No. 625,760. Patented May 30, 1899.

E. C. HARGRAVE.

LIQUEFIED AIR CONTAINER FOR REFRIGERATING PURPOSES.

(Application filed July 25, 1898.)

(No Model.)

Fig. 1.

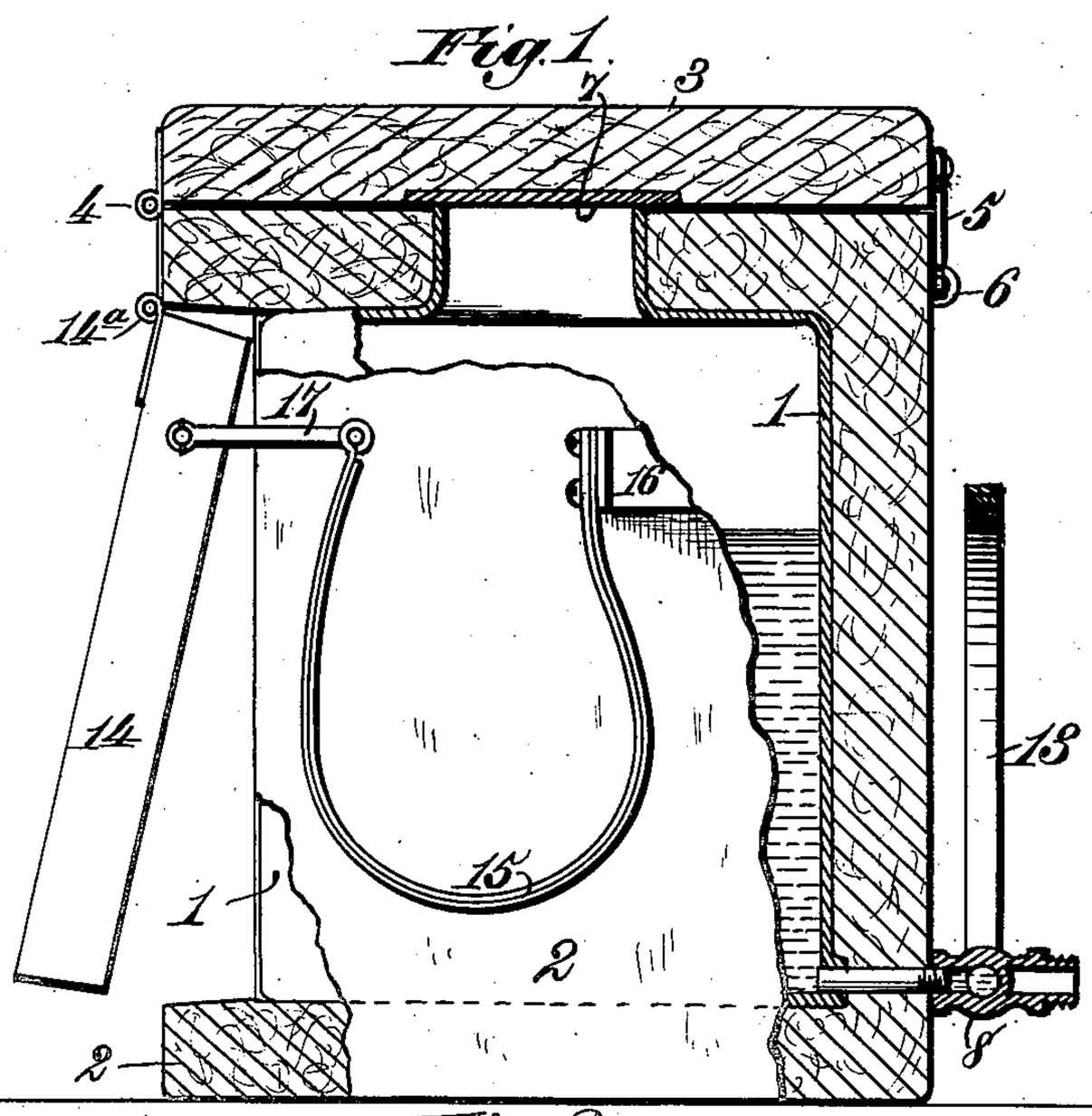
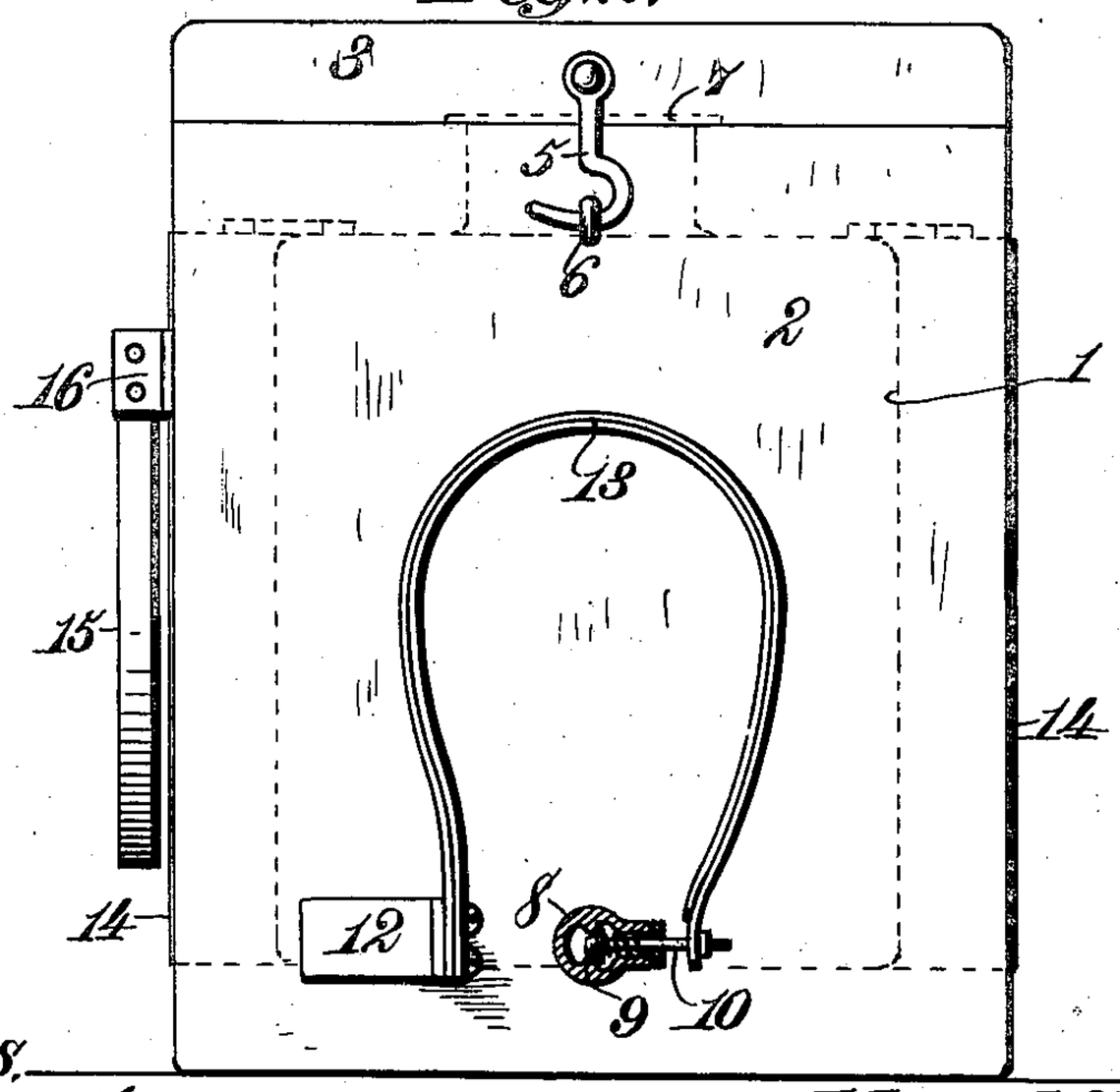


Fig. 2.



Witnesses.
Robert Orratt.
Albert H. Norris.

Inventor.
Edward C. Hargrave.
By James L. Norris.
Attl.

UNITED STATES PATENT OFFICE.

EDWARD C. HARGRAVE, OF BAY CITY, MICHIGAN.

LIQUEFIED-AIR CONTAINER FOR REFRIGERATING PURPOSES.

SPECIFICATION forming part of Letters Patent No. 625,760, dated May 30, 1899.

Application filed July 25, 1898. Serial No. 686,833. (No model.)

To all whom it may concern:

Be it known that I, EDWARD C. HARGRAVE, a citizen of the United States, residing at Bay City, in the county of Bay and State of Michigan, have invented new and useful Improvements in Liquefied-Air Containers for Refrigerating Purposes, of which the following is a specification.

This invention relates to apparatus or means designed particularly for utilizing liquefied atmospheric air or gas for refrigerating purposes by which clean dry cold can be delivered to the apartment or space to be refrigerated—such as the room of a building, a domestic refrigerator, a railway-car, or any other structure wherein a low temperature is desired.

The chief object of my invention is to provide a new and improved liquefied-air container possessing such characteristic features of construction that the contents are maintained in a liquefied state by excluding the heated atmosphere from the walls of the container and providing for the escape of the evaporating air in the latter in contradistinction to maintaining the air or gas liquefied by excessive pressure within the container.

The invention also has for its object to provide a liquefied-air container wherein the air is maintained in a liquefied state by excluding heated atmosphere from the walls of the container and providing for the escape of the evaporating air in the latter and the liquefied air can be withdrawn from the bottom of the container for refrigerating purposes.

The invention also has for its object to provide a liquefied-air container wherein the air is maintained in a liquefied state by excluding heated atmosphere from the walls of the container and providing for the escape of the evaporating air in the latter and the delivery of the liquefied air from the bottom of the container for refrigerating purposes is automatically regulated according to the temperature in the apartment, chamber, or space to be refrigerated.

The invention also has for its object to provide a liquefied-air container with an enveloping casing or jacket and means whereby the transmission of heat from the exterior to and through the casing or jacket and the container may be varied for the purpose of accelerating or retarding the evaporation of the liquefied air, according to the conditions required or circumstances render advisable.

These objects are accomplished in the manner and by the means hereinafter described and claimed, reference being made to the accompanying drawings, in which—

Figure 1 is a broken sectional elevation of a liquefied-air container constructed in accordance with my invention; and Fig. 2 is a side elevation of the same, looking in a direction at right angles to the side represented in Fig. 1.

In order to enable those skilled in the art to make and use my invention, I will now describe the same in detail, referring to the drawings, wherein—

The numeral 1 indicates a tank constituting the receptacle of the container. This tank is preferably composed of glass; but it may be made of any material suitable for the purpose in hand. The liquefied air or gas, such as oxygen or atmospheric air, is obtained by reducing the same to a liquid state through the medium of high pressure and reduction of temperature, as is known, and this liquefied air is introduced into the tank to be utilized for refrigerating purposes by delivering the same, as required, into an apartment, chamber, room, or space which is to be refrigerated—as, for example, into the room of a building, domestic refrigerator, railway-car, steamship, or any other structure wherein very low temperature is desired.

The top wall of the tank is constructed with a tubular neck or mouth, by which the liquefied air may be introduced and through which the evaporated air may escape to lower the temperature outside and avoid excessive external pressure, which would likely burst the tank. The top, bottom, and side walls of the tank are surrounded by a non-conducting casing or jacket 2, composed of felt, rock-wool, or other material suitable for the purpose in hand—that is to say, to exclude heat from the walls of the tank and thus preserve the latter at a low temperature, which, in connection with the escape of the evaporating liquefied air in the tank, maintains the liquefied air in a liquid state. The top of the casing or jacket is provided with a cover-section 3, hinged thereto, as at 4, and composed of felt,

rock-wool, or other non-conducting material. The cover-section is preferably provided with a fastening device by which to secure it in its closed position. As represented in the drawings, the fastening is composed of a simple hook 5 and eye 6, but this is only typical of many fastening devices that may be employed. The center of the hinged cover is provided with a section of leather or similar yielding material preferably made in the form of a disk, as at 7, and of such dimensions that when the hinged cover is in its closed position the leather disk will wholly cover the open mouth of the tubular neck at the top of the tank. This leather disk is susceptible of yielding under slight pressure, so that the evaporating liquefied air in the tank may escape between the top edge of the tubular neck and the lower surface of the leather disk and flow into and through the non-conducting material of the casing or of the jacket. The bottom of the tank is provided with a discharge-valve designed for the purpose of delivering liquefied air from the tank into the apartment, chamber, room, or space to be refrigerated. The valve is composed of a valve-casing 8 and a spring-pressed valve disk or plug 9, having its stem 10 arranged horizontally and connected at its outer end with one extremity of a bow-shaped thermostat 13, which has its other extremity mounted on a suitable bracket 12, applied to the exterior of the non-conducting casing or jacket. The thermostat is made of metals of different expansibility and may be of any form to suit the conditions required. One of the metals should be susceptible of expanding under the action of heat for the purpose of more or less opening the valve and delivering a greater or less quantity of the liquefied air into the apartment, chamber, or space which is to be refrigerated, and, conversely, when the desired high temperature is obtained the expansible metal of the thermostat will more or less contract and entirely or partially close the valve. By this means the liquefied air is gradually released from the tank and as it expands lowers the temperature where the refrigeration is desired.

The disk of leather before mentioned constitutes, in effect, a valve which permits the escape of evaporating liquefied air from the interior of the tank, and the non-conducting casing or jacket excludes heat from the tank, all in such manner that the air or gas in the latter is maintained in a liquefied state without the necessity of excessive high pressure in the tank for such purpose.

In order to accelerate or retard the evaporation of the liquefied gas in the tank according as circumstances demand, I provide the non-conducting casing or jacket with a movable section, as at 14, which may be adjusted or moved to and from a portion of the wall of the tank to more or less expose a part of the surface thereof to the action of the surrounding atmosphere. As represented in the drawings, the adjustable or movable section 14 composes one complete side of the non-conducting casing or jacket, and it is hinged at its upper end, as at 14^a, so that it may be swung in the arc of a circle to any position necessary to secure the desired exposure of the side of the tank where the adjustable or movable section is located. The adjustment of the section from or toward the wall of the tank more or less exposes part of the surface thereof to the action of the surrounding atmosphere, and by proper adjustment of this section the evaporation of the liquefied gas in the tank can be accelerated or retarded to suit the conditions required. When the air in the apartment, chamber, room, or space which is to be refrigerated comes in contact with the surface of the tank, a portion of the liquefied gas is evaporated and the temperature of the surrounding air is materially lowered.

While I have represented the adjustable or movable section 14 as constituting one complete side wall of the casing or jacket, I do not wish to be understood as limiting myself to this precise construction, for any part of the surrounding casing or jacket may be provided with an adjustable or movable section to secure the results hereinbefore explained. The section may be adjusted or moved from or toward the outer surface of the tank through the medium of any suitable devices; but, as shown in the drawings, I effect the adjustment or movement of the section automatically by the action of a thermostat 15, like or similar to the thermostat 13, which controls the discharge-valve at the bottom of the tank. The thermostat 15 is located outside the casing or jacket, and at one end is supported by a suitable bracket 16, while the other end is pivotally connected by a link 17 with the adjustable or movable section 14. When the expansible part of the thermostat expands, the section 14 will be adjusted or moved a greater or less distance away from a part of the outer surface of the tank, and, conversely, when the expansible metal of the thermostat contracts the section will be adjusted or moved a greater or less extent toward the said part of the surface of the tank, thereby more or less exposing a part of the surface of the tank to the action of the surrounding atmosphere and accordingly accelerating or retarding the evaporation of the liquefied gas in the tank.

The container embodying the features or elements described and shown is designed to deliver the liquefied air into the apartment, chamber, room, or space to be refrigerated, and for this purpose it is advisable to place the apparatus directly in such apartment, chamber, or space where the temperature therein will, through the medium of the thermostat, control the delivery of the liquefied air and of the evaporated air in the tank to exactly suit whatever conditions are required or circumstances may demand for the

purpose of securing the best results. The adjustable or movable section 14 of the non-conducting casing or jacket constitutes a means whereby the transmission of heat from the exterior to and through the casing or jacket and the container may be varied for the purpose of accelerating or retarding the evaporation of the liquefied air. As regards this part of my invention, I desire it understood that I do not limit myself to the precise means described and shown for varying the transmission of heat from the exterior to and through the casing or jacket and the container, as this may be accomplished by means other than the specific means illustrated.

In my invention liquefied air may be delivered directly into the space to be refrigerated, and the efficiency of this method is greater than that of a system in which compressed air or gases are allowed to expand in closed pipes.

In my invention there is no excessive pressure in the tank, but, on the contrary, practically no pressure as compared with the maintaining of liquefied air or gas in a liquid state by excessive high pressure.

Having thus described my invention, what I claim is—

1. A liquefied-air container having an enveloping non-conducting casing, a liquefied-air-delivery valve at its bottom portion for delivering liquefied air to the space which is to be refrigerated, and means at the top portion for the escape of evaporated liquefied air from the container, substantially as described.

2. A liquefied-air container having an enveloping non-conducting casing, a liquefied-air-delivery valve at its bottom portion for delivering liquefied air to the space which is to be refrigerated, and a valve at the top portion for the escape of evaporated liquefied air from the container, substantially as described.

3. A liquefied-air container, having an enveloping non-conducting casing, an automatically-operated liquefied-air-delivery valve at its bottom portion for delivering liquefied air to the space to be refrigerated, and a valve at its top for the escape of the evaporating liquefied air from the container, substantially as described.

4. A liquefied-air container, having an enveloping non-conducting casing, a liquefied-air-delivery valve at its bottom portion for delivering liquefied air to the space to be refrigerated, and a non-conducting movable cover provided with a valve located over the mouth of the tank for permitting the escape of evaporated liquefied air from the container, substantially as described.

5. A liquefied-air container, having an enveloping non-conducting casing, an automatically-operated liquefied-air-delivery valve at its bottom portion for delivering liquefied air to the space to be refrigerated, and a non-conducting movable cover having a valve located over the mouth of the container for permitting the escape of evaporating liquefied air therefrom, substantially as described.

6. A liquefied-air container, having an enveloping non-conducting casing, a liquefied-air-delivery valve at its bottom portion for delivering liquefied air to the space to be refrigerated, and a hinged non-conducting cover provided with a valve located over the mouth of the container for permitting the escape of evaporating liquefied air therefrom, substantially as described.

7. A liquefied-air container provided with an enveloping casing or jacket, and means whereby the transmission of heat from the exterior to the surface of the container or liquid may be varied for the purpose of accelerating or retarding the evaporation of the liquefied air, substantially as deseribed.

8. A liquefied-air container having an enveloping non-conducting casing, means whereby the transmission of heat from the exterior to the surface of the container may be varied for accelerating or retarding the evaporation of the liquefied air, a liquefied-air-delivery valve at the bottom portion for delivering liquefied air to the space to be refrigerated, and means for permitting the escape of evaporating liquefied air from the top portion of the container, substantially as described.

9. A liquefied-air container having an enveloping non-conducting casing provided with an adjustable section for more or less exposing a part of the surface of the container or liquid to the action of the atmosphere, whereby the evaporation of the liquefied air in the container may be accelerated or retarded, substantially as described.

10. A liquefied-air container having an enveloping non-conducting casing, provided with an adjustable section for more or less exposing a part of the surface of the container to accelerate or retard evaporation of the liquefied air therein, a liquefied-air-delivery valve at the bottom of the container, and a valve at the top thereof for the escape of evaporating liquefied air from the container, substantially as described.

11. A liquefied-air container having an enveloping non-conducting casing provided with an automatically-adjusted section for more or less exposing a part of the surface of the container or liquid to accelerate or retard evaporation of the liquid air in the container, substantially as described.

12. A liquefied-air container, having an enveloping non-conducting casing provided with a movable section for more or less exposing a part of the surface of the container to accelerate or retard evaporation of the liquid air in the container, and a thermostat connected with said movable section to automatically move it relatively to a part of the surface of the container, substantially as described.

13. A liquefied-air container having an enveloping non-conducting casing provided with a hinged movable section for more or

less exposing a part of the surface of the container or liquid to accelerate or retard variation of the liquefied air, substantially as described.

14. A liquefied-air container, having an enveloping non-conducting casing provided with a movable section for more or less exposing a part of the surface of the container or liquid to accelerate or retard evaporation of the liquefied air, a liquefied-air-delivery valve at the bottom of the container, and a valve at the top thereof for the escape of evaporating liquefied air, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

EDWARD C. HARGRAVE.

Witnesses:
ALBERT H. NORRIS,
F. B. KEEFER.