May 12, 1970 W. P. CROWE 3,511,415

WATER COOLER

Filed Sept. 3, 1968

FIG. 2

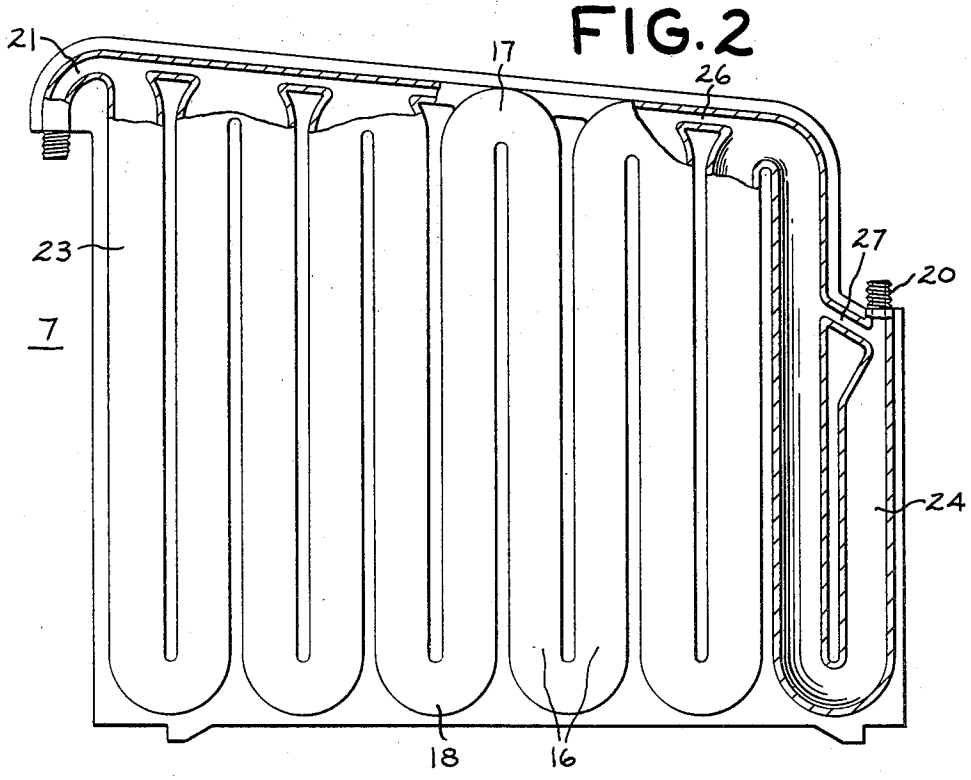
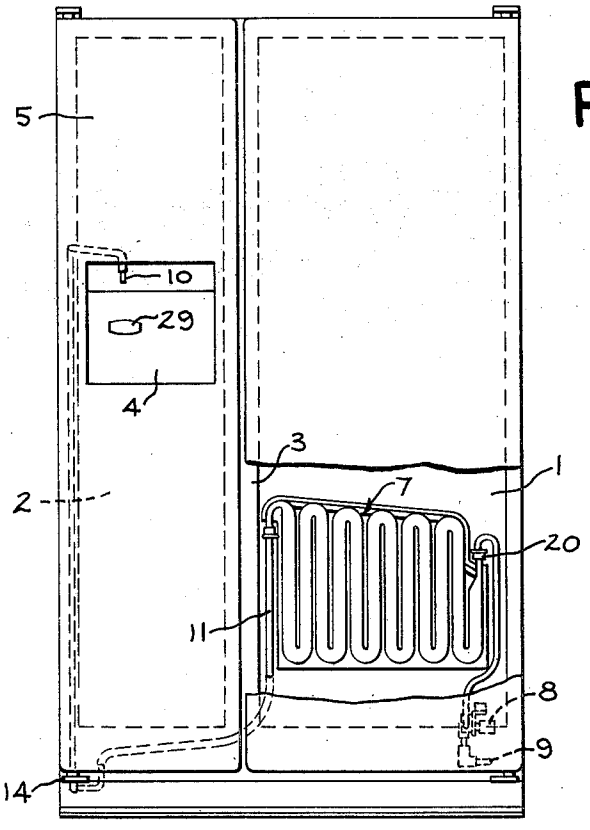


FIG. 1



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WATER COOLER

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U.S. Cl. 222—146 7 Claims

ABSTRACT OF THE DISCLOSURE

A water cooler particularly adapted for household refrigerator application includes a storage volume in the form of a serpentine passage comprising a plurality of passes series connected at their upper and lower ends to form a series flow passageway with a restricted outlet at the upper end of the last pass. A flow controlling valve means connects the first pass to a source of high pressure water. The uppermost portion of each successive pass is higher than the uppermost portion of any preceding pass and these portions are interconnected to one another and to the outlet by flow restricting passages for purging air directly to the outlet.

Background of the invention

In the provision of a cold water service in a household refrigerator, mounting of the water cooler in the fresh food compartment of the refrigerator provides cooled water at desired drinking temperature. To avoid loss of refrigerated air resulting from opening of the refrigerator door for access to the cold water, it is desirable that the water cooler be connected to a water spout or outlet exterior of the refrigerator cabinet. Preferably also the water cooler should be positioned in some less accessible or usable portion of the fresh food compartment as for example along the lower rear wall thereof. For minimum cost, both the water cooler and the conduit leading from the cooler to the outlet should operate at relatively low pressures. This requires that the water valve controlling flow from the outlet be located ahead of the water cooler and in the line connecting the water cooler to the usual high pressure home water supply line. Such a service is described and claimed in the copending application of Frederick M. White, Ser. No. 704,493 filed Feb. 9, 1968, now Pat. No. 3,429,140 of Feb. 26, 1969 and assigned to the same assignee as the present invention.

Water coolers used or proposed for use in household refrigerators have been of various designs and shapes. Coolers providing a tortuous or serpentine flow path decrease the mixing of the warm incoming water with water which has already been cooled. Coolers of this type for household refrigerators are disclosed, for example in Pats. 2,477,210, Skinner; 2,787,131, Wurtz and 2,788,642, Burkhead et al. However all of these serpentine coolers are mounted in the refrigerator with all of the passes in the same substantially herizontal plane with the outlet below or at about the same elevation as the inlet and hence include a flow control valve at the outlet regardless of the pressure of the water stored therein.

Pat. 1,692,223 Pinkerton et al. discloses a vertically arranged serpentine flow path water cooler in a household refrigerator with the passes forming the flow path extending vertically rather than horizontally and the valve control at the inlet rather than the outlet so that the cooler operates at a low pressure. However it has been found that during use of a cooler such as that disclosed in the Pinkerton et al. patent, air liberated from the water contained in the cooler collects at the upper ends of the passes where it is compressed during each time that the valve is opened and thereafter expands when the valve is

closed thus forcing water to continue to flow from the outlet when shut-off is desired.

Summary of the invention

The present invention is directed to, and has as its principal object the provision of, a serpentine water cooler of the type including a plurality of vertically extending passes and valve means at the inlet end thereof connecting the water cooler to a source of high pressure water, the cooler being designed to prevent the accumulation of liberated air within the serpentine cooler.

In accordance with the illustrated embodiment invention, there is provided a water cooler comprising a closed receptacle having an inlet and an outlet connected by a serpentine storage volume comprising a plurality of vertically extending passes series connected at their upper and lower ends to provide a series flow passageway between the inlet and outlet. The outlet is at the upper end of the last of the passes and is at a higher elevation than the inlet. The upper ends of each of the passes from the inlet to the outlet is slightly higher than the upper end of any preceding pass. Restricted flow means interconnecting the upper ends of the passes to the outlet provides a vent path for purging air from the upper end of all of the passes to the outlet. Thus any air liberated from high pressure water introduced into the cooler gravitates to the upper ends of the passes from which it is bled to the outlet.

Brief description of the drawing

With reference to the accompanying drawing:

FIG. 1 is a front elevational view of a side-by-side refrigerator-freezer cabinet incorporating the present invention; and

FIG. 2 is an enlarged front view, partly in section,, of a serpentine water cooler of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

While the invention is applicable to any refrigerator including a water service comprising a water cooler positioned in the fresh food compartment of the refrigerator, it will be particularly described with reference to a refrigerator including two vertically extending compartments separated by a vertical partition. The cabinet illustrated in FIG. 1 of the drawing is of this type. It includes a fresh food storage compartment **1** and a freezer compartment **2** separated by an insulating partition **3**. A water service area **4** is provided in the face of the door **5** closing the access opening to the freezer compartment **2**.

Means for supplying cold water to the service area **4** includes a water cooler positioned in hte rear portion of the fresh food compartment and generally indicated by the numeral **7** connected through a solenoid operated valve **8** to a high pressure water supply line **9**. The cooler **7** is connected to a water spout tap or outlet **10** in the upper portion of the service area **4** by a relatively small plastic tube **11** extending from the water cooler through the insulated walls forming the bottom portion of the storage compartments **1** and **2** and upwardly through the lower hinge **14** supporting the door **5** and through the door **5** to the spout **10**.

This general means for supplying water cooled in the fresh food compartment to a remote service area in a refrigerator door is more fully described and claimed in the copending application of Frederick M. White, Ser. No. 704,493 filed Feb. 9, 1968 and assigned to the same assignees as the present invention.

In this type of service, it will be noted that the flow of water from the outlet **10** is controlled by the solenoid valve **8** connecting the water cooler to a source of high

pressure water. Thus the water stored in the cooler **7** is normally at atmospheric pressure with the result that any air dissolved in the high pressure supply water is liberated at the lower pressure in the water cooler **7**.

The water cooler of the present invention is designed to assure venting of all such liberated air through the outlet end of the cooler while at the same time providing a serpentine flow of water through the cooler to assure adequate cooling thereof before it is conducted to the spout **10**.

This water cooler **7**, illustrated in greater detail in FIG. 2 of the drawing, comprises a plurality of vertically extending passes **16** series connected by upper loops or return bends **17** and lower loops or return bends **18** to form a series flow passageway of serpentine configuration between the cooler inlet **20** and the outlet **21**. The cross sectional area of the serpentine passageway defined primarily by the passes **16** is large enough to provide the desired total water storage volume within the cooler **7** while the outlet **21** is of a much smaller diameter more closely matching the diameter of the supply line **11** conveying water from the outlet **21** to the tap **10**. This supply line should, of course have a relatively low total storage volume since it passes through portions of the cabinet which may be operating at a higher temperature than the fresh food compartment **1**.

The cooler outlet **21** is at the upper end of the last pass indicated by the numeral **23** while the inlet **20** is connected to the first pass indicated by the numeral **24** and is at a lower elevation than the outlet **21**. Also each of the upper ends of the intermediate passes **16** as represented by the upper return bends or loops **17** is at a slightly higher elevation than the upper ends of any of the preceding passes and at a lower elevation than any subsequent pass. Thus in the illustrated embodiment the upper ends of the passes **16** as represented by the top portions of the loops **17** are in slanting alignment with one another and the outlet **21**. In addition, the upper ends of each of the passes **16** or more specifically the upper return bends **17** are connected to one another and to the outlet **21** by restricted flow means in the form of relatively small vents or passages **26** slanting upwardly towards the outlet **21**. Also in the illustrated embodiment of the invention the upper end of the first pass **24** adjacent the inlet **20** is connected to the next adjacent pass below the upper end thereof by means of an upwardly slanting passage **27**. Collectively the passages **26** and the passage **27** are designed to purge air from the upper ends of the passes to the outlet **21** both during initial filling of the cooler and during operation thereof.

The water flow through the serpentine cooler passageway is of course downwardly through the first pass **24** upwardly through its next adjacent pass and thereafter through each succeeding pass until it finally reaches the last pass **23**. While in normal operation some mixing of warmer and colder water may take place in each of the vertically extending passes **16**, a major advantage of the serpentine storage volume including a plurality of inclined or vertically extending passes is that this mixing is restricted to each pass and there is no possibility of the warm incoming water mixing directly with the coolest water in the last pass **23**, that is, the water adjacent the outlet **21**.

Upon each opening of the valve **8**, high pressure water is introduced into the water cooler through the inlet **20** where its pressure is initially reduced to a lower but somewhat above atmospheric pressure as determined by the flow restriction provided by the outlet **21** and the supply line **11** connecting the outlet end of the cooler to the tap **10**. Upon closing of the valve **8**, the water pressure in the cooler decreases to substantially atmospheric pressure.

However there is substantial liberation of air from the incoming water as the water pressure is initially reduced in the pass **24** and a significant, but substantially smaller

liberation of air from the water in most of the remaining passes **16** as it slowly travels through these passes. In the absence of any means for venting this liberated air, it will collect in pockets adjacent the upper end of the pass **24** and in each of one or more of the upper return loops **17**. Thereafter each time that the valve **8** is opened, the pockets of air contained or trapped within the serpentine passageway will be compressed from atmospheric pressure to a higher pressure determined by the flow restriction of the outlet **21** and the conduit **11**. Thereafter, when the valve **8** is again closed, this air expands thus forcing water to continue to flow from the tap **10** after the valve **8** has been closed and when complete shut-off is desired and expected.

By continuously venting the liberated air to the outlet **21** through the flow restricting vent passages **26** and **27**, the trapped air will be purged from the cooler each time that the valve **8** is opened. The increased velocity of the water as it flows from the last passage **23** through the outlet **21** aids in this air purging.

It is of course desirable that each of the passages **26** and **27** be of a size such that there will be a minimum flow of water therethrough. In other words, they should be designed so that substantially all of the water introduced into the cooler **7** flows through the serpentine passageway as defined by the passes **16**.

While the illustrated water cooler is shown as being arranged within the fresh food compartment **1** in a substantially vertical position, it will be understood that it will operate equally effectively in somewhat inclined positions and may for example be mounted along the sloping bottom back wall portion forming part of the fresh food compartments of a number of refrigerators. The requirement for complete air purging is that the outlet **21** be at the highest elevation and that the vent passages represented by the vents **26** and **27** connect the upper ends of all of the passes to the outlet **21** to assure complete venting of air from the entire cooler.

Any suitable means may be provided for controlling the operation of the valve **8**. In the illustrated embodiment of the invention, this control is the same as that disclosed in the aforementioned White application. It includes a switch (not shown) within the freezer compartment door **5** rearwardly of the service area **4** having an arm or actuator **29** in the form of a pushrod extending into the service area and designed, when depressed, to close the switch and operate the valve **8**.

While there has been shown and described a specific embodiment of the invention, it will be understood that it is not limited thereto and it is intended by the appended claims to cover all such modifications as falls within the spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A water cooler comprising:

a closed receptacle having an inlet and an outlet and a serpentine storage volume comprising a plurality of vertically extending passes series connected at their upper and lower ends to provide a series flow passageway between said inlet and outlet;

said outlet being connected to the upper end of the last of said passes and being at a higher elevation than said inlet;

the upper ends of the remaining passes ahead of said last pass being lower than said outlet;

valve means for connecting said inlet to a source of high pressure water to control the flow of water from said outlet;

and restricted flow means connecting said upper ends of said remaining passes to said outlet for purging air from all of said passes to said outlet.

2. The cooler of claim **1** in which said passes are substantially vertical.

3. The cooler of claim **2** in which said outlet has a substantially greater flow restriction than said last pass.

4. The cooler of claim **3** in which said upper ends of

said passes are in substantial slanting alignment and said restricted flow means comprises slanting aligned conduits.

5. A water cooler comprising:

a closed receptacle having an inlet, an outlet at a higher elevation than said inlet, and a serpentine storage volume comprising a plurality of vertically extending passes series connected at their upper and lower ends by upper and lower return loops to provide a series flow passageway between said inlet and outlet;

said outlet being at the upper end of the last of said passes and having a greater flow restriction than said passageway;

the upper portion of each of said upper loops being at a higher elevation than any of the preceding upper loops;

valve means for connecting said inlet to a source of high pressure water to control the flow of water from said outlet;

restricted flow means interconnecting said upper loops

and said upper end of said last pass for purging air from said upper loops to said outlet.

6. The cooler of claim 5 including an inclined restricted flow means connecting said inlet end of said passageway to a following pass.

7. The cooler of claim 6 in which said passes are substantially vertical.

References Cited

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U.S. Cl. X.R.

62—339