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LIQUID COOLING APPARATUS

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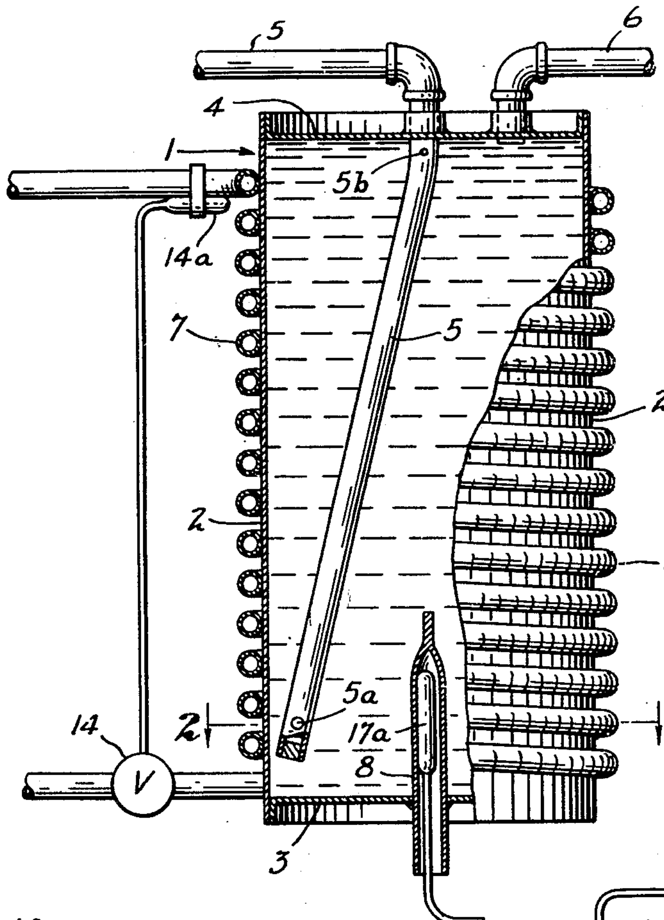

Fig. 1

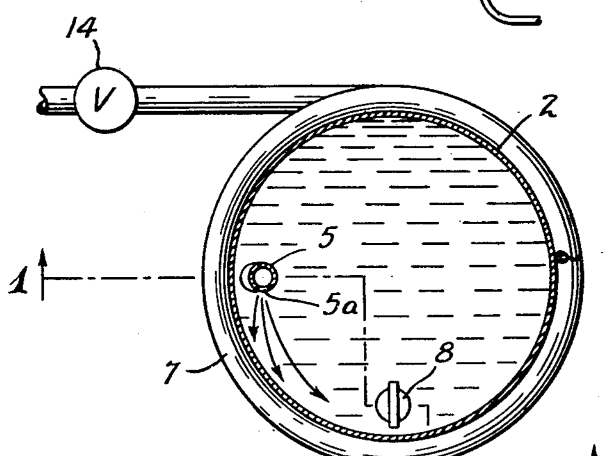

Fig. 2

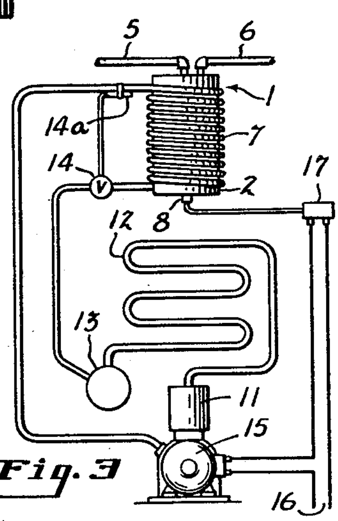

Fig. 3

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LIQUID COOLING APPARATUS

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4 Claims. (Cl. 62—141)

1

This invention relates to liquid coolers of the storage type.

A principal object of the invention is to produce a storage water cooler of high capacity in relation to size and having a simple construction susceptible of low cost production.

Other objects of the invention are included in the provision of a storage water cooler that is not liable to become gas bound or to accumulate sediment entering the storage chamber with the water to be cooled and that is not subject to injury by freezing.

With the above stated and other incidental or ancillary objects in view the invention consists in certain forms, arrangements and combinations of parts which will be set forth and explained, in connection with the accompanying drawing of a preferred form of construction, and particularly pointed out and defined in appended claims.

In the drawing,

Fig. 1 is a view, partly in side elevation and partly in vertical section on the broken line 1—1 of Fig. 2, of a water cooler embodying the invention in a form suitable for drinking fountains, together with a diagrammatic showing of a refrigerating system for the operation and control of the cooler.

Fig. 2 is a horizontal section on the line 2—2 of Fig. 1.

Fig. 3 shows diagrammatically an arrangement of the improved cooler as part of a conventional refrigerating system.

In the construction illustrated 1 designates generally a metal tank having a cylindrical side wall 2 and circular bottom and top walls 3 and 4, respectively.

The tank is fitted with a supply conduit 5 which extends through a central aperture in the top wall 4 and thence downward and laterally to a point in the lower half of the tank chamber and adjacent the side wall thereof. The bottom end of conduit 5 is closed and near its lower end is provided with a major outlet opening 5a arranged to discharge incoming liquid in a circumferential direction in relation to the cylindrical side wall 2, as indicated by the arrows in Fig. 2. At a point adjacent the top wall 4 of the tank and approximately at the vertical axis thereof the conduit 5 is provided with a smaller aperture 5b for a purpose which will later be explained.

The tank is fitted with a discharge conduit 6 which communicates with the interior of the tank through top wall 4 as shown in Fig. 1.

To effect cooling of liquid in the tank the latter is fitted with a helical refrigerant expansion coil

2

7 associated with the side wall 2 and preferably arranged on the exterior of said side wall in heat conducting relation therewith to provide a metallic heat-flow path between water in the tank and refrigerant in the coil. The bottom wall 3 of the tank is fitted with a thermostat element in the form of an inverted well 8 adapted to receive a thermostat bulb, the well being located in the path of the discharge from the opening 5a of the supply conduit 5.

The cooler is designed to have its cooling coil function as the low pressure side of a conventional refrigerating system of the compressor-condenser-expander type and in Fig. 1 the elements of such a system are indicated diagrammatically for clarity of explanation. These elements comprise a compressor 11 connected to discharge compressed refrigerant to a condenser 12 which delivers liquid refrigerant to a receiver 13. The receiver is connected to supply liquid refrigerant to a thermostatic expansion valve 14 which in turn is connected to the inlet end of the cooler coil 7, the thermostat bulb 14a of the valve being associated with the discharge end of said coil. This discharge end of coil 7 is connected, in turn, to the intake of compressor 11. The compressor is driven by electric motor 15 supplied by current from a source 16 and controlled by a thermostatic switch 17 comprising a bulb 17a associated with the well 8 of the cooler.

In the operation of the device as a water cooler, the supply conduit 5 is connected with a source of water supply under pressure and the discharge conduit 6 is extended to a point of draft where the conduit is ordinarily provided with a valve or faucet. When water is drawn from the cooler the warm or uncooled water entering under pressure through the conduit 5 is discharged through opening 5a in a circumferential direction adjacent the cold side wall of the tank and thus sets up a strong circumferential movement in one direction of the entire body of liquid in the tank, and this movement of the liquid and the centrifugal force to which the liquid is subjected by the movement gives added assurance of effective moving contact of the liquid with the surrounding cold side wall so that there is a highly effective transfer of heat from the liquid to the cold wall and thence to the refrigerant in the cooling coil. In addition, this manner of introducing the incoming liquid into the tank chamber insures a thorough mixing of the incoming warm liquid with the previously cooled liquid of lowest temperature which in non-draft periods accumulates in the lower part of the tank. Thus the maximum difference in temperature of the liquid in the upper and lower parts, respectively, of the tank at times of draft is markedly reduced by the very rapid cooling of the incoming liquid, and this is very advantageous. One advantage is that at times of draft the entire body of liquid in the tank, including that last to enter, can be kept within the temperature range permissible for the liquid dispensed for a longer period of continuous draft than would otherwise be possible. Thus a given effective storage and dispensing capacity is attained by a smaller size of tank with corresponding saving of space and production cost. A second advantage is that it is possible to draw cooled liquid of suitable temperature from the top of the tank so that any air or other gas entering the tank is constantly freely vented therefrom during draft of liquid, and it is impossible for the cooler to become gas bound with resultant loss of cooling capacity or other objectionable effect. Furthermore, by drawing the cooled liquid from the tank at a level substantially higher than the liquid inlet to the tank there results a long circumferential movement of the water in contact with the inner surface of the cold side wall of the tank before the liquid can escape through the tank outlet. This, in effect, increases the cooling capacity of a tank of given size.

The swirling movement of the liquid contents of the tank during draft therefrom also prevents a sedimental accumulation of fine solid particles in the bottom of the tank which might result in the course of time in an unsanitary condition in the cooler. The prevention of such sedimentation and the described mixing of the incoming liquid with that already cooled are best accomplished by disposing the outlet of the supply conduit in the lower half of the tank chamber and preferably rather near the bottom of the chamber, as shown in the drawing.

The arrangement of the thermostat bulb well **8** directly in the path of the entering warm liquid discharged through inlet opening **5***a* insures starting of the compressor before the volume of liquid in the tank at dispensing temperature is exhausted. This secures the fullest utilization of the cooling capacity of the refrigerating apparatus of which the cooler is capable without unduly short working cycles of the compressor.

Notwithstanding the provision of automatic means to control the temperature of the refrigerant expansion coil, there is always a possibility of failure of the automatic regulating means and if this occurs during a prolonged idle period of a water cooler the cooler is likely to freeze up and burst. In accordance with the present invention this is prevented by the provision of the small escape orifice **5***b* with which the inlet conduit **5** is provided. This orifice is located at a point of maximum remoteness from the heat absorbing side walls of the cooler and consequently, in case of a freeze-up, the water in the central part of the cooler chamber is the last to freeze and is permitted to escape through the aperture **5***b* into the supply conduit outside the cooler so as to compensate for expansion in the cooler incident to ice formation.

Coolers constructed in the manner shown in the drawing have a remarkably high cooling capacity and it is clearly apparent that this result is secured with a construction of marked simplicity susceptible of manufacture at low cost.

It is to be understood that the invention is not limited to the specific form of construction which has been illustrated and described but may be embodied in various modified forms of construction equivalent thereto and within the bounds of the appended claims.

What is claimed is:

1. In a storage type liquid cooler, the combination of a tank having top and bottom walls and a cylindrical metal side wall greater in height than diameter and with its inner surface substantially unobstructed throughout its circumference; cooling means outside the tank comprising a metal refrigerant expansion coil in direct heat exchange relation with the outer side of the tank side wall; an inlet conduit for supplying under pressure to the tank liquid to be cooled, said conduit having an outlet opening within the tank disposed at a level below the middle of the tank to discharge the entering liquid under pressure adjacent to the tank side wall and in a circumferential direction in relation to said wall, whereby the energy of the entering liquid sets up a circumferential movement in one direction of the entire body of liquid in the tank; and an outlet conduit for cooled liquid communicating with the tank chamber at a level considerably higher than the outlet of the inlet conduit, whereby liquid entering the tank is given a long circumferential movement before it can escape through the outlet conduit.

2. A liquid cooler as claimed in claim 1 in which the inlet conduit has, in addition to its main outlet opening adjacent the tank side wall, a minor opening into the tank chamber at a point remote from the tank side wall.

3. A liquid cooler as claimed in claim 1 in which the outlet conduit has communication with the top of the tank chamber.

4. A liquid cooler as claimed in claim 1 in which the cooling coil is adapted to serve as the refrigerant expansion element of a compressor-condenser-expander refrigerating apparatus in which the compressor motor is thermostatically controlled, and the bottom wall of the tank is fitted with a thermal control element disposed in the path of the relatively warm liquid issuing from the outlet opening of the inlet conduit, said element being adapted to serve as part of the thermostatic control means of a compressor motor.

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