(No Model.)

C. LADD-DAVIS.

METHOD OF AND APPARATUS FOR PREVENTING CLOSURE OF WATER TANKS BY FREEZING.

No. 533,653. Patented Feb. 5, 1895.

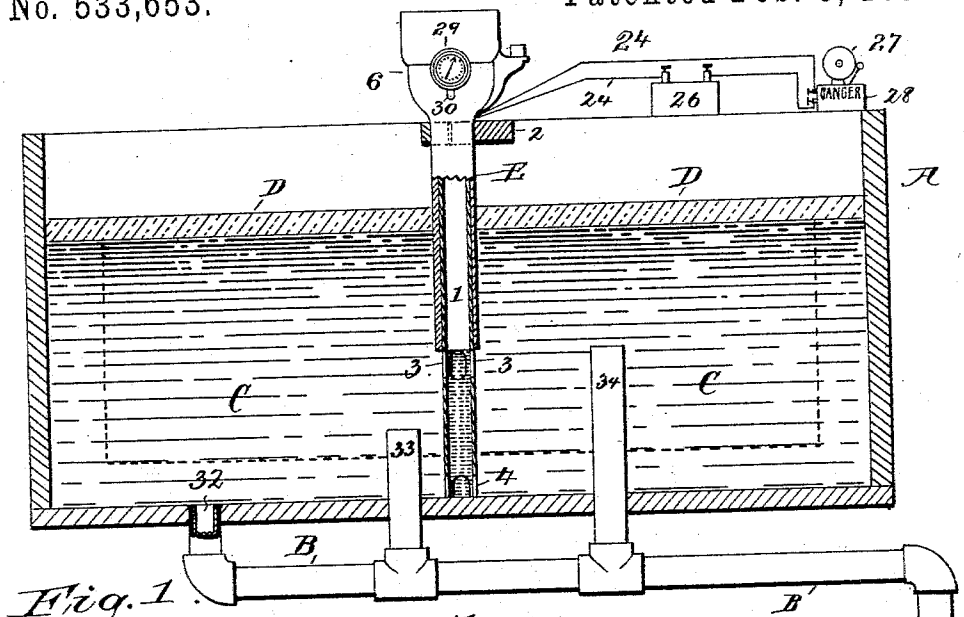

Fig. 1.

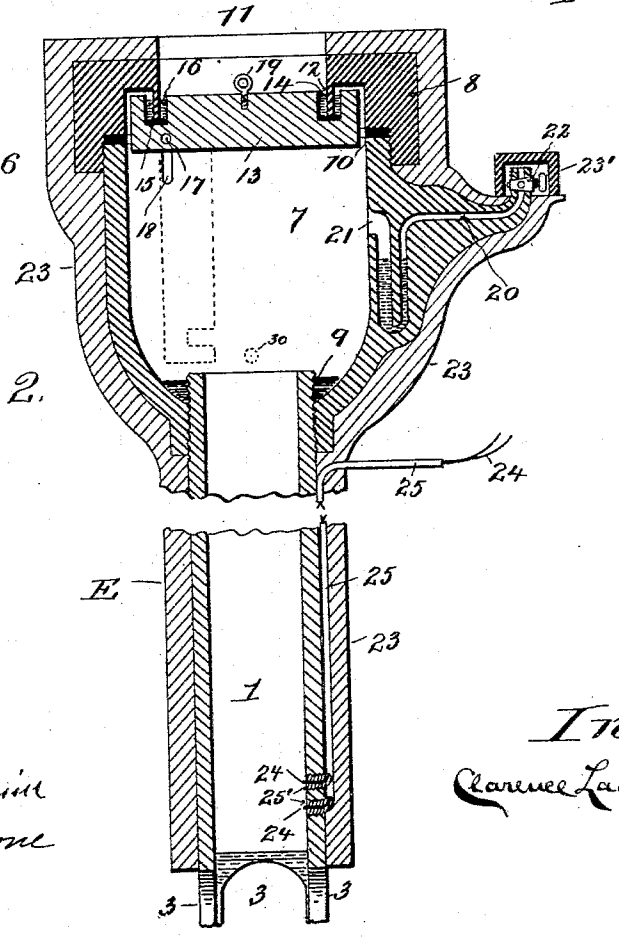

Fig. 2.

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UNITED STATES PATENT OFFICE.

CLARENCE LADD-DAVIS, OF NEW YORK, ASSIGNOR TO HIMSELF, AND GERARD D. MOLL, OF BROOKLYN, NEW YORK, AND HENRY H. DE VOS AND JOHN C. LEBRET, OF HUDSON COUNTY, NEW JERSEY.

METHOD OF AND APPARATUS FOR PREVENTING CLOSURE OF WATER-TANKS BY FREEZING.

SPECIFICATION forming part of Letters Patent No. 533,653, dated February 5, 1895.

Application filed January 19, 1894. Serial No. 497,415. (No model.)

To all whom it may concern:

Be it known that I, CLARENCE LADD-DAVIS, a citizen of the United States, residing in the city and county of New York, in the State of New York, have invented certain new and useful Improvements in Methods of and Apparatus for Preventing the Closure of Water-Tanks by Freezing, of which the following is a specification, such as will enable others skilled in the art to which it appertains to make and use the same.

In cold climates wherever elevated water tanks are used from which the water flows by gravity to the point of use, and especially in tanks designed to supply water to automatic-sprinkler or fire-extinguishing plants, great trouble has hitherto been experienced in cold weather by the closure of such tanks by the formation of a film of ice on the top of the water therein, so as to prevent the air pressure from acting upon such water when the out-flow pipes of the tank are opened to draw water therefrom for any purpose; and in some instances, in extremely cold weather, where tanks are used without being provided with non-conducting coverings of suitable insulating material, in addition to the ice forming over the top of the water therein, a film of ice of greater or less thickness frequently forms on the bottom and sides of the tank, in such manner as to freeze up and completely close with ice the entrance to the out-flow pipe, whereby the flow of water from the tank is prevented even after the ice has been broken through at the top; and heretofore it has been found necessary to keep the water in such tanks, especially those designed for fire-protection, from freezing, by heating the water therein, either by the injection of steam, or in any other desired manner, but all of these methods have been of such character as to demand the labor and attention of at least one person, and the use of more or less fuel, and are therefore all of them objectionable by reason of the great expense attached thereto.

The objects of my invention are, first, to provide a new and improved method of preventing the closure of water tanks by freezing, and, second, to provide a new and improved apparatus for carrying such method into effect, which is operated without heat, which will unerringly permit the water to flow from the tank with freedom whenever the out-flow pipes are opened, and which shall be absolutely automatic of action; and to these ends my invention consists of the new and improved method of preventing the closure of water-tanks by freezing, set forth in the following specification, and of the construction, combination, and arrangement of the several parts of the apparatus for carrying such method into effect, shown and described in the following specification, of which the accompanying drawings form a part, wherein similar letters and numerals of reference designate like or equivalent parts wherever found throughout the both views, and in which—

Figure 1, is a side view of a water-tank, in central vertical longitudinal section thereof, showing my improved apparatus for preventing the closure of the same by freezing in position therein, a portion of the wall of the lower part of such apparatus being broken away in order to show the interior; and Fig. 2, an enlarged detail view of such apparatus in central vertical section thereof.

In said drawings, the reference letter A designates the tank; B, the outlet or out-flow pipe thereof; C, the body of water in such tank; D, a film of ice formed at the top of such body of water C, and E my improved anti-closure apparatus in position in the tank A.

The tank A is formed preferably of wood, as the same being a non-conductor will to a large extent act as an insulator of the water in the tank, and prevent loss of heat therefrom by radiation through the walls of such tank, which may of course be of any desired shape and form of construction.

The anti-closure device or apparatus E located in the tank A, is formed preferably of iron, and consists of a pipe 1, which is preferably of somewhat less interior diameter than is the out-let pipe B of such tank, but always of sufficiently large area to allow of a perfectly free flow of water through the pipe B when such pipe 1 is acting as an air-vent to the pipe B, and such pipe 1 is supported in

an upright position in the tank A, preferably at or near the center thereof, as shown, in any desired manner, preferably by passing through a hole formed for that purpose in a timber 2 which is secured to the top of the tank in any desired manner, and such pipe 1 may also if desired rest upon and be secured to the bottom of the tank. In any event such pipe 1 is in communication with the interior of the tank some little distance below the surface of the body of water therein, and preferably at about midway between the top and bottom of such body of water C by way of suitable perforations 3, formed for that purpose in such pipe 1, or in any other desired manner, and such pipe if it extends clear to the bottom of the tank, is in addition preferably provided with like perforations or holes 4 which form a communication between the tank and such pipe adjacent to the bottom thereof, as shown.

Secured to the top of the pipe 1, in any desired manner, so as to form an air-tight joint therewith, is a head 6, of somewhat larger diameter than the pipe 1, which head 6 consists preferably of a lower portion 7, and an upper portion 8, both of which are preferably of substantially the shape shown; and the top-piece 8 of such head 6 is secured to the bottom portion 7, and such bottom portion 7 is in turn secured to the top of the pipe 1, in any desired manner that will render the various joints air-tight, preferably by red-leaded screw-joints of ordinary form, as shown, which joints are also preferably further tightened by being provided with suitable packing-rings or gaskets 9 and 10, of lead or any other suitable packing metal or material.

The upper portion or top-piece 8 of the head 6 is provided with a central air-inlet orifice or opening 11, preferably substantially circular in form, which is preferably provided with a downardly extending flange 12, which extends some little distance into the interior of the head 6, as shown in Fig. 2, and the lower edge of such flange 12 is preferably ground or dressed to complete smoothness so as to form an air-tight joint around the entire circumference of the air-inlet orifice 11, when brought into contact with the face of the valve 13, which is preferably provided with a suitable circular groove 14 designed to receive such flange 12, the tightness of the joint between the face of such flange and the valve being preferably further increased by a rubber-ring or gasket 15 lying in the bottom of such groove 12, and by a liquid-seal formed by filling such groove with a suitable non-freezing liquid 16, such as mercury, oil, or the like.

The valve 13 opens inward, as shown, and is preferably hinged to the lower portion 7 of the head 6, by a pin 17, running through the same at one side of the center thereof, the ends of which pin preferably slide easily up and down in suitable slots or ways 18 formed for that purpose in opposite sides of the bottom portions 7 of such head 6, and to facilitate the closing of such valve 13 the same is preferably provided with a hook or ring 19 screwed into the top face thereof at or about the center of such face, as shown.

Located in one side of the head 6, preferably in the lower portion 7 thereof, and preferably formed therein by having been cored out during the operation of casting such lower portion 7 of such head, is a filling channel 20, in communication with the interior of the head 6, and consequently with the interior of the pipe 1 also, through a suitable liquid-seal 21, which is of such size and form that all the sealing liquid in the filling-channel when forced by pressure into the main portion of such seal will not be sufficient to cause the same to overflow, and such liquid-seal 21 is of course filled with any suitable non-freezing liquid, in the same manner as is the seal formed by the groove 14 of the valve 13, and at the outer end of the filling channel 20, is located a suitable air-tight stop-cock 22, which may be turned so as to bring the interior of the head 6 into or out of communication with the atmosphere by way of the filling channel 20 and liquid-seal 21.

Both the pipe 1 and the head 6 are preferably protected from the cold by being covered with a covering 23 of any suitable non-conducting insulating material, which extends down on the pipe 1 to or nearly to the top of the perforations or holes 3 therein, or such pipe and head may if desired be wholly formed of any suitable insulating material, which covering 23 when used is preferably treated with a coating of any suitable water-proofing paint or substance to prevent the loss of its non-conducting and insulating properties by wetting, or the same may be made water-proof in any other desired manner, and passing down alongside of the pipe 1, preferably within the covering of water-proof insulating non-conducting material 23, are two conducting wires 24, which are covered and insulated one from the other by a suitable electric insulating covering 25, which wires 24 pass through blocks 25′, of suitable insulating material which are inserted in the pipe 1 a short distance above the tops of the perforations 3 therein, say about three inches, as shown in Fig. 2, and such wires 24 have included in the electric circuit formed thereby a battery or other suitable source of electric energy 26, an electric bell or other auditory signal 27 and an annunciator or electric visual signal 28, which signals are preferably located in the office of the works at which the tank is situated, or at any other convenient point where the same can be seen and heard when actuated; and if desired, in addition to such electric signals for indicating the rise of the water in the pipe 1, the device may be also if desired provided with a pressure gage 29 of ordinary form, in communication with the interior of the head 6 by way of a suitable pipe 30, and the fall of pressure indicated upon such gage will show whenever the

water in the pipe 1 has risen from its normal depressed position therein.

In communication with the interior of the tank A at or near the bottom thereof is the out-flow or outlet pipe B, through which the water in the tank flows to any desired point of use, and ordinarily such pipe B is in communication with such tank A, only at the lowest point thereof, as shown at 32, but in extremely cold climates, where there is danger of a layer of ice forming on the bottom and sides of the tank as well as on the top of the body of water therein, short-out-flow pipes 33 and 34, are added, which may be of any desired number, and these pipes are in communication at their lower ends with the main out-flow pipe B, and each extend up into the interior of the tank A a different distance from the others, and such additional out-flow pipes are, as is also the pipe B, covered both within and without the tank with a covering of suitable insulating non-conducting material, by which the water in such pipes is prevented from freezing, and such non-conducting covering, especially that upon that portion of the pipes within the tank is preferably provided with a suitable water-proof coating to prevent the same from becoming water-soaked.

The operation of the device is as follows:— The anti-closure device or apparatus E being in position in the tank A, and such tank being filled with water to the height shown in Fig. 1, so long as the valve 13 is open and held by gravity in the position shown in dotted lines in Fig. 2, the interior of the head 6 and consequently also the interior of the pipe 1 as well, will be in free communication with the atmosphere, and the water in such pipe 1 will consequently stand at the same level as does the water in the tank A outside of such pipe, and it being open to the air the water in such pipe will of course freeze as easily and as quickly as does the water in the tank outside of such pipe. To prepare the device for use so as to prevent the complete closure of the tank by freezing, and the formation of a film of ice over the top thereof, the cap 23′, which is formed of a suitable non-conducting insulating material similar to that with which the pipe 1 and head 6 are covered, and which normally covers the stop-cock 22 of the filling channel 20, is removed, and the discharge pipe of a suitable air-compressor or pump, (not shown) of any desired form of construction, is attached to such stop-cock 22, the same being for such purpose preferably provided with a suitable screw-thread formed thereon, as shown. Such stop-cock 22 having been brought into communication with such air-compressor as described, such stop-cock is turned so as to allow the compressed air from such compressor or pump to flow into the filling-channel 20, and the valve 13 having been lifted up into the position shown in full lines in Fig. 2, so that the lower edge of the flange 12 presses firmly against the packing-ring or gasket 15 lying in the bottom of the groove 14 in such valve 13, which may be done by taking hold of the ring 19 of such valve with the hand, or with a suitably hooked rod provided for that purpose, and such valve 13 being held in such raised position so as to tightly close the air-inlet orifice 11 in the top portion of the head 6, the air-compressor or pump is actuated, and air under pressure is forced into the interior of the head 6 through the stop-cock 22, filling channel 20 and liquid-seal 21, and emerging from the inner end of the liquid-seal 21 in the form of bubbles gradually fills such head 6, and consequently the pipe 1, with compressed air, and as the pressure therein increases as more and more air is forced into the said head 6, the water in the pipe 1 is forced lower and lower therein, and the valve 13 is by the same pressure forced tighter and tighter against the seat thereof, formed by the lower edge of the flange 12 and the pumping is continued until the water in such pipe 1 has been forced down to the level of the perforations or holes 3 in said pipe, which is indicated by the escape of air therethrough and the rising of the same in the form of bubbles to the surface of the water in the tank alongside of the pipe 1, and outside the same, and as soon as the water in the pipe 1 has been forced to such low level, the pumping is discontinued, the stop-cock 22 is turned so as to close the entrance to the filling-channel 20, the air pump or compressor is disconnected from such stop-cock, and the same is covered with the insulating cover or cap 23′, when the device will be in operative condition; and in order to prevent leakage of the compressed air from the head 6 at the joint between the valve 13 and the flange 12 which forms the seat thereof, and the consequent rising of the water in the pipe 1, the groove 14 in the top face of such valve is preferably filled with any suitable non-freezing liquid 16, such as mercury, oil, or the like, whereby a liquid seal is formed at the valve-joint, and leakage of air thereat, consequently absolutely prevented.

The device being in operative condition, as shown in full lines in Fig. 2, if freezing weather should then ensue, while a film of ice of greater or less thickness will of course form over the top of the body of water C as shown at D in Fig. 1, at all points outside of the pipe 1, the water in such pipe, so long as the air pressure therein is maintained, and the water therein remains below the level of the lower side of the ice-film D, will not freeze over, even though the temperature of the atmosphere outside of the tank is extremely low, for the reason that the pipe 1 being heavily insulated, and the air therein being out of communication with the surrounding atmosphere and consequently acting as an insulating medium interposed between the outside air and the water in the pipe 1, there will be but slight loss of heat from the water in the pipe, and it will be impossible for such water

surface in the pipe 1 to freeze over until such time as the latent heat of liquefaction of such water has been absorbed or dissipated, but such freezing can in no event take place until the water surface in such pipe has also taken up and dissipated so much of the sensible heat of the surrounding body of water as is readily communicable by induction to the portion so freezing, but when the pipe 1 and head 6 are properly insulated, this could not take place, except in the event of almost the lowest natural temperature known to even the coldest climates, if even then; and while I prefer for the reasons above given to depress such surface in the pipe, as shown, in some cases, and where insulation of the pipe 1 is perfect, the same may be little if at all depressed with the same effect, but of course an insulating fluid must in all cases be interposed between the surface of the water in the pipe, and the surrounding atmosphere.

The parts being in the position shown in Figs. 1 and 2, if now the out-flow valves or cocks of the out-let pipe B should for any purpose be opened, the pressure of the air in the pipe 1 and head 6, will force the water in the tank A out through said out-let pipe B, until the pressure in the head 6 is reduced to that of the atmosphere, or nearly thereto, when the valve 13 will fall by gravity into the position shown in dotted lines in Fig. 2, which will bring the interior of the head 6 and pipe 1 into free communication with the atmosphere by way of the air-inlet orifice 11 in the head 6, and as the water continues to flow from the tank A by way of the pipe B, air will pass down through the pipe 1, out through the perforations or holes 3 and rising to the top of the water outside of the pipe 1 will form an air space underneath the film of ice D which will take the place of the water flowing out through the pipe B, the compressed air originally in such pipe having of course as it expanded also first passed out through said perforations 3 and risen to the top of the water, as described, and this will of course continue until all the water has been drawn from the tank; and if the film of ice D is of such strength as not to fall of its own weight when deprived of the support of the water beneath the same, the tank may be refilled to its original height, after being partially or wholly emptied, by simply breaking a hole in the ice-film D and pouring water through the same, or through the air-inlet orifice 11, as desired, after which the valve 13 may be closed, and the head 6 and pipe 1 filled with compressed air, as hereinbefore described, when the device will be again ready for automatic operation, in the manner set forth. After a thick film of ice D has once formed over the body of water C in the tank A, there being no pressure on the surface of the water in the tank outside of the pipe 1, the water in such pipe will have a tendency to remain at the low level shown in the drawings, even when the normal pressure in such pipe may have been decreased by leakage; but for many reasons I prefer to maintain a comparatively steady and uniform pressure in such pipe 1, and to consequently maintain the water therein with certainty at the extreme low level shown, and for that reason I prefer to equip the device with an alarm signal, preferably of the electric form shown, which shall unerringly indicate the rise of the water in such pipe 1; and when made as I prefer to form such signaling device, the same consists substantially of an electric circuit formed by two conducting-wires 24, in which circuit is included the battery or other source of electric energy 26, an alarm-bell or other auditory signal 27, and an annunciator or other visual signal 28, and the circuit so formed by the wires 24 is normally broken at 25′ at which point the ends of such wires 24 pass through the wall of the pipe 1 being of course surrounded by suitable plugs of insulating material, and the wires being further insulated one from another by a suitable covering of insulating material 25 where they pass up alongside of the pipe 1, preferably within the non-conducting covering 23 of the same as shown, and the ends of such wires where they project into the pipe 1 are preferably situated a short distance, say about three inches or so, above the top of the perforations 3 and consequently the instant the water rises in the said pipe 1 to a height sufficient to cover the ends of such wires, the electric circuit formed thereby is completed through said water so covering the same, and thereupon the various electric signals, which are preferably located in the office of the works at which the tank is situated, are instantly actuated, and the auditory alarm will continue to be sounded until the circuit is broken by the water being forced down below the ends of such wires, or in any other manner or until the battery is exhausted, and during such period the annunciator or visual signal will of course display the danger signal, as shown in Fig. 1.

The additional out-flow or out-let pipes 33 and 34, which are of course in communication with the main out-let pipe B at the lower ends thereof, are designed to be used only in the coldest of climates where there is danger of ice forming on the bottom and sides of the tank, as well as on the top of the body of water therein, and when such additional out-flow pipes are used, it will be seen that even when the ordinary out-flow orifice 32 has been completely closed by reason of ice forming on the bottom of the tank to the depth of the dotted lines shown in Fig. 1, the body of water in the tank will still be in free communication with the main out-flow-piye B by way of the pipes 33 and 34, the tops of which are above such ice, and the water in which, as well as that in the pipe B, is kept from freezing by reason of the fact that such pipes are thickly covered both within and without the tank A with a covering of suitable insulating material, as shown, and such being

the case, and the pipe 1, being kept at all times in operative condition, whatever water may remain liquid in the tank A, although it may be surrounded by ice on all sides, will flow freely from the outflow pipe B, whenever the valves thereof are opened for any purpose, and such will continue to be the case, until the water in such tank has been practically frozen to a solid mass of ice to the center thereof.

While I prefer to locate the perforations 3 in the pipe 1 at such a height within the tank A as will bring the tops thereof about midway between the top and bottom of the body of water contained therein, such pipe may of course be in communication with the tank at any point below the level of the under side of any covering film of ice which can by any possibility in the climate where used form thereon, with the same effect, and it is of course not essential that such pipe should be located in the tank, as it is sufficient for the working of the device to have the lower end thereof in free communication in any manner with the tank at any point below the film of ice, while at the same time the water in the pipe is kept from freezing by proper insulation, and for a part of such insulation. While I prefer to use the covering for the pipe shown, as hereinbefore stated, such pipe may if desired be itself wholly formed of any suitable insulating material. In like manner while I prefer to use compressed air as a non-freezing fluid for keeping the water in the pipe insulated from the atmosphere, I do not by any means intend to limit myself to the use of the same for such purpose, as any suitable non-freezing fluid may be used in place of air with similar effect, and of course when the non-freezing fluid is one which is heavier than air, and one which will not mingle with air, the valve at the upper end of the pipe 1 may be omitted, and the pressure of the atmosphere be thus at all times exerted upon the water surface in such pipe 1 through the medium of the body of such fluid contained in such pipe.

While I have set forth herein the method and apparatus which I prefer to use for the purposes stated, I do not intend to limit myself strictly thereto, as it is evident that many changes other than those mentioned may be made without departing from the scope of my invention, within which I consider included any means whatever for insulating in any manner one portion of a water surface from another portion of the surface of the same body, combined with means for insulating such insulated surface from the air by covering it with a body of non-freezing fluid, and also combined with means for bringing atmospheric pressure to bear upon the main body of the water through the medium of the insulated surface, when desired. Neither is my invention limited to use in connection with tanks, or for preventing the freezing of water only, for as used by me herein, I consider the word "tank" to cover and include any reservoir or receptacle whatsoever for holding liquids, and the word "water" to include any liquids capable of being frozen.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, what I claim, and desire to secure by Letters Patent, is—

1. The herein described method of preventing the closure of water tanks by freezing, which consists in insulating a portion of the water surface from the rest, and then insulating such insulated surface from the atmosphere by covering the same with a non-freezing fluid, in such manner that the pressure of the atmosphere will be exerted upon the insulated surface when the main surface is frozen over and water is drawn from the tank.

2. The herein described method of preventing the closure of water tanks by freezing, which consists in insulating a portion of the water from the rest by inclosing the same in a pipe in communication with the tank below the level of the water therein, and then insulating the water surface in the pipe from the atmosphere by filling the pipe above the water surface with a non-freezing fluid which will remain therein until driven out at the lower end by atmospheric pressure.

3. The herein described method of preventing the closure of water tanks by freezing, which consists in insulating a portion of the water from the rest by inclosing the same in an insulating pipe in communication with the tank below the water level thereof and also in communication at the other end with the atmosphere by way of an inwardly opening valve, and then insulating the water surface in the pipe from the atmosphere by filling the pipe with a non-freezing fluid.

4. The herein described method of preventing the closure of water tanks by freezing, which consists in insulating a portion of the water from the rest by inclosing the same in an insulating pipe in communication with the tank below the water lever thereof and also in communication at the other end with the atmosphere by way of an inwardly opening valve, and then insulating the water surface in the pipe from the atmosphere by filling the pipe with air.

5. The herein described method of preventing the closure of water tanks by freezing, which consists in insulating a portion of the water from the rest by inclosing the same in an insulating pipe in communication with the tank below the water level thereof and also in communication at the other end with the atmosphere by way of an inwardly opening valve, and then insulating the water surface in the pipe from the atmosphere by filling the pipe with air under pressure.

6. The herein described method of preventing the closure of water tanks by freezing, which consists in depressing a portion of the

water surface below the level of the surface of the main portion thereof and insulating such depressed surface from the atmosphere in such manner that the pressure of the atmosphere will be exerted upon such depressed surface when the main surface is frozen over and water is drawn from the tank.

7. The combination with a tank, of a suitable pipe in communication with the tank below the surface of the water therein and also in communication with the atmosphere through an air-inlet orifice, of an inwardly opening valve for closing the air-inlet orifice, and a non-freezing fluid filling the pipe between the valve and the water surface therein, substantially as shown and described and for the purposes set forth.

8. The combination with a tank, of a suitable pipe in communication therewith below the surface of the water therein and also in communication with the atmosphere through an air-inlet orifice, an inwardly opening valve for closing the air-inlet orifice, and a non-freezing fluid filling the pipe between the valve and the water surface therein in such manner as to depress such surface, substantially as shown and described and for the purposes set forth.

9. The combination with a tank, of a suitable pipe in communication therewith below the surface of the water therein and also in communication with the atmosphere through an air-inlet orifice, of an inwardly opening valve for closing the air-inlet orifice, and a body of air filling the pipe between the valve and the water surface therein, substantially as shown and described, and for the purposes set forth.

10. The combination with a tank, of a suitable pipe in communication therewith below the surface of the water therein and also in communication with the atmosphere through an air-inlet orifice, of an inwardly opening valve for closing the air-inlet orifice, and a body of compressed air filling the pipe between the valve and the water surface in such manner as to depress the water surface within the pipe below the level of the water surface of the tank, substantially as shown and described and for the purposes set forth.

11. The combination with a tank, of a suitable pipe in communication therewith below the surface of the water therein and also with the atmosphere through an air-inlet orifice, an inwardly opening valve for closing the air-inlet orifice, and a filling channel provided with means for closing the same in communication with the pipe, substantially as shown and described and for the purposes set forth.

12. The combination with a tank, of a suitable pipe in communication therewith below the surface of the water therein and also with the atmosphere through an air-inlet orifice, an inwardly opening valve for closing the air-inlet orifice, a filling-channel communicating with the interior of the pipe, a liquid-seal located in the channel, and a valve or stop-cock for the channel, substantially as shown and described.

13. The combination with a tank, of a suitable pipe in communication therewith below the surface of the water therein and also with the atmosphere through an air-inlet orifice, and a valve for closing the air inlet orifice normally shutting off communication between the interior of the pipe and the atmosphere but adapted to yield and admit air to the pipe whenever the pressure in the pipe falls below a predetermined point, substantially as shown and described and for the purposes set forth.

14. The combination with a tank, of a suitable pipe in communication therewith below the surface of the water therein and also with the atmosphere through an air-inlet orifice, a covering of non-conducting material upon the pipe, and a non-freezing fluid in the pipe, substantially as shown and described and for the purposes set forth.

15. The combination with a tank, of a suitable pipe in communication therewith below the surface of the water therein and also in communication with the atmosphere through an air-inlet orifice, an inwardly opening valve for closing the air-inlet orifice, and a covering of non-conducting material upon the pipe, substantially as shown and described and for the purposes set forth.

16. The combination with a tank, of a suitable pipe in communication therewith below the surface of the water therein and also in communication with the atmosphere, means for retaining the water surface in the pipe in a depressed position below the level of the surface of the main body of water in the tank, and means for indicating the rising of the water in the pipe, substantially as shown and described and for the purposes set forth.

17. The combination with a tank, of a suitable pipe in communication with the tank below the surface of the water therein and with the atmosphere, a non-freezing fluid held in the pipe by which the surface of the water in the pipe is forced below its normal level, and means for indicating the rising of the water in the pipe, consisting of electric signaling devices adapted to be actuated by the rising of the water in the pipe, substantially as shown and described and for the purposes set forth.

18. The combination with a tank, of a suitable pipe in communication therewith below the surface of the water therein and with the atmosphere, a non-freezing insulating fluid held in the pipe by which the surface of the water in the pipe is forced below its normal level, a broken electric circuit the two ends of which are in communication with the interior of the pipe in the space filled by the insulating fluid but below the normal level of the water when released from pressure, and a source of electric energy and an electric signal located in the electric circuit, the construction being such that the rising of the

water in the pipe will close the circuit and actuate the signal, substantially as shown and described and for the purposes set forth.

19. The combination with a tank, of a suitable pipe in communication therewith below the surface of the water therein and also in communication with the atmosphere through an air-inlet orifice, an inwardly opening valve for closing the air-inlet orifice, and a seal of non-freezing liquid located at the junction of the valve with its seat to prevent leakage thereat, substantially as shown and described and for the purposes set forth.

20. The combination with a tank, of a suitable pipe in communication therewith below the water surface therein and also in communication with the atmosphere through an air-inlet orifice, a depending flange 12, surrounding the air-inlet orifice, and an inwardly opening valve 13 having a groove 14 adapted to receive the flange, and a suitable non-freezing liquid filling the groove so as to form a seal at the joint between the valve and the flange forming its seat, substantially as shown and described and for the purposes set forth.

21. In a device for preventing the closure of water tanks by freezing, the combination with a pipe formed of or covered with a suitable insulating material and adapted to insulate a portion of the surface of a body of water from the main surface, of an inwardly opening valve for closing the outer end of the pipe, a channel 20 in communication with the interior of the pipe and with the atmosphere, and means for closing such channel 20, substantially as shown and described and for the purposes set forth.

Signed at the city and county of New York, in the State of New York, this 16th day of January, A. D. 1894.

CLARENCE LADD-DAVIS.

Witnesses:

H. G. HARRIS,

A. C. S. BROWNE.