

March 22, 1938.

P. SCHLUMBOHM
REFRIGERATING SYSTEM

2,111,904

Filed Nov. 19, 1932

2 Sheets-Sheet 1

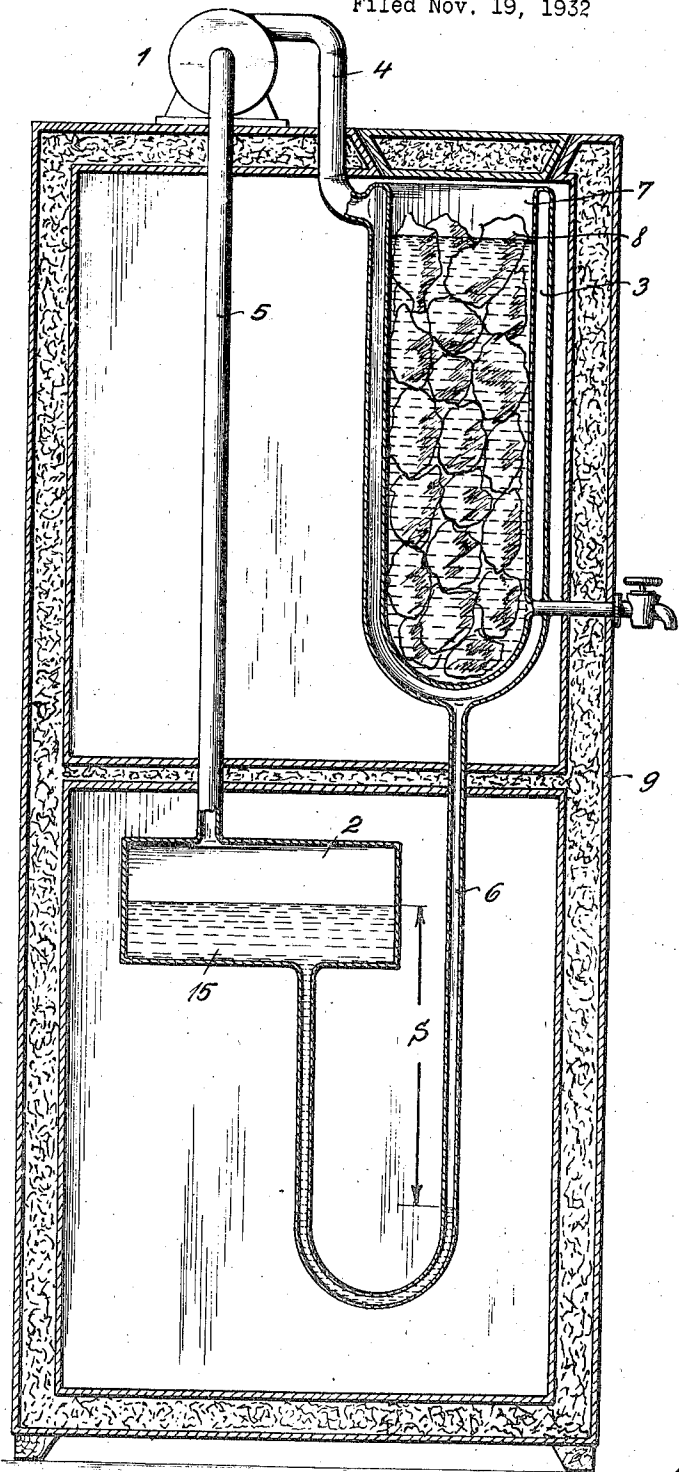


Fig. 1

Inventor:

P. Schlumbohm

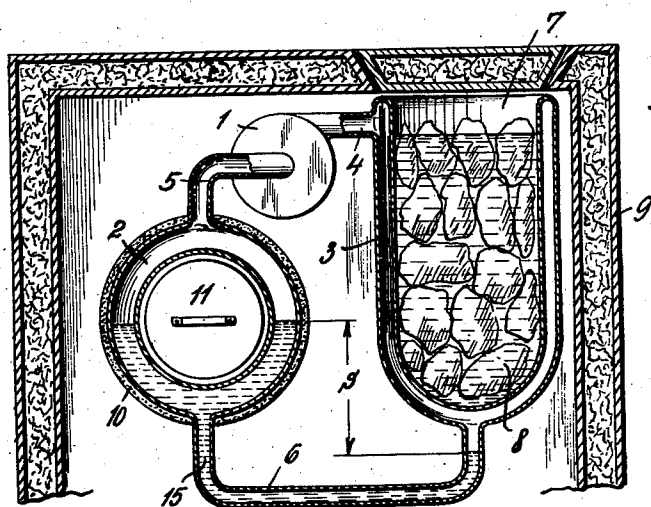
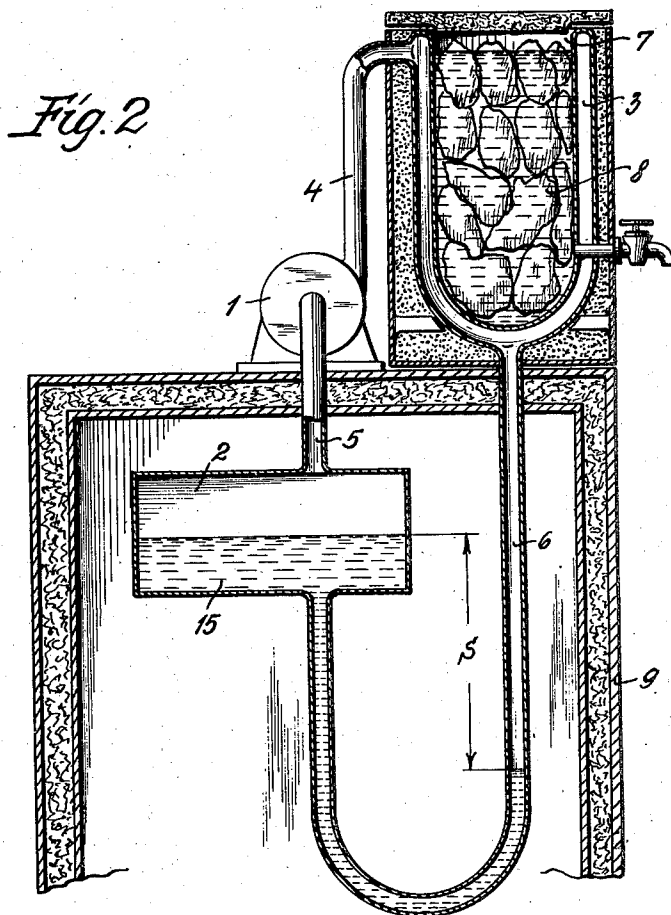
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Inventor:

P. Schlumbohm

UNITED STATES PATENT OFFICE

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REFRIGERATING SYSTEM

Peter Schlumbohm, Berlin, Germany

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16 Claims. (Cl. 62-115)

The purpose of my invention is to improve water ice cooling systems by the combined use of water ice and power, especially electric power. This new procedure is more economical for the consumer of the cold than the exclusive use of power as usual in entirely mechanical refrigerators.

The invention relates to improved refrigeration systems in which the ordinary commodity, water ice, is combined with refrigerating apparatus of the compression type in which the cold is produced by the evaporation of a refrigerant, the vapors of which become liquefied again by means of a compressor, and to improved methods of refrigeration and refrigerators utilizing such systems. In a particular embodiment, the new refrigerating system is characterized by the use of water ice for cooling the condenser of the compression type apparatus.

In accordance with the practice of the invention the user of water ice is able to obtain temperature effects which are sufficiently low for storing ice cream, e. g. $-10^{\circ}\text{C}.$, while avoiding the uneconomic consumption of power that is incident to the use of entirely mechanical refrigerators. In addition to these advantages, he may also secure all the advantages of water ice refrigeration. It is therefore obvious that the invention opens up new field for the water ice industry and enables it effectively to meet competition by entirely mechanical refrigerators and "dry-ice."

One object of my invention is to provide methods and apparatus by which temperatures below the freezing point of water may be produced although the calorific effect is derived from ordinary water ice. Another object is to provide improved ice boxes or refrigerators in which refrigerating apparatus of the compression type is utilized in combination with water ice so that advantages of both are obtained, while individual disadvantages of each, from both an economic and technical point of view, are avoided.

I am aware of the fact that it is known to cool the condenser of a refrigerating system by the cold evaporator of another refrigerating machine. This arrangement has been made in order to produce extremely low temperatures. However, this is not the aim of my invention, which aims only at temperatures sufficiently low for freezing or storing ice cream, e. g. $-10^{\circ}\text{C}.$,—temperatures that heretofore have not been available to the users of refrigerators cooled by water ice.

The compression refrigerating apparatus in-

cludes in combination, a compressor, a condenser and an evaporator. The compressor may be one having a low compression ratio, that is about 1:2 rather than that which is usual in compression systems, namely 1:5 or even 1:6, and hence more economical than that found in normal mechanical refrigerating practice. This small compression corresponds to the relation between the saturated pressure of the refrigerant near the freezing point of water, this temperature being maintained by the water ice cooled condenser, and the saturated pressure of the refrigerant in the evaporator at the temperature of e. g. about $-10^{\circ}\text{centigrade}.$

The low ratio of compression utilized allows a simplification of the compression system by the use of a cheap compressor, e. g. of the blower type, and further by the use of liquid traps instead of complicated valves for shutting off the condenser from the evaporator and for bringing the liquefied refrigerant from the condenser back to the evaporator. The expression "low ratio compressor" as used in the claims is to be understood as defining such a compressor, that is to say, one having a ratio not greater than 3 to 1.

The invention is illustrated by way of exemplification in the accompanying drawings.

Fig. 1—Fig. 3 illustrate the new system partly in perspective and partly in section as installed in a refrigerator of the ice box type.

In Figs. 1 to 3 the compression system comprises in combination the compressor 1, the evaporator 2, the condenser 3, and connecting pipes including pipe 4 between compressor and condenser, pipe 5 between the evaporator and the compressor, and pipe 6 between the condenser and the evaporator. In Figs. 1 to 3 the condenser 3 is preferably built as a double walled container. The inside of the container or cooling space 7 is filled with ice 8, and the space between the double walls of the container 7 forms the condensing space 3.

In Fig. 1 the compression system is installed in a refrigerator 9, the refrigerator 9 being divided into two compartments, one above the other. In the upper compartment the ice container 7 is placed, while the evaporator 2 is arranged in the lower compartment. The compressor 1, in this case, is placed outside on the top of the refrigerator 9. The upper compartment is cooled by the water ice 8 and the lower compartment is cooled by the refrigerant 15, which evaporates at temperatures lower than the freezing point of water when the compressor

1 is started. The refrigerants employed are those which are useful in the refrigerating art, for example, ammonia, sulfur dioxide, methyl chloride, ethyl chloride, and others.

5 The exemplification as shown in Fig. 2 shows the ice container 7 together with the condenser 3, insulated by a special jacket, and positioned outside of the refrigerator 9, which in this case is cooled exclusively by the refrigerant 15. The
10 connecting pipe 6 between the condenser 3 and the evaporator 2 is formed in the shape of a U in order to allow the liquid refrigerant 15 to form a liquid trap and a column S, thus separating the domain of higher pressure in the condenser from the domain of lower pressure in the
15 evaporator.

In Fig. 3 an apparatus is shown which forms a constructional unit, comprising the compressor 1, the ice container 7, the condenser 3, the evaporator 2, and the connecting pipes 4, 5, and 6. The unit thus formed may be removably placed
20 inside of the refrigerator 9. The construction as shown in Fig. 3 includes an evaporator 2 which is formed as a double walled container, the inside of which is equipped as a refrigerating
25 chamber 11 e. g. for the freezing and storing of ice cream. The outside of the double walled evaporator 2 is surrounded by a heat insulating jacket 10. In this case the refrigerator 9 is
30 cooled by the ice container 7 only, and the compressor 1 is started only occasionally when it is desired to use the refrigerating chamber for the storing or for the making of ice cream.

Having now described the various exemplification of the apparatus, it is desired to point out
35 some special features which appear if the system is used in connection with a refrigerator 9 or any other suitable cooling room. As shown in Fig. 1 and Fig. 3 even the heat developing parts of the
40 refrigerator may be installed inside of the refrigerator whereas it is necessary in the normal installations of refrigerators in cooling rooms, to penetrate the walls of the cooling room in order to arrange the cold developing parts of the machine
45 inside of the cooling room and to place the heat developing parts of the refrigerator outside of the cooling room. The new apparatus can be placed entirely and even removably, as shown especially in Fig. 3, inside of the cooling room.
50 This is particularly important for transportable cooling rooms, refrigerator cars and trucks. Furthermore, this factor makes it easy to equip subsequently a normal water ice box of the old system with the apparatus of the invention.

I have found it to be practical to provide means for allowing the vapors of the refrigerant to flow from the evaporator to the condenser
55 even while the compressor is not working. Accordingly a compressor with a small compression ratio can be used, for instance, a centrifugal blower. It will be realized that this blower, while
60 not working, allows the vapors to flow from the evaporator through the suction tube, through the blower and through the pressure tube into the condenser. The practical advantage is that when
65 the compressor is not working the temperature in the evaporator does not rise considerably higher than the temperature of the condenser owing to the evaporation of refrigerant taking place
70 when the temperature in the evaporator becomes higher than the temperature in the condenser.

It is apparent that ice boxes including features of the embodiments of my invention illustrated in Figs. 1 to 3 constitute substantial improvements over known constructions. The

user of such an ice box is able to secure humid refrigeration of the kind supplied by water ice, or, as desired, the more intense refrigeration or freezing effects of an evaporating refrigerant. Because of the refrigerating effect of the water
5 ice, to secure subfreezing temperatures does not require that the entire heat load of the box be carried away by the evaporator-compressor system. When not needed, operation of the compression apparatus may be discontinued, in which
10 event the water ice serves effectively to maintain entirely satisfactory temperature conditions for preserving foodstuffs. Furthermore, by employing open circulation of the refrigerant from the evaporator to a point in heat exchange with the
15 water ice and thence back to the evaporator, temperatures sufficiently low for many purposes may also be maintained in the chamber or compartment wherein the evaporator is located.

I wish to emphasize that cooling the condenser with water ice is a feature of my invention which is employed only to obtain the optimum, technical solution. The new ice box is superior to entirely mechanical refrigerators or ice
20 boxes cooled only by water ice when it is provided with an air cooled compression refrigerating apparatus in combination with water ice.

After having thus described the nature of my invention and in what manner the same is to be performed, what I claim is:

1. The method of operating a refrigerator which consists in simultaneously absorbing the heat of the storage space and the contents thereof by melting a renewable charge of water ice within said space and cooling a heat insulated
35 zone within said space to a sub-freezing temperature by evaporating a second refrigerant within said zone.

2. The method of operating a refrigerator, which consists in simultaneously absorbing the heat of the storage space and the contents thereof by melting externally produced water ice within said space and cooling a heat insulated zone within said space to a sub-freezing temperature by evaporating a second refrigerant within said
45 zone.

3. The method of improving the economy of a mechanical refrigerating system in which the evaporator operates in a heat-insulated zone at low temperatures to freeze substance in said
50 zone, which comprises reducing the heat load to be taken up by the evaporating refrigerant to approximately the net heat load extracted from the substance to be frozen by shielding said zone against additional outside heat flowing thereto by means of externally produced water ice in an outer heat-insulated zone.

4. A cooling system for the use of water ice and a temperature transformer of the compression type in functional relation to each other, said transformer having an evaporator, a condenser, a mass of water ice in heat exchange with the condenser and a low ratio compressor arranged between evaporator and condenser in functional relation thereto, the working ratio
65 of said compressor being such that said transformer is operative to evaporate a refrigerant in the evaporator at temperatures below the melting point of ice only when the vapors of said refrigerant are compressed by said compressor and condensed in heat exchange with said water ice.

5. A cooling system as defined in claim 4, wherein a U-shaped conduit is connected between an evaporator and a condenser and the
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difference in the pressures thereof is balanced by a difference in level of said refrigerant in the U-shaped conduits.

6. An ice box comprising a heat insulated casing enclosing a cooling compartment and the evaporator of a compression refrigerating machine having a condenser arranged outside said compartment and a compressor, a heat insulated chamber outside of said compartment for storing a mass of ice, and means to cool said cooling compartment by heat exchange with said ice when the compressor is not operating.

7. The method of operating a refrigerating apparatus of the ice box type having a chamber and ice holding means therein and a second chamber, which method comprises cooling the first mentioned chamber by heat exchange with water ice and cooling the second chamber by means of a refrigerating unit of the compression type while cooling heat developing parts of the latter by heat exchange with water ice.

8. In a refrigerating system of the ice-box type using water ice as the cooling agent and having two cooling chambers one maintained at a temperature above and one maintained at a temperature below the temperature of melting water ice, the method of refrigeration which comprises cooling the first chamber by means of water ice in heat exchange relation therewith and cooling the second chamber by means of a compression type refrigerating machine having an evaporator in said second chamber and a condenser in the first chamber and cooling the condenser by means of water ice alone.

9. A structure of the type described comprising the combination of a refrigerator device having an interior to be cooled and a refrigerating apparatus, said apparatus including a condenser mechanism arranged to hold water ice in heat exchange relation to compressed refrigerant and also in position to cool said interior, and a secondary refrigerating system including said condenser, an evaporator arranged in said interior, and a compressor and means connecting the compressor to the evaporator and the condenser.

10. A structure of the type specified in claim 9 in which said interior is divided into separate compartments and said condenser mechanism is disposed in one compartment and said evaporator in another compartment.

11. A structure of the type specified in claim 9 in which said evaporator comprises a device adapted to maintain a temperature below that

of melting water ice and includes an insulated exterior wall enclosing a space for goods to be cooled and a closure for said space.

12. In a refrigerating system of the type using water ice as the main cooling agent, the combination with a cooling chamber of a condenser adapted to hold water ice in heat exchange relation with the cooling chamber and arranged to provide a substantial portion of the cooling of the cooling chamber, and a refrigerating unit providing a region at a temperature lower than that of the water ice and comprising a compressor, said condenser and an evaporator, the water ice forming the condensing medium for the condenser.

13. A refrigerating apparatus of the ice box type comprising a casing having upper and lower compartments, tubular means associated with the upper compartment adapted to hold water ice in heat exchange relation with said upper compartment, a cooling unit comprising a condenser associated with and forming a part of said tubular means, an evaporator in heat exchange relation with said lower compartment and a compressor connected to said evaporator and condenser.

14. A refrigerating apparatus as defined in claim 13, wherein the compressor is a low ratio compressor.

15. A structure of the type described comprising the combination of a refrigerator device having an interior to be cooled and a refrigerating apparatus, said apparatus including a condenser mechanism arranged to hold water ice in heat exchange relation to compressed refrigerant and also in position to cool said interior, and a secondary refrigerating system including said condenser, an evaporator arranged in said interior, and a compressor, and means connecting the compressor to the evaporator and the condenser, and means connecting the condenser to the evaporator.

16. A refrigerating apparatus of the ice box type comprising a casing having upper and lower compartments, a tubular means in the upper compartment adapted to hold water ice and forming a condenser, a cooling unit comprising an evaporator in the lower compartment and a low ratio compressor cooperating with the condenser and adapted to cool the lower compartment to a temperature below the melting point of the water ice.

PETER SCHLUMBOHM.