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(54) Liquid dispenser flow regulator

(57) A flow regulator for a liquid nitrogen droplet dispenser comprises a region (R) adjacent the outlet (14) and means for creating a back pressure (P) with said region thereby to reduce or inhibit the flow of liquid through the outlet. A suitable source of pressurising gas is the "boil off" gas from a bulk liquid nitrogen vessel.

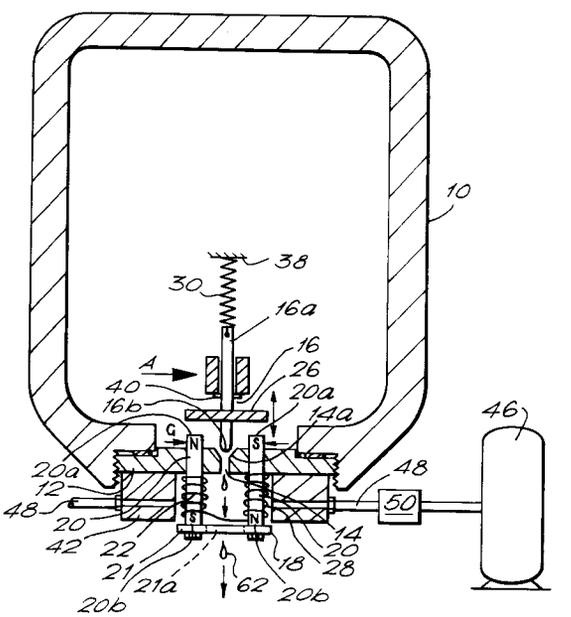

FIG.1.

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Description

The present invention relates to an apparatus for dispensing droplets of liquid and relates particularly, but not exclusively, to a flow regulator for an apparatus for dispensing droplets of cryogenic liquid, such as for example, liquid nitrogen.

Liquid gases are typically used in industry in bulk quantities and can thus be metered by conventional methods. On some occasions, however, a need arises for only a small quantity, for example, up to a few millilitres of liquified gas to be delivered. Such a need may arise when bottling a beverage. It is often desirable for the neck of each bottle to contain an atmosphere consisting essentially of a gas such as nitrogen that does not adversely affect the quality of the beverage. Moreover, even if nitrogen is not required for this reason, it has been found that in a closed plastic bottle or metal can containing a beverage, a partial vacuum can be created as a result of a reduction in temperature, which partial vacuum can cause a wall of the bottle or can to be sucked inwards, and accordingly filling the void space with a small volume of nitrogen (or other suitable gas) before fitting a closure to the bottle will guard against the creation of such a partial vacuum. The gas may also be used to pressurise the walls of a thin walled can thereby acting to increase its resistance to crushing.

Previous attempts to solve the problem of delivering or dispensing droplets of liquid nitrogen (or other liquified gas) include that described in GB2092552 in which an insulated tank of liquid nitrogen is provided with a valve on its inside bottom surface and an actuator on an outer upper surface thereof. The actuator is linked to the valve via a long rod such that, in operation, the valve is actuated whenever the rod is moved up and down. This arrangement whilst providing a perfectly adequate method of dispensing droplets does suffer from problems associated with temporary or long term line closedowns during which liquid cryogen can leak past the valve which can be unsafe, untidy, wasteful and could cause freezing of the conveyors. Icing, whilst not damaging the apparatus can cause problems during startup when the valve may stick or the ice may interrupt the smooth flow of liquid cryogen from the vessel, causing uneven or inaccurate amounts of liquid nitrogen to be dispensed.

It is an object of the present invention to provide a dispenser for dispensing drops of cryogenic liquid which reduces and possibly overcomes the problems associated with the above mentioned arrangement.

Accordingly, the present invention provides a dispenser for dispensing drops of cryogenic liquid comprising a vessel for holding a cryogenic liquid and having an outlet orifice for allowing liquid cryogen to drain from said vessel together with control means for controlling the flow of liquid cryogen from said vessel characterised in that said flow control means comprises means for back pressurising the liquid cryogen through said outlet thereby to reduce or inhibit the flow of cryogen from said outlet.

It will be appreciated that by back pressurising the liquid cryogen it will be possible to reduce the reliance on the mechanical valve and hence reduce and possibly eliminate the leakage associated therewith.

Preferably, the back pressurising means comprises a source of gas at higher pressure than any liquid cryogen at said outlet and in which said gas is directed at said outlet so as to affect said back pressurisation.

Advantageously, the back pressurising means includes a wall portion surrounding said outlet and acting to define a region in which said back pressure can be created.

In a particularly convenient arrangement, the means for back pressurising comprises gas generated as a result of the boil off of liquid cryogen.

In an even more convenient arrangement, the means for back pressurising comprises gas generated as a result of the boil off of liquid cryogen stored for potential use in said liquid dispenser.

Advantageously, said wall portion is formed by a ring surrounding said outlet and in which said back pressurising is generated within the inner portion thereof.

Preferably, the dispenser includes ducting means for transporting said back pressurising gas to a region adjacent said outlet.

Conveniently, the ducting means passes through said wall portion and/or said ring.

The present invention will now be more particularly described by way of example only with reference to the accompanying drawings, in which:

Figure 1 is a cross-sectional view of a liquid cryogen droplet dispenser and flow regulator according to the present invention; and

Figure 2 is a detailed cross sectional view of the dispenser and flow regulator taken in the direction of arrow A in Figure 1; and

Figure 3 is a schematic drawing illustrating part of a bottle or canning line fitted with an apparatus similar to that illustrated in Figure 1 or 2.

Referring now to Figure 1, a cryogenic vessel 10 includes a base portion 12 having an outlet orifice 14 for allowing liquid cryogen to drain from the vessel 10. A valve 16 associated with the outlet orifice and operable, in use, to allow or inhibit the flow of cryogenic liquid from the vessel 10 is positioned immediately above the base portion 12. The valve includes a low mass rod 16a made from, for example, aluminium and having a rounded end 16b for engagement in a tapered portion 14a of orifice 14. A magnetic device such as, for example, an electromagnetic device 18 is positioned wholly outside the vessel 10 but acts to generate a magnetic force within the vessel 10 capable of causing said valve 16 to move between open and closed positions.

The actuator 18 may comprise any one of a number

of well known magnetic field generators but most conveniently comprises a multiple coil and core arrangement similar to that shown in Figure 1. The double core arrangements, comprise two cores 20 each having a proximal end 20a positioned sufficiently close to the valve portion so as to enable any magnetic field generated thereat to act upon a magnetic portion 26 of valve 16. The distal ends 20b of the rods 20 are connected via a simple magnetic ring 21 having a hole 21a through which, in operation, drops of liquid cryogen pass. Conveniently, the two coils 22, 28 may be wound in opposite directions so as to produce differing polarities at their proximal ends. In such an arrangement, the magnetic portion 26 need have no magnetism of its own and may simply comprise a steel portion. The magnetic portion 26 simply acting to bridge the gap G between the core ends 20a so as to complete the magnetic circuit whenever the coils are energised. A spring 30 and guide arrangement 32 is provided so as to bias the valve towards an opened position and guide the valve when in operation. Conveniently, the guide 32 and spring 30 are mounted on a frame 34 comprising a pair of uprights 36 having the guide 32 and an anchor point 38 for the spring mounted thereon. a pin 40 acts to limit valve travel.

Operation of the dispenser is achieved by applying a D.C. current to coils 22, 24 so as to generate a magnetic field adjacent the proximal end(s) of core(s) 20. The magnetic field acts to attract (or repel in appropriate arrangements) the magnet 24 or magnetic portion 26 of valve 16 thereby drawing the rounded end of rod portion towards a closed position in it acts to obturate the tapered portion 14a of outlet orifice 14. As soon as the current is turned off, spring 30 acts to retract the rod 16 and allow liquid cryogen to pass through orifice 14. By simply turning the current on and off, it is possible to initiate control over the valve so as to allow or inhibit the flow of cryogen from the vessel 10. The faster the rate of switching the higher the number of drops of cryogen per minute. Operation at over 1800 cycles per minute is possible. Clearly, one could use an A.C. current so as to electromagnetically drive the valve between open and closed positions. In such an arrangement one need only vary the frequency of the current in order to control the speed of the valve operation.

Features of the present invention are best seen towards the bottom of Figures 1 and 2 and comprises a ring 42 secured to base plate 12 by screws (not shown) and surrounding outlet 14. The inner surface 44 of ring 42 effectively acts to define a wall portion which forms the boundary of a region R in which a back pressure P can be generated. A suitable source of gas can be found in the vessel 46 used to store liquid cryogen for eventual use in the above mentioned dispensing apparatus. Such a vessel 46 could comprise an on site liquid nitrogen tank for supplying nitrogen in liquid or gas phase to any one of a number of on site apparatus. Typically, such vessels vent "boil off" gas to atmosphere and it is this, otherwise wasted, gas which is used in the present arrangement.

Referring once again to Figures 1 and 2, one or more supply ducts 48 act to transport "boil off" gas through ring 42 and vent it in region R where it acts to back pressurise the outlet 14 and, if the pressure is sufficiently high, effectively block the flow of liquid cryogen from the vessel 10. Flow and/or pressure control means shown schematically at 50 may be provided for regulating the back pressure within region R. Clearly, a number of different arrangements of the present invention will present themselves to a person skilled in the art. Fore example, the pressurising gas may be drawn from the factory compressed air supply or from any other suitable bottled or piped source.

Whilst the amount of back pressure required to hold back a quantity of liquid is very much dependant upon the liquid head and outlet size it has been found that 15 psi is sufficient to hold back 60 mm of liquid nitrogen when positioned above a 6 mm diameter outlet 14.

Turning now to Figure 3, it will be seen that vessel 10 is positioned above a bottle or canning line 60 such that, in operation, droplets 62 of dispensed cryogen (eg nitrogen) may be dispensed directly into the opening 63 in a bottle or can 64 positioned thereunder. An optical or mechanical sensor 66 acts to detect the presence of a can or bottle and sends a signal to control panel 68 which initiates operation of actuator 18 as and when desired. A bulk source of liquid cryogen is provided for ensuring an adequate liquid level is maintained in vessel 10.

The present invention is generally operated during short or long term line stoppages during which it is necessary to ensure liquid cryogen does not leak past the valve and cause ice to form near the outlet or on superstructure beneath the dispenser. It may be necessary to provide some form of extraction system to ensure any back pressure gas is adequately vented. Start up of the dispenser is simply achieved by first stopping the flow of back pressurising gas and then initiating control valve 16. Upon close down, the back pressurising gas is directed towards the outlet 14 and effectively acts to hold back the liquid cryogen.

Claims

1. A dispenser for dispensing drops of cryogenic liquid comprises a vessel (10) for holding a cryogenic liquid and having an outlet orifice (14) for allowing liquid cryogen to drain from said vessel (10) and control means for controlling the flow of liquid cryogen from said vessel characterised in that said flow control means (50) comprises means for back pressurising the liquid cryogen through said outlet (14) thereby to reduce or inhibit the flow of cryogen from said outlet (14).

2. A dispenser as claimed in Claim 1 characterised in that said back pressurising means (50) comprises a source of gas at higher pressure (P) than any liquid

cryogen at said outlet (14) and in which said gas is directed at said outlet (14) so as to affect said back pressurisation.

3. A dispenser as claimed in Claim 1 or Claim 2 characterised in that said back pressurising means includes a wall portion (44) surrounding said outlet (14) and acting to define a region (R) in which said back pressure (P) can be created.

4. A dispenser as claimed in an one of Claims 1 to 3 characterised in that the means for back pressurising (50) comprises gas generated as a result of the boil off of liquid cryogen.

5. A dispenser as claimed in any one of Claims 1 to 3 characterised in that the means for back pressurising (50) comprises gas generated as a result of the boil off of liquid cryogen stored for potential use in said liquid dispenser.

6. A dispenser as claimed in any one of Claims 3 to 5 characterised in that said wall portion (44) is formed by a ring (42) surrounding said outlet (14) and in which said back pressurising is generated within the inner portion thereof.

7. A dispenser as claimed in any one of Claims 2 to 6 characterised by ducting means (48) for transporting said back pressurising gas to a region adjacent said outlet (14).

8. A dispenser as claimed in Claim 7 when dependant upon any one of Claims 3 to 6 characterised in that said ducting means (48) passes through said wall portion (44) and/or said ring (42).

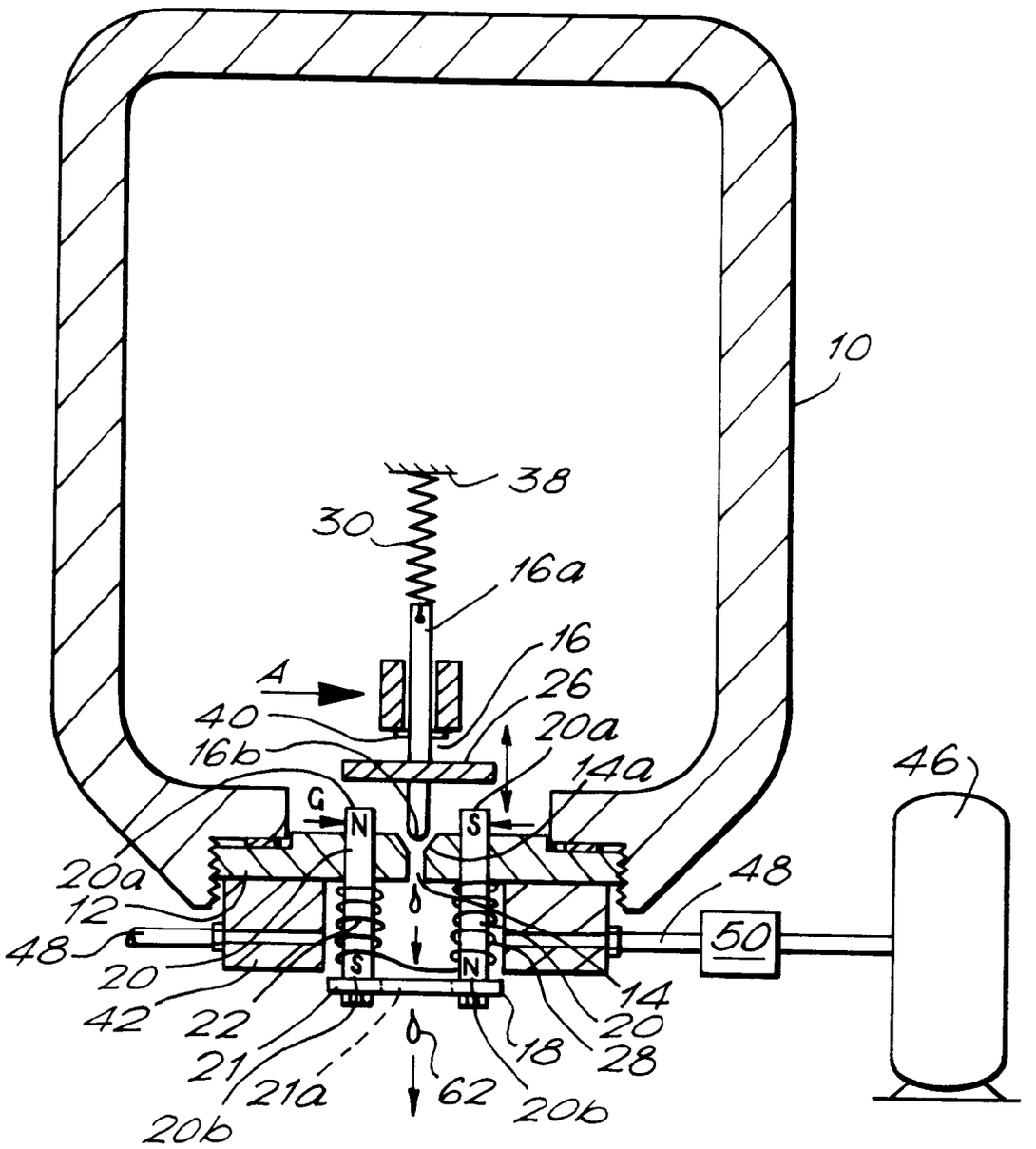
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FIG.1.

FIG. 2.

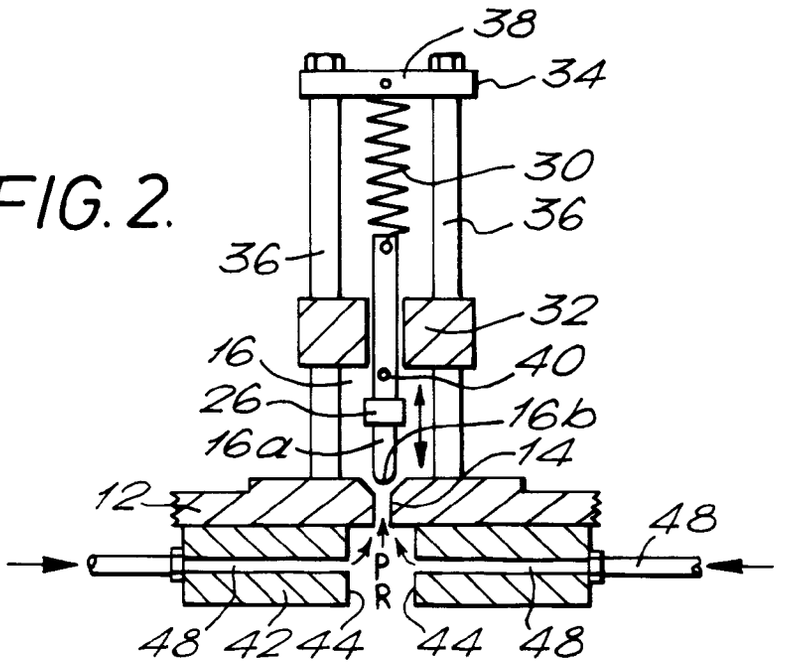
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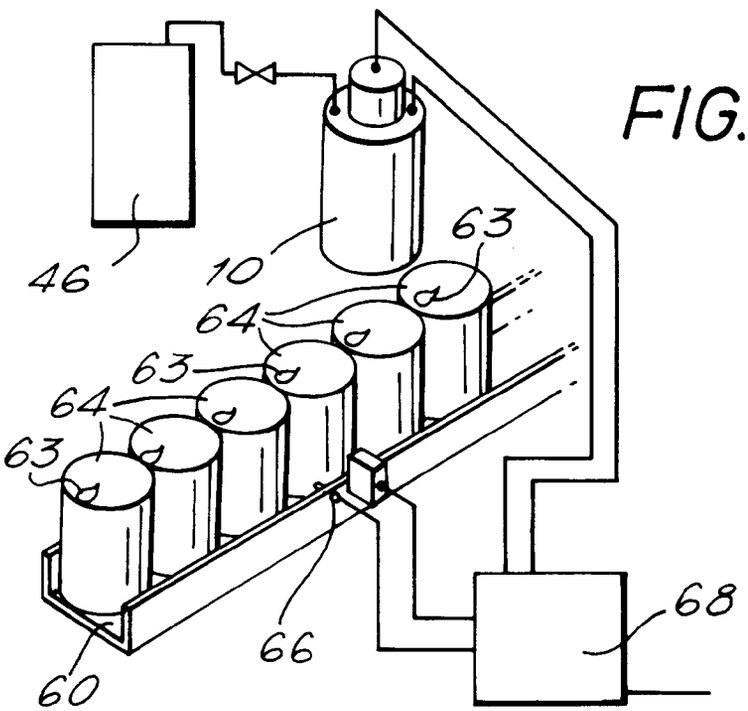
FIG. 3.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EUROPEAN SEARCH REPORT

Application Number
EP 95 30 5229

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)
X	EP-A-0 421 597 (ARTHUR GUINNESS SON & COMPANY (DUBLIN) LTD) * abstract * * column 3, line 53 - column 4, line 38 * * column 6, line 29 - column 9, line 48 * * claims 1,10,11 * * figure *	1-4,7,8	B65B31/00 F17C9/00
A	---	5	
X,P	US-A-5 385 025 (MG INDUSTRIES) 31 January 1995 * abstract * * figure * * column 1, line 65 - column 2, line 27 * * column 2, line 55 - column 4, line 29 * -----	1-8	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F17C
B65B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30 October 1995	Siem, T

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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