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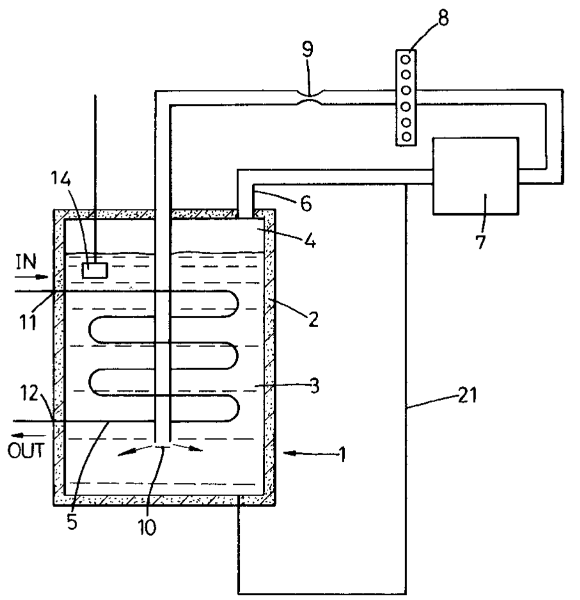
(54) **Beverage Cooling.**

(57) A beverage cooling system has a tank (1) filled with refrigerant but with a head space retained for evaporation. Product coils (5) pass through the tank (1) such that they are cooled and refrigerant gas evaporates into the head space from where it is collected and condensed by a conventional refrigeration system (7,8). The condensed refrigerant is re-introduced into the tank (1) below the surface of the refrigerant already in there and such that turbulent mixing occurs.



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The present invention relates to beverage cooling and more particularly but not exclusively to almost instantaneous cooling of beer and soft drinks.

Conventional approaches to cooling beverages have either involved use of ice bank or cold plate technologies. In either technology ice provides thermal cooling of a beverage flowing in pipes.

Ice bank technology involves creation of an ice bank about evaporator coils of a refrigeration system in a water vat. The ice bank provides a thermal reserve for cooling beverages during periods of high demand when the refrigeration system would be over loaded. However, a major dis-advantage with ice bank technology is that there is a requirement to start and operate the system many hours before dispense of beverage can begin. Thus, ice bank technology may not be suitable for one-off events and venues used sporadically such as football grounds.

Cold plate technology involves placing a volume of ice, crushed or flaked, into a vat containing beverage circuits mounted in thermally conducted plates. The ice cools the plates but slowly melts. Thus, there is a constant requirement to drain the vat which may cause problems. Furthermore, there is a requirement for a ready supply of ice.

It is an objective of the present invention to provide a beverage cooling system that substantially relieves the above mentioned problems.

In accordance with the present invention there is provided a beverage cooling system comprising a tank substantially filled with liquid refrigerant gas and having a beverage coil passing through said liquid refrigerant gas such that said gas is evaporated into a head space of the tank as heat is exchanged between the beverage and the liquid refrigerant gas, the evaporated gas being condensed by a refrigeration system and sprayed back into the liquid refrigerant gas in order to induce turbulent mixing.

Preferably, there is lubrication means between the tank and the input of the compressor of the refrigeration system to ensure adequate lubrication.

An embodiment of the present invention will now be described by way of example only with reference to the accompanying drawing which is a schematic illustration of a beverage cooling system.

Referring to the drawing, a tank 1 is covered in insulation material 2 and substantially filled with a refrigerant gas in liquid phase such as R134A. However, a head space 4 is left to allow the gas 3 to evaporate by drawing heat energy from beverage flowing in a beverage coil 5.

The evaporated gas 3 creates a pressure in the head space 4 which forces the gas down a sump tube 6 to a compressor 7. This compressor 7 compresses the gas 3 and delivers it to a condenser 8 in which the gas 3 is condensed to a liquid. This liquid then passes through a constrictor element 9 before being sprayed out of a nozzle 10 beneath the surface of the refrigerant gas 3 (liquid phase) in the tank 1.

Beverage is simply pumped through the coil 5 from an input 11 to an output 12. The coil 5 is made typically of stainless steel or copper tube to ensure there is good heat exchange between the refrigerant gas 3 (liquid phase). Thus, the beverage passing through the coil 5 is rapidly cooled.

It is necessary to use the nozzle 10 to spray the returned refrigerant gas 3 (liquid phase) into the tank in order to ensure good mixing and agitation within the tank 1. Furthermore, it will be understood that as heat is exchanged between the beverage in the coil 5 and the refrigerant gas (liquid phase) 3 bubbles are created about the coil 5. These bubbles eventually rise to the head space 4 and in the process increase agitation and mixing of the refrigerant gas (liquid phase) 3. The beverage coil 5 may be only partly submerged in liquid, since agitation and splashing from the refrigerant bubbles will ensure coil cooling.

The restrictor element 9 is necessary to regulate flow, create the pressure drop to allow the change of state of the refrigerant and to create turbulence within the liquid refrigerant in tank 1 ensuring even temperature distribution.

It will be understood that it is important that a good head space 4 is retained. If there is only a limited head space 4 then there is little opportunity for the gas (liquid phase) 3 to evaporate and so heat exchange/cooling of the beverage is inhibited. Thus, it is normal to fill the tank with refrigerent gas 3 (liquid phase) to 50% - 95% capacity so that during operation there is a 50% to 5% head space 4.

It will be understood that several beverage coils 5 could be included in the tank 1 to cool respective beverages. One beverage coil 5 is illustrated for ease of description and clarity. Alternatively, several tanks 1 with respective beverage coils 5 could be used. However, it is most convenient to have a common head space 4 and so one large tank 1 is preferred.

In order to ensure good heat exchange it is advanageous to have a small diameter bore tube for coil 5 typically between 4 mm and 15 mm in diameter. However, another consideration is to ensure adequate beverage through put for dispense so a compromise tube diameter must be determined.

It is necessary to set a cooled beverage temperature. It is not acceptable to just cool the beverage as much as possible. Thus, temperature regulation is normally achieved by switching the compressor 7 on/off as required. If the compressor 7 is switched off the refrigerent gas 3 (gas phase) can not flow through the compressor 7/condenser 8. Thus, the refrigerant gas 3 (gas phase) builds up in the head space 4 and its pressure increases inhibiting further evaporation of gas (liquid phase) 3 and so heat exchange between the beverage in the coil 5 and the refrigerant gas (liquid phase) 3. With reduced heat exchange the beverage is not so highly cooled.

In order to control the compressor 7 in respect to temperature, a sensor 14 may be placed in the refrigerant gas (liquid phase) 3 to determine its temperature and switch the compressor 7 on or off in response to changes in this temperature level. Alternatively, the pressure of the refrigerent gas 3 in the head space 4 may be determined.

It will be understood that the beverage cooled is normally beer. Furthermore, the beer may enter the beverage cooler illustrated in the drawing at 32°C and leave at about 8°C.

In order to enhance mixing it is possible to have several nozzles 10 to spray the returned refrigerant gas (liquid phase) 3 into the tank 1 particularly if the tank 1 is large with several beverage coils 5.

It will be understood that normally a lubricant for the compressor 7 is mixed with the refrigerant gas 3. Unfortunately, with certain lubricants due to certain physical phenomena and relative coefficients of evaporation it is found that the lubricant gradually settles and/or is decanted from the refrigerant gas 3. If there is no lubricant eventually the compressor 7 will fail.

In order to ensure lubricant remains in the refrigerant gas (gas phase) stream entering the compressor 7, a capillary tube connection 21 is made between the bottom of the tank 1 and the compressor 7 inlet or just before it. Thus, lubricant is drawn from the bottom of the tank 1 into the refrigerant gas (gas phase) flow entering the compressor. The dimensions of the capillary tube 21 are determined by the amount of lubrication required, the length of the tube 21 and the type of lubricant.

Claims

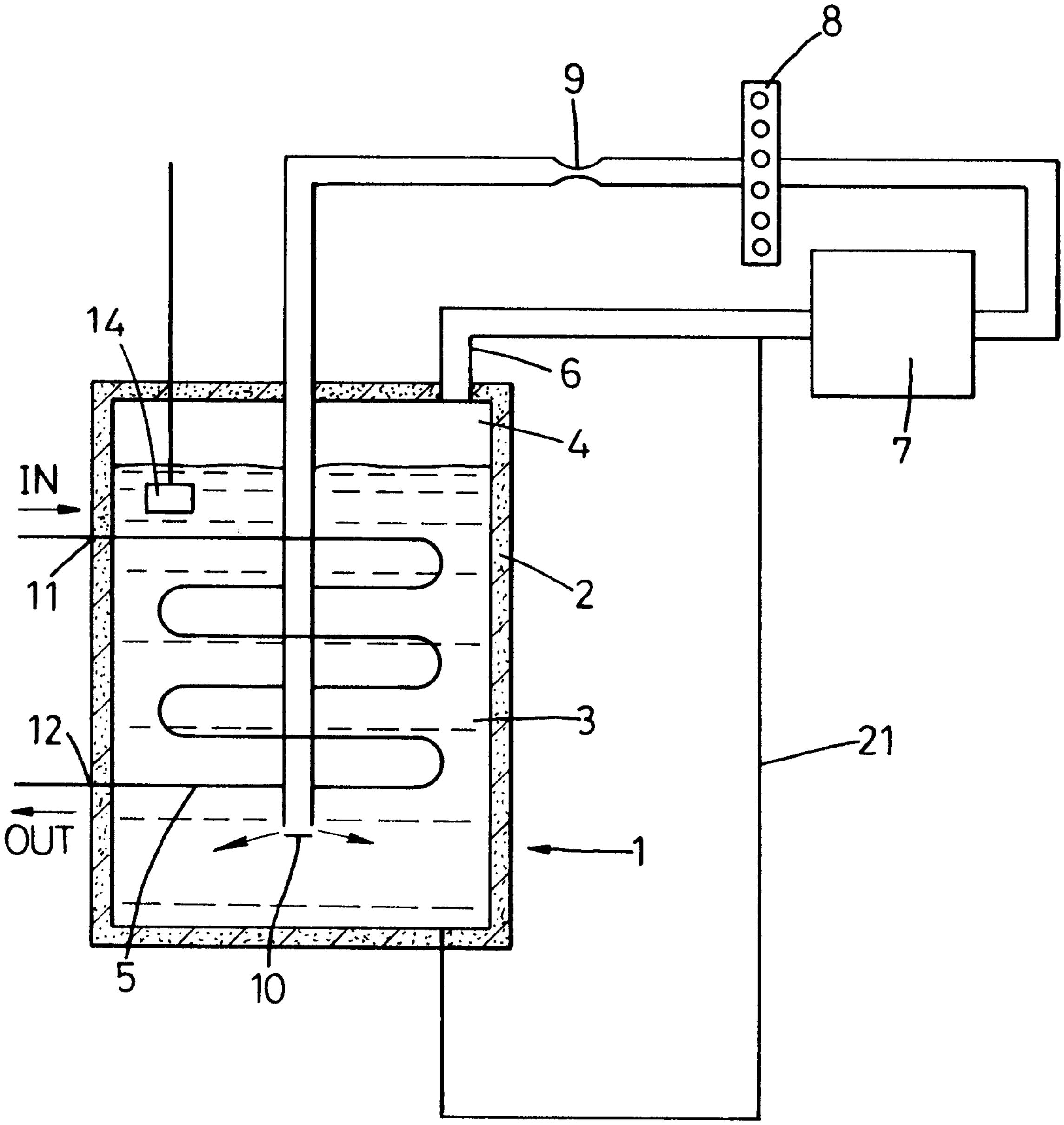
1. A beverage cooling system comprising a tank (1) substantially filled with liquid refrigerant gas (3) and characterised by having a beverage coil (5) passing through said liquid refrigerant gas (3) such that said liquid is evaporated into a head space of the tank (1) as heat is exchanged between the beverage and the liquid refrigerant gas (3), the evaporated gas being condensed by a refrigeration system (7,8) and sprayed (10) back into the liquid refrigerant gas (3) in order to induce turbulent mixing.

2. A beverage cooling system as claimed in claim 1 characterised by a sensor (14) located in the liquid refrigerant gas (3) so as to determine its temperature such that a compressor (7) may be switched on or off in response to changes in a set temperature level.

3. A beverage cooling system as claimed in claim 1 or claim 2 in which coil (5) is of a diameter between 4 and 15 mm.

4. A beverage cooling system as claimed in any preceeding claim characterised by a lubricant line between the inlet of compressor (7) and the bottom of tank (1).

5. A beverage cooling system as claimed in any preceeding claim characterised by a restrictor element (9) in the line supplying condensed refrigerent gas to be sprayed with the liquid refrigerent gas (3) to induce turbulent mixing.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EUROPEAN SEARCH REPORT

Application Number
EP 95 30 3526

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	US-A-1 675 108 (KELLOGG) * page 1, line 70 - page 4, line 45; figures 1-5 *	1,2,5	F25B39/02 F25D31/00
Y	US-A-1 613 687 (WALES) * page 1, line 61 - page 2, line 115; figure 2 *	1,2,5	
A	US-A-2 646 667 (KROMER) * column 3, line 28 - column 12, line 36; figures 1-6 *	1-3,5	
A	US-A-2 450 735 (MILLET) * column 1, line 48 - column 4, line 74; figures 1-4 *	1,2,4,5	
A	US-A-2 191 623 (PHILIPP) * page 1, right column, line 8 - page 3, left column, line 9; figures 1-4 *	1,2,5	
A	GB-A-1 110 041 (MIECZYLAW KOMEDERA) * page 2, line 39 - page 3, line 34; figures 1-7 *	1,2,5	TECHNICAL FIELDS SEARCHED (Int.Cl.6) F25B F25D
A	CH-A-176 128 (GEBRÜDER SULZER) * page 2, left column, paragraph 4 - page 3, left column, paragraph 1; figures 1-3 *	1,4	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 September 1995	Boets, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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