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Europäisches Patentamt
European Patent Office
Office européen des brevets



11 Publication number:

0 364 009 B1

12

EUROPEAN PATENT SPECIFICATION

45 Date of publication of patent specification: **23.03.94** 51 Int. Cl.⁵: **F17C 9/00, B65B 31/00**

21 Application number: **89122730.8**

22 Date of filing: **30.01.89**

60 Publication number of the earlier application in accordance with Art.76 EPC: **0 331 287**

54 **Dispenser for dispensing cryogenic liquid.**

30 Priority: **29.02.88 GB 8804760**

43 Date of publication of application:
18.04.90 Bulletin 90/16

45 Publication of the grant of the patent:
23.03.94 Bulletin 94/12

64 Designated Contracting States:
AT BE CH DE ES FR GR IT LI LU NL SE

56 References cited:
US-A- 4 407 340
US-A- 4 469 304

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Description

This invention relates to a dispenser for dispensing slugs of cryogenic liquid to bottles or cans on a bottling or canning line and to a method for dispensing slugs of cryogenic liquid from such a dispenser.

In the canning and bottling industries it is common practice to insert a small quantity of liquid nitrogen into the cans or bottles immediately prior to closure. The liquid nitrogen vaporizes in the can or bottle and displaces air from the can or bottle before the closure is applied.

When filling cylindrical cans of uniform diameter it is quite convenient to dispense liquid nitrogen in a continuous spray since the percentage of liquid nitrogen wasted is relatively small. Such a method is disclosed in US-A-4 612 773. However, this technique is extremely wasteful for bottles having relatively small necks, for example beer bottles.

In order to introduce liquid nitrogen into beer bottles it has been proposed to drop a discrete quantity of liquid nitrogen into each beer bottle immediately prior to closure.

US-A-4 407 340 discloses a dispenser for dispensing slugs of cryogenic liquid to bottles or cans on a bottling or canning line, which dispenser comprises a vessel for holding cryogenic liquid, a dispenser tube mounted on said vessel, a valve associated with said dispenser tube and operable in use, to allow or inhibit the flow of cryogenic liquid from said vessel. In this dispenser the valve is opened and closed by a solenoid mounted on top of the vessel. This dispenser has two disadvantages, viz:-

1. Instead of discrete slugs or droplets of liquid nitrogen descending into the bottles from a dispenser the bottles have been assailed by a diverging cone of minute droplets only a tiny portion of which enter the bottle; and
2. Insofar as the output of the dispenser might be regarded as slugs, the maximum continuous output which can be achieved in practice is around 500 slugs/minute.

A solution to reduce the former problem is disclosed in our co-pending European Patent Application No. 89 300 891.2 (EP-A-0 331 287).

In order to help overcome the later problem the present invention provides a dispenser for dispensing slugs of cryogenic liquid to bottles or cans on a bottling or canning line, which dispenser comprises a vessel for holding cryogenic liquid, a dispenser tube mounted on said vessel, a valve associated with said dispenser tube and operable, in use, to allow or inhibit the flow of cryogenic liquid from said vessel, and means for opening and closing said valve, characterized in that said means for opening and closing said valve are wholly con-

tained within said vessel and are capable of opening and closing said valve at least 600 times per minute.

Preferably, said means for opening and closing said valve comprises a permanent magnet connected to said valve, and a coil circumjacent said permanent magnet and arranged to receive, in use, direct current.

In conventional dispensers a globule of liquid nitrogen remains in the dispenser tube after each injection due to surface tension. If the canning or bottling line is stopped for any reason part of the globule evaporates. The vapour thus formed collects between the valve and the globule and ejects the globule downwardly. If a can or bottle is below the dispenser tube at the time it thus receives more liquid nitrogen than intended. If the canning or bottling line is restarted soon after this happens the can or bottle can be sealed whilst it contains excess nitrogen. Because of the 700:1 volumetric expansion when liquid nitrogen evaporates this can be followed by the can or bottle closure being blown off or, in some cases, the can or bottle breaking or exploding.

In order to reduce this problem dispensers in accordance with the present invention are preferably provided with a gas relief tube which communicates with said dispenser tube between the valve and the outlet of the dispenser tube.

Preferably, said gas relief tube is arranged to relieve gas from said dispenser tube into said dispenser, preferably at a level which, when said dispenser is in use, is above the level of the cryogenic liquid in said vessel.

The present invention also provides a method for dispensing slugs of cryogenic liquid from a dispenser according to the invention, which method comprises the step of opening and closing said valve at least 600 times per minute.

Advantageously, said method includes the step of opening and closing said valve at a rate greater than 1000 cycles per minute.

For a better understanding of the present invention reference will now be made, by way of example, to the accompanying drawing which is a diagrammatic vertical section through a dispenser for dispensing cryogenic liquid in accordance with the invention.

Referring to the drawing, there is shown a dispenser which is generally identified by reference numeral 1.

The dispenser 1 comprises a vacuum insulated vessel 2. An inlet conduit or pipe 3 extends downwardly through the vacuum insulated vessel 2 to a float valve 4. A vent pipe 5 extends upwardly from the vacuum insulated vessel 2 and is provided with a sensor 6 which is arranged to close safety valve 7 in pipe 3 if liquid is detected in the vent pipe 5.

A dispenser head 8 is mounted on the bottom of the vacuum insulated vessel 2. The dispenser head 8 is provided with a central bore 9 which is disposed circumjacent and in intimate thermal contact with a dispenser tube 10 which extends downwardly from the inside of the vacuum insulated vessel 2.

The dispenser head 8 is provided with a heater 11 which can be connected to a source of electric power via wires 12 and 13.

The upper end of the dispenser tube 10 can be opened or closed by means of a tapered valve 14 which is biased downwardly by a spring 15. The tapered valve member 14 is connected to a permanent magnet 16 disposed in a coil 17 which, when actuated by a DC current in one sense, raises the tapered valve member 14 to open the upper end of the dispenser tube 10. When the DC field is reversed the tapered valve member 14 is driven down. This arrangement gives positive control compared with the solenoid and spring arrangement of the prior art which relies on the spring to close the valve.

A gas relief tube 18 extends from a position in the dispenser tube 10 between the tapered valve member 14 and the outlet of the dispenser tube 10 and opens in the vacuum insulated vessel 2 above the float valve 4.

In use, safety valve 7 is opened and liquid nitrogen flows into the interior of the vacuum insulated vessel 2 through pipe 3 until it reaches level 19 when the float valve 4 closes. Vapour leaves the vacuum insulated vessel 2 via the vent pipe 5.

Power is applied to heater 11 to warm the dispenser head 8.

When a slug of nitrogen is required a DC current is applied in the appropriate sense to coil 17 thereby raising permanent magnet 16 against the bias of spring 15. Liquid nitrogen then enters the top of dispenser tube 10.

The heater 11 transmits sufficient heat such that a film of gas is formed on the inner surface of the dispenser tube 10. This acts as an insulating and lubricating barrier which permits individual slugs of liquid nitrogen to pass downwardly through the dispenser tube 10. The liquid nitrogen emerges from the bottom of the dispenser tube 10 in the form of slugs of liquid with negligible or little dispersion compared with the prior art. Vapour in the dispenser tube 10 rises through the gas relief tube 18 into the vacuum insulated vessel 2 and thence to vent pipe 5.

Clearly the power input to the heater 11 depends on the frequency with which the coil 17 is actuated and the volume of liquid nitrogen being released with each operation.

In order to set up the equipment correctly the coil 17 is first operated at the desired frequency with the level of liquid nitrogen in the vacuum insulated vessel 2 being maintained substantially constant by float valve 4.

At first the nitrogen leaves the bottom of the dispenser tube 10 in the form of a diffuse atomized cone, i.e., in the form common to the prior art. Power is then applied to heater 11 slowly to allow for the heat capacity of the dispenser head 8.

As the power increases the volume of the spray appears to decrease. However, beyond a certain point the discharge turns into a stream of discrete slugs of liquid nitrogen which fall vertically downwardly like droplets of water. These slugs can be directed into the necks of beer bottles and the like with little or no difficulty. Furthermore, work with a prototype according to the invention suggests that a single dispenser may be capable of delivering discrete slugs of liquid nitrogen to as many as 2000 bottles per minute on a high speed bottling line.

As a by-product of the heater 11 ice does not accumulate on the base of the dispenser head 8. In this connection it should be noted that heaters have previously been used to prevent ice accumulating on the base of dispenser heads (see UK 2 091 228A). However, in such arrangements special arrangements have been made to ensure that the dispensing tube is kept cold, in particular by passing cold nitrogen vapour circumjacent the dispensing tube in the aforesaid patent specification and positioning the dispensing tube well away from the base. It should also be noted that the aforesaid specification discloses the use of a separate heater for removing ice from the dispenser during shut-down. However, it is explained that this heater is deactivated during start-up, i.e., it is not used whilst the dispenser is dispensing liquid.

Example:-

Liquid nitrogen slugs having an average volume of 0.037 cc were dispensed at a rate of 600 slugs/minute through a dispenser tube made of brass and having a nominal external diameter of 5 mm and a nominal internal diameter of 3 mm. The dispenser head 8 was made from high purity copper.

At equilibrium the heater 11 consumed 32 watts of power.

Claims

1. A dispenser (1) for dispensing slugs of cryogenic liquid to bottles or cans on a bottling or canning line, which dispenser comprises a vessel (2) for holding cryogenic liquid, a dispenser

tube (10) mounted on said vessel (2), a valve (14) associated with said dispenser tube (10) and operable, in use, to allow or inhibit the flow of cryogenic liquid from said vessel (2), and means (16,17) for opening and closing said valve, characterized in that said means (16,17) for opening and closing said valve (14) are wholly contained within said vessel (2) and are capable of opening and closing said valve (14) at least 600 cycles per minute.

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2. A dispenser as claimed in Claim 1, characterized in that said means (16,17) for opening and closing said valve (14) comprises a magnet (16) connected to said valve (14), and a coil (17) circumjacent said permanent magnet (16) and arranged to receive, in use, direct current.

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3. A dispenser as claimed in Claim 1 or 2, characterized in that a gas relief tube (18) is provided which communicates with said dispenser tube (10) between said valve (14) and the outlet of said dispenser tube (10).

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4. A dispenser as claimed in Claim 3, characterized in that said gas relief tube (18) is arranged to relieve gas from said dispenser tube (10) into said vessel (1).

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5. A dispenser as claimed in Claim 4, characterized in that said gas relief tube (18) is arranged to relieve gas from said dispenser tube (10) into said dispenser (1) at a level which, when said dispenser (1) is in use, is above the level of the cryogenic liquid in said vessel (2).

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6. A method for dispensing slugs of cryogenic liquid from a dispenser according to any preceding Claim, characterized in that said method comprises the step of opening and closing said valve (14) at least 600 times per minute.

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7. A method according to Claim 6, characterized in that it includes the step of opening and closing said valve (14) at a rate greater than 1000 cycles per minute.

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Patentansprüche

1. Ausgabegerät (1) zum Zapfen dosierter Mengen eines Tieftemperaturfluids in Flaschen oder Dosen auf einer Abfüllstrecke für Flaschen oder Dosen, wobei dieses Ausgabegerät ein Gefäß (2) zur Aufnahme des Tieftemperaturfluids, eine Ausgabeleitung (10), die auf diesem Gefäß (2) angebracht ist, ein Ventil (14), das mit dieser Ausgabeleitung (10) verbunden ist und bei Verwendung betätigt werden kann,

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um den Strom des Tieftemperaturfluids aus dem Gefäß (2) zu gestatten oder zu unterbinden, und eine Einrichtung (16, 17) umfaßt, um dieses Ventil zu öffnen und zu schließen, dadurch gekennzeichnet, daß diese Einrichtung (16, 17) zum Öffnen und Schließen des Ventils (14) vollkommen innerhalb des Gefäßes (2) enthalten ist, und das Ventil (14) mit mindestens 600 Zyklen pro Minute öffnen und schließen kann.

2. Ausgabegerät nach Anspruch 1, dadurch gekennzeichnet, daß die Einrichtung (16, 17) zum Öffnen und Schließen des Ventils (14) einen Magnet (16), der mit dem Ventil (14) verbunden ist, und eine Spule (17) umfaßt, die den Dauermagnet (16) umgibt und so angeordnet ist, daß sie bei Verwendung Gleichstrom empfängt.

3. Ausgabegerät nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß eine Gasüberdruckleitung (18) vorgesehen ist, die zwischen dem Ventil (14) und dem Auslaß der Ausgabeleitung (10) mit dieser Ausgabeleitung (10) in Verbindung steht.

4. Ausgabegerät nach Anspruch 3, dadurch gekennzeichnet, daß die Gasüberdruckleitung (18) so angeordnet ist, daß sie das Gas aus der Ausgabeleitung (10) in das Gefäß (1) entspannt.

5. Ausgabegerät nach Anspruch 4, dadurch gekennzeichnet, daß die Gasüberdruckleitung (18) so angeordnet ist, daß sie das Gas aus der Ausgabeleitung (10) an einem Niveau in das Ausgabegerät (1) entspannt, das bei Verwendung dieses Ausgabegerätes (1) oberhalb des Niveaus des Tieftemperaturfluids im Gefäß (2) liegt.

6. Verfahren zum Zapfen dosierter Mengen eines Tieftemperaturfluids aus einem Ausgabegerät nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß dieses Verfahren mindestens 600 mal pro Minute den Schritt des Öffnens und Schließens des Ventils (14) umfaßt.

7. Verfahren nach Anspruch 6, dadurch gekennzeichnet, daß es den Schritt des Öffnens und Schließens des Ventils (14) mit einer Geschwindigkeit von mehr 1000 Zyklen pro Minute umfaßt.

Revendications

1. Appareil distributeur (1) pour délivrer des doses de liquide cryogénique dans des bouteilles ou des bidons sur une ligne de remplissage de bouteilles ou de bidons, lequel appareil distributeur comprend un récipient (2) pour renfermer un liquide cryogénique, un tube distributeur (10) monté sur ce récipient (2), une soupape (14) associée à ce tube distributeur (10) et apte à fonctionner, en cours d'utilisation, pour permettre ou empêcher l'écoulement du liquide cryogénique à partir du récipient (2) et des moyens (16, 17) pour ouvrir ou fermer ladite soupape, caractérisé en ce que les moyens (16, 17) pour ouvrir ou fermer la soupape (14) sont entièrement contenus à l'intérieur du récipient (2) et sont aptes à ouvrir et fermer la soupape (14) au moins 600 fois par minute.

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2. Appareil distributeur selon la revendication 1, caractérisé en ce que lesdits moyens (16, 17) pour ouvrir et fermer la soupape (14) comprennent un aimant (16) relié à la soupape (14) et une bobine (17) circonjacent audit aimant permanent (16) et agencée pour recevoir, en cours d'utilisation, un courant continu.

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3. Appareil distributeur selon la revendication 1 ou 2, caractérisé en ce qu'il est prévu un tube de détente de gaz (18) qui communique avec ledit tube distributeur (10) entre la soupape (14) et la sortie du tube distributeur (10).

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4. Appareil distributeur selon la revendication 3, caractérisé en ce que le tube de détente de gaz (10) est agencé pour décharger des gaz depuis le tube distributeur (10) dans le récipient (1).

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5. Appareil distributeur selon la revendication 4, caractérisé en ce que le tube de détente de gaz (18) est agencé pour décharger des gaz depuis le tube distributeur (10) dans l'appareil distributeur (1) à un niveau qui, lorsque ledit appareil distributeur (1) est en fonctionnement, est situé au-dessus du niveau du liquide cryogénique dans le récipient (2).

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6. Procédé pour délivrer des doses de liquide cryogénique à partir d'un appareil distributeur selon l'une quelconque des revendications précédentes, caractérisé en ce que ledit procédé comprend l'étape consistant à ouvrir et fermer la soupape (14) au moins 600 fois par minute.

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7. Procédé selon la revendication 6, caractérisé en ce qu'il comporte l'étape consistant à ouvrir et fermer la soupape (14) à une vitesse supérieure à 1000 fois par minute.

