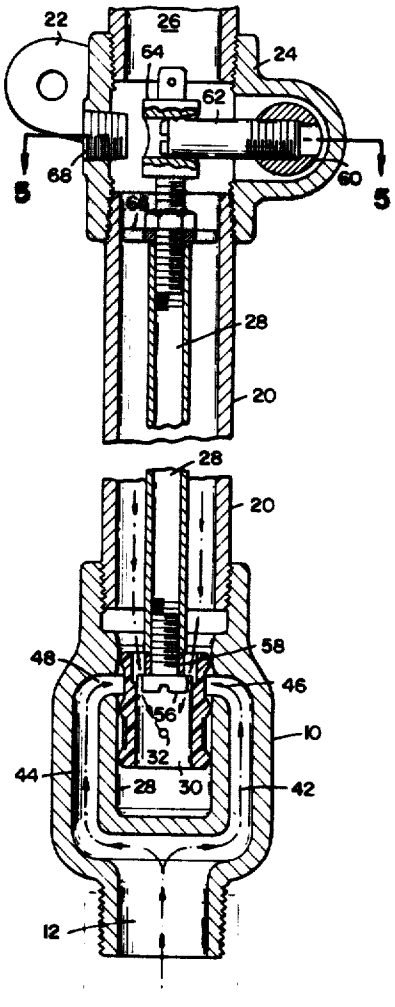
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ABSTRACT: A self-draining valve having an inlet port, an outlet port, a drainage port, and a moveable valve member which automatically couples the drainage port to the outlet port when the inlet and outlet ports are uncoupled, thereby automatically draining the valve and its associated outlet conduit whenever the valve is turned off. To provide freezeproof properties, the valve is buried at a depth greater than P/D below the frost line, where P is the maximum ground water pressure at the drainage port and D is the density of the fluid to be controlled by the valve. When buried, the valve is remotely controlled by means of a linkage which extends downwardly within the outlet conduit to the interior of the valve, where it is connected to the moveable valve member. A check valve prevents fluid from entering the valve through its drainage port without blocking the discharge of fluid therefrom.



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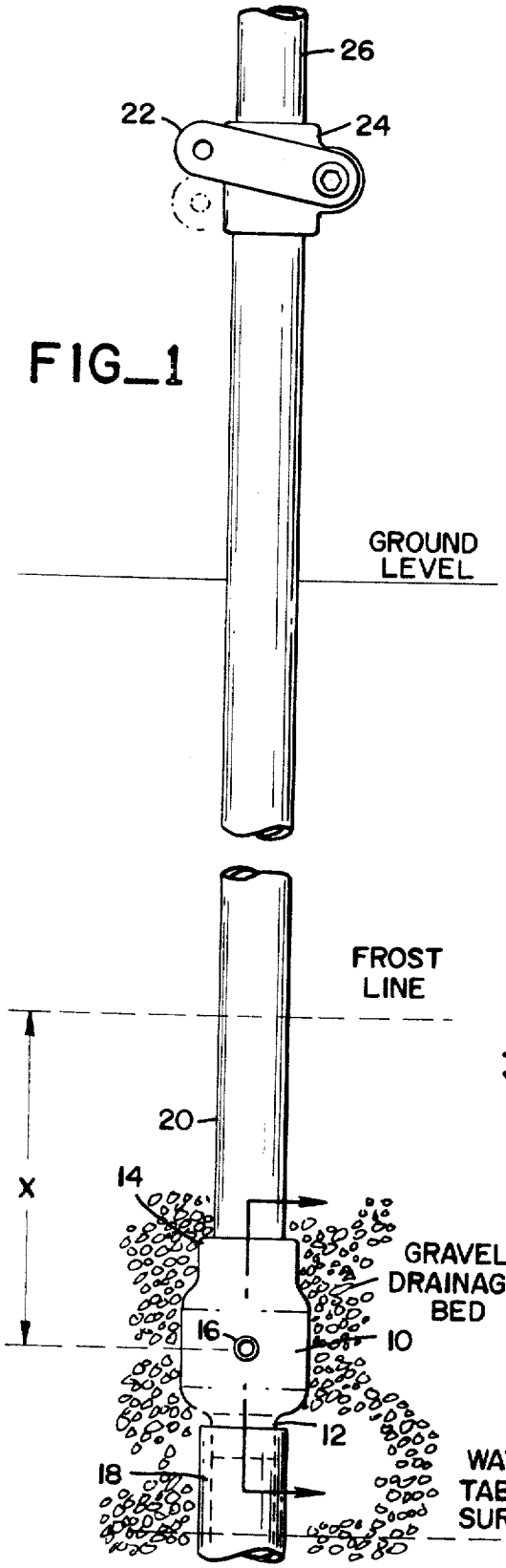


FIG_1

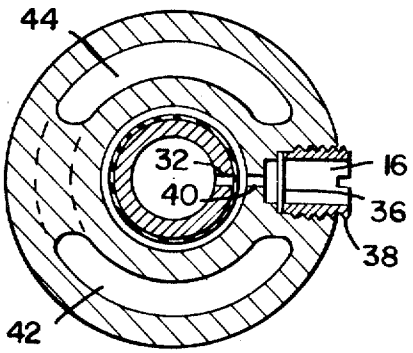


FIG_3

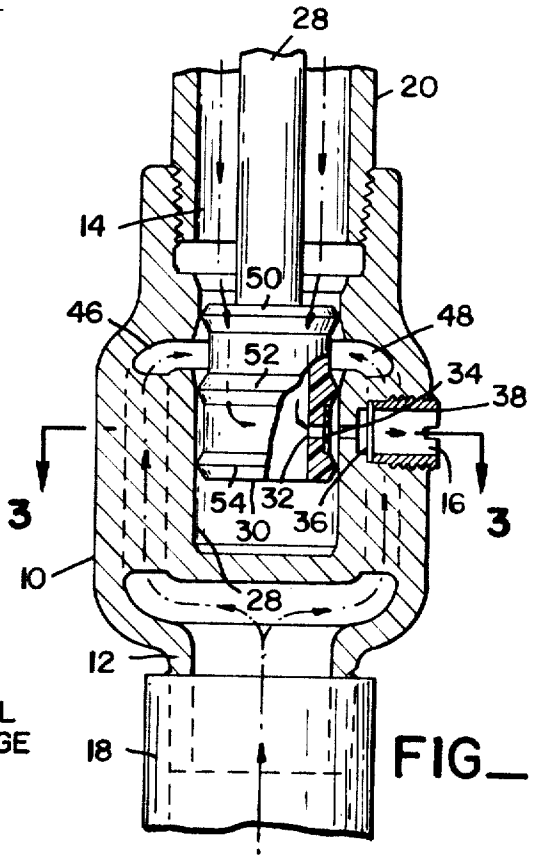


FIG_2

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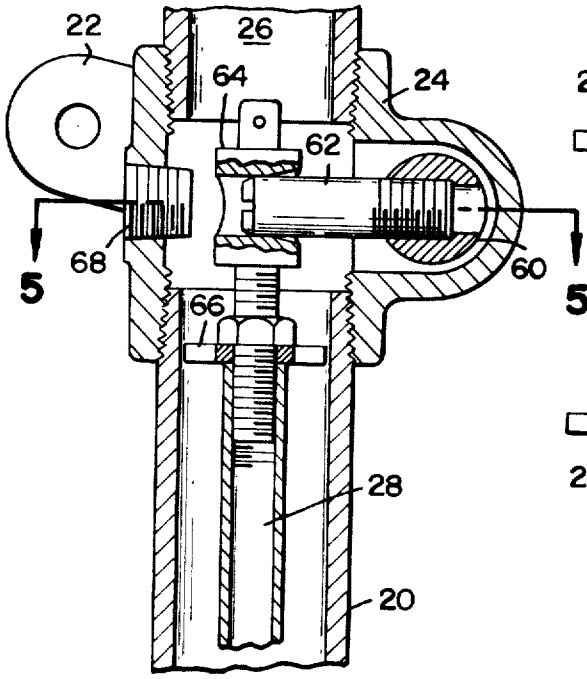


FIG_4

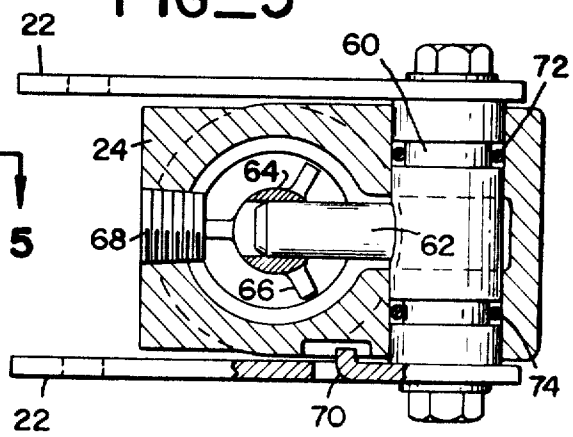


FIG_5

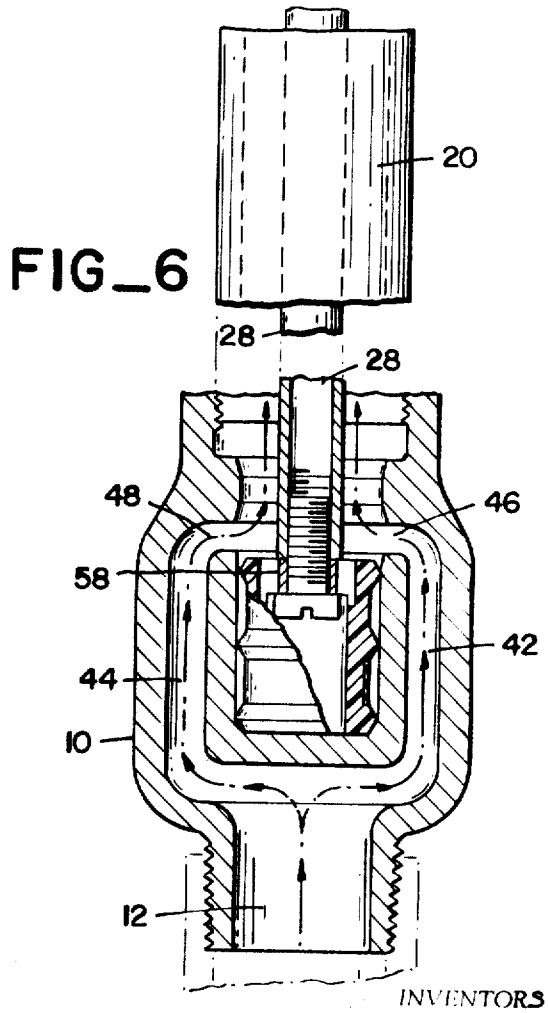


FIG_6

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SELF-DRAINING VALVE FOR FLUID DISTRIBUTION SYSTEMS

This invention relates to valves for a fluid distribution system, and more particularly to a self-draining valve which is adaptable for use in a freezeproof fluid system.

In many fluid distribution systems it is essential to insure that the system will function with a high degree of reliability in spite of severe cold, even when the heating system associated with the fluid distribution system has failed. Common examples are fire hydrants, water supply systems for hospital operating rooms, water supply systems for decontamination showers in atomic energy installations or in other installations which utilize radioactive materials, and chemical distribution systems for automated processing equipment. In these, as in many other fluid distribution systems, no failures due to freezing can be tolerated under any condition.

Heretofore, fluid distribution systems were protected from the cold through the use of insulation or auxiliary heating systems or both. These methods, however, failed to provide the level of reliability that is necessary for critical situations which involve human lives or expensive, large scale chemical processing operations. .Auxiliary heaters are as prone to failure as normal heating systems, and the best insulation can do no more than delay the ultimate time of freezing in the absence of a source of heat. Accordingly, the principal object of this invention is to provide a valve which can be used to completely eliminate the possibility of freezing in fluid distribution systems under the most adverse conditions.

In accordance with this invention, the possibility of freezing can be completely eliminated through the use of a novel self-draining valve containing an inlet port, an outlet port, a drainage port, and a moveable valve member which automatically couples the drainage port to the outlet port when the inlet and outlet ports are uncoupled, thereby automatically draining the valve and its associated outlet conduit whenever the valve is turned off. The valve is connected in the fluid supply line at a depth greater than P/D below the frost line for the fluid to be controlled thereby where P is the maximum ground water pressure at the drainage port and D is the density of the fluid. The valve is remotely controlled at the ground level or above, e.g., by a mechanical linkage arm which extends downwardly within the outlet conduit to the interior of the valve, where it is connected to the moveable valve member to open and close the valve. When the valve is closed, the moveable valve member automatically connects the outlet port to the drainage port, thereby automatically draining the outlet conduit below the frost line for the fluid involved. A check valve prevents fluid from entering the valve through its drainage port without blocking the discharge of fluid therefrom.

The above-noted arrangement completely eliminates the possibility of freezing under any conditions. When the valve is turned on, all of the fluid in the system is above its freezing temperature due to having been drawn from beneath the frost line. The motion of the fluid provides an additional impediment to freezing, so that the fluid will flow normally even when the outlet conduit itself is below the freezing temperature for the fluid. Moreover, when the outlet conduit is below the freezing temperature, the flow of fluid will raise the conduit temperature above the freezing level so that the fluid above the frost line will not freeze while it is in the process of being drained below the frost line after the valve has been closed. The thin film of fluid which adheres to the inside of the outlet conduit after it drains will, of course, freeze under these conditions, but this thin film will be almost instantly melted by the warm fluid from below the frost line the next time the valve is turned on. Thus the valve of this invention completely eliminates the possibility of freezing under the most adverse conditions and raises the reliability of the fluid distribution system to a level which is limited only by the reliability of the fluid supply pressure and the mechanical reliability of the valve itself.

In addition, this invention provides a novel self-draining valve which is particularly simple in construction and reliable in operation. The preferred embodiment of the valve contains a substantially cylindrical valve chamber within the valve housing with a hollow piston slidable within the valve chamber between and "off" position and an "on" position. The interior of the hollow piston is in fluid communication with the outlet port in all positions of the piston, and an opening in the wall of the piston connects the interior of the piston to the drainage port in the piston's "closed" position. The switching action for the inlet, outlet, and drainage ports is effected by three spaced piston rings which encircle the piston and bear against the wall of the valve chamber to effect a fluid seal. In the preferred embodiment of the invention, the piston and piston rings comprise a unitary structure which is made of a resilient material such as teflon or the like. The outlet port is coaxial with the piston and opens into the outlet end of the valve chamber so that a mechanical linkage can be run down the interior of the outlet conduit and attached directly to the piston. It will be apparent to those skilled in the art that a valve structure of this type is not only simple and effective but also extremely reliable.

Although the self-draining valve of this invention has many applications other than use as a freezeproof valve, the freezeproof application will be described by way of example in the detailed description which follows. It should be understood, however, that this invention is not limited to freezeproof valves but rather includes all applications of the novel self-draining valve disclosed herein.

Other objects, advantages and features of the invention will become apparent from the following detailed description presented in conjunction with the accompanying drawing, in which:

FIG 1 is a view in elevation of a self-draining valve embodying the principles of the present invention, shown connected in a water supply line so as to render the line freezeproof;

FIG. 2 is a view in cross section taken along line 2–2 of FIG. 1, with the valve in the closed position;

FIG. 3 is a view in cross section taken along a line 3—3 of FIG. 2;

FIG. 4 is a fragmentary view in elevation and in section with a central portion broken away showing the valve of FIG. 1 in its closed position and rotated 90° from the view of FIG. 2;

FIG. 5 is a cross-sectional view taken along the line 5–5 of FIG. 4; and

FIG. 6 is a fragmentary view in elevation and in section showing the valve of FIG. 1 in its open position.

With reference to the drawing, FIG. 1 shows one illustrative self-draining valve of this invention connected to a water supply line so as to render the water supply freezeproof The valve housing **10** has an inlet port **12**, an outlet port **14**, and a drainage port **16**. Inlet port **12** is coupled to a water supply line **18** below the frost line and above the surface of the water table. A gravel drainage bed is provided between the water table surface and drainage port **16** to facilitate the drainage of water from drainage port **16** to the water table. It should be noted, however, that it is not necessary for valve **10** to be located above the surface of the water table. If necessary, valve **10** can be located below the surface of the water table. This will slightly retard the drainage of water from drainage port **16**, and limit the level of drainage to the water table surface, but it will not alter any of the essential functions of the valve or reduce its effectiveness.

The outlet port **14** is coupled to a standpipe **20** which extends upwardly to a water faucet, shower, or other water outlet. A valve operator arm **22** is attached to the standpipe **20** above ground level by a special coupling **24** which will be described in detail later. The coupling **24** joins the standpipe **20** to an outlet conduit **26** and contains a mechanical linkage member **28** (FIG. 2) which extends downwardly within the standpipe **20** to the interior of the valve housing **10**.

FIGS. 2 and 3 show the interior of the valve housing **10**. A cylindrical valve chamber **28** is formed within the valve hous-

ing 10 and a hollow piston 30 is movable within the valve chamber 28 between an upper and a lower position. The valve chamber 28 is closed at its lower end and limits the downward movement of the piston 30. The upward movement of piston 30 is limited within the special coupling 24 as will be described later.

The hollow interior of piston 30 is in direct fluid communication with the outlet port 14 in all positions of the piston. An opening 32 is positioned in the wall of the piston 30 so as to be aligned with drainage port 16 when the piston 30 is in its closed position, which is illustrated in FIGS. 2 and 4. Water then drains downward through the standpipe 20, the outlet port 14, the hollow interior of piston 30, and then through the opening 32 out drainage port 16. A band of resilient material 34 is located directly over opening 32 on the exterior of piston 30 to act as a check valve which prevents water from entering the valve through the drainage port 16 without blocking the flow of water in the opposite direction.

When valve housing 10 is located below the surface of the water table, there will, of course, be a back pressure applied to check valve 34 which will limit the drainage of standpipe 20 to the surface of the water table. In cases where the fluid in standpipe 20 is not water, or only partly water, the level of drainage will depend on the ground water pressure at the drainage port 16 and the density of the fluid. In mathematical terms, the drainage level for the general case will be equal to P/D above the level of drainage port 16 where P is the ground water pressure at drainage port 16 and D is the density of the fluid. Therefore, the distance X between the lowest level of the frost line for the fluid in question and the center of drainage port must be greater than P/D where P is the maximum ground water pressure at drainage port 16.

The outlet port 16 is preferably provided with a screen insert 36 which is secured therewithin by a hollow threaded retaining sleeve 38. The screen 36 prevents dirt and other loose particles from entering the valve chamber 28. The outlet port 16 is coupled to the interior of valve chamber 28 through an opening 40 (FIG. 3). Opening 40 is not designated by a number in FIG. 2 due to lack of space but can be seen extending through the wall of valve chamber 28 immediately to the left of screen 36.

Water is coupled from the inlet port 12 to the upper end of the valve chamber 28 through two semicylindrical conduit chambers 42 and 44 which both open into the inlet port 12 at their lower end and enter valve chamber 28 at diametrically opposed openings 46 and 48 (FIG. 2). In the closed position of the piston 30, the openings 46 and 48 are sealed off by piston rings 50 and 52, which encircle the exterior of piston 30 at axially spaced intervals and bear against the wall of valve chamber 28 to effect a fluid seal. A third piston ring 54 interacts with piston ring 52 to seal off opening 32 in all positions of piston 30 and to seal off opening 40, which leads into outlet port 16, in the closed position of piston 30. Piston rings 50, 52 and 54 are spaced so that the uppermost ring 50 will drop below openings 46 and 48 in the open position of piston 30 (FIG. 6) thus allowing water to flow from the inlet port 12 through the conduit chambers 42 and 44 and openings 46 and 48 into the standpipe 20. In the open position of piston 30 (FIG. 6) the upper pair of piston rings 50 and 52 seal off the valve chamber drainage opening 40 and the lower pair of piston rings 52 and 54 seal off the piston drainage opening 32. In the illustrated embodiment the piston 30 and piston rings 50, 52, and 54 are made of a unitary piece of resilient material such as teflon or the like, with the outside diameter of the piston rings being slightly larger than the inside diameter of the valve chamber to effect a fluid seal. It will be readily apparent, however, that the piston rings could be separate from the body of the piston, if desired.

As best shown in FIGS. 4 and 6, piston 30 is attached to linkage member 28 by a machine screw 56 which passes through a central collar 58 which is connected to the top of hollow piston 30 by means of radial spokes which are not designated by number in the drawings but which can be seen in FIGS. 4 and 5 extending between the collar 58 and the upper interior surface of piston 30. The radial spokes provide a firm attachment between the piston 30 and mechanical linkage 28 without impeding the drainage of fluid from the standpipe 20 through the interior of piston 30.

At its upper end, mechanical linkage arm 28 is attached to a valve operator assembly which is contained in a special coupling 24. This assembly includes an operator shaft 60 which is journaled to the coupling 24, two operator arms 22 which are rigidly connected to operator shaft 60, an operator finger 62 which is rigidly attached to the operator shaft 60 and extends into the interior of the coupling 24, an operating stem anvil 64 which is attached to the top of linkage 28 and engages the operator finger 62, a radial spoke stem guide 66 which is attached to the top of linkage 28 and centers it within the conduit 20, and an access plug 68 which can be removed for access to the interior of coupling 24. The upward and downward movement of operator arms 22 and the resulting upward and downward movement of linkage 28 is limited by means of a finger 70 (FIG. 5) extending inwardly from one of the operator arms 22 and engaging the upper and lower surfaces of a matching recess formed in the exterior of coupling 24. Two O-ring seals 72 and 74 provide a fluid seal for operator shaft 60 and prevent any escape of fluid from the housing. It will be appreciated that this type of valve operator assembly provides a rugged and reliable mechanism for controlling the valve under the most adverse of conditions. The operator can be used with either a foot or hand control and in conjunction with a wide variety of outlet arrangements for providing different washing functions, such as an emergency eye-wash or shower.

While one illustrative embodiment of the invention has been disclosed for purposes of example, it should be understood that many modifications can be made in the disclosed structure without departing from the basic teaching of this invention, and that this invention includes all modifications falling within the scope of the following claims.

We claim:

1. A self-draining valve, comprising: a valve housing forming a valve chamber having an inlet port, an outlet port, and a drainage port, and a movable valve member in the form of a hollow piston slidable within said valve housing between a first and second position, the interior of said piston being in fluid communication with said outlet port in both positions of said piston, and opening extending through the wall of said piston, and means on the exterior of said piston for coupling said inlet and outlet ports together in the first position of said piston and for uncoupling said inlet and outlet ports in the second position of said piston and for coupling said outlet and drainage ports together in the second position of said piston, and yieldable drainage valve means normally covering said opening in said piston for blocking the flow of fluid from said drainage port to the interior of said piston without blocking the flow of fluid from the interior of said piston to said drainage port.

2. A self-draining valve as defined in claim 1 wherein said valve chamber and said hollow piston are substantially cylindrical in shape, said outlet port being adjacent to one axial end of said valve chamber and being directly coupled to the interior of said piston in all positions thereof, said inlet port being coupled to said valve chamber via a first opening in the wall thereof, said drain port being coupled to said valve chamber via a second opening in the wall thereof, said first and second openings being spaced apart with respect to the axis of said valve chamber and said first opening being positioned closer to said outlet port than said second opening, and wherein said means on the exterior of said piston comprises three axially spaced piston rings each of which completely encircle the exterior of said piston and bear against the wall of said valve chamber to effect a fluid seal, the two piston rings closest to said outlet port being positioned to seal off said first opening in the second position of said piston and to seal off said second opening in the first position of said piston, said opening in the wall of said piston being located between the two piston rings farthest from said outlet port, and said two piston rings

farthest from said outlet port being positioned to couple said opening in the wall of said piston to said second opening in the wall of said valve chamber when said piston is in its second position.

3. A self-draining valve as defined in claim 2 wherein said drainage valve means comprises a band of resilient material encircling the exterior of said piston between said two piston rings farthest from said outlet valve and covering said opening in said piston to block the flow of fluid from said drainage port to the interior of said piston without blocking the flow of fluid from the interior of said piston to said drainage port.

4. A self-draining valve as defined in claim 3 wherein said piston and said piston rings comprise a unitary spool-shaped hollow cylinder made of resilient material, the outside diameter of said piston rings being slightly larger than the inside diameter of said valve chamber.

5. A self-draining valve as defined in claim 4 wherein said valve housing is generally cylindrical in shape, said inlet port being located at one axial end of said valve housing and said outlet port being located at the other axial end thereof, said cylindrical valve chamber being substantially coaxial with said valve housing, the axial end of said valve chamber adjacent to said inlet port being closed and the axial end thereof adjacent to said outlet port being open, said first opening in the wall of said valve chamber being located near the open end thereof, said housing further comprising a conduit chamber located between the wall of said valve chamber and the exterior of said valve housing, said conduit chamber being semicylindrical in shape and opening at one end into said inlet port and at the other end into said first opening in the wall of said valve chamber.

6. A self-draining valve as defined in claim 5 and further comprising a second semicylindrical conduit chamber located between the wall of said valve chamber and the exterior of said valve housing, said second conduit chamber being positioned opposite the first mentioned conduit chamber and opening at one end into said inlet port and at the other end into a third opening in the wall of said valve chamber, said third opening being diametrically opposed to said first opening in the wall of said valve chamber, and said second opening in the wall of said valve chamber being positioned between said first and second conduit chambers.

7. A self-draining valve as defined in claim 6 and further comprising a screen within said drainage port to prevent loose particles from entering said valve chamber.

8. A freezeproof valve for use in combination with a fluid distribution system which includes a fluid outlet conduit positioned above the frost line for the fluid to be pumped therethrough and a fluid supply conduit positioned below the frost line for said fluid, said freezeproof valve comprising a valve housing having an inlet port, an outlet port, and a drainage port, a movable valve member within said valve housing for coupling said inlet and outlet ports together in a first position of the movable valve member and for uncoupling said inlet and outlet ports in a second position of said movable valve member and for coupling said outlet and drainage ports together in said second position of said movable valve member, means coupling said inlet port to said fluid supply conduit at a depth greater than P/D below the frost line for said fluid where P is the maximum ground water pressure at said drainage port and D is the density of said fluid, a standpipe coupled between said outlet port and said fluid outlet conduit, means coupled to said movable valve member for moving the valve member to said first position thereof to deliver fluid to said fluid outlet conduit and for moving the valve member from said first position thereof to said second position thereof to terminate the flow of fluid in said fluid outlet conduit, thereby automatically draining the fluid in said standpipe below said frost line due to the force of gravity, and a check valve within said valve housing located adjacent said drainage port for blocking the entry of fluid into said drainage port without blocking the exit of fluid therefrom.

9. A freezeproof valve a s defined in claim 8 and further comprising a valve chamber within said valve housing said inlet, outlet, and drainage ports being coupled to said valve chamber, and wherein said valve member comprises a hollow piston which is slidable within said valve chamber between a first and second position, the interior of said piston being in fluid communication with said outlet port in both positions of said piston, an opening extending through the wall of said piston, and means on the exterior of said piston for coupling said inlet and outlet ports together in the first position of said piston and for uncoupling said inlet and outlet ports in the second position of said piston and for coupling said outlet and drainage ports together in the second position of said piston.

10. A freezeproof valve as defined in claim 9 wherein said valve chamber and said hollow piston are substantially cylindrical in shape, said outlet port being adjacent to one axial end of said valve chamber and being directly coupled to the interior of said piston in all positions thereof, said inlet port being coupled to said valve chamber via a first opening in the wall thereof, said drain port being coupled to said valve chamber via a second opening in the wall thereof, said first and second openings being spaced apart with respect to the axis of said valve chamber and said first opening being positioned closer to said outlet port than said second opening, and wherein said means on the exterior of said piston comprises three axially spaced piston rings each of which completely encircle the exterior of said piston and bear against the wall of said valve chamber to effect a fluid seal, the two piston rings closest to said outlet port being positioned to seal off said first opening in the second position of said piston and to seal off said second opening in the first position of said piston, said opening in the wall of said piston being located between the two piston rings farthest from said outlet port, and said two piston rings farthest from said outlet port being positioned to couple said opening in the wall of said piston to said second opening in the wall of said valve chamber when said piston is in its second position.

11. A freezeproof valve as defined in claim 10 wherein said check valve comprises a band of resilient material encircling said exterior of said piston between said two said piston between said two piston rings farthest from said outlet valve and covering said opening in said piston to block the flow of fluid from said drainage port to the interior of said piston without blocking the flow of fluid from the interior of said piston to said drainage port.

12. A freezeproof valve as defined in claim 11 wherein said piston and said piston rings comprise a unitary spool-shaped hollow cylinder made of resilient material, the outside diameter of said piston rings being slightly larger than the inside diameter of said valve chamber.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,548,860 December 22, 1970

Ellis H. Jacobs et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 6, "and" should read -- an --; line 51, after "freezeproof" insert a period. Column 4, line 45, "and" should read -- an --. Column 6, lines 51 and 52, cancel "said piston between said two"; line 12, "a s" should read -- as --.

Signed and sealed this 25th day of May 1971.

(SEAL)
Attest:

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Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents