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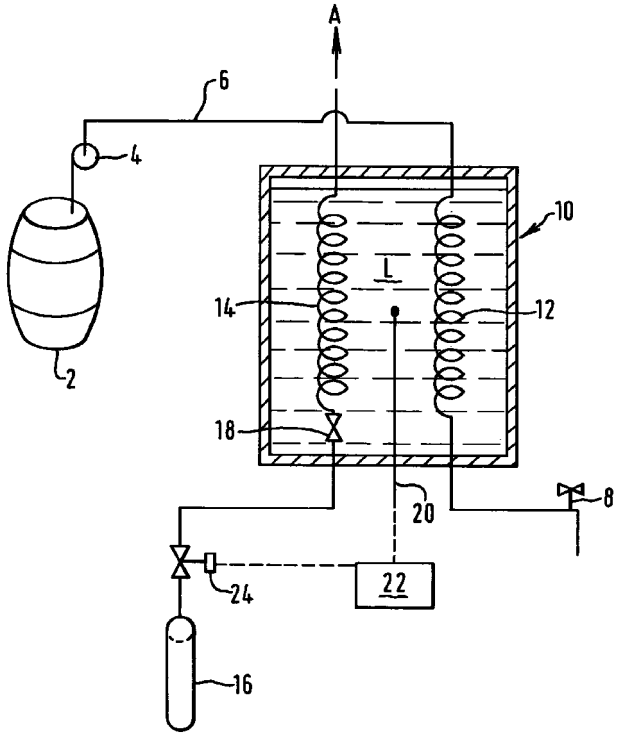
(71) Applicant: **The BOC Group plc**
Windlesham Surrey GU20 6HJ (GB)

(72) Inventors:
- **Garrett, Michael Ernest**
  Working Surrey, GU22 7XR (GB)
- **Shervington, Evelyn Arthur**
  Near Petersfield, Hampshire, GU31 5NE (GB)

(74) Representative:
Bousfield, Roger James et al
The BOC Group plc
Chertsey Road
Windlesham Surrey GU20 6HJ (GB)

(54) Draught breverage refrigerator

(57) Refrigeration apparatus for use in the dispensing of draught beverages comprising a heat exchanger (12) through which flows beverage (6) to be dispensed, beverage flowing through the heat exchanger being in heat exchange relationship with a flow of a fluid cooled below ambient temperature following its controlled expansion, characterised in that the fluid comprises carbon dioxide (16) and in that the expanded carbon dioxide is vented to atmosphere.



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Description

[0001] This invention relates to an apparatus for use in the dispensing of draught beverages. For the avoidance of doubt, the term "draught beverage" denotes a beverage which is supplied from a large container, such as a barrel, or keg, via pipework to be discharged from a tap into a glass or other drinking vessel. Typically, such draught beverage containers are located in a cellar some distance away from the dispensing tap, the beverage being pumped to the tap by means of a compressed gas, typically nitrogen or carbon dioxide.

[0002] Many types of draught beverage, particularly beers, lagers and the like, are cooled prior to being dispensed by means of small refrigeration units, because consumers usually prefer cool drinks. Conventional refrigeration units use chlorofluorocarbons and/or hydrofluorocarbons as a circulating refrigerant, however these substances are increasingly environmentally objectionable. Also, these refrigeration units require an external power supply for their operation. Thus, conventional refrigeration units are polluting and energy inefficient.

[0003] In accordance with the present invention, refrigeration apparatus for use in the dispensing of draught apparatus comprises a heat exchanger through which flows beverage to be dispensed, beverage flowing through the heat exchanger being in heat exchange relationship with a flow of a fluid cooled below ambient temperature following its controlled expansion, characterised in that the fluid comprises carbon dioxide and in that the expanded carbon dioxide is vented to atmosphere.

[0004] With such an arrangement, mechanical refrigeration is not required, hence there is no need for an external power supply. Accordingly, cool drinks can be supplied even where electrical power is unreliable or unavailable, such as in less developed countries or at outdoor events. Moreover, carbon dioxide is relatively unpolluting and, provided there is adequate ventilation, safe in use - it is also familiar to those who work in bars and public houses, where it is in widespread use for pumping and/or carbonating draught beverages.

[0005] The expanded carbon dioxide may be allowed to pass through a liquid heat exchange medium within the heat exchanger before being vented to atmosphere. This both improves heat exchange between the carbon dioxide and the liquid medium and also promotes circulation of the medium.

[0006] Advantageously, the heat exchanger comprises at least two adjacent passages arranged for the flows of beverage and carbon dioxide therethrough. A heat exchange medium is preferably provided to facilitate heat exchange therebetween. Heat exchange occurs in such an arrangement between the passage, or coil, containing carbon dioxide and the liquid heat exchange medium and between the bubbles of carbon dioxide and the medium, and between the heat exchange medium and the passage containing the beverage, this latter exchange being assisted by the circulation of the medium. Preferably, the expansion of the carbon dioxide takes place surrounded by the liquid medium, so as to maximise the cooling of the medium.

[0007] Advantageously, the heat exchanger may comprise means adapted to sense the temperature of the beverage and/or of the heat exchange medium, means being provided to actuate the flow of carbon dioxide whenever the sensed temperature(s) rises above predetermined level(s). This arrangement means that carbon dioxide is only used when cooling is actually required, and therefore carbon dioxide is conserved.

[0008] Where the beverage is dispensed through a tap connected to a source of the beverage by pipework, the heat exchanger is preferably connected in circuit with the pipework adjacent the tap and upstream thereof, so that substantially only that beverage to be dispensed is cooled.

[0009] Preferably, the carbon dioxide is supplied from a source of liquid carbon dioxide, an orifice or control valve being provided and adapted to allow the liquid carbon dioxide to expand in a controlled manner, the valve being located within the heat exchanger, thereby to produce a reduction in its temperature according to the Joule-Kelvin effect. Ideally, the liquid carbon also moves from the liquid to the gas phase, so as to maximise its refrigerating effect in the heat exchanger.

[0010] The invention will now be described by way of example and with reference to the accompanying drawing, which is a schematic diagram of an apparatus in accordance with the invention for refrigerating a draught beverage during the dispensing thereof.

[0011] Beverage is pumped from a source 2 by a pumping means 4 (which might be a conventional pump, or a source of a pumping gas such as nitrogen, as is known in the art) through pipework 6 (which might be of considerably length, as is the case where draught containers are located in a cellar a significant distance away from the point of dispensing of the beverage) to a tap 8, from which the beverage is discharged into a glass or other drinking vessel.

[0012] Immediately upstream of the tap 8 the beverage pipework 6 passes through a thermally-insulated heat exchanger 10. The pipework within the heat exchanger is in the form of a coil 12, which is in heat exchange relationship with another coil 14 by virtue of their mutual immersion in a heat exchange medium (L), such as water, contained in the heat exchanger 10. The coils 12,14 are arranged so that they respectively pass countercurrent flows of beverage and carbon dioxide gas. The carbon dioxide flows from a source of liquid carbon dioxide 16, through a control valve 18, into the coil 14 and hence out of the heat exchanger 10 to be vented to atmosphere (A). Alternatively, the carbon dioxide can be allowed to exit the coil within the heat exchanger so as to bubble up through the heat exchange medium (L), thus both improving heat

exchange therebetween and also promoting circulation of the medium and enhancing heat exchange between the coil 12 and the medium (L). The carbon dioxide then vents to atmosphere through a vent at the top of the heat exchanger.

[0013] The reduction in temperature of the carbon dioxide arising from its expansion (and, preferably, its conversion from the liquid to the gaseous state) as it flows through the control valve 18 and the coil 14, cools the liquid medium (L) and, by conduction and convection, the beverage passing through coil 12.

[0014] A temperature sensor 20 is provided to sense the temperature within the heat exchanger 10, and is operatively linked to a controller 22 which is effective to actuate the flow of carbon dioxide via an on/off valve 24 whenever the sensed temperature falls below a predetermined level. In this way carbon dioxide is conserved, so as not to overcool beverage in the coil 12 when the tap 8 is not open and beverage is static in the pipework 6. Means (not shown) may also be provided to sense the temperature of the beverage in the pipework immediately upstream of the tap 8 or in the coil 12, and effective to retain beverage in the coil 12 until it is at the predetermined, optimum temperature.

[0015] It will be appreciated that the system described above has several advantages over conventional draught beverage refrigeration devices. Since no mechanical refrigeration is required, there is no requirement for any external energy supply; beverage can be pumped through the system using a compressed gas such as nitrogen, and cooled by the carbon dioxide above. Cooling is only required for the actual beverage dispensed, and not for the entire barrel or keg, thus minimising the refrigeration required, and the beverage is dispensed at the optimum desired temperature. The apparatus is simple to operate and maintain, and relatively inexpensive. For example, 25 kg of liquid carbon dioxide would yield over 4 MJ of "refrigeration", which would be adequate to chill about 100 litres of a typical beverage.

[0016] A number of alternative arrangements will occur to those skilled in the art. For example, the cylinder 16 could be positioned within the heat exchanger 10 (not shown) so that the temperature reduction arising as carbon dioxide flows from the cylinder and hence the pressure therein is reduced can be used further to cool the liquid medium (L), so maximising the cooling effect. Also, it is clearly desirable that the coil 14 is configured so as to minimise the possibility that it might become blocked in use by "plugs" of solid carbon dioxide; this might be achieved by the configuration of the coil 14, as is known in the art, or by using a known sintered block heat exchanger. The valve 24 should preferably also be linked closely to the control valve 18 so as to ensure that the apparatus runs smoothly, and to avoid sudden carbon dioxide flow pulses, which would tend to create such "plugs".

Claims

1. Refrigeration apparatus for use in the dispensing of draught beverages comprising a heat exchanger through which flows beverage to be dispensed, beverage flowing through the heat exchanger being in heat exchange relationship with a flow of a fluid cooled below ambient temperature following its controlled expansion, characterised in that the fluid comprises carbon dioxide and in that the expanded carbon dioxide is vented to atmosphere.

2. Apparatus according to Claim 1 in which the heat exchanger comprises at least two adjacent passages arranged for the flows of beverage and carbon dioxide therethrough.

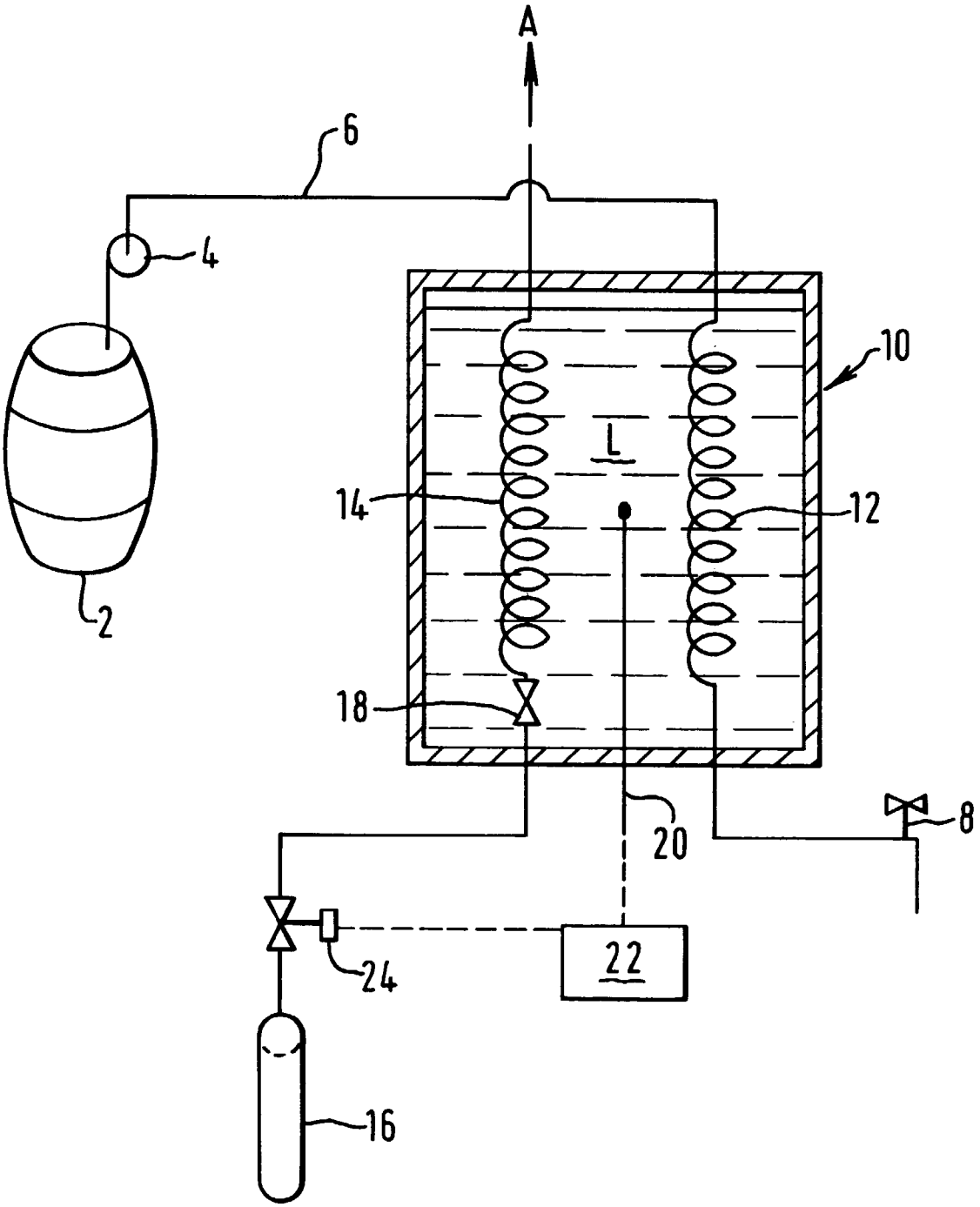
3. Apparatus according to Claim 2 in which the heat exchanger includes a liquid heat exchange medium.

4. Apparatus according to Claim 2 or Claim 3 in which the heat exchanger comprises means adapted to sense the temperature of the beverage and/or of the heat exchange medium, means being provided to actuate the flow of carbon dioxide whenever the sensed temperature(s) rise(s) above predetermined level(s).

5. Apparatus according to any preceding claim in which the beverage is dispensed through a tap connected by pipework to a source of beverage, in which the heat exchanger is connected to the pipework adjacent the tap and upstream thereof in relation to the flow of beverage.

6. Apparatus according to any preceding claim comprising a source of liquid carbon dioxide and a valve adapted to allow liquid carbon dioxide to expand in a controlled manner, the valve being located within the heat exchanger.

7. Apparatus according to any preceding claim in which the expanded carbon dioxide is allowed to pass through a liquid heat exchange medium within the heat exchanger before being vented to atmosphere.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EUROPEAN SEARCH REPORT

Application Number
EP 00 30 5488

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B67D
F25D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	2 October 2000	Deutsch, J.-P.

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00 30 5488

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82