United States Patent [19]

Jacobs

[11] **3,914,957**

[45] **Oct. 28, 1975**

[54] **FAST COOLING LIQUID DISPENSING CONTAINER ACCESSORY FOR REFRIGERATORS**

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[73] Assignee: **General Motors Corporation,** Detroit, Mich.

[22] Filed: **Oct. 24, 1974**

[21] Appl. No.: **517,458**

[52] **U.S. Cl.** **62/338;** 62/99; 62/119; 165/105; 62/333

[51] **Int. Cl.²** **F25D 23/12**

[58] **Field of Search** 62/293, 338, 119, 99, 389, 62/333; 165/105

[56] **References Cited**

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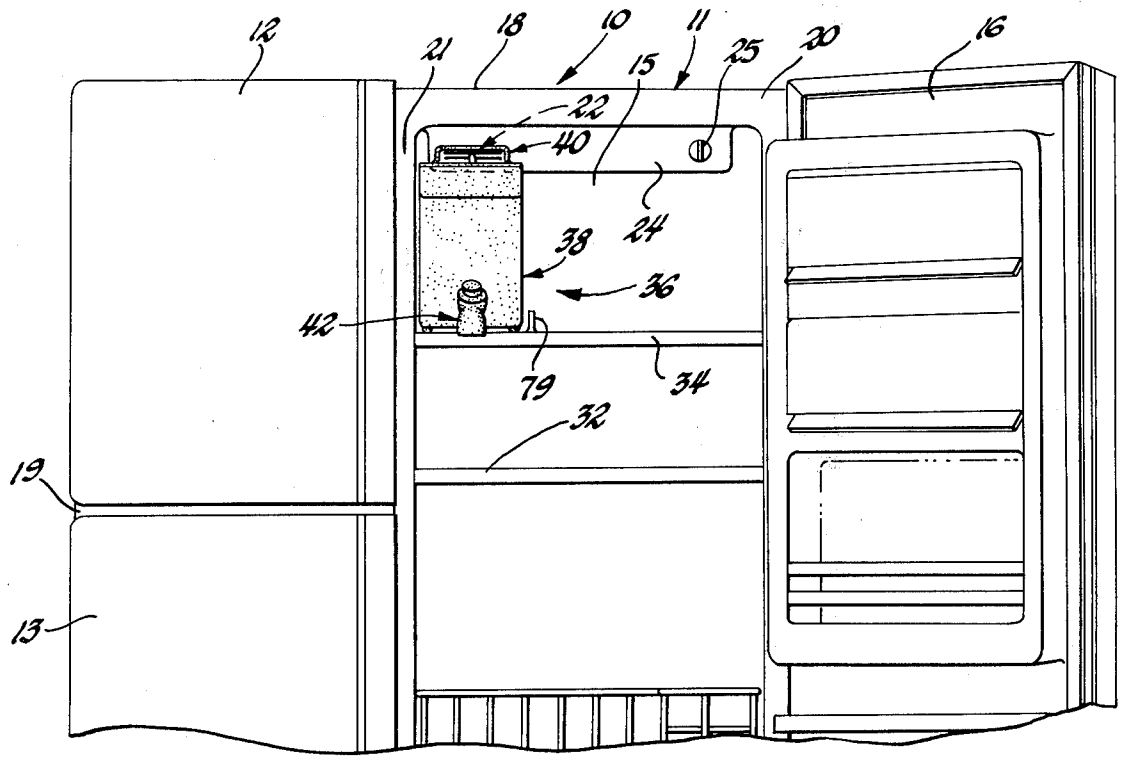
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Primary Examiner—William J. Wye
Attorney, Agent, or Firm—Edward P. Barthel

[57] **ABSTRACT**

A liquid cooling accessory kit for dispensing cold water or flavored beverages from a storage container removably located on a shelf in the above-freezing storage compartment of a refrigerator. The storage container has a secondary cooling unit therein in the form of a roll bonded aluminum plate-type volatile fluid heat exchanger having continuous interconnected flow passages providing a lower evaporator section for heat exchange immersion in the stored water to be cooled, and an upper finned condenser section located in a longitudinally extending passage or tunnel in the lid of the container such that the tunnel inlet receives refrigerated air from adjacent outlet means in the refrigerator fresh food compartment cooling system whereby more efficient and rapid cooling of the liquid is achieved.

3 Claims, 6 Drawing Figures



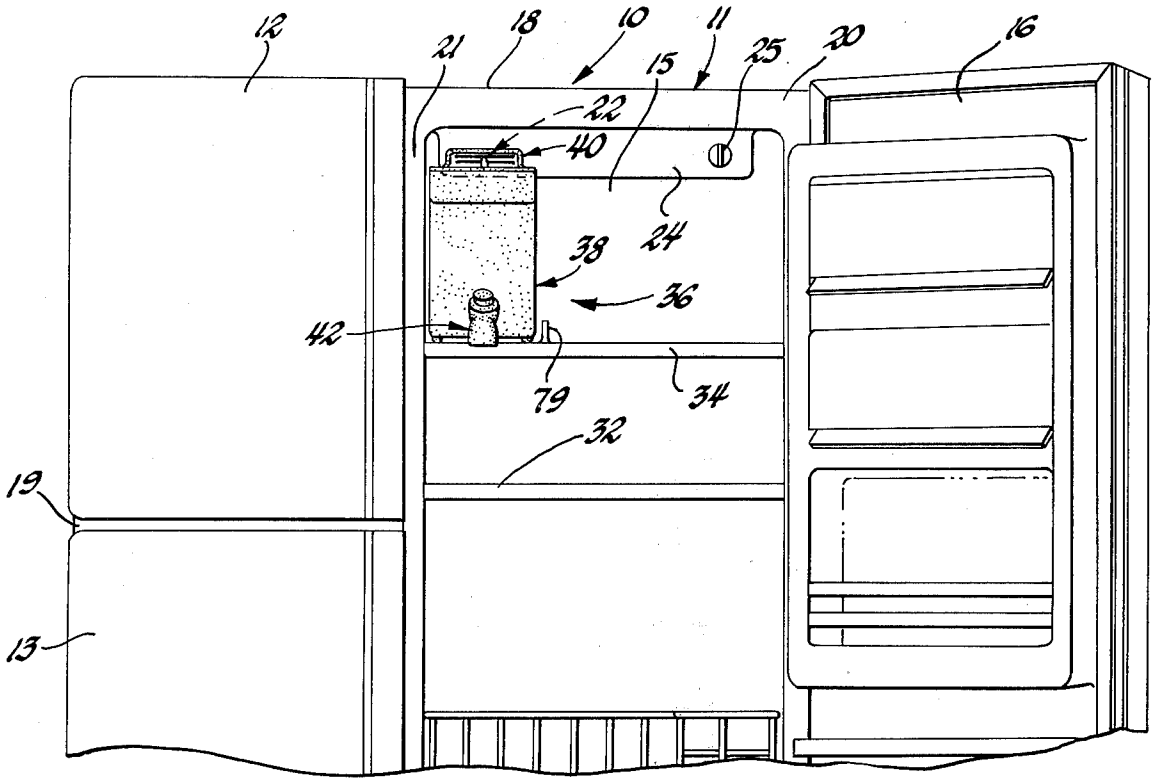

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Fig. 1

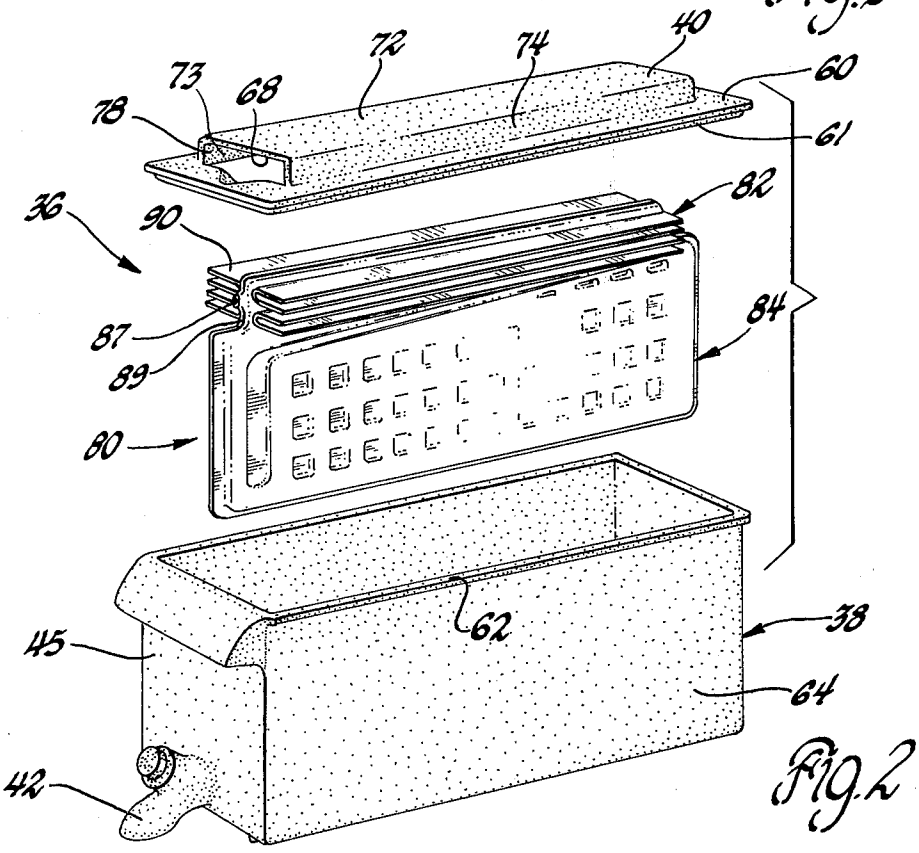

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Fig. 2

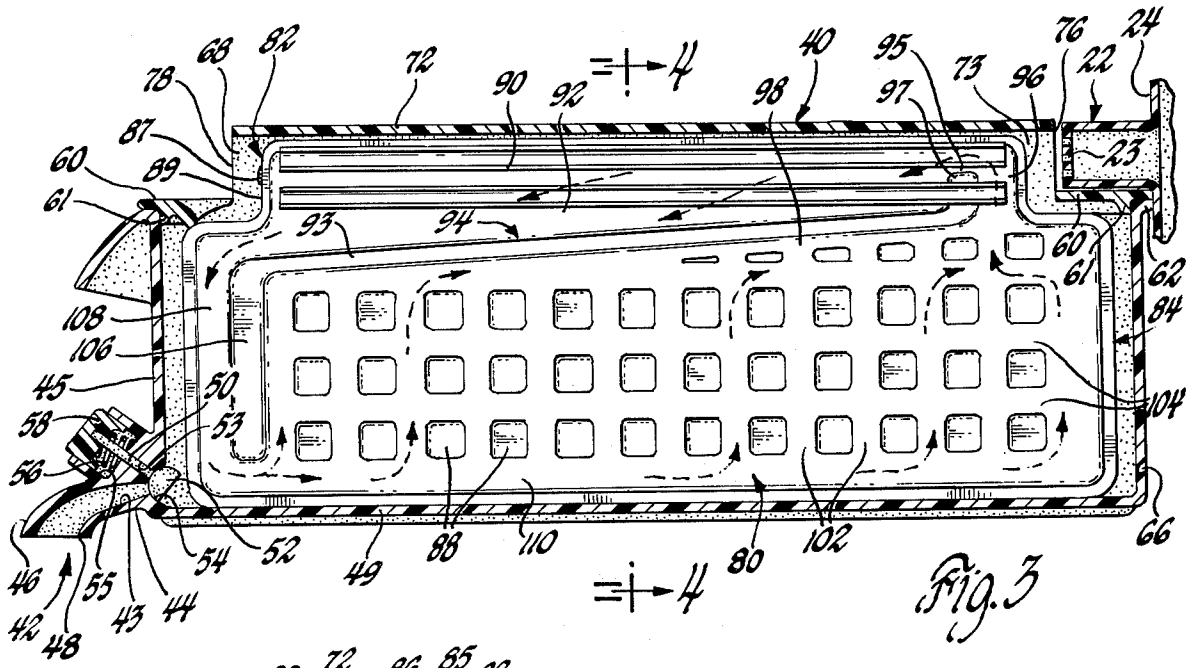


Fig. 3

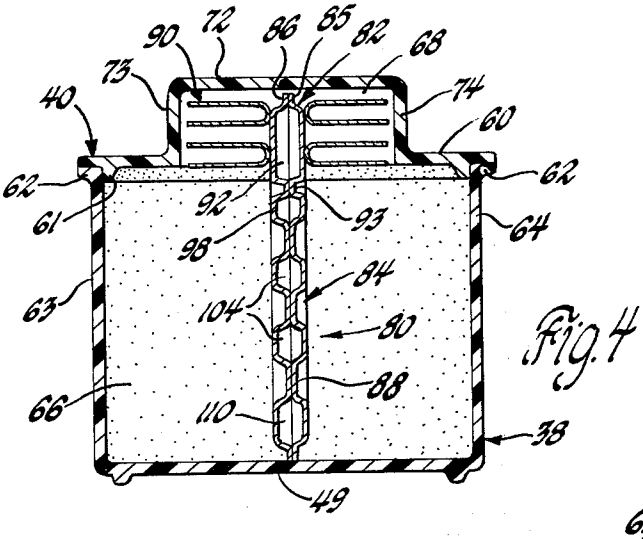


Fig. 4

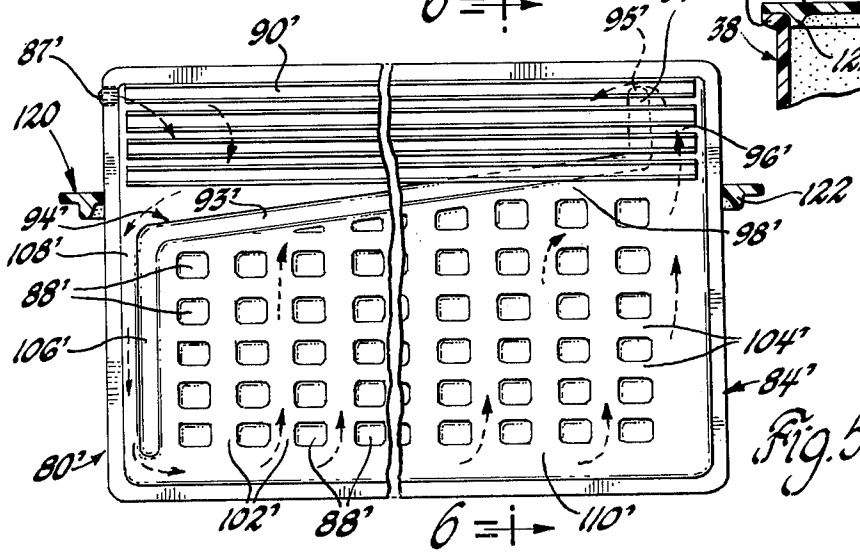


Fig. 5

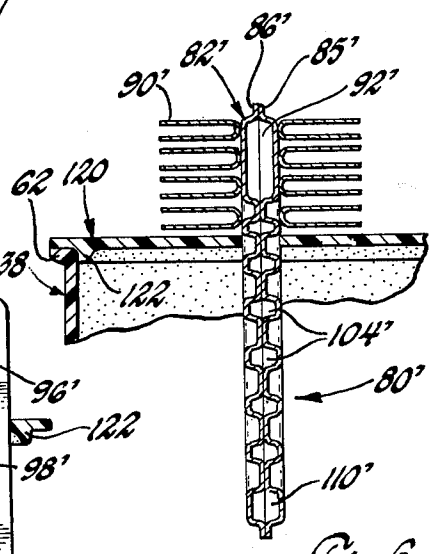


Fig. 6

FAST COOLING LIQUID DISPENSING CONTAINER ACCESSORY FOR REFRIGERATORS

This invention relates to a self contained rapid liquid cooling unit which is removably located in the fresh food compartment of a domestic refrigerator, to provide for dispensing of chilled water or flavored beverages from the compartment while allowing for ready removal therefrom for refill or liquid dispensing from without the compartment.

A desirable accessory for household refrigerators is a low cost add-on unit capable of rapidly cooling and storing water or other beverages for dispensing same from the above freezing or food storage compartment while being readily removable by the housewife for refilling or dispensing of the liquid beverage at a location removed from the refrigerator such as the dining area. Accordingly, it is an object of my invention to provide a liquid cooling accessory for rapid chilling and dispensing of water, flavored beverages or the like from a household refrigerator by utilizing the cooling air flow circulated into the above freezing compartment of the refrigerator with the accessory incorporating a secondary cooling unit in the form of a volatile fluid heat exchanger providing an evaporator section for immersion in the liquid for removing heat therefrom and transferring the heat via a condenser section to the refrigerated air of the refrigerator.

It is another object of my invention to provide an add-on accessory kit for rapid cooling, storing and dispensing liquid from the above freezing compartment of a domestic refrigerator having a storage container including a removable secondary rapid cooling unit therein in the form of a hermetically sealed closed circuit plate-type heat exchanger having an upper finned condenser section and a lower evaporator section with the sections interconnected by continuous flow passages adapted to contain a volatile liquid refrigerant. The evaporator section in the form of a longitudinal partition is immersed in heat exchange relation with the stored liquid while the upper condenser section, having horizontally spaced longitudinally extending cooling fins thereon, is located in cooling air tunnel means formed in the cover of the liquid dispensing container for heat exchange with the refrigerated air directed through the tunnel means while valve means on the container permit the ready dispensing of the chilled liquid either in the refrigerator cabinet or at a location removed therefrom.

Other features and advantages of the invention will be apparent from the following description of a certain embodiment taken in combination with the accompanying drawings, wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

FIG. 1 is a front elevational view of a household refrigerated cabinet to which the present invention may be applied, disposed in an above freezing food storage compartment of the cabinet;

FIG. 2 is an exploded perspective view of the water cooling unit of the invention;

FIG. 3 is a vertical sectional view of the water cooling unit and refrigerator air discharge duct showing the heat exchange plate in side elevation;

FIG. 4 is a vertical sectional view taken substantially on the line 4—4 of FIG. 3;

FIG. 5 is a detailed view of a modified roll bonded heat exchanger for use with the storage container of FIGS. 1–4; and

FIG. 6 is a view taken substantially on the line 6—6 of FIG. 5.

In the preferred embodiment of the invention, as disclosed in FIGS. 1–4 of the drawings, a refrigeration apparatus generally designated 10 is shown in the form of a domestic refrigerator including a cabinet 11 containing, in side-by-side relationship, a freezer compartment enclosed by upper and lower freezer doors 12 and 13 shown in their closed position and an above freezing fresh food compartment 15 enclosed by fresh food door 16 shown in its open position. The cabinet compartments are defined by a plurality of insulated walls including an insulated top wall 18, insulated side walls 19 and 20, and an insulated vertical center partition 21. The refrigerator is provided with the usual cooler unit (not shown) wherein refrigeration of the fresh food compartment 15 is effected by delivery of chilled air through a duct system providing a forwardly extending duct 22 from the cabinet rear panel 24 with cold control knob 25 having a louvered outlet 23 (FIG. 3) for directing air into the refrigerator compartment 15 via a secondary liquid cooling device to be described. The air is forced through the duct 22 by suitable air translating or moving means such as a blower (not shown) which may be driven by an electric motor as disclosed, for example, in the U.S. Pat. No. 3,104,533 issued to J. J. O'Connell, owned by the assignee of the subject application, the disclosure of which is incorporated by reference herein.

The refrigerator fresh food compartment 15 is provided with a plurality of shelves, one of which is shown at 32, while supported on the top or uppermost shelf 34 of the compartment 15 is a water cooling, storing and dispensing container assembly or accessory, generally indicated by the reference numeral 36 in FIG. 1 of the drawing. Preferably, the container assembly 36 is of a length so as to occupy or extend substantially the full depth of the compartment shelf 34 while its width and height may be varied depending upon the available storage space provided in compartments of various refrigerator models.

As best seen in FIGS. 2, 3 and 4 the water cooling accessory comprises a fluid storage container or tank 38 which is shown removably positioned on the shelf adjacent the center partition 21 in the above freezing compartment 15. The water cooling assembly, which is the subject of the present application, is designed to be as an add-on unit or accessory for domestic refrigerators with no mechanical connection therewith such that the accessory may be readily removed from the cabinet shelf 34 for various purposes such as the addition to or refilling of the container 38 with tap water or a flavored beverage, or the dispensing of beverages at other locations within the house. As seen in FIG. 2, the assembly includes the liquid storage and dispensing container 38, a cover or lid member 40 and a heat exchange unit to be described. The container and lid are preferably molded of a suitable plastic material such as ABS plastic.

As best seen in FIG. 3, chilled liquid may be discharged from the container 38 through liquid dispensing faucet means 42 including an outlet passage 43 of tube or conduit portion 44 which is shown preferably integrally molded on the container front wall 45 and

extends forwardly therefrom, terminating exteriorly of the wall in a downwardly extending nozzle or discharge spout **46** having an outlet **48** at an elevation below the bottom wall **49** of the container **38.** Liquid is dispensed by suitable valve means such as by a ball valve having a stem **50** fixed to a resilient ball **52** with the stem extending through an upwardly and rearwardly directed bore **53** leading from arcuate ball seat **54** to a counterbore socket **55** having return spring means in the form of a helical coil spring **56** therein surrounding the stem **50** while a push button actuator **58,** fixed on the outer end of stem **50,** is slidably received in the counterbore **55.** When the user depresses the push button **58** the ball **52** is unseated, and the liquid flows from the storage container through the passage **43** and out the spout **46** and into the user's glass.

The container **38** is closed by a horizontal peripheral frame portion **60** of lid **40** and is seated on the container by providing the frame **60** with a downwardly extending continuous annular rib **61** which engages the inner edge of a mating peripheral container lip flange **62.** The rib **61** is arranged circumferentially adjacent the periphery of the lip flange **62** and is adapted to extend downwardly into the container along the inner side of the front wall **45,** side walls **63** and **64** and back wall **66** to prevent spillage of liquid from the container.

The container assembly may be designed for receiving a portion or all of the air cooled by the evaporator of the primary refrigeration system. In the embodiment of FIGS. **1–4** refrigerated air is delivered to the fresh food compartment **15** through the louvered air outlet **23** of duct portion **22** after passing through the container assembly **36.** This is achieved by means of a longitudinally extending refrigerated air passage means provided in the container cover which in the disclosed form is a tunnel or passage **68** preferably formed by an inverted open ended channel having its raised base **72** and vertical side panels **73** and **74** dimensioned to be spaced a defined distance from the front **45** and back **66** container walls providing a rear air inlet **76** and a front air outlet **78.** As seen in FIGS. **1** and **3** the refrigerator duct **22** has a rectangular cross section matching the rectangular section of the container tunnel **68** such that upon the tunnel inlet **76** being located in juxtaposed relation to the exit **76** substantially all the refrigerated air of the primary system will be directed through the tunnel. It will be noted in FIG. **1** that a longitudinal guide rail **79** is shown located on the shelf **34** to position the dispenser assembly thereon to insure that the container tunnel inlet **76** is aligned with the duct outlet **23.**

A secondary fast cooling heat transfer system, adapted to be removably located in the container **38,** is disclosed in the form of volatile fluid charged heat exchanger means. The fast cooling system is shown in FIGS. **2** and **3** to include a plate-type heat exchanger generally indicated at **80** having a hermetically closed circuit forming a liquifying zone or condenser portion **82** within the tunnel air passage **68** and a vaporizing zone or evaporator portion **84** disposed within the container **38** in the form of a longitudinally extending partition wall. As best seen in FIGS. **3** and **4,** the plate type heat exchanger is preferably of a roll forged or roll bonded construction in which two sheets of metal **85** and **86** such as aluminum are integrally welded together to form a single composite plate while having a pattern of weld preventing or stop weld material interposed between the sheets in the manner shown in the U.S. Pat. No. **2,795,113** to Wurtz.

Upon being inflated by having a needle inserted at an inflation pass **87** at the left hand offset edge **89** of the condenser section the plates are inflated by means of fluid pressure forming volatile fluid horizontal and vertical passages or conduits and having the walls integrally joined together around the periphery of the composite plate and at a multiplicity of spaced points or welded rectangular areas indicated at **88** for supporting the sheets in a definite spaced relation. After the passages are charged with a volatile fluid which in the disclosed form is a vaporizable refrigerant having the designation **R–12, R–22** or **R–144** commonly known as Freon, the charging opening is pinched closed and welded.

A plurality of horizontally extending vertically spaced heat transfer members in the form of U-sectioned fins **90** are positioned on the upper condenser section **82** of the heat transfer unit so as to extend substantially the full width of the air tunnel **68.** In the preferred embodiment four equally spaced paired U-shaped fins **90** are shown spaced from the tunnel raised base **72** with the lowermost one of the paired fins substantially coplanar with the peripheral lid frame portion **60** to define the condenser section of the water cooler unit.

The secondary refrigeration unit **80** upper condenser section **82** is formed with a single substantially rectangular sectioned header **92,** to provide a forwardly diverging or expanding refrigerant condenser passage with the lower edge of the header passage **92** being forwardly pitched in conformity with the forwardly sloped or canted intermediate leg portion **93** of double-L shaped welded separation web **94.** A rear reduced header entrance **95** communicates with the upper end of a second rearward vertically extending connecting passage **96** for evaporated refrigerant in gaseous form defined by upward leg extension **97** of the web **94.** The lower end of the vertical passage **96** communicates with uppermost horizontally extending evaporator section passage defined in part by the underside of the canted web portion **93.** The vertical passage **96** connects via the upper header passage **98** to a waffle-like network of vertical and horizontal passages **102** and **104** respectively, formed by the weld areas **88.**

The double-L web downwardly extending vertical long leg **106** defines a liquid refrigerant first forward vertical connecting passage **108.** The sloped header tube **92** connects to the upper entrance of the vertical liquid refrigerant passage **108** such that after the refrigerant vapor gives up its heat to the condenser section **82** and condenses the refrigerant vapor to a liquid the liquid flows by gravity in the forwardly and downwardly sloped header passage **98** to the vertical connecting passage **108** and thence to the lowermost evaporator section passage **110** for movement through the evaporator so that the heat transfer action is continuous. Upon the vaporization of the liquid refrigerant in the evaporator section **84** the vapor rises through the waffle-like network through entrance **95** into header passage **92** and is cooled and liquified by the refrigerated air flowing through tunnel **68** and over the condenser section fins **90.** Thus, the refrigerant vapor gives up its heat to the upper finned condenser section, cooled by the refrigerated air flow, and the liquid refrigerant evaporates and extracts heat from the water or bever-

age stored in the container **38** to rapidly cool the water by means of the lower plate evaporator section **84** being immersed directly in the water. The volatile fluid or refrigerant charged heat exchanger thus, provides an efficient means to rapidly transfer heat from the container water or liquid to the cold air stream thereabove by condensing and vaporizing the refrigerant fluid in a continuous process while, upon the water being chilled to a temperature colder than the air, the fast cooling process of the secondary refrigerant circuit ceases.

A modification of applicant's heat exchanger portion of his fast cooling system is disclosed in FIGS. **5** and **6** wherein like or similar compartments are given numbers corresponding with equivalent components of the embodiment of FIGS. **1–4.** The heat exchanger **80'** is positioned in a substantially planar lid member **120** preferably molded from suitable plastic material, formed with an annular rib **122** similar to the rib **61** of FIG. **4** which rib **122** is designed to engage the inner edge of the mating peripheral lip flange **62** of the container **38.** Thus, the heat exchanger **80'** of FIGS. **5** and **6** functions in the same manner as the heat exchanger **80** when its lid **120** is located on the container **38** with the principal exception that the tunnel for refrigerated air embodiment of FIGS. **1–4** is not utilized. It will be noted that in the modification of FIGS. **5** and **6** the total surface area of the U-shaped fins **90'**, suitably secured to the sheets **85'** and **86'** as by welding, is approximately doubled to thereby increase the heat exchange rate of the condenser section **82'** to partially compensate for the loss of the direct cooling effect or rate achieved in the first embodiment wherein the flow of refrigerated air through tunnel **68** is utilized upon its initial entrance into the fresh food compartment. The advantage of the modification of FIGS. **5** and **6** is that a fast cooling liquid container is provided that may be located in a domestic refrigerator fresh food compartment without requiring any special air duct design.

While the embodiment of the present invention constitutes a preferred form, it is to be understood that other forms might be adopted.

I claim:

1. A fast cooling water dispensing accessory for a refrigerator comprising a substantially rectangular-sectioned container adapted to be supported on a rack in the refrigerator above-freezing compartment and arranged to receive a liquid to be cooled, said container including a front wall, a rear wall, a pair of side walls and a removable lid; a vertically disposed unitary plate-type closed volatile refrigerant heat exchanger positioned intermediate said side walls, said plate-type heat exchanger having interconnected refrigerant flow passages therein including a lower evaporator section and an upper condenser section separated by a forwardly sloped web, said upper condenser section including a header tube having a plurality of horizontally extending vertically spaced fins located thereon, said finned header tube adapted to contain the refrigerant in gaseous form to operate as a heat dissipator to the refrigerated air flowing through said compartment, said bottom evaporator section being immersed in the container liquid to be cooled and adapted to contain the refrigerant in liquid form in its passages to operate as a heat absorber to rapidly cool the liquid, said intermediate web providing for the separation of the gaseous and liquid refrigerant by forming a first forward vertical passage for the refrigerant in liquid form from said upper condenser section to said lower evaporator section, and a second rearward vertical passage for the refrigerant in gaseous form from said lower evaporator section to said upper condenser section, and said container being provided with a valved outlet adjacent its bottom wall for dispensing the cooled liquid from said container.

2. A fast cooling water dispensing accessory for a refrigerator comprising a substantially rectangular-sectioned container adapted to be supported on a rack in the refrigerator above-freezing compartment and arranged to receive a liquid to be cooled, said container including a front wall, a rear wall, a pair of side walls and a removable lid; said lid having a longitudinally extending inverted open-ended channel formed thereon forming a tunnel, the inner open end of said channel located adjacent to a refrigerated air duct outlet in the compartment, a vertically disposed unitary plate-type closed volatile refrigerant heat exchanger positioned intermediate said side walls, said plate-type heat exchanger having interconnected refrigerant flow passages therein including a lower evaporator section and an upper condenser section separated by a forwardly sloped web, said upper condenser section including a header tube having a plurality of horizontally extending vertically spaced fins located thereon, said finned header tube adapted to contain the refrigerant in gaseous form to operate as a heat dissipator to the refrigerated air flowing through said tunnel, said bottom evaporator section being immersed in the container liquid to be cooled and adapted to contain the refrigerant in liquid form in its passages to operate as a heat absorber to rapidly cool the liquid, said intermediate web providing for the separation of the gaseous and liquid refrigerant by forming a first forward vertical passage for the gravity flow of refrigerant in liquid form from said upper condenser section to said lower evaporator section, and a second rearward vertical passage for the upward movement of refrigerant in gaseous form from said lower evaporator section to said upper condenser section, and said container being provided with a valved outlet adjacent its bottom wall for dispensing the cooled liquid from said container.

3. A fast cooling water dispensing removable accessory for a refrigerator comprising a substantially rectangular-sectioned container adapted to be supported on a rack in the refrigerator above-freezing compartment and arranged to receive water to be cooled, said container including a front wall, a rear wall, a pair of side walls and a removable lid; said lid having a longitudinally extending inverted open-ended channel formed thereon forming a tunnel, said channel having its forward and aft ends recessed a defined distance from the edge of said lid, said channel aft end providing an air inlet upon being located adjacent to the outlet of a refrigerated air duct extending forwardly from the compartment rear wall, a vertically disposed unitary plate-type closed volatile refrigerant heat exchanger positioned intermediate said side walls, said plate-type heat exchanger having interconnected refrigerant flow passages therein including a lower evaporator section and an upper condenser section separated by a double-L shaped web having a forwardly sloped intermediate leg, said upper condenser section including a header tube having a plurality of horizontally extending vertically spaced fins located thereon, said finned header tube providing a forwardly diverging pas-

sage adapted to contain the refrigerant in gaseous form to operate as a heat dissipator to the refrigerated air flowing through said tunnel, said bottom evaporator section having interconnected horizontal and vertically disposed refrigerant flow passages of the waffle-type therein, said evaporator section being immersed in the water to be cooled and adapted to contain the refrigerant in liquid form such that heat from the water will be absorbed by the liquid refrigerant and the resultant gas will flow upwardly in said horizontal and vertical passages thereby rapidly cooling the water, said intermediate double-L web having a forward downwardly extending vertical leg portion, said web forward leg providing in part for the separation of the gaseous and liquid refrigerant by defining with the sealed front edge of said heat exchange plate a first forward vertical passage to provide for gravity flow of the refrigerant in liquid form from said upper condenser section to said lower evaporator section, and a second rearward vertical passage defined in part by said web rearward leg and the sealed rear edge of said plate for the upward movement of the refrigerant in gaseous form from said lower evaporator section to said upper condenser section, and said container being provided with a valved outlet in said front wall adjacent its bottom wall for dispensing the cooled water from said container.

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