April 19, 1932. W. FOURNESS 1,854,466

REFRIGERATING SYSTEM

Filed May 15, 1926 2 Sheets-Sheet 1

Fig. 1

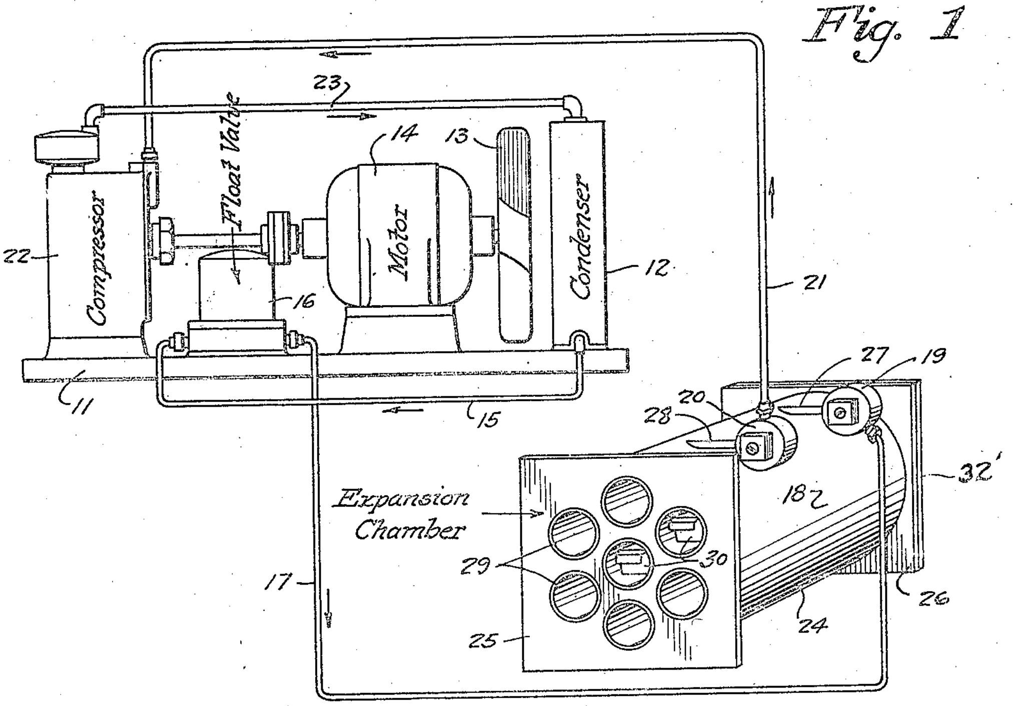


Fig. 3

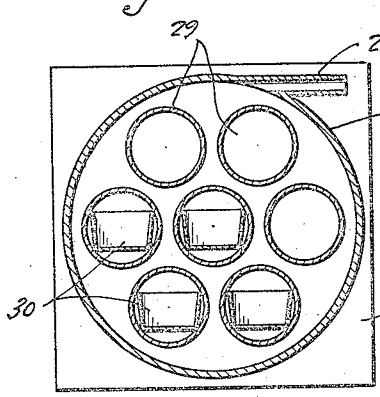


Fig. 2

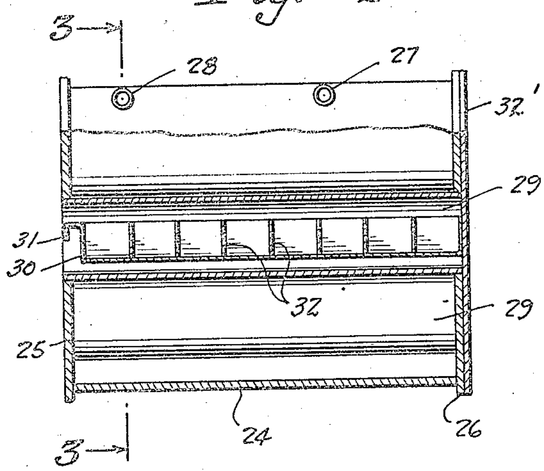
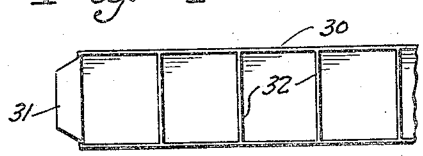


Fig. 4



Inventor
Wilfred Fourness
by John Flam
Attorney

April 19, 1932. W. FOURNESS 1,854,466

REFRIGERATING SYSTEM

Filed May 15, 1926 2 Sheets-Sheet 2

Fig. 5

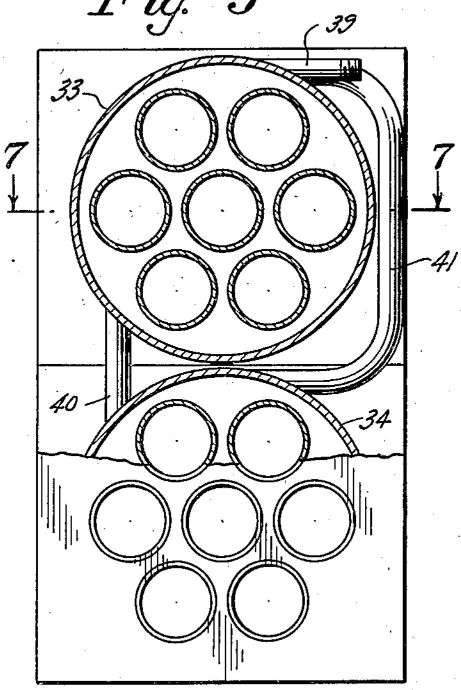


Fig. 6

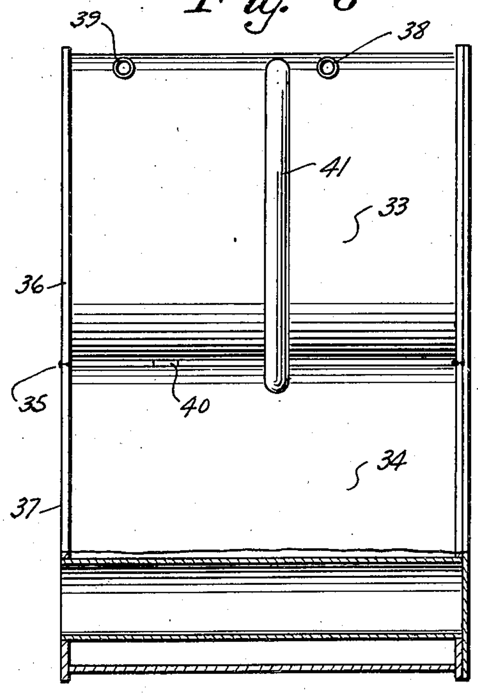
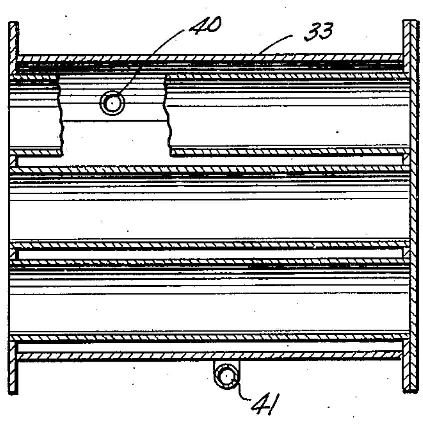


Fig. 7



Inventor
Wilfred Fourness
by John Flam
Attorney

Patented Apr. 19, 1932 1,854,466

UNITED STATES PATENT OFFICE

WILFRED FOURNESS, OF PASADENA, CALIFORNIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO FOURNESS DEVELOPMENT CORPORATION LTD., OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

REFRIGERATING SYSTEM

Application filed May 15, 1926. Serial No. 109,306.

This invention relates to refrigeration, and more particularly to a system capable of use in connection with ice boxes in homes or stores, or with store display cabinets.

In the usual type of mechanical refrigeration, use is made of a fluid refrigerant, which absorbs heat as it is allowed to expand in a space specifically provided for this purpose. Mechanical work can then be performed on the fluid after it is fully expanded and removed from the space, to compress it and thereby to abstract its heat content. It can then be recondensed, and passed again to the expansion space to complete the cycle.

It is thus evident that such systems have the following important elements operating upon the fluid: a compressor, a condenser, and a space where the fluid is permitted to expand. Several different kinds of fluids can be utilized for the refrigerant; in my system I have used sulphur dioxide.

It is common to provide the expansion space where the refrigerant absorbs heat, in the form of a long coil, placed adjacent the elements that are to be kept cold. For example, it may be placed inside one of the compartments in an ordinary ice box, or around the interior of a show case that is to be kept cold. Such coils are rather expensive to manufacture, and are difficult to replace or repair. It is accordingly one of the objects of my invention to provide a form of expansion chamber that is simple and inexpensive, and that obviates the undesirable coil construction.

It is another object of my invention to improve in general mechanical refrigeration systems; and specifically by providing an expansion space formed by any desired number of standard unit elements or containers.

It is still another object of my invention to provide an expansion space of such form that it can very readily be placed in intimate heat exchanging relation with respect to receptacles for water, whereby the water may be quickly frozen into small ice cubes for use in beverages.

My invention possesses many other advantages, and has other objects which may be made more easily apparent from a consideration of several embodiments of my invention. For this purpose I have shown a few forms in the drawings accompanying and forming part of the present specification. I shall now proceed to describe these forms in detail, which illustrate the general principles of my invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of my invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a diagrammatic view of a complete refrigerating system embodying one form of my invention;

Fig. 2 is a view, mainly in section, of an expansion unit constructed in accordance with my invention and used in the system of Fig. 1;

Fig. 3 is a sectional view, taken along plane 3—3 of Fig. 2;

Fig. 4 is a plan view of a water tray capable of use in connection with my invention, for forming small cubes of ice;

Fig. 5 is an elevation, partly in section, of an expansion chamber formed from a plurality of units, and illustrating the manner in which the capacity of the chamber can be varied at will by the aid of my invention;

Fig. 6 is a side view, partly in section, of the chamber shown in Fig. 5; and

Fig. 7 is a sectional view taken along plane 7—7 of Fig. 5.

In Fig. 1, the elements of the system are mainly diagrammatically disclosed, especially those that are shown as mounted on a base 11, which can rest, for example, on top of an ordinary ice box. A complete circulatory system is disclosed for a refrigerant that is cyclically permitted to expand, and is then compressed and condensed. Thus a condenser chamber 12 is shown on base 11; this condenser can be of the air cooled type, made up of a network of conduits, somewhat like automobile radiators. A fan 13, driven by motor 14, can be used to assist the movement of cool air over the condenser 12, in the bottom of which the condensed refrigerant settles.

By the aid of pipe or conduit 15, the condensed refrigerant is shown as conducted to a device 16, which controls the supply of the refrigerant to the expansion space to be later described. In the present instance, the controlling device 16 is indicated as a float valve, which opens the connection between conduit 15 and a conduit 17, whenever a definite amount of refrigerent accumulates in the float valve chamber.

The refrigerant thence passes to an expansion chamber 18, the details of which will be later described. In this chamber, it vaporizes and rapidly absorbs heat. The conduit 17 connects to the inlet valve 19 of the chamber 18; and an outlet valve 2 is provided through which the vaporized refrigerant can pass up into a conduit 21. The valves 19 and 20 are arranged to be manually controlled, whereby it is possible to close them and to disconnect the chamber 18 for inspection or repairs or replacement.

The vaporized refrigerant passes into the intake side of a compressor 22, which is directly connected in this instance to the motor 14, and rests upon base 11. The compressor can be of any desired type. The compressor compresses the refrigerant which in its compressed state leaves the outlet side through pipe or conduit 23, and enters the condenser 12. Here it is liquefied and starts the cycle all over again, of expansion with attendant absorption of heat, compression and condensation.

The system of refrigeration just described is quite general, and its principles are well understood, obviating any necessity for further detailed description. An important feature, however, resides in the particular manner in which the refrigerant is permitted to expand. In other well-known systems, the expansion takes place in a long coil or conduit, the pressure in which, is controlled by an expansion valve or its equivalent. Such a coil necessarily permits a rather slow rate of expansion, its passageway or bore being rather restricted; and consequently the rate of cooling is low. One of the important features of my invention resides in making the expansion chamber of very large size in comparison with the connections leading into it.

Thus, as shown in Figs. 2 and 3, I utilize a cylindrical drum or shell 24, forming the main portion of the expansion chamber. It has two heads 25 and 26, shown in this instance as square, and which may be fastened to shell 24 as by electric welding. The square shape permits use of the heads for supports for the entire chamber structure. The intake valve 19 is connected to the interior of the drum 18 by the aid of a connection 27, which is arranged tangentially with respect to the drum, and is preferably welded therein. The outlet valve 20 connects to a similar connection 28.

As thus far described, it is evident that the chamber 18 forms a very large space, into which the refrigerant is projected in a tangential direction directly from a comparatively small pipe. There is afforded every opportunity for immediate expansion and consequent rapid absorption of heat. The fact that a tangential direction is chosen for the intake, ensures that little if any impediment or hindrance will be opposed to the expansion, the vapor smoothly circulating around the drum 24.

It is desirable to provide a scheme for freezing small cubes or blocks of ice for use in drinking water or other beverages. With my invention, I am able to accomplish this result in a simple manner. For this purpose, I incorporate one or more tubes or passages 29 extending into the drum 24 and preferably entirely across it between the heads 25 and 26. These tubes can be welded into these heads, so as to maintain the chamber 18 fluid tight. In this manner, the tubes 29 have an outer peripheral surface enclosed in drum 24, and an inner surface open to the outside air, and forming cavities or recesses. By the use of an expansion or cooling chamber embodying a plurality of cooling tubes, the cooling effect is greatly speeded up and enhanced, due to the consequent increase of exposed cooling area. As the cooling area is measured by the outer peripheral surface of the tubes 29 multiplied by the number of tubes, it is clearly apparent that the cooling area is directly dependent upon the number of cooling tubes employed. The inner tube surfaces form a medium for a rapid and efficient heat exchange, which can be utilized to abstract heat from water placed in trays or containers 30 (Fig. 4). These trays have an overall length about the same as that of drum 24, and each has an ear or handle 31 making it easy to place them into tubes 29 and to remove them. It is advantageous to have the inner tube surface closely confining the trays 30, see Fig. 3, as in this manner the maximum cooling effect is obtained. If the trays were much smaller than the cavity defined by the inner tube surface, a great deal of the cooling effect would be lost due to the insulating effect of air surrounding the tray. Walls 32 separate the trays 30 into approximately cubical compartments in which the water can be frozen.

It is quite generally recognized that bubbles of cooling fluid are formed on the outer peripheral surface of the tubes 29 due to surface tension. The air or gas entrapped by these bubbles form an insulating medium about the tubes which prevents the full effect of the expanded cooling fluid thereon. It is also quite generally recognized that part of the refrigerant entering the chamber 24, through the inlet connection 27, does not immediately expand but drops in liquid form to the bottom of the chamber. In dropping, the particles of liquid refrigerant entrap some of the expanded refrigerant, or gas, and maintains the entrapped gas at the bottom of the chamber 24 for a brief interval of time. This entrapped gas soon separates from the liquid and rises to the top of the chamber 24 and finally out through the outlet connection 28. By arranging the tubes 29, in the chamber 24, in an offset overlying relation, the gas separated from the liquid at the bottom of the chamber acts to remove the bubbles collected on the outer periphery of the tubes. This is accomplished by the brushing of the rising gas on the outer peripheries of the tubes as it follows the tortuous path defined by the offset tubes. The tubes also cause the expanded gas to follow a tortuous path through the chamber.

It is advantageous to prevent circulation of air through the passageways formed by tubes 29; and for this purpose a cover 32′ is placed over one of the heads, such as 26, and held thereto in any appropriate fashion, as by screws or welding.

One of the advantages resulting from the form of expansion chamber is that it is a simple matter to nest a plurality of them together for increasing the capacity of the system. This can be done by placing them adjacent one another, either in a vertical or horizontal series, or both. Thus for example, I show in Figs. 5, 6, and 7, details of a pair of chambers connected together to form a larger unit; one being shown as 33, and the other as 34. They can be placed one above the other, and can be welded together by spot welding 35 at the adjacent surfaces of edges of the heads 36 and 37. These heads are merely placed one on top of each other. Both units 33 and 34 are similar to the expansion chamber shown in Figs. 2, 3 and 4.

The upper unit 33 has the inlet 38 and the outlet 39, similar to the connections 27 and 28 of the single form. There are two connections between the two units. One is a short straight pipe 40, which is welded to both units and extends tangentially thereof. It is in about the same plane as the outlet 39. The other connection 41 is U-shaped, and also extends tangentially to both units in a plane near that of the intake 38.

The arrangement can obviously be multiplied in order to take care of varying sizes of installations. For example, a larger number of units can be connected together for cooling a large space, like a display or show case, or an ice box for stores, clubs, or hotels. The small unit alone can be used for domestic ice boxes or the like. The important feature is that each unit has an element, such as heads 25 and 26, which have surfaces permitting a ready nesting thereof and simple mechanical connections and fastenings.

I claim:

1. A container for defining a space in which a refrigerant can expand, characterized by the fact that supporting means are provided for the container for resting it on a surface, which means are so formed that when a plurality of containers are nested adjacent one another to form a series, the adjacent means have contiguous and contacting surfaces that can be fastened together in any appropriate manner.

2. In a refrigerator system, means for compressing a refrigerant, means for condensing a refrigerant, means including a curved wall, defining a space in which refrigerant in the form of liquid expands to form a gas, means whereby a volatile liquid refrigerant is directly led to the space from the condensing means without materially expanding until it reaches the space, said means for leading the refrigerant forming a substantially tangential opening through the curved wall into the space, means directly conducting the gaseous expanded refrigerant to the compressing means, said space forming means including a hollow container of large volume, said container having a plurality of large cavities, said cavities each having an opening to the external atmosphere, as well as a wall that is in direct contact with the refrigerant in the container, and a tray arranged to be inserted into the cavity for holding material to be cooled, said container thus forming a space in which substantially the entire refrigerating effect is secured, whereby the material in the tray can be subjected to rapid cooling.

3. In a refrigerator system, means for compressing a refrigerant, means for condensing a refrigerant, means defining a space in which refrigerant in the form of liquid expands to form a gas, means whereby a volatile liquid refrigerant is directly led to the space from the condensing means without materially expanding until it reaches the space, said means for leading the refrigerant forming a substantially tangential opening into the space, means directly conducting the gaseous expanded refrigerant to the compressing means, said space forming means including a hollow container of large volume, said container having one or more large cavities, said cavities each having an opening to the external atmosphere, as well as a wall that is in direct contact with the refrigerant in the container, said wall forming with the wall of the container a non-uniform passageway between them, and a tray arranged to be inserted into the cavity for holding material to be cooled, said container thus forming a space in which substantially the entire refrigerating effect is secured, whereby the material in the tray can be subjected to rapid cooling.

4. In a refrigerator system, a compressor and a condenser, means forming an expansion chamber in which the refrigerant in the form of a liquid expands to form a gas, said means comprising a large chamber having cooling members formed therein, said members being arranged in offset overlying rela-

tion whereby due to the arrangement of the members the expanded gas is caused to follow a tortuous path through said chamber as and for the purpose specified.

5. In a refrigerator system, a compressor and a condenser, means forming an expansion chamber in which the refrigerant in the form of a liquid expands to form a gas, said means comprising a large chamber having a plurality of cooling members formed therein whereby the maximum cooling is obtained, said members being arranged in overlying rows, each row being offset from its adjacent row, and the members in each row being offset from the members in the adjacent row, whereby due to the arrangement of the members the expanded gas is caused to follow a tortuous path through said chamber as and for the purpose specified.

6. In the combination set out in claim 4 in which the chamber is in the form of a large tube, and in which the cooling members consist of tubes extending throughout the length of the large tube and secured thereto.

7. In the combination set out in claim 5 in which the chamber is in the form of a large tube, and in which the cooling members consist of tubes extending throughout the length of the large tube and secured thereto.

8. In the combination set out in claim 5 in which the chamber is in the form of a large tube, and in which the cooling members consist of tubes extending throughout the length of the large tube and secured thereto, said tubes closely confining a container adapted to be inserted therein, as and for the purpose specified.

In testimony whereof I have hereunto set my hand.

WILFRED FOURNESS.