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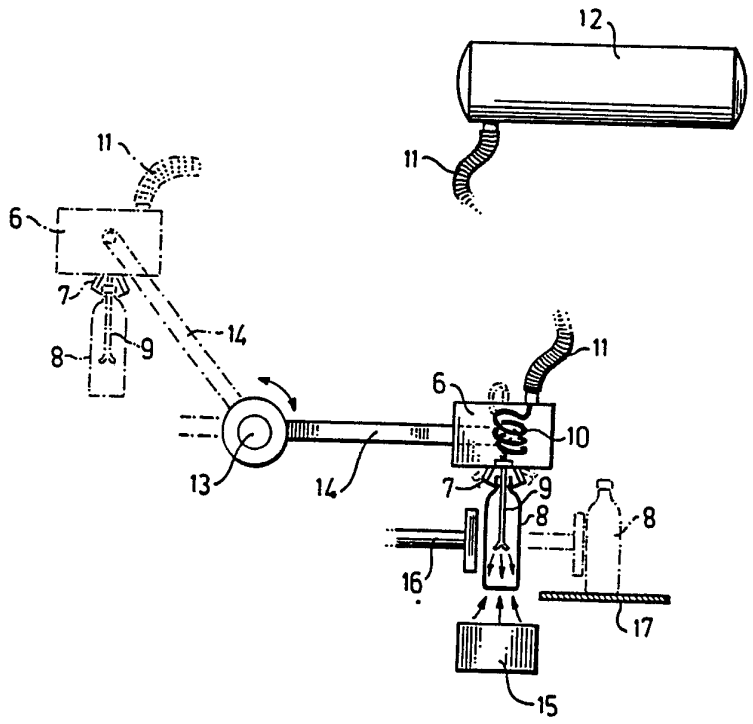

(57) Abstract

A method in the manufacture of hollow glass objects, such as bottles and jars, with the aid of at least one mould arrangement. According to the method, each object (8) is cooled externally and internally with the aid of a cooling fluid, subsequent to removing the object from the mould (5) and prior to placing the object for transportation to a cooling chamber or the like. The object is cooled internally by introducing a condensed gas, such as condensed carbon dioxide or condensed nitrogen, into the cavity of the object (8). The condensed gas vapourizes in the cavity while cooling the glass. The invention also relates to apparatus for carrying out the method.

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A Method and Apparatus for Use in the Manufacture of Hollow Glass Objects

The present invention relates to a method in the manufacture of hollow glass objects, such as glass bottles and jars, with the aid of at least one mould arrangement, in which subsequent to being removed from the mould, but prior to being placed in position for transportation to a cooling chamber or the like, each object is cooled, both externally and internally, with the aid of a fluid coolant. The invention also relates to apparatus for use when carrying out the method.

The manufacture of, for instance, glass bottles is typically effected in two stages, the neck of the bottle being formed in the first stage and the final bottle shape being achieved in the second stage, by blowing in a two-part mould. The bottle is removed from the mould with the aid of an arm-carried gripping device which grips around the neck of the bottle, so that the bottle hangs vertically from said arm.

The U.S. Patent No. 4 553 999, which is assigned to applicant in the present case, teaches a method and apparatus in which a glass bottle is formed and then cooled with the use of cryogen gas while the bottle is still located in the finishing mould.

In the manufacture of glass bottles in so-called IS-machines, the finished bottle is lifted from the mould and suspended for some seconds above an upwardly streaming air flow, so as to cool the bottle externally, and particularly so as to stablize the bottom of the bottle prior to placing the bottle onto a conveyor belt for transportation to a cooling chamber. The temperature of

the molten glass during bottle manufacture is about 1100-1200°C , and it is necessary to cool the formed bottle to a temperature of about 600°C before it can be placed on the conveyor belt. If the bottle is not cooled down to this temperature, there is a risk that the bottle will be deformed, and particularly that the lower part of the bottle will become crooked or warped in relation to the remainder of the bottle. Since the glass is thickest at the bottom of the bottle, it is necessary to cool the bottom of the bottle very effectively. This is achieved externally with the aid of the aforesaid upwardly moving airflow. It is necessary to adapt the production rate of the machine concerned so that requisite cooling can be achieved prior to placing the bottle in position for further transportation.

EP-A2-0 071 825 describes a glass bottle manufacturing machine, in which the glass bottles are cooled internally to some extent with the aid of air or or some other gas. According to the descriptive part of this prior specification, air is sprayed into the bottle through a nozzle positioned above the mouth of the bottle. This method, however, cannot result in effective cooling of the bottle, particularly the bottom of the bottle, since the temperature of the air used is the same as ambient temperature and since the air is passed freely through the same narrow opening as that through which the return air exits. It should be noted that the pressure under which the air can be sprayed into the bottle is limited by the risk of further blowing the bottle and the risk of deforming the readily de-formable bottle.

A primary object of the present invention is to provide a method by means of which the interior of a bottle and

the bottom of said bottle can be cooled much more effectively than was hitherto the case, without risk of deforming the bottom of the bottle. This will enable the production rate to be increased and/or the quality of the finished product to be improved.

Another object is to provide apparatus for use when carrying out the method.

The primary object of the present invention is achieved by introducing a liquefied gas into the interior of the hollow glass object, where the liquefied gas vapourizes while taking-up heat from the glass. The gas used must be chosen so that the pressure within the bottle or object will not increase to any appreciable extent. Furthermore, the gas will preferably have a high thermal capacity, so that a small volume of gas will provide effective cooling of the object.

In accordance with the invention, a method of the kind defined in the first paragraph of the description and which fulfills the aforesaid requirements is particularly characterized in that internal cooling of the hollow glass object is effected by introducing a condensed gas, such as condensed carbon dioxide or nitrogen, into the hollow of said object, where said condensed gas vapourizes while cooling the glass.

Preferably, the fluid coolant used is liquid carbon dioxide, of which at least a part first converts to a solid state and then vapourizes, and that the carbon dioxide is sprayed through a probe which is configured with at least one fluid passageway and which is introduced into the hollow of the glass object to a depth such as to achieve internal cooling of the bottom part

of said object. To achieve the best cooling effect, the carbon dioxide is sprayed in mutually different directions over the bottom of the object.

The use of carbon dioxide is highly beneficial, since it can be introduced, for instance, at a pressure of about 15 bars, which signifies a temperature of about -40° C. When the condensed carbon dioxide is sprayed into the bottle, in which atmospheric pressure prevails, the solid phase obtained, i.e. carbon-dioxide snow, has a lower temperature of about -76° C, which affords an effective cooling action, since the amount of energy required to vapourize the carbon-dioxide snow is very high per unit of weight.

In accordance with one preferred embodiment of the inventive method, the probe is inserted into the cavity of said object while moving the object from the mould to a position in which external cooling of the bottom of the object takes place, therewith to increase the production rate.

The particular characteric features of apparatus for use when carrying out the method are set forth in the following apparatus Claims.

The invention will now be described in more detail with reference to the accompanying drawings.

Figure 1 illustrates schematically the two first stages of a conventional bottle manufacturing process.

Figure 2 illustrates schematically the inventive apparatus for cooling a bottle manufactured in accordance with Figure 1, with the aid of a liquid carbon dioxide

coolant.

Figure 3 illustrates in larger scale a probe included in the apparatus of Figure 2.

In Figure 1, the reference numeral 1 identifies a bottle blank moulded from molten glass introduced into a first mould. The bottle blank 1 is formed in an upside-down position and is held firmly by its neck, even when the mould (not shown) has been removed. The bottle blank 1 is transferred to a separatable finishing mould 5, with the aid of an arm 4 pivotally mounted on a pivot shaft 3. The bottle blank is blown to its final bottle form in the finishing mould. The finishing mould is then opened and the bottle is gripped around its neck and transferred to a cooling chamber, where the bottle is cooled.

In accordance with the invention, apparatus according to Figure 2 is used for transferring the finished bottle from the mould 5 to the cooling chamber (not shown). The illustrated apparatus comprises a box 6 which, among other things, supports gripping means 7 for coaction with a finished bottle 8. The box 6 also carries a probe 9 which can be inserted down into a bottle gripped by the gripping means 7. The probe 9 is connected to a flexible, low-temperature hose 10 so as to permit the requisite vertical movement of the probe. The end of the hose 10 distal from the probe 9 is connected to an insulated supply hose 11 which leads from a carbon-dioxide container 12 and which is also flexible so as to permit the box 6 to move.

The box 6 is carried by an arm 14 which is pivotally mounted on a pivot shaft 13 and which is operative to move the box 6 between a collecting position and a

cooling and laying-off position.

The illustrated embodiment of apparatus for transferring and cooling a bottle operates in the following manner. When a bottle 8 has been blown to its final form in the finishing mould 5, th box 6 is lowered towards the bottle, so that the gripping means 7 are able to grip around the neck of the bottle. At the same time, the probe 9 is lowered comparatively deeply into the bottle 8. A valve (not shown) is then opened, so that liquid carbon dioxide will flow from the container 12 into the interior of the bottle, through the probe 9, at the same time as the bottle is being transferred by means of the arm 4 to the laying-off position shown in full lines in Figure 2, in which position the bottle 8 hangs above a nozzle means 15 which functions to blow cooling air onto the outer surfaces of the bottom of the bottle. The bottle is held in this position for some seconds, whereafter the bottle 8 is moved, e.g. with the aid of a pusher 16, to a conveyor belt 17 which transports the bottle to a cooling chamber (not shown).

As will be seen from the enlarged view of Figure 3, the probe 9 of the illustrated embodiment includes four separate passageways, suitably in the form of separate pipes 18 of small dimensions in order to maintain a low outlet pressure and therewith avoid blowing the bottle to a larger sixe and deforming the bottle. The lower parts of the pipes 18 are bent outwards, so as to achieve effective spreading of the carbon dioxide over the bottom of the bottle.

As mentioned in the aforegoing, the use of carbon

dioxide as a coolant is highly advantageous, since carbon dioxide can be introduced at relatively low temperatures at a manageable pressure, and also since when carbon dioxide is sprayed into the bottle in which atmospheric pressure prevails, part of the carbon dioxide will convert to carbon-dioxide snow which has a lower temperature than the carbon dioxide supplied. Consequently, there is obtained in the bottle interior a temperature which is lower than the temperature for which the conduits and components used to supply carbon dioxide to the bottle need to be adapted, this lower temperature providing more effective cooling of the bottle interior.

By way of example, it can be mentioned that liquid carbon dioxide can be supplied at a temperature of about -40°C and a pressure of 15 bars. Conversion of the liquid carbon dioxide to carbon dioxide snow, or dry ice, inside the bottle lowers the temperature to about -76°C, which results in highly effective cooling of the bottle interior. Carbon dioxide snow also has a very high thermal capacity and it can be mentioned by way of example that 199 kJ are consumed when fuming-off 1 kg of liquid nitrogen at atmospheric pressure, whereas 573 kJ are consumed when fuming-off 1 kg of carbon dioxide snow. In addition to the aforesaid technical advantages, the use of carbon dioxide also affords considerable advantages from a cost aspect.

When using a probe of the illustrated configuration with the outlet orifices of the probe positioned at an appropriate distance from the bottom of the bottle, the carbon dioxide snow that forms within the bottle will be vapourized and depart in vapour or gas form before it reaches the bottom of the bottle. The increase in

pressure in the bottle will be extremely moderate, will not exceed about 0.02 bar, and consequently there is no risk of the bottle being deformed.

In trials in which the aforedescribed method was applied, carbon dioxide was introduced into a bottle for a period of about 4 seconds. It was found that the temperature of the bottom of the bottle was lowered additionally by about 30°C, which was highly advantageous, since hardening of the glass mass, and therewith the stability of the bottle, increases rapidly with lowered temperatures within the range of interest. This enables the production rate and/or the bottle quality to be further improved. A contributory factory in this regard is that the interior of the bottle can be cooled while moving the bottle from the finishing mould 5 to the laying-off position, thereby affording an additional cooling time of about 4 seconds. The fact that internal cooling of the bottle commences prior to the bottle reaching the laying-off position enables the bottle to be hung above the nozzles for external cooling of the bottom of the bottle for a shorter period than normal.

In the aforegoing, the invention has been described with reference to the exemplifying embodiment illustrated in the drawing, where carbon dioxide is used as the cooling agent. Cooling can also be effected advantageously with other cryogen gases, such as condensed nitrogen, while obtaining several of the aforementioned advantages. Other variations and modifications can also be made within the scope of the following Claims. For example, the means for gripping and moving the bottle may have a form different to that shown, as can also the means by which condensed gas is supplied to the

bottle. The only essential criterion in this respect is that the condensed gas can be introduced into the bottle effectively, so as to cool the internal surfaces of the bottle and particularly the bottom part thereof immediately the bottle has been formed, although without extending the time in the finishing mould.

CLAIMS

1. A method in the manufacture of hollow glass objects, such as glass bottles and jars, with the aid of at least one mould arrangement,in which each object is cooled with the aid of a fluid both externally and internally subsequent to removing said object from the mould and prior to placing said object for transportation to a cooling chamber or the like, c h a r a c t e r i z e d by introducing into the cavity of said object a condensed gas, such as condensed carbon dioxide or condensed nitrogen, and permitting said condensed gas to vapourize while cooling the glass internally of said object.

2. A method according to Claim 1, c h a r a c t e r i z e d by using liquid carbon dioxide as the cooling fluid, of which at least a part first converts to a solid state and then to a gaseous state; and by injecting the carbon dioxide into said cavity through a probe which is configured with at least one fluid passageway, said probe being introduced into said cavity to a depth such as to primarily achieve internal cooling of the bottom of said object.

3. A method according to Claim 2, c h a r a c t e r i z e d by injecting carbon dioxide through a plurality of small openings directed in mutually different directions over the bottom of the object.

4. A method according to Claim 2 or 3, c h a r a c t e r i z e d by introducing the probe into the cavity of said object while moving the object from the mould to a position in which external cooling of the bottom of said object takes place.

5. Apparatus for use when manufacturing hollow glass objects, such as glass bottles and jars, comprising at least one mould arrangement (5) for the objects intended, said apparatus further including means (9-12; 15) for cooling each object (8) both externally and internally with the aid of a fluid subsequent to removing said object from the mould but prior to placing said object for transportation to a cooling chamber or the like, c h a r a c t e r i z e d in that the internal cooling means include devices (9-12) for introducing a condensed gas, such as carbon dioxide or nitrogen, into the cavity of the object (8), where the condensed gas vapourizes while cooling the glass.

6. Apparatus according to Claim 5, c h a r a c t e r i z e d by a probe (9) which incorporates at least one fluid passageway and which is intended to be inserted into the cavity of said object to a depth such as to primarily achieve internal cooling of the bottom of the object (8).

7. Apparatus according to Claim 6, c h a r a c t e r i z e d in that the probe includes a plurality of fluid passageways (18), the outlet orifices of which face in mutually different directions over the bottom of the object (8).

8. Apparatus according to Claim 7, c h a r a c t e r i z e d in that the outlet orifices of said passageways exhibit a small throughflow area.

9. Apparatus according to any one of Clainms 6-8, c h a r a c t e r i z e d by means for introducing the probe (9) into the cavity of said object while moving

the object (8) from the mould (5) to a position in which external cooling of the bottom of the object takes place.

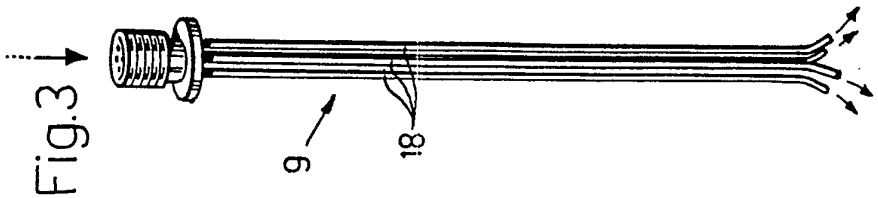


Fig.3

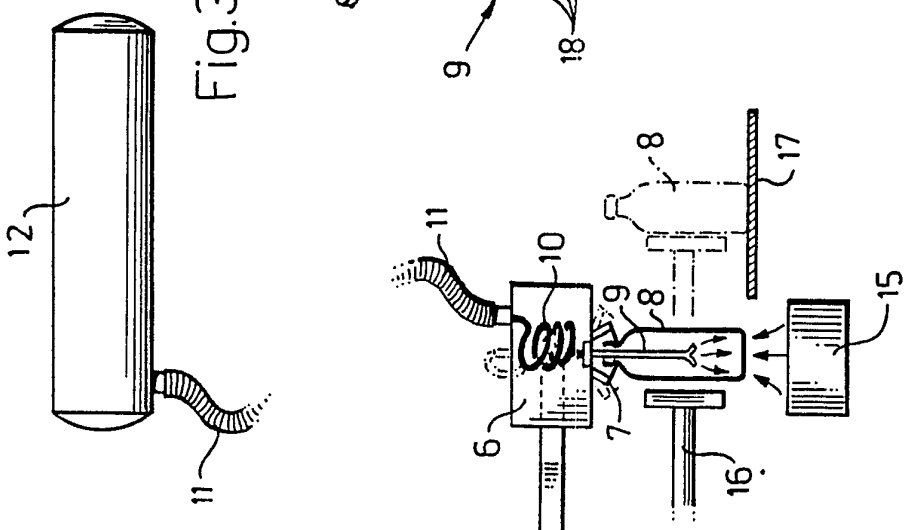
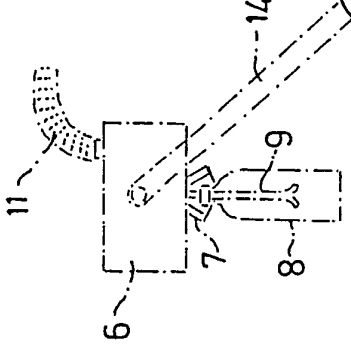


Fig.2



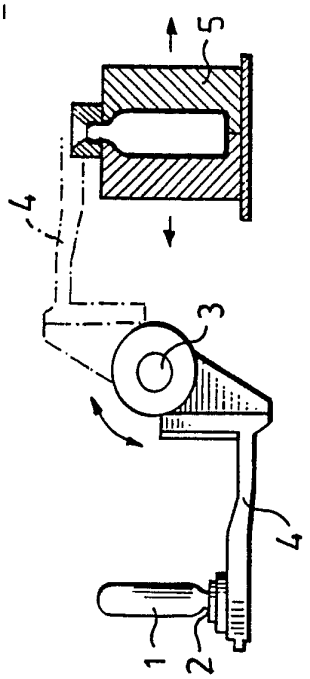


Fig.1

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 90/00531

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: C 03 B 9/16, 9/44

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	C 03 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	SE, B, 407179 (AGA AB) 19 March 1979, see the whole document --	1-9
A	US, A, 3929442 (JAMES E. NEELY, JR) 30 December 1975, see the whole document --	1-9

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* Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
5th November 1990	1990 -11- 07
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	May Hallne May Hallne

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/SE 90/00531

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on 90-09-27
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
SE-B- 407179	79-03-19	CH-A- 616875	80-04-30
		DE-A- 2729093	78-07-27
		SE-A- 7700727	78-07-26
US-A- 3929442	75-12-30	NONE	