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APPARATUS FOR COOLING LIQUIDS

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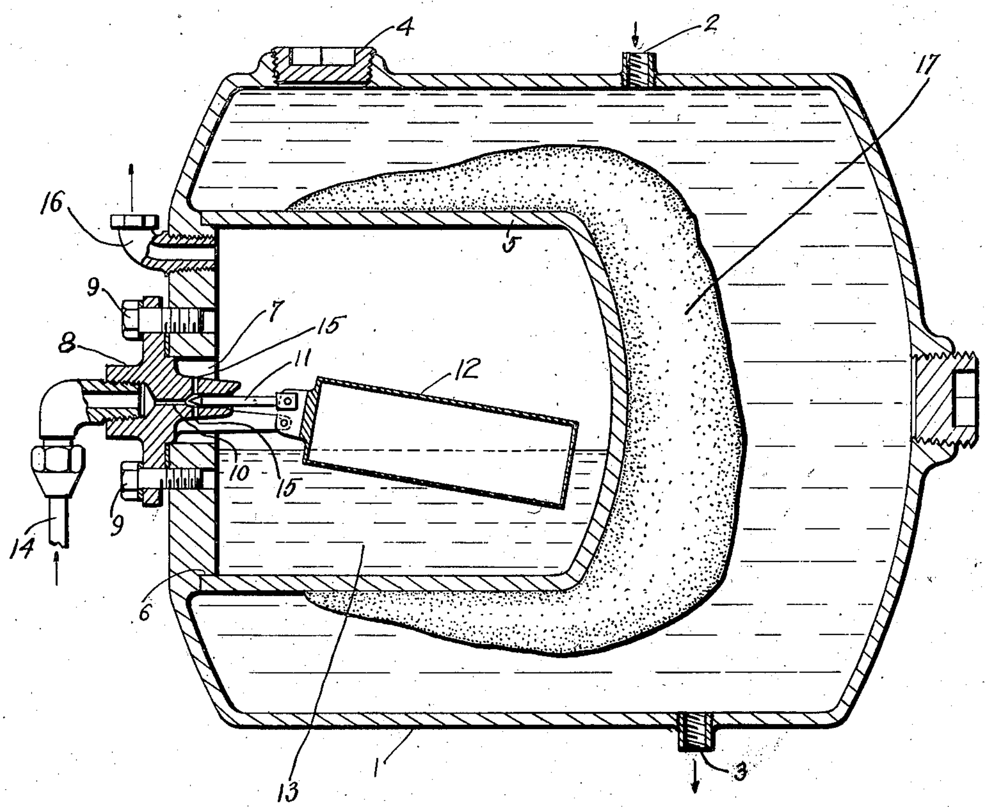

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APPARATUS FOR COOLING LIQUIDS

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This invention relates to an apparatus for cooling liquids in a simple and effective manner. The invention particularly relates to an apparatus whereby liquids may be cooled in small increments although the total quantity of liquid cooled may be large. The apparatus utilizes a liquefied refrigerant and also employs a portion of the liquid being cooled as a cooling agent for further quantities of liquid.

Although liquefied refrigerants such as sulfur dioxide and carbon dioxide have been utilized in maintaining low air temperatures in refrigerators and the like, such refrigerants have not been employed heretofore for cooling liquids. In most cooling of refrigerating systems heat is transferred from the bodies being cooled by radiation, convection and conduction simultaneously and this involves necessarily a slow rate of heat transfer at low temperatures.

At high temperatures, that is temperatures of over about 210° F., the rate of heat transfer under these conditions is materially increased, for example, radiation increases as the square of the temperature of the radiating surfaces increases. By substantially eliminating radiation and convection and limiting the transfer of heat almost exclusively to that transferred by conduction alone, I am able to cool fluids very rapidly at low temperatures or to low temperatures.

An object of this invention is to disclose and provide an apparatus adapted to carry out this invention in a simple and effective manner. Another object is to disclose and provide an apparatus adapted to cool liquids with a liquefied refrigerant. Another object is to disclose an apparatus adapted to cool liquids with liquefied refrigerants and utilize transfer of heat by conduction.

Other objects, advantages and results obtained by the use of my invention will become apparent from the following more detailed description of one form of apparatus. It will be understood that numerous changes and modifications may be made in the particular form of apparatus shown, the drawing appended hereto showing one form of apparatus merely for purposes of illustration.

The drawing appended hereto is a vertical cross-section of an apparatus adapted to cool liquids by means of a liquefied refrigerant. In the drawing, 1 denotes a receptacle or housing of any desired shape but preferably cylindrical provided with inlet means 2 and outlet means 3 for the liquid to be cooled. A plug 4 may be provided in the upper portion of the receptacle 1 so as to provide means for the escape of air or other gases present within the receptacle before the interior of the receptacle 1 is filled with the liquid to be cooled.

One or more smaller receptacles or chambers may be formed within the larger receptacle 1 by means of a shell 5 operably connected with the receptacle 1 by welding as at 6 or by means of screw threads. The receptacle 1 may be provided with an outlet or opening 7 which leads into the inner compartment formed by the shell 5. A flanged body or closure 8 is operably placed over the opening 7 and connected to the receptacle 1 in any suitable manner, for example by means of tap bolts 9. Means for admitting a liquefied refrigerant through the closure 8 into the inner shell 5 are provided. The flanged body 8 may be the body portion of a pin valve having a port 10 adapted to be closed by means of a valve 11.

The particular shape and construction of the pressure tank 1 with opening 7 leading directly into the inner tank chamber 5 without any liquid or gas connections or openings between the interior of tank 1 and tank 5, results in a simple unitary body of particular utility.

The pin 11 is preferably operated by means of a float 12 of any desired description adapted to float upon the surface of a liquefied refrigerant 13 within the inner chamber formed by the shell 5. Float valves of this description are known in the art and the details of construction need not be entered into here. All of these valves, however, operate in such a manner that a lowering of the liquid level within the chamber formed by the shell 5 results in a depression of the float 12 which activates the valve 11 pivotally connected thereto in such a manner that the port 10 is opened and the liquefied refrigerant such as liquid sulfur dioxide enters the chamber formed by the shell 5 through a supply means 14 operably connected to the flanged body portion 8, port 10 and discharge ports 15 emptying into the inner chamber.

A vapor outlet 16 is provided from the inner chamber so that any liquefied refrigerant volatilized within the inner chamber made by the shell 5 may be discharged through the outlet 16.

The operation of this apparatus is as follows: After the receptacle 1 has been filled with liquid to be cooled, for example water, and all air removed from the receptacle by allowing it to escape through the port or opening closed by the plug 4, and liquid refrigerant is admitted into the inner chamber formed by the shell 5 within the receptacle 1 through supply pipe means 14, the liquid refrigerant will boil and vaporize, the vapors being discharged from the chamber made by the shell 5 through the outlet 16 which may lead to any suitable storage tank or compressor wherein the vaporized refrigerant may be reliquefied and turned back into the system for reuse. It is well understood that vaporization of a liquid causes a reduction in temperature and this reduction in temperature is transmitted to the liquid within the receptacle 1 by conduction through the shell 5 of the inner chamber. This cooling action forms a zone adjoining the shell 5 in which the liquid being cooled is in a super-cooled condition or reduced to a temperature below the desired temperature. In case water is the liquid being cooled, the portion of super-cooled water may take the form of an ice cap 17 upon the outer surface of the inner chamber 5. The quantity of liquid reduced to this super-cooled condition will depend entirely upon the rate of flow of liquid to be cooled through the apparatus. For example, if only a small quantity of liquid is being withdrawn and supplied to the apparatus, the proportion of super-cooled liquid will become quite large. For example, the ice cap 17 may acquire a thickness of two or three inches. It has been found, however, that the transmission of heat through a super-cooled liquid is relatively slow and for this reason the entire contents of the receptacle 1 will not be reduced to a super-cooled condition. Any increase in the quantity of liquid being cooled, for example any increase in the quantity of liquid being withdrawn from the apparatus through the outlet 3, will materially increase the quantity of heat being imparted to the liquid in that the super-cooled liquid or ice cap 17, for example, will impart its heat to the liquid being cooled in addition to the heat being transmitted through the ice cap into the chamber 5 in which it is absorbed by the liquid refrigerant.

In this manner it will be seen that the liquid being admitted and discharged from the receptacle 1 is cooled to a desired temperature at a rate varying with the quantity of liquid being cooled. The character of the liquid refrigerant being supplied to the inner chamber 5 (or a plurality of such inner chambers) should be so regulated as to cause the refrigerant to super-cool a portion of the liquid when the quantity of liquid to be cooled is small, but the liquid refrigerant should be of such character and capable of absorbing heat at such a rate that the transmission of heat from the liquid being cooled to the refrigerant is insufficient to super-cool the liquid when a large quantity of liquid is being cooled. Furthermore, the formation of a super-cooled liquid (ice, when water is the liquid) may be said to form a reservoir of "cold" which is first drawn upon when a large quantity of water is suddenly passed through the cooler. In practice such "peak loads" occur with frequency and by means of the hereinabove described invention such "peak loads" prevent the compressor of the liquid refrigerant system from continuously starting and stopping.

I claim:

1. In an apparatus for cooling liquids, a cylindrical tank provided with closed ends for liquid to be cooled, liquid inlet and outlet ports communicating with the interior of said cylindrical tank, a small tank within said cylindrical tank and welded to the inner side of one of the closed ends thereof, an opening in said closed end communicating with the interior of said small tank, a closure for said opening, and means for introducing a liquefied refrigerant into said small tank through said closure.

2. In an apparatus for cooling liquids, a cylindrical tank provided with closed ends for liquid to be cooled, liquid inlet and outlet ports communicating with the interior of said cylindrical tank, a small tank within said cylindrical tank and attached to one of the closed ends thereof, an opening in said closed end communicating with the interior of said small tank, a closure for said opening, and means for introducing a liquefied refrigerant into said small tank through said closure.

3. In an apparatus for cooling liquids, a cylindrical tank provided with closed ends for liquid to be cooled, liquid inlet and outlet ports communicating with the interior of

said tank, a small tank within said cylindrical tank and welded to the inside of one of the closed ends thereof, an opening in said closed end communicating with the interior of said small tank near the wall thereof, a second opening in said closed end leading to the interior of said small tank, a closure member for said second opening, and valve means carried by said closure member for admitting liquefied refrigerants into said small tank.

Signed at Los Angeles, California, this 25th day of June, 1928.

OTTO F. BOYER.