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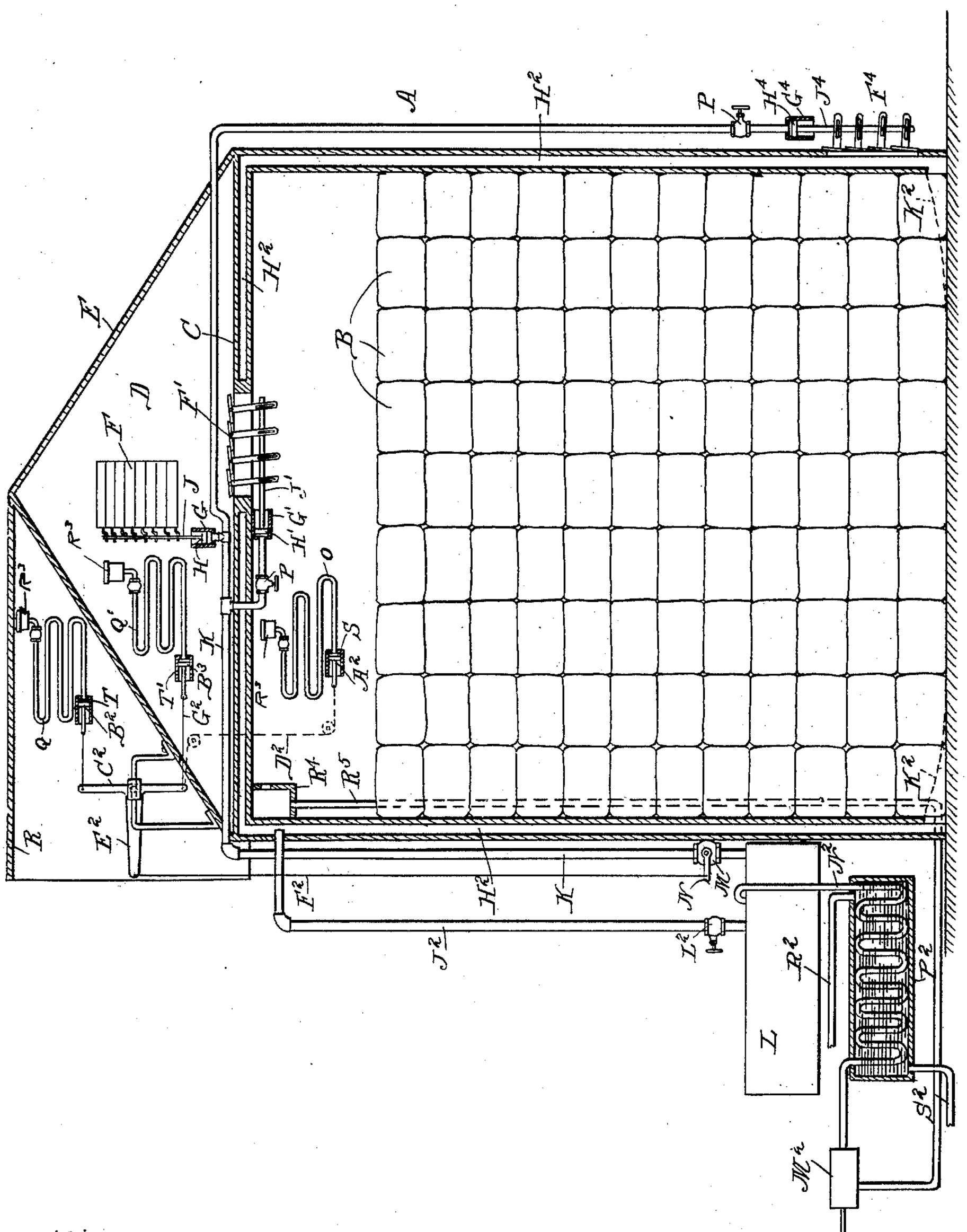
O. GUTHRIE.

REFRIGERATION APPARATUS.

(Application filed Feb. 1, 1899.)

(No Model.)



Witnesses.
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UNITED STATES PATENT OFFICE.

OSSIAN GUTHRIE, OF CHICAGO, ILLINOIS.

REFRIGERATION APPARATUS.

SPECIFICATION forming part of Letters Patent No. 660,771, dated October 30, 1900.

Application filed February 1, 1899. Serial No. 704,115. (No model.)

To all whom it may concern:

Be it known that I, OSSIAN GUTHRIE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Refrigeration Apparatus, of which the following is a specification.

This invention relates to refrigeration apparatus, and one object is to provide means for preserving ice in ice-houses.

A further object of the invention is to provide means whereby advantage may be taken of low atmospheric temperatures in reducing the temperature of ice stored in ice-houses.

A further object of the invention is to provide means whereby undermining of the stored ice at the outer edges of the houses through the melting thereof from transmitted heat of the sun is prevented.

Other objects of the invention will appear more fully hereinafter.

The invention consists substantially in the construction, combination, location, and relative arrangement, all as will be more fully hereinafter set forth, as shown in the accompanying drawing, and finally specifically pointed out in the appended claims.

The single view in the accompanying drawing is a transverse sectional view of an ice-house, showing the application of my invention thereto.

It is the common practice to store ice in ice-houses at or in convenient proximity to the place where the ice is harvested or manufactured until it is required for shipment or use. The ice is stacked up in the ice-house in cakes piled or arranged upon each other, and each ice-house usually comprises one or more rooms, the ice stored in one room being withdrawn for shipment or use before the next room is opened. After the ice-house or one or more rooms thereof has been filled, it frequently happens that a cold atmospheric wave occurs, with the result that the temperature of the atmosphere outside of the house is reduced far below that of the stored ice within the house for a day or two at a time, more or less. It is the purpose of my invention to take advantage of these drops of the atmospheric temperature in reducing the temperature of the stored mass of ice, thus storing up the cold, so to speak, of the atmosphere for use in maintaining the stored ice at a temperature below the melting-point, thus preserving the ice for a longer period of time and preventing waste through meltage during the succeeding summer months. Moreover, it is a well-established fact that the average range of temperature between the maximum temperature of the day-time and the minimum temperature at night-time throughout the summer months is about twenty degrees. It is also an established fact that in the summer the average velocity of the wind is greatest at or about two o'clock in the afternoon, and hence at the hour when the heat is greatest. Therefore in carrying out the principles of my invention one of the purposes in view is to utilize this variation in atmospheric temperature by storing up, so to speak, the lower temperature of the night-time to overcome or resist the greater or increased temperature of the day-time and to close the ice-house securely against the effect of the heated air, the velocity of which, as above observed, is greatest at or about the hour when its temperature is raised to the average maximum. Again, during the summer-time the heat of the sun is transmitted through the ground or floor of the ice-house to the stored ice, thus causing meltage thereof at the base of the stack or pile, and hence undermines a considerable section of the stored ice, and the undermined section finally from its own weight breaks away from the stacked-up ice and falls against the wall of the room in which the ice is stored, thus causing serious damage to the building. Moreover, during the summer months the ice at the top surface of the stack or pile begins to melt, and the meltage trickles down through the crevices between adjacent blocks or cakes beneath, where regelation takes place, thus causing adjacent blocks of ice to freeze or to be joined together and requiring the use of saw and chisel-bars to again separate it into blocks or cakes, and the expense and damage occasioned from this source frequently exceed the loss from the meltage of the topmost cakes of the ice. My invention therefore contemplates the provision of means whereby during the summer months air at a reduced

temperature is supplied to the stored ice, thus providing an artificial ventilation through the mass of stacked-up cakes, employing for the purpose air at any desired temperature below the freezing-point, thus preventing the undermining of the same at the outer edges thereof, as well as preventing the expense, damage, and loss through melting and regelation.

Referring to the accompanying drawing, wherein I have illustrated an arrangement embodying the principles of my invention, reference-sign A designates a building which may be of any suitable or convenient construction and arrangement adapting it for use as an ice-house and having one or more separated rooms in the usual manner. The ice (indicated at B) in the form of cakes or blocks is stacked or piled up in the rooms of the ice-house in the usual manner. In the usual construction of ice-houses a ceiling C is provided for the several rooms into which the house is divided, with a space (indicated at D) above the ceiling C and beneath the roof E, such space extending throughout the length and breadth of the building.

In carrying out the principles of my invention, whereby advantage is taken of an atmospheric temperature lower than that of the ice stored in order to preserve the ice—as, for instance, in case of a blizzard or cold wave ocurring after the ice is stored—I arrange suitable ventilators F at convenient points in the roof of the building or in the gable ends thereof and also at one or more convenient points in the ceiling C of each room in which ice is stored, as indicated at F', and in the side walls of the room, if desired, and preferably at a point adjacent to the ground or floor, as indicated at F^4, and I provide means automatically actuated by variations in temperature for opening and closing said ventilators. In the form of apparatus shown for accomplishing the desired object I provide a suitable motor, which in the present instance (but to which the invention is not limited or restricted) consists of an air-cylinder G G' G^4, in which operates a piston H H' H^4, the rod J J' J^4 of which is connected to and operates the ventilator to open or close the same, as the case may be, when said piston is moved. Communicating with cylinders G G' G^4 is a pipe K, leading to a suitably and conveniently arranged and located compressed-air reservoir L. Arranged in said pipe connection at any desired or convenient point is a valve M, having a lever or arm N, by which it may be operated, and adapted when turned in one direction to open said pipe to the air-reservoir L and when turned in the other direction to close the communication with the reservoir and to open the pipe K to the atmosphere. From this arrangement it will be seen that when valve M is suitably operated air-pressure is admitted to the pipe K and to the air-cylinders G G' G^4 throughout the system, and thus causes the pistons H H' H^4 therein to move in a direction to open the ventilators. Of course it will be readily understood that an air-cylinder G G' G^4 is provided for each ventilator and that all the air-cylinders are in communication with pipe K, so that when air-pressure is admitted to said pipe all the ventilators may be simultaneously opened; but by arranging suitable stop-cocks P in the pipe connections of the air-cylinders any one or more of such cylinders may be cut off from the pipe K, and hence will not effect an actuation of its associated ventilator when compressed air is admitted to said pipe K from the reservoir. In practice I prefer to arrange the ventilators to occupy a normally-closed position, so that when valve M is operated to admit air-pressure to the air-cylinders the ventilators will be opened and when the valve M is operated in the opposite direction to open pipe K to the atmosphere the ventilators are permitted to return to their normal or closed position. The next feature of the invention is the provision of means operated automatically by the difference between the temperature inside the rooms in which the ice is stored and that of the outer atmosphere for controlling valve M. In carrying out this feature of my invention I provide a coil O of pipe and arrange the same at any convenient point in the room in which the ice is stored and preferably in the space above the ice and below the ceiling where it would be subjected to about the temperature of the stored ice, a similar coil being arranged in each room, if desired. Outside the building, preferably at a convenient point on the roof thereof, I arrange a similar coil of pipe Q where it would be subjected to variations in the atmospheric temperature. In practice and in order to protect the coil Q from rain, sleet, and snow I prefer to arrange a protecting-roof R over coil Q. One end of each of the coils O Q opens into a cylinder S T, in which operates a piston A^2 B^2. The piston A^2 is suitably connected, as indicated at D^2, to one end of a lever C^2, suitably pivoted intermediate its ends, and piston B^2 is similarly connected to the other end of said lever. An arm E^2 is connected to and moves with lever C^2, and this arm is suitably connected through connection F^2 to the arm or lever N of valve M. The coils O Q are designed to contain any suitable fluid which expands and contracts readily according to variations in temperature to which it is subjected. In practice I have found that wood-alcohol is well adapted for the purpose, as it responds quickly to changes and variations in temperature. The operation of this part of my invention is as follows: In case a cold wave occurs after the ice is stored, whereby the atmospheric temperature is reduced to a degree below that of the rooms in which the ice is stored, the contraction of the wood-alcohol in the coil

Q will cause piston B^2 to be moved, thus rocking lever C^2 and arm E^2 in a direction to open valve M, thus admitting air-pressure to pipe K and to the various air-cylinders G G′ G^4, and hence causing the ventilators F F′ F^4 to be opened, thus admitting the outer air of lower temperature to the room in which the ice is stored and reducing the temperature of the stored ice to an equality with that of the low atmospheric temperature. When the atmospheric temperature rises, the wood-alcohol in pipe Q begins to expand, thus forcing the piston B^2 in the opposite direction, which movement through lever C^2, arm E^2, and connection F^2 operates valve M to cut off the supply of compressed air to pipe K and to open said pipe to the outer air, thus permitting the ventilators to again close. It is to be understood that the coils O and Q are of identically the same capacity and exactly the same quantity of wood-alcohol or other suitable fluid is employed in each. Therefore when the temperature of the outer air and of the room in which the ice is stored is the same or varies in unison with each other the lever C^2 will be held in neutral position—that is, will not be rocked in either direction—said lever being suitably mounted to move laterally under these circumstances and conditions, and hence the valve M will not be moved. If the temperature of the room in which the ice is stored is lower than that of the outer air, the action of the coil O is to rock lever C^2 in a direction to maintain valve M closed, while if the temperature of the outer air falls below that of the room in which the ice is stored the action of coil Q is to cause valve M to be opened, thus opening the ventilators F F′ F^4. In this manner I take advantage of the cold waves occurring during the winter after the ice is stored to reduce the temperature of the stored ice, thus storing up the cold, and hence preserving and protecting the ice more thoroughly against the heat of summer, and from the foregoing description it will be seen that I accomplish this result automatically through variations in the temperature, which is an agency of nature, and hence special care of and attention to the apparatus when once installed is unnecessary, only sufficient care being taken to maintain air-pressure in the tank or reservoir L. It will also be seen that by arranging one or more ventilators F^4 in the side walls at or near the ground or floor and which are opened during the very cold weather, as above explained, I secure a circulation of the cold air through the mass of stored ice, thus thoroughly reducing the temperature of the entire mass of stored ice. When the winter is so far advanced that no further advantage can be derived in the manner above described from cold waves, the ventilators F′ F^4 in the ceilings and side walls of the ice-rooms are permanently closed for the summer and the stop-cocks P are turned off and the connection D^2 of pistons A^2 to lever C^2 is detached, thus rendering coil O and air-cylinders G′ G^4 of no further utility.

I will now describe the arrangement embraced in my invention for taking advantage of the range of temperature between the maximum of the day-time and the minimum of the night-time during the summer months. Of course it is obvious that if when the atmospheric temperature at night is twenty degrees or more below that of the following day and the temperature of the space D above the ceiling of the ice-rooms and below the roof E of the building is reduced to the atmospheric temperature, then the heat of the following day is more successfully resisted in its tendency to warm up the ice-rooms and so melt the ice. Therefore in order to take advantage in the early summer of the variations in temperature between night and day I arrange a coil Q′, exactly similar in all respects to coils O and Q, above described, at some convenient point in the space D. Said coil should be located at a point where it will not be too close to the roof, so as to be unduly affected by the temperature of the outer air, nor too close to the ceiling, where it would be unduly affected by the temperature of the stored ice. This coil delivers or opens at one end into a cylinder T′, the piston B^3 of which may be connected to the end of lever C^2, through connection G^2, in a manner similar to that above described with reference to coil O. The operation is the same as that above described with respect to the conjoint action of coils O and Q, except that instead of automatically opening up the ventilators in the ceiling or side walls of the ice-rooms through a reduced temperature of the outer air only the ventilators F in the roof or gable ends of the building are opened up automatically when the temperature of the outer air falls below that of the space D, thus admitting the cooler atmospheric air to the space D, and hence reducing the temperature in such space to that of the outer air. When this equilibrium is established, the ventilators are again closed automatically, thus retaining and storing up the lower temperature in the space D, to be utilized in more efficiently resisting the heating effect of the higher temperature of the following day, while at the hour when the outer air is hottest and the velocity of the wind is about twelve per cent. greater than at night the ventilators are closed, thus more perfectly preserving the ice. It will be observed that this operation is also automatic in action and does not require special care or attention, and that advantage is taken of natural agencies, thus reducing the cost to a minimum.

In order to compensate for any loss of fluid from the coils O Q Q′ through evaporation, leakage, or the like, I provide a cup R^3 for each coil adapted to contain an additional

quantity of wood-alcohol or other fluid and which replenishes any loss in the coils, thus maintaining absolute uniformity in quantity of the fluid in all of the coils.

When the summer season is well advanced and the ice begins to melt under the outer edges, as indicated at K^2, and upon the top surface thereof, through the transmission of the sun's heat, as above explained, and when a room is once opened up for the removal of the stored ice, it becomes desirable to avoid the attendant loss of ice through meltage and exposure and the damage and expense due to regelation from the drippings of the melting topmost blocks or cakes of ice, as above pointed out. To accomplish this result, I construct the walls and roof of the rooms in which the ice is stored hollow, as indicated at H^2, and into this space I arrange the delivery end of a pipe J^2, which pipe communicates with air-reservoir L, a stop-cock L^2 being provided therein, whereby the flow of compressed air therethrough from the reservoir may be cut off when desired. By this arrangement it will be seen that I am enabled to deliver compressed air into the space H^2 of the hollow walls of the ice-rooms, which circulates through such space, and through the expansion thereof reduces the temperature of the stored ice to a point where the melting thereof from the transmitted heat of the sun is prevented. In order to utilize the compressed air to the best possible advantage for this purpose, it is desirable to extract from it the latent heat. To accomplish this result, the air from the compressor (indicated at M^2) is delivered into reservoir L through a pipe N^2, which is arranged in a coil in a suitable tank P^2. By permitting water or other cooling medium to flow through this tank, as indicated by the delivery and outlet pipes R^2 S^2, I extract the latent or liberated heat from the compressed air during its passage from the compressor to the reservoir, thus delivering the compressed air into the reservoir at or about the atmospheric temperature or lower, if desired, and this results in a very low degree of temperature when this cold compressed air is permitted to expand when delivered into the hollow space in the walls of the ice-rooms. By leaving off or removing one or more boards at the bottom of the inner wall of space H^2 the cold air supplied to space H^2 may be permitted ready entrance to the room at points from which it may circulate upwardly through the cakes of ice, thus driving out any heated air and maintaining the temperature of the ice below the melting-point. It will also be seen that after a room has been opened up for removal of the stored ice such room may be flooded with this cold air over night, for instance, thus maintaining the temperature thereof at a low degree, and hence preventing the rapid melting and great loss of ice which usually attends the opening up of an ice-room and while the ice is being removed for shipment. The cold air thus admitted to the ice-room rises toward the ceiling of the room, circulating through the crevices between the blocks of ice, and finally collects in the space above the top of the ice. During its travel to the space at the top of the room its temperature is raised above that at which it enters the room, but it is still colder than the atmospheric temperature. My invention contemplates the utilization of this cold air, which has accomplished all that it can accomplish in the ice-room. In order to still further utilize this cold air, I arrange to draw the same off and supply it to the air compressor for recompression, thus reducing the amount of heat to be extracted after compression and before the compressed air is again delivered into the reservoir. To this end I arrange a pipe box or casing R^4 in any suitable or convenient location adjacent to the ceiling C of the room and provided with suitable openings through the side thereof. In practice I arrange this pipe box or casing to extend through all the rooms of the building, and I connect the same through the pipe R^5 with the air-compressor M^2. In this manner, after the cooled air has accomplished its work of reducing the temperature of the stored ice, it is again drawn off and compressed, while still colder than the atmospheric air, for use over again.

From the foregoing description it will be seen that I provide an exceedingly simple system for preserving and protecting ice and wherein the apparatus employed is inexpensive in initial cost, wherein the expense of operation is inconsequential after the plant is installed, wherein the apparatus operates automatically and requires no special care or attention, wherein every possible advantage is taken of natural agencies, which is efficient in preserving the ice throughout one or more seasons, and which saves the expense, damage, and loss usually resulting from meltage and regelation.

While I have described my invention as applied to ice-houses, it is apparent that the principles thereof are equally well adapted for use in cooling buildings, public halls, hospitals, and the like during the summertime by storing up the colder temperature of the night for use in resisting the heat of the following day and by reducing the temperature of the compressed air to about that of the atmosphere and then permitting such cooled compressed air to expand into the rooms, halls, and the like to be cooled. In this manner the temperature of the building, hall, or hospital may be maintained at any suitable or desirable degree. It is also apparent that my invention is of particular value as applied to the preservation of manufactured ice, as from the use of my invention the ice may be manufactured in quantity at a convenient season and then stored

at small expense until required for consumption or sale and without danger of the serious loss which heretofore has attended the storage of ice manufactured any considerable period of time in advance of the demand of the trade therefor.

It is obvious that many variations and changes in the details of construction and arrangement would readily suggest themselves to persons skilled in the art and still fall within the spirit and scope of my invention. I do not desire, therefore, to be limited or restricted to the exact construction and arrangement shown and described; but

Having now set forth the object and nature of my invention and a form of apparatus as an illustrative embodiment of the principles thereof and having described the construction, function, and mode of operation thereof, what I claim as new and useful and of my own invention, and desire to secure by Letters Patent, is—

1. In a system for preserving ice in ice-houses, ventilator for opening communication between the interior of the ice-house and the outer air, and means actuated by the conjoint action of variations in the temperature of the outer air and the interior of the house for operating said ventilator, as and for the purpose set forth.

2. In a system for preserving ice, an ice-house having a ventilator, means for operating said ventilator, and means actuated by the conjoint action of variations in the temperature of the outer air and the interior of the house for automatically controlling said operating means, as and for the purpose set forth.

3. In a system for preserving ice, an ice-house having a ventilator, an expansion-coil arranged within the house, to be acted upon by variations in temperature, an expansion-coil arranged outside the house, to be acted upon by variations in atmospheric temperature, and means actuated by the conjoint action of said coils for operating said ventilator, as and for the purpose set forth.

4. In a system for preserving ice, an ice-house having an ice-storage room, ventilators arranged in the roof of said house and in the ceiling of said room, means for opening and closing said ventilators, an expansion-coil arranged in the ice-room, an expansion-coil arranged outside of said house, and means actuated by the conjoint action of said expansion-coils for operating said opening and closing means, as and for the purpose set forth.

5. In a refrigeration system, a house, an expansion-coil arranged within the house and acted upon by the temperature on the inside of the house, an expansion-coil arranged on the outside of the house and acted upon by the atmospheric temperature, and means actuated by the conjoint action of said coils for opening communication between the outer air and the interior of the house, whereby the temperature in the house is reduced to that of the outer atmosphere, as and for the purpose set forth.

6. In a system for preserving ice, an ice-house, a ventilator for opening communication between the interior of the house and the outer air, means for actuating said ventilator, a rock-lever for controlling said actuating means, means connected to one end of said lever and actuated by variations in the temperature of the outer air, and means connected to the other end of said lever and actuated by variations in the temperature within the house, whereby said lever is rocked by the conjoint action of variations of temperature of the outer air and the interior of the house, as and for the purpose set forth.

7. In a system for preserving ice, an ice-house having ventilators, a motor for operating each ventilator, an expansion-coil arranged within the house, a similar coil arranged outside of the house, said coils acted upon by the temperature to which they are respectively subjected, and means actuated by the conjoint action of said coils for controlling the operation of said motors, as and for the purpose set forth.

8. In a system for preserving ice, an ice-house having ventilators, an air-cylinder and piston for operating each ventilator, a compressed-air reservoir, a pipe connecting said reservoir with said cylinders, and a valve for controlling said pipe, in combination with an expansion-coil arranged within said house, a similar coil arranged outside of the house, said coils adapted to be affected by variations in the temperature to which they are respectively subjected, and means actuated by the conjoint action of said coils for operating said valve, as and for the purpose set forth.

9. In a system for preserving ice, an ice-house having ventilating-openings, an expansion-coil arranged within the house and adapted to contain a fluid influenced by variations in the temperature to which it is subjected, a similar coil arranged outside the house and adapted to contain a similar fluid influenced by variations in the atmospheric temperature, a cylinder communicating with one end of each coil, a piston for each cylinder, a rock-lever, to the opposite ends of which said pistons are respectively connected, and means actuated by the rocking of said lever for opening or closing said ventilating-openings, as and for the purpose set forth.

10. In a refrigerating system, a house, an air-compressor, a reservoir into which said compressor delivers, means for extracting the heat of compression of said compressed air, whereby said compressed air is delivered into said reservoir at a reduced temperature, a delivery-pipe for the compressed air, delivering from said reservoir and into said house, a valve for opening and closing said pipe, a rock-lever for actuating said valve, means connected to one end of said lever and actu-

ated by variations in the temperature of the outer air, and means connected to the other end of said lever and actuated by variations in the temperature within the house, whereby said lever is rocked by the conjoint action of variations of temperature of the outer air and the interior of the house, as and for the purpose set forth.

In witness whereof I have hereunto set my hand, this 19th day of December, 1898, in the presence of the subscribing witnesses.

OSSIAN GUTHRIE.

Witnesses:
S. E. DARBY,
E. C. SEMPLE.