

April 27, 1943.

W. E. RICHMOND ET AL

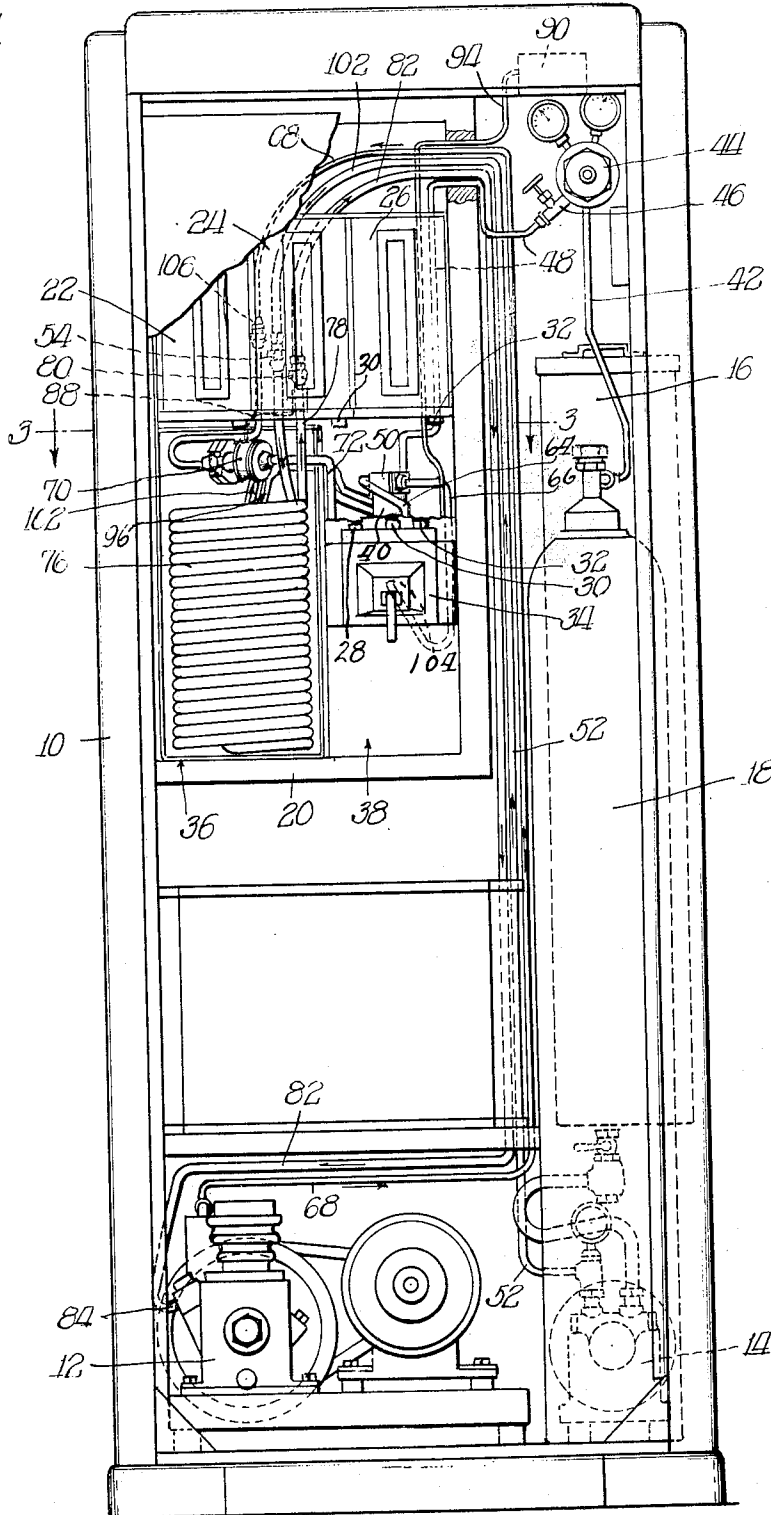
2,317,484

COOLING SYSTEM FOR BEVERAGE VENDING MACHINES

Filed April 14, 1941

2 Sheets-Sheet 1

Fig. 1



INVENTORS.

Arthur D. Ames.

William E. Richmond.

BY

Spencer, Margall, Johnston & Cook  
attys.

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2 Sheets-Sheet 2

Fig. 2

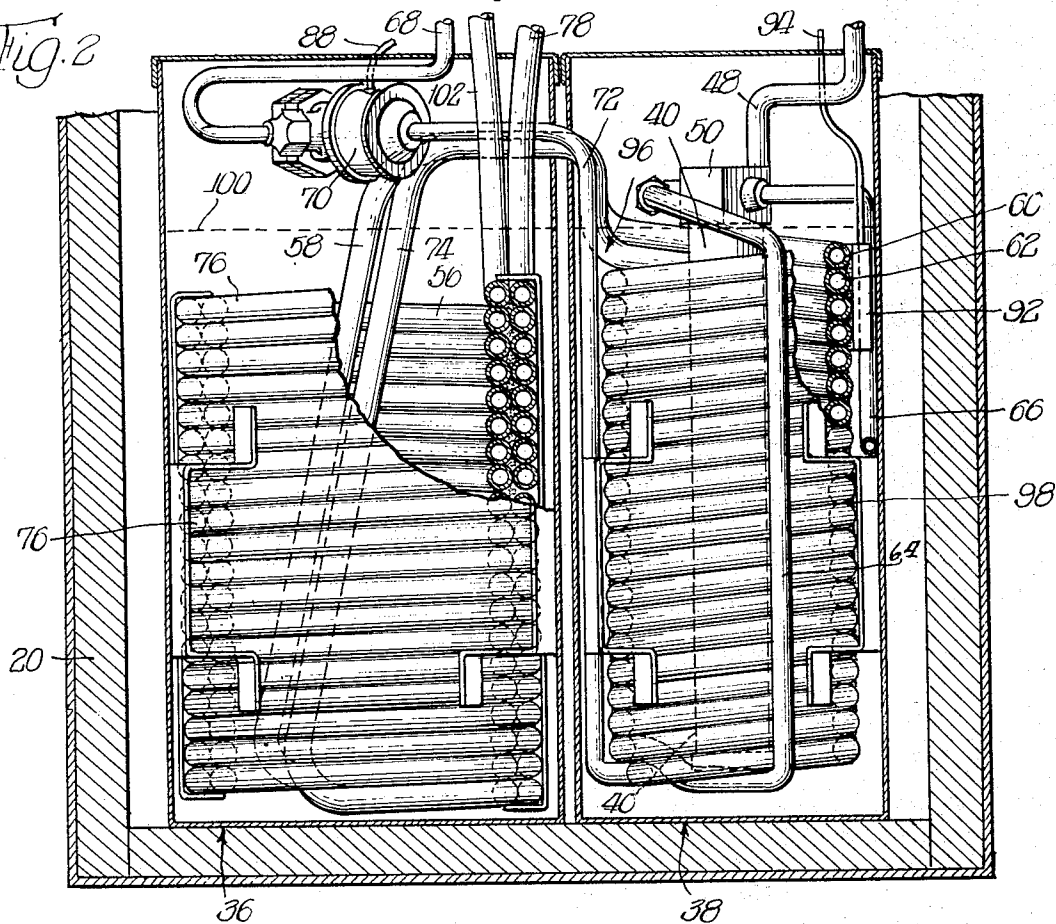
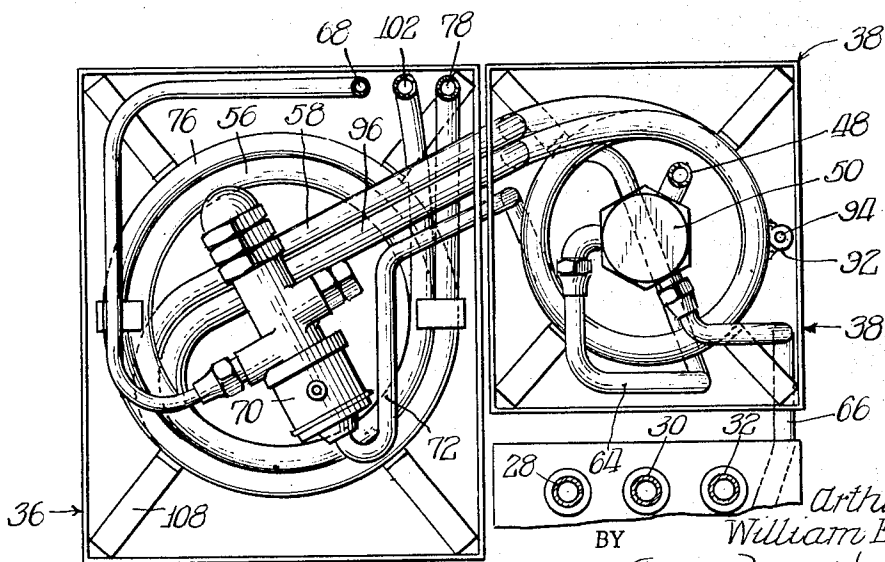


Fig. 3



INVENTORS  
Arthur D. Ames.  
William E. Richmond  
BY Spencer, Marjall, Johnston & Co. Attys.

## UNITED STATES PATENT OFFICE

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## COOLING SYSTEM FOR BEVERAGE VENDING MACHINES

William E. Richmond, Kenilworth, and Arthur D. Ames, Galesburg, Ill., assignors to Automatic Canteen Company of America, Chicago, Ill., a corporation of Delaware

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4 Claims. (Cl. 62—141)

This invention relates to a new and improved cooling system for beverage vending machines and more particularly to a cooling system for beverage vending machines of the type which do not maintain the entire beverage supply at delivery temperature.

The need for this invention arises in those beverage vending machines wherein the entire supply of all of the ingredients for preparing a beverage is not held at a selected low, beverage delivery temperature. Such a vending machine may contain an inner, insulated, refrigerated cabinet wherein is disposed one or more tanks containing flavoring extract, a mixing assembly, and a carbonating means, together with a water line connected to a source of water supply outside the insulated cabinet. This type of vending machine has the advantage over machines which cool the entire supply of all of the ingredients necessary to prepare a certain number of drinks in that, for example, the refilling of a water storage tank in the latter type of machine raises the temperature in the tank so that the machine cannot dispense a cool beverage until sufficient time has elapsed for the refrigerating apparatus to draw down the temperature of the whole water storage tank; whereas, in the type which cools water as used, water at room temperature may be added to a water storage reservoir and the machine will continue in condition to deliver a cold beverage. This type of machine that cools water as rapidly as used heretofore necessitated use of a cooling system of large capacity in order to take care of load periods when the vending machine cycles frequently.

The first object of this invention is to maintain beverages dispensed by such a vending machine during a load period at a selected low temperature without employing a refrigerating unit of a capacity sufficient to cool the beverage ingredients from room temperature to the selected temperature as rapidly as required. In order to attain this object, we provide pre-cooling tanks for storing refrigeration during idle periods of the vending machine and further means for concentrating the refrigerating capacity of the refrigerating machine on the water delivery line, as in a flash-cooling tank (hereinafter more fully described), during load periods so that water at the delivery orifice into the mixing assembly will be held at a predetermined temperature regardless of a rising temperature in the refrigeration storage means, or pre-cooling tank. By having a definite knowledge of the duration of load periods, it becomes possible to select pre-cooling

tanks, flash-cooling tanks and a refrigerating mechanism of such respective capacities that any given load period may be handled by the machine.

The second object of this invention is to position the carbonator at the coldest point in the system, namely, near the water delivery line to the mixing assembly, whereby the concentration of the refrigerating capacity of the refrigerating mechanism on this part of the water line will also be concentration of the refrigerating capacity on the point of carbonation. The ability of water to dissolve carbon dioxide gas varies indirectly with its temperature, that is to say, the colder the water the more readily carbon dioxide gas dissolves therein. In order to obtain the desired tang, it is necessary that the carbon dioxide concentration in the beverage after it has been poured into a cup be from two to three volumes of gas per volume of water. Inasmuch as the mixing and pouring operations may release one volume of gas from the solution, it is desirable for a carbonator to produce a carbonated water of as much as four volumes of gas for each volume of water. When the carbonator and the water are held at a temperature of 35° to 40° F., a given degree of carbonation may be obtained with certain equipment. Where the temperature of the carbonator and the water is at a point substantially higher, the same equipment will not produce the same degree of carbonation. The use of a single, large hold-over bath which slowly rises in temperature during a load period, therefore, is unsatisfactory not only because drinks prepared from water cooled in such a bath have an increasingly high temperature but more importantly because they have an increasingly low carbon dioxide content.

The foregoing objects are attained by three features of applicants' invention. One feature is the provision of a large pre-cooling, hold-over bath and a smaller flash-cooling, hold-over bath, the two hold-over baths being cooled by a single refrigerant line which leads from a refrigerant expansion valve into the flash-cooling bath and then into the pre-cooling bath. By this arrangement, the cooling capacity of the refrigerant is primarily expended in the flash-cooling bath and only after the flash-cooling bath has reached a selected low temperature will the full effect of the refrigerant on the pre-cooling tank be felt.

The second feature comprises the positioning of the carbonator inside the flash-cooling tank with a short delivery line between the carbonator and the mixing assembly. By this arrangement, cooling capacity is concentrated not only

on the delivery end of the water line but also upon the carbonator itself, with the important result that the carbonating takes place at that point in the water line where the water temperature is the lowest.

A third feature of this invention is the positioning of the capillary control for the refrigerating mechanism inside the flash-cooling, hold-over bath and adjacent to the conduit carrying incoming water from the pre-cooling bath. By this arrangement, the cycling of the refrigerating mechanism is made dependent upon the temperature in the small flash-cooling, hold-over bath and as will appear more clearly in the description that follows, when a load period commences it is desirable to commence cycling the refrigerating mechanism as quickly as possible. The temperature of the small, flash-cooling, hold-over bath will rise comparatively rapidly through a selected range. Additionally, the positioning of the capillary control on the conduit carrying water from the pre-cooling bath further assures early cycling of the refrigerating mechanism during a load period because the capacity of the water coil in the pre-cooling tank is only about four drinks with the result that after the vending machine has been cycled four or five times, a slightly warmer water will be in that part of the conduit adjacent the capillary control. The water will be warmer because it entered the pre-cooling bath only a short time before, perhaps one minute, at room temperature and this water was not in the pre-cooling bath sufficiently long to be brought down to the desirable temperature. Reference is hereby made to applicants' application, Serial No. 305,588, filed November 22, 1939, now matured into U. S. Patent No. 2,235,244.

These and such other objects as may hereinafter appear are attained in one embodiment of the invention shown in the accompanying drawings, comprising two sheets, wherein:

Figure 1 is a diagrammatic view of the interior of a liquid vending machine showing the carbon dioxide gas and water connections from sources of supply through a cooling system to a mixing assembly;

Figure 2 is a view of the cooling coil elements in two hold-over baths; and

Figure 3 is a plan view of the structure illustrated in Figure 2 taken on the line 3-3 of Figure 1.

Continuing to refer to the drawings and particularly to Figure 1, the numeral 10 identifies a vending machine cabinet in the base of which is disposed a refrigerating mechanism 12, a water pump 14, a water storage tank 16 and a carbon dioxide cylinder 18. Within the vending machine cabinet 10 is an insulated cabinet 20 in the upper portion of which is disposed a plurality of syrup tanks 22, 24 and 26 having outlets 28, 30 and 32 leading to a mixing assembly 34. Beneath the syrup tanks 22, 24 and 26 are tanks 36 and 38 of an equal height but of a different size. Referring to Figure 3, the larger tank 36 contains a bath and will be referred to as the pre-cooling tank, while the smaller tank 38 likewise contains a bath and will be referred to as a flash-cooling tank. The tanks may contain sweet water baths, as the temperature is not to be drawn below the freezing point of water. Returning to Figure 1, a carbonator 40 is positioned centrally of the flash-cooling tank 38. The water levels in the two hold-over baths is indicated.

Tracing the carbon dioxide and water lines from the sources of supply to the carbonator,

the carbon dioxide cylinder 18 supplies gas through a conduit 42, a regulator 44, a shut off valve 46 and a conduit 48 to a head portion 50 of the carbonator 40. A water outlet in the bottom of the water tank 16 is connected to the pump 14 which by the conduit 52 forces the water through the fitting 54 to a helical coil 56. Referring to Figure 2, the outlet of the helical coil 56 is the conduit 58 which extends over the edge of the tank 36 to connect to a second coil 60 which is spirally wound on the same axis and the same radius as a similar coil 62 for carrying a refrigerant. The outlet of the coil 60 is a vertical conduit 64 communicating with a water inlet in the carbonator head 50. The numeral 66 identifies the carbonator water outlet from the carbonator 40 and leads to the mixing assembly 34, see Figure 1. A suitable mixing assembly is illustrated in Carlson U. S. Patent No. 2,261,338.

The refrigerant line comprises the conduit 68 carrying refrigerant from the refrigerating mechanism 12 to an expansion valve 70. From the expansion valve 70, see Figure 2, a conduit 72 opens into an inlet at the base of refrigerant coil 62. The outlet of the refrigerant coil 62 is connected by a conduit 74 to the inlet at the base of a coil 76 wound around the coil 58, the inlet being at the bottom of the coil 76 and the outlet being at the top. A conduit 78 leads the expanded gas, see Figure 1, through the fitting 80 and another conduit 82 to the low pressure side 84 of the refrigerating mechanism 12.

The cycling of the refrigerating mechanism 12 is controlled by a temperature controlled switch 90, which in turn is controlled by the end 92, see Figure 2, of a capillary tube 94 positioned on a bracket sweated to the upper walls of both coils 60 and 62.

The two tanks 36 and 38 are separate so that the water in each cannot flow into the other. It will be noted that the refrigerant flows from the expansion valve 70 to the bottom of the flash-cooling tank 38 where it exerts its maximum refrigerating effect. This refrigerating effect steadily decreases in succeeding higher turns of the coil until the least refrigerating effect exerted in the flash-cooling tank 38 by any given amount of refrigerant occurs at the point 96. (The foregoing statement is not to be construed as indicating that the coldest point in the flash-cooling tank 38 is at the bottom. In commercial practice, at least during rest periods, the temperature of the bath is below the point of water's greatest density with the result that the coldest water rises causing the upper portion of the bath to be at the lowest temperature. Positioned as it is, the capillary control and switch may be adjusted so that a freeze-up at the coldest point of the system will not occur.) From this point the refrigerant is carried to the bottom of the coil 76 in the pre-cooling tank 36 at which point it exerts its maximum refrigerating effect in this tank. Thus it is evident, referring to Figure 2, that a counter-flow relationship is established between the water and the refrigerant. From the point where the refrigerant exerts its greatest cooling effect, that is, the bottom of the flash-cooling tank 38, the water is delivered directly to the carbonator 40 from which it flows to the mixing assembly 34, and at the point where the refrigerant exerts its least refrigerating effect, the water is coming from the room temperature supply tank 16.

Those portions of the refrigerant line and of the water line disposed within the pre-cooling

tank and the flash-cooling tank may be described as sections. That is to say, the refrigerant line comprises a flash-cooling section in heat exchange relationship to a flash-cooling section of the water line and a second section in the refrigerant line called the pre-cooling section in heat exchange relationship with a pre-cooling section of the water line.

Before describing certain structural features of the refrigerant and water coils, the features of applicants' invention will be viewed as a whole. One cardinal feature may better be understood by describing the pre-cooling tank 36 as a refrigeration storage means. It is important that the tank be so viewed because there is one time when the addition of water to the water reservoir 16 and the cycling of the machine several times will not produce a cool drink and that is when the machine is first placed in operation. At such a time the temperature of the hold-over bath in the pre-cooling tank 36 as well as the hold-over bath in the flash-cooling tank 38 will be at room temperature and the capacity of the refrigerating mechanism 12 and the cooling surfaces of the coils 62 and 76 are not sufficiently great to draw down the temperature of the carbonated water to produce cold drinks. In order to function properly, the temperature of the pre-cooling tank must be reduced to 35° to 40° F. before entering a load period. Once the tank has been so cooled, the occurrence of a load period in which one or two hundred drinks may be drawn as rapidly as the machine can be cycled will cause a slowly rising temperature of the hold-over bath in the pre-cooling tank 36, which slowly rising temperature in turn will be reflected in a slowly rising temperature in the water leaving the pre-cooling tank 36 by the conduit 58 where it is conducted into the flash-cooling tank 38. This rising temperature of the water being delivered to the flash-cooling tank imposes an increasing refrigerating burden in the flash-cooling tank and this causes increasing exhaustion of the refrigerating capacity of the refrigerant in the flash-cooling tank 38. This reduces refrigerating capacity of the refrigerant when it reaches the pre-cooling tank 36 permitting the temperature in the tank 36 to rise higher. If this process continued for a sufficient period of time, the system would break down, that is, the temperature of the carbonated water delivered to the mixing assembly would cease to be at the selected low point. In order to avoid this, applicants have related the size of the pre-cooling tank 36 to the size of the flash-cooler 38 and to the capacity of the refrigerating mechanism 12 so that once the pre-cooling tank 36 is drawn down to a selected temperature, the machine may be cycled continuously without danger of delivering beverages at an undesirably high temperature until the machine is locked for lack of beverage ingredients. Ordinary vending machines are designed to have a capacity that will satisfy a location for twenty-four hours. This is an average value. Where the location is one which requires more than the capacity of one vending machine during twenty-four hours, it is customary to position additional machines at the location.

The importance of positioning the carbonator in the flash-cooling tank 38 has been mentioned heretofore. The carbonator is nearly submerged in water and the conduit 66 connecting the carbonator outlet to the mixing assembly 34 is short. By this arrangement the maximum cooling ca-

capacity of the system will be exerted upon the water immediately before and during its carbonation and the resulting carbonated water is fed as directly to the mixing assembly as physical positioning of the mixing assembly with respect to the carbonator outlet will permit. The conduit 66 holds only a very small amount of fluid. During one mixing operation most of the carbonated water required for a beverage will have come not from the conduit 66 but from the carbonator itself. By this arrangement, inadequate carbonation due to undesirably high temperatures of the water or the carbonator and excessive carbonation loss after carbonation will be reduced to a minimum, it being borne in mind that carbonating loss in the mixing assembly and during the pouring operation are, so far as this invention is concerned, fixed factors.

Attention is now invited to the functioning of the refrigerating mechanism cycling control, which is actuated by the capillary 92. The positioning of this control is important for by placing it at the top of the water bath in the flash-cooling chamber, it is responsive to water temperatures which are the highest in the flash-cooling tank and which may be the lowest in the pre-cooling tank. Bearing in mind that the objective is to turn on the refrigerating mechanism as quickly as possible when the machine is entering a load period and further bearing in mind that it is desirable not to turn off the refrigerating mechanism until the temperature of the water bath in the pre-cooling tank 36 has been reduced to a selected level, it is evident that the capillary tube must be located at some medium point between these two tanks. If not so located, the operating of the refrigerating mechanism 12, which started on a rise in temperature of the hold-over bath in the flash-cooling tank 38, might cease when the temperature of that hold-over bath dropped to a selected point and prior to drawing down the hold-over bath in the pre-cooling tank 36 to a desired temperature. Under such circumstances the temperature of the hold-over bath in the pre-cooling tank 36 would steadily rise with the result that it might not have sufficient stored refrigeration to deliver pre-cooled water to the flash-cooling tank 38 should a load period be encountered by the vending machine.

Positioned as it is, the capillary closes the circuit to the refrigerating mechanism in response to warmer water flowing in the upper end of the coil 60. The refrigerating mechanism continues to function despite requisite coldness in the flash-cooling tank 38 until the temperature of the pre-cooling tank 36 is such that comparatively cool water is being delivered to the upper end of the coil 60. The reason for this is that the capillary is in heat conductive relationship with the upper part of the coil 60 as well as with the hold-over bath in the flash-cooling tank 38.

Examining now certain mechanical features of this invention, the two coils 60 and 62, in Figure 2, are interlaced helices having a common axis wound with a like advancing radius. The metal contact between the touching edges of the tubular portions that make up these two coils is increased by metal 98 which performs the joint function of holding the two coils in assembled relationship and increasing the metal conductive volume between the two. The two coils in the pre-cooling tank 36 are of larger capacity than the two coils in the flash-cooling tank 38. In the pre-cooling tank 36, the two coils are nested, one inside the other and a metal conductive rela-

tionship between the water coil and the refrigerant coil similar to that in tank 38 is provided. The water level is indicated by the numeral 100.

Referring to Figure 1, from the point 102 where the water conduit enters the hold-over bath of the pre-cooling tank 36 to the point 104 where the carbonated water is released into the mixing assembly by a valve not shown, the water capacity of the system is about one quart. Stated in terms of number of drinks, there being four or five ounces of water required for each drink, some seven or eight drinks can be prepared from water in the system at the beginning of a load period.

As cycling of the machine continues, the cooling system must be able to cool the water almost continuously. Thus, it is possible to cycle such a vending machine four or five times a minute. Inasmuch as the flow of carbonated water will probably not exceed six or seven seconds for each cycling of the machine, the water will actually be flowing from one-quarter to one-third of the time that the machine is cycling.

Referring to Figure 3, it is desirable that the coils in both tanks be such that they may be easily removed as a unit for servicing purposes. In order to facilitate this, the fittings 54, 80 and 106 are positioned in side by side relationship at the back of the tank so that they may be disassembled. The gas conduit 48 under such circumstances is disconnected from the head 50 of the carbonator 40. In order to position centrally the various coils in their respective tanks, referring to Figure 3, bracket members 108 are fastened to the outside of the water coil so that they will penetrate the inside corners of the respective tanks and hold the coils centrally of the two tanks.

It will be understood that the employment of a hold-over bath is not essential to obtain the new and improved result provided by the positioning of the capillary control as shown. It might be desirable to substitute some other flash-cooling means for the flash-cooling, hold-over bath and under such circumstances similar positioning of the capillary control would accomplish the desired result.

While the invention in one phase has been described with emphasis upon locating a carbonator in association with a flash-cooling device, it will be appreciated that the cooling system will have great merit in machines dispensing pre-mixed drinks. In machines of the type where the complete drink supply is held at atmospheric temperature, the problem of maintaining a low temperature during load periods will be similar to that encountered in the specific equipment here described and the invention shown will affect the desired purpose.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent of the United States, is:

1. A cooling assemblage for a beverage vending machine having ingredient storage means, a mixing assembly, and a conduit connecting the ingredient storage means to the mixing assembly, comprising a refrigerating mechanism, means for storing refrigeration during inactive periods of the vending machine and means for concentrating the refrigerating capacity of said refrigerating mechanism on a part of said conduit near the mixing assembly during a period of vending activity.

2. A cooling assemblage for that type of vend-

ing machine which prepares a beverage by adding a flavoring to carbonated water in a mixing assembly and which dispenses the same, comprising an insulated cabinet, a pre-cooling hold-over bath and a flash-cooling hold-over bath disposed in said cabinet, a refrigerant line for cooling said hold-over baths and disposed to cool said hold-over baths in series so that the high pressure end of the refrigerant line will be in the flash-cooling bath and the low pressure end of the refrigerant line will be in a pre-cooling bath, a water line passing through both baths and having its inlet end in the pre-cooling bath and its outlet end in the flash-cooling bath, means disposed in the flash-cooling bath for receiving water from the water line and carbonating the same, a refrigerating mechanism for supplying refrigerant to the refrigerant line, and control means for the refrigerant mechanism disposed in the flash-cooling bath.

3. A cooling assemblage for that type of vending machine which prepares a beverage by adding a flavoring to carbonated water in a mixing assembly and which dispenses the same, comprising an insulated cabinet, a pre-cooling hold-over bath and a flash-cooling hold-over bath disposed in said cabinet, a refrigerant line for cooling said hold-over baths and disposed to cool said hold-over baths in series so that the high pressure end of the refrigerant line will be in the flash-cooling bath and the low pressure end of the refrigerant line will be in a pre-cooling bath, a water line passing through both baths and having its inlet end in the pre-cooling bath and its outlet end in the flash-cooling bath, means disposed in the flash-cooling bath for receiving water from the water line and carbonating the same, a refrigerating mechanism for supplying refrigerant to the refrigerant line, and heat responsive control means disposed in the flash-cooling bath and in metal conductive relationship to that portion of the water line carrying water from the pre-cooling bath into the flash-cooling bath.

4. A cooling assemblage for that type of vending machine which prepares a beverage by adding a flavoring to carbonated water in a mixing assembly and dispenses the same, comprising an insulated cabinet, a flavoring storage tank in the upper portion of said cabinet, a pair of open top tanks, one large for pre-cooling and one small for flash-cooling, and a mixing assembly in the lower part of said cabinet; a water line from a source of water supply entering the larger tank and spiralling downwardly to the bottom, then upwardly and into the smaller tank, thence spiralling to the bottom, thereafter connecting to a carbonator disposed in the smaller tank, the outlet of the carbonator leading to the mixing assembly; a refrigerant line receiving refrigerant from a refrigerating mechanism and entering the smaller tank, spiralling upwardly from the bottom of said tank in metallic contact with the water line in said tank, thence to the bottom of the larger tank, spiralling upwardly in metallic contact with the water line therein and returning to the refrigerating mechanism, hold-over baths in each of said tanks and control means for the refrigerating mechanism disposed adjacent the upper portions of the refrigerant and water conduits in the smaller tank.

WILLIAM E. RICHMOND,  
ARTHUR D. AMES.