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(54) **METHOD AND DEVICE FOR COOLING PRODUCTS**

(57) Method for cooling products (3) comprising conveying the products (3) through a cooling chamber (2), wherein an inlet airlock (7) is situated at a product inlet (5) of the cooling chamber (2) and/or an outlet airlock (8) is situated at a product outlet (6) of the cooling chamber (2), and wherein a gaseous medium is continuously provided into the inlet airlock (7) and/or into the outlet airlock (8).

With the described device (1) and with the described method products (3), in particular food products, can be cooled while being conveyed through the cooling chamber (2). Due to the inlet airlock (7) and the outlet airlock (8), which are provided with a gaseous medium, air from the environment of the cooling chamber (2) can be prevented from being sucked into the cooling chamber (2). Thereby, formation of ice within the cooling chamber (2) can be prevented and energy consumption can be reduced.

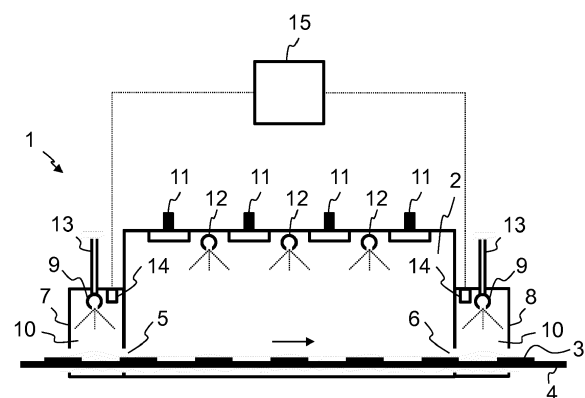


Fig. 1

Description

[0001] The present invention is directed to a method and a device for cooling products, in particular for freezing food products.

[0002] In industrial applications food products are commonly frozen by freezers, through which the products are conveyed. Therein, usually a cryogenic medium is introduced into a cooling chamber and circulated through the cooling chamber by means of fans. In order to allow the products to be conveyed through the cooling chamber as a continuous process, the cooling chamber must have a product inlet and the product outlet. Via the product inlet and/or via the product outlet air can be sucked into the cooling chamber from the environment of the cooling chamber. This can happen, in particular, if the amount of cryogenic medium supplied to the cooling chamber varies over time. If the momentary supply of the cryogenic medium is low, the pressure within the cooling chamber is correspondingly low such that air can enter the cooling chamber from the outside. This is even enhanced if fans are used to circulate the cryogenic medium within the cooling chamber.

[0003] Since air usually contains a substantial amount of water, air within the cooling chamber is disadvantageous. As soon as moist air enters the cooling chamber, the water component of the air can condense and freeze to form ice. Hence, frequent deicing of the cooling chamber may be required, which causes a respective downtime of the cooling chamber. Further, the temperature within the cooling chamber can be increased if warm environmental air is sucked into the cooling chamber. Thus, the products are not cooled as desired and/or an unnecessarily high amount of energy is required to achieve a desired product temperature.

[0004] It is, therefore, an object of the present invention to overcome at least in part the disadvantages known from prior art and, in particular, to provide a method and a device for cooling products with particularly low maintenance and particularly low energy consumption.

[0005] These objects are solved by the features of the independent claims. Dependent claims are directed to preferred embodiments of the present invention.

[0006] According to the present invention a method for cooling products is provided that comprises conveying the products through a cooling chamber. An inlet airlock is situated at a product inlet of the cooling chamber and/or an outlet airlock is situated at a product outlet of the cooling chamber. A gaseous medium is continuously provided into the inlet airlock and/or into the outlet airlock.

[0007] According to the described method the products are conveyed through the cooling chamber. Therefore, preferably a conveyor is provided that extends through the cooling chamber at least from the product inlet to the product outlet. The conveyor is preferably configured as a conveyor belt. The products are preferably placed onto the conveyor upstream of the product inlet of the cooling chamber. The products can enter the cooling chamber

via the product inlet while being conveyed by the conveyor. From the product inlet the products can be conveyed by the conveyor through the cooling chamber to the product outlet, leave the cooling chamber via the product outlet and be removed from the conveyor downstream of the product outlet.

[0008] Within the cooling chamber the products are preferably cooled by circulating a cryogenic medium, in particular by means of fans. The cryogenic medium is preferably nitrogen or carbon dioxide. The cryogenic medium can be introduced into the cooling chamber via cryogenic inlets. An exhaust opening may be provided for exhausting the cryogenic medium from the cooling chamber. However, the cryogenic medium can also leave the cooling chamber via the product inlet and/or via the product outlet, such that no distinct exhaust opening is required.

[0009] The amount of cooling can be controlled, for example, by means of a control valve that controls the amount of cryogenic medium that is introduced into the cooling chamber. This is preferred if nitrogen is used as the cryogenic medium. Alternatively or additionally, a fixed amount per time of the cryogenic medium can be provided into the cooling chamber. This is preferred if carbon dioxide is used as the cryogenic medium.

[0010] With the described method air from the environment of the cooling chamber can be prevented particularly well from being sucked into the cooling chamber. This is achieved by the inlet airlock and/or by the outlet airlock. Thereby, the above-described disadvantages of air being sucked into the cooling chamber can be avoided, in particular the formation of ice within the cooling chamber and the increase of energy consumption.

[0011] It is preferred that an inlet airlock is provided at the product inlet and an outlet airlock is provided at the product outlet. The configuration of the method and of the respective device are described herein in particular in terms of features of "the inlet airlock and/or the outlet airlock". If only one of the airlocks is provided, the respective features consequently apply to only this airlock. If both airlocks are provided, the respective features may apply to the inlet airlock only, to the outlet airlock only or to both the inlet airlock and the outlet airlock. Preferably, the respective features apply to both the inlet airlock and the outlet airlock. The configuration of the method and of the respective device are also described herein in terms of features of "the airlocks". If only one of the airlocks is provided, the respective features consequently apply to only this airlock. If both airlocks are provided, the respective features apply to both the inlet airlock and the outlet airlock.

[0012] The inlet airlock and/or the outlet airlock are preferably configured as separate elements that are distinguishable, in particular, from the cooling chamber. It is preferred that the inlet airlock and the outlet airlock are separate from each other. However, it is also possible that the inlet airlock and the outlet airlock are formed jointly. In that case the products can enter the cooling

chamber via an airlock and leave the cooling chamber via the same airlock. This airlock can be considered as both the inlet airlock and the outlet airlock.

[0013] The inlet airlock and/or the outlet airlock are preferably configured such that the products can be conveyed through the respective airlock. In particular, an airlock can surround the conveyor. The products are preferably placed onto the conveyor upstream of the inlet airlock and removed from the conveyor downstream of the outlet airlock.

[0014] The airlocks can separate the cooling chamber from its environment. Therefore, a gaseous medium is continuously provided into the inlet airlock and/or into the outlet airlock. Instead of environmental air being sucked into the cooling chamber, the gaseous medium from the airlocks can be sucked into the cooling chamber. The airlocks can be considered reservoirs of the gaseous medium. These reservoirs can be used to compensate fluctuations in the supply of the cryogenic medium to the cooling chamber. If the momentary supply of the cryogenic medium is low, the gaseous medium from the airlocks can be sucked into the cooling chamber instead of air from the environment of the cooling chamber. This is advantageous since the composition of the gaseous medium provided into the airlocks can be easily controlled. Hence, the gaseous medium can be chosen such that it causes no undesired effects within the cooling chamber.

[0015] A respective exhaust opening may be provided for exhausting the gaseous medium from the inlet airlock and/or from the outlet airlock. However, the gaseous medium can also leave the respective airlock towards the cooling chamber and/or towards the environment through openings provided for the products, such that no distinct exhaust openings are required.

[0016] According to a preferred embodiment of the method the gaseous medium is provided in terms of a respective continuous flow through the inlet airlock and/or through the outlet airlock.

[0017] The inlet airlock and/or the outlet airlock preferably comprise a respective nozzle installation by means of which the gaseous medium can be provided into the respective airlock. Preferably, the continuous flow of the gaseous medium is configured as a curtain of the gaseous medium. The products are preferably conveyed through this curtain. The term curtain is supposed to be understood as a flow of the gaseous medium that extends across a plane. That is, the flow is essentially two-dimensional and not three-dimensional. For example, several nozzles can be arranged next to each other in a straight line in order to obtain a curtain of the gaseous medium. The flow of the gaseous medium through the inlet airlock and/or through the outlet airlock is preferably oriented from top to bottom.

[0018] According to a further preferred embodiment of the method the products are food products.

[0019] It is preferred that the food products are shock-frosted by the described method. That is, the food products are cooled at a particularly high cooling speed.

[0020] According to a further preferred embodiment of the method the products are cooled to a temperature within the range of -15°C to -30°C.

[0021] In this embodiment the products are preferably food products.

[0022] According to a further preferred embodiment of the method the gaseous medium is an inert medium.

[0023] With an inert medium as the gaseous medium disadvantageous chemical reactions of the products with air, in particular with oxygen in the air, can be suppressed. This is particularly advantageous if the described method is applied to food products.

[0024] According to a further preferred embodiment of the method the gaseous medium is nitrogen or carbon dioxide.

[0025] Nitrogen and carbon dioxide are particularly cheap and easy to handle. Also, providing nitrogen and carbon dioxide is particularly easy.

[0026] According to a further preferred embodiment of the method the products are cooled by introducing a cryogenic medium in its liquid state into the cooling chamber, wherein the cryogenic medium in its gaseous state is used as the gaseous medium that is continuously provided into the inlet airlock and/or into the outlet airlock.

[0027] In this embodiment the cryogenic medium is used both for cooling the products within the cooling chamber and for being provided to the inlet airlock and/or to the outlet airlock. Cooling of the products can be achieved, in particular, by using the cryogenic medium in its liquid state. That is, the cryogenic medium can be supplied in its liquid state to cryogen inlets of the cooling chamber. Evaporation of the cryogenic medium causes a cooling within the cooling chamber.

[0028] The inlet airlock and/or the outlet airlock are preferably provided with the cryogenic medium in its gaseous state. That is sufficient, since the function of the airlocks does not require a cooling effect. Hence, it is sufficient that the cryogenic medium is provided to the inlet airlock and/or to the outlet airlock in its gaseous state. The cryogenic medium can be in its gaseous state before it is let into the inlet airlock and/or into the outlet airlock, for example via a respective nozzle installation of the airlock. However, it is also possible that the cryogenic medium is supplied in its liquid state to the inlet airlock and/or to the outlet airlock. In that case, the cryogenic medium forms the gaseous medium that is provided to the inlet airlock and/or to the outlet airlock after evaporation.

[0029] According to a further preferred embodiment of the method a pressure within the inlet airlock and/or within the outlet airlock is maintained above the atmospheric pressure.

[0030] The atmospheric pressure is the pressure of the air that surrounds the cooling chamber and the airlocks, that is of the air of the environment of the cooling chamber. Providing the gaseous medium at an overpressure ensures that no air from the environment is sucked into the airlocks and, eventually, into the cooling chamber. It

is preferred that the pressure within the inlet airlock and/or within the outlet airlock is at least 1 mbar higher than the atmospheric pressure. Preferably, the overpressure is as high as that loss of the gaseous medium to the cooling chamber can be compensated for.

[0031] According to a further aspect of the present invention a device for cooling products is presented that comprises:

- a cooling chamber,
- a conveyor for conveying the products through the cooling chamber, and
- an inlet airlock situated at a product inlet of the cooling chamber and/or an outlet airlock situated at a product outlet of the cooling chamber.

The inlet airlock and/or the outlet airlock are connected to a respective gas supply such that the inlet airlock and/or the outlet airlock can be provided with a gaseous medium.

[0032] The details and advantages disclosed for the described method can be applied to the described device, and vice versa.

[0033] According to a preferred embodiment of the device the inlet airlock and/or the outlet airlock comprise a respective nozzle installation for providing a respective continuous flow of the gaseous medium through the inlet airlock and/or through the outlet airlock.

[0034] The nozzle installation is preferably configured such that the gaseous medium can be provided as a curtain. Therefore, the nozzle installation preferably comprises a plurality of nozzles that are arranged on a straight line.

[0035] According to a further preferred embodiment of the device the inlet airlock and/or the outlet airlock comprise a respective airlock chamber of the respective airlock.

[0036] The conveyor preferably passes through the airlock chamber such that the products can be conveyed through the airlock chamber by means of the conveyor. The airlock chamber is preferably arranged next to the cooling chamber.

[0037] According to a further preferred embodiment the device further comprises a respective pressure sensor arranged within the inlet airlock and/or within the outlet airlock.

[0038] It is preferred that a respective pressure sensor is arranged within the inlet airlock and within the outlet airlock.

[0039] By means of the pressure sensor(s) the pressure within the respective airlock can be measured. The obtained information can be used in order to maintain the pressure within the respective airlock at a predetermined value, within a predetermined range and/or above the atmospheric pressure.

[0040] According to a further preferred embodiment the device further comprises a control unit that is configured for maintaining the pressure within the inlet airlock

and/or within the outlet airlock above the atmospheric pressure.

[0041] The control unit is preferably connected to the previously described pressure sensor(s) such that the control can be based on the information obtained with the pressure sensor(s).

[0042] It should be noted that the individual features specified in the claims may be combined with one another in any desired technologically reasonable manner and form further embodiments of the invention. The specification, in particular taken together with the figure, explains the invention further and specifies particularly preferred embodiments of the invention. Particularly preferred variants of the invention and the technical field will now be explained in more detail with reference to the enclosed figure. It should be noted that the exemplary embodiment shown in the figure is not intended to restrict the invention. The figure is schematic and may not be to scale. The figure displays:

Fig. 1: a sectional side view of a device according to the present invention.

[0043] Fig. 1 shows a device 1 for cooling products 3. The device 1 comprises a cooling chamber 2 and a conveyor 4 for conveying the products 3 through the cooling chamber 2. On the conveyor 4 seven products 3 are shown. The device 1 further comprises an inlet airlock 7 situated at a product inlet 5 of the cooling chamber 2 and an outlet airlock 8 situated at a product outlet 6 of the cooling chamber 2. The inlet airlock 7 and the outlet airlock 8 are connected to a respective gas supply 13 such that the inlet airlock 7 and/or the outlet airlock 8 can be provided with a gaseous medium. The cooling chamber 2 is equipped with four fans 11 and three cryogen inlets 12. Via the cryogen inlets 12 a cryogenic medium can be introduced into the cooling chamber 2. With the fans 11 the cryogenic medium can be circulated within the cooling chamber 2.

[0044] The inlet airlock 7 and the outlet airlock 8 comprise a respective nozzle installation 9 for providing a respective continuous flow of the gaseous medium through the inlet airlock 7 and through the outlet airlock 8. The inlet airlock 7 and the outlet airlock 8 comprise a respective airlock chamber 10.

[0045] With the device 1 products 3, in particular food products, can be cooled while being conveyed through the cooling chamber 2. Thereby, a gaseous medium is continuously provided into the inlet airlock 7 and into the outlet airlock 8 in order to prevent air from the environment of the cooling chamber 2 to be sucked into the cooling chamber 2. The gaseous medium is provided in terms of a respective continuous flow through the inlet airlock 7 and through the outlet airlock 8. The products 3 can be cooled to a temperature in the range of -15°C to -30°C. The gaseous medium is an inert medium such as nitrogen or carbon dioxide. The products 3 can be cooled by introducing the cryogenic medium in a liquid state into the cooling chamber 2, wherein the cryogenic medium in a gaseous state is used as the gaseous medium that is

continuously provided into the inlet airlock 7 and into the outlet airlock 8. A pressure within the inlet airlock 7 and within the outlet airlock 8 is maintained above the atmospheric pressure.

[0046] The device 1 further comprises a respective pressure sensor 14 arranged within the inlet airlock 7 and within the outlet airlock 8. The pressure sensors 14 are connected to a control unit 15 that is configured for maintaining the respective pressure within the inlet airlock 7 and within the outlet airlock 8 above the atmospheric pressure. The control unit 15 therefore may be connected to a further pressure sensor (which is not shown) for measuring the atmospheric pressure.

[0047] With the described device 1 and with the described method products 3, in particular food products, can be cooled while being conveyed through the cooling chamber 2. Due to the inlet airlock 7 and the outlet airlock 8, which are provided with a gaseous medium, air from the environment of the cooling chamber 2 can be prevented from being sucked into the cooling chamber 2. Thereby, formation of ice within the cooling chamber 2 can be prevented and energy consumption can be reduced.

List of reference numerals

[0048]

- | | | |
|----|---------------------|--|
| 1 | device | |
| 2 | cooling chamber | |
| 3 | product | |
| 4 | conveyor | |
| 5 | product inlet | |
| 6 | product outlet | |
| 7 | inlet airlock | |
| 8 | outlet airlock | |
| 9 | nozzle installation | |
| 10 | airlock chamber | |
| 11 | fan | |
| 12 | cryogen inlet | |
| 13 | gas supply | |
| 14 | pressure sensor | |
| 15 | control unit | |

Claims

1. Method for cooling products (3) comprising conveying the products (3) through a cooling chamber (2), wherein an inlet airlock (7) is situated at a product inlet (5) of the cooling chamber (2) and/or an outlet airlock (8) is situated at a product outlet (6) of the cooling chamber (2), and wherein a gaseous medium is continuously provided into the inlet airlock (7) and/or into the outlet airlock (8).
2. Method according to claim 1, wherein the gaseous medium is provided in terms of a respective contin-

uous flow through the inlet airlock (7) and/or through the outlet airlock (8).

3. Method according to one of the preceding claims, wherein the products (3) are food products.
4. Method according to one of the preceding claims, wherein the products (3) are cooled to a temperature within the range of -15°C to -30°C.
5. Method according to one of the preceding claims, wherein the gaseous medium is an inert medium.
6. Method according to one of the preceding claims, wherein the gaseous medium is nitrogen or carbon dioxide.
7. Method according to one of the preceding claims, wherein the products (3) are cooled by introducing a cryogenic medium in a liquid state into the cooling chamber (2), and wherein the cryogenic medium in a gaseous state is used as the gaseous medium that is continuously provided into the inlet airlock (7) and/or into the outlet airlock (8).
8. Method according to one of the preceding claims, wherein a pressure within the inlet airlock (7) and/or within the outlet airlock (8) is maintained above the atmospheric pressure.
9. Device (1) for cooling products (3) comprising:
 - a cooling chamber (2),
 - a conveyor (4) for conveying the products (3) through the cooling chamber (2), and
 - an inlet airlock (7) situated at a product inlet (5) of the cooling chamber (2) and/or an outlet airlock (8) situated at a product outlet (6) of the cooling chamber (2),
 wherein the inlet airlock (7) and/or the outlet airlock (8) are connected to a respective gas supply (13) such that the inlet airlock (7) and/or the outlet airlock (8) can be provided with a gaseous medium.
10. Device (1) according to claim 9, wherein the inlet airlock (7) and/or the outlet airlock (8) comprise a respective nozzle installation (9) for providing a respective continuous flow of the gaseous medium through the inlet airlock (7) and/or through the outlet airlock (8).
11. Device (1) according to claim 9 or 10, wherein the inlet airlock (7) and/or the outlet airlock (8) comprise a respective airlock chamber (10).
12. Device (1) according to one of claims 9 to 11, further comprising a respective pressure sensor (14) ar-

ranged within the inlet airlock (7) and/or within the outlet airlock (8).

13. Device (1) according to one of claims 9 to 12, further comprising a control unit (15) that is configured for maintaining the pressure within the inlet airlock (7) and/or within the outlet airlock (8) above the atmospheric pressure.

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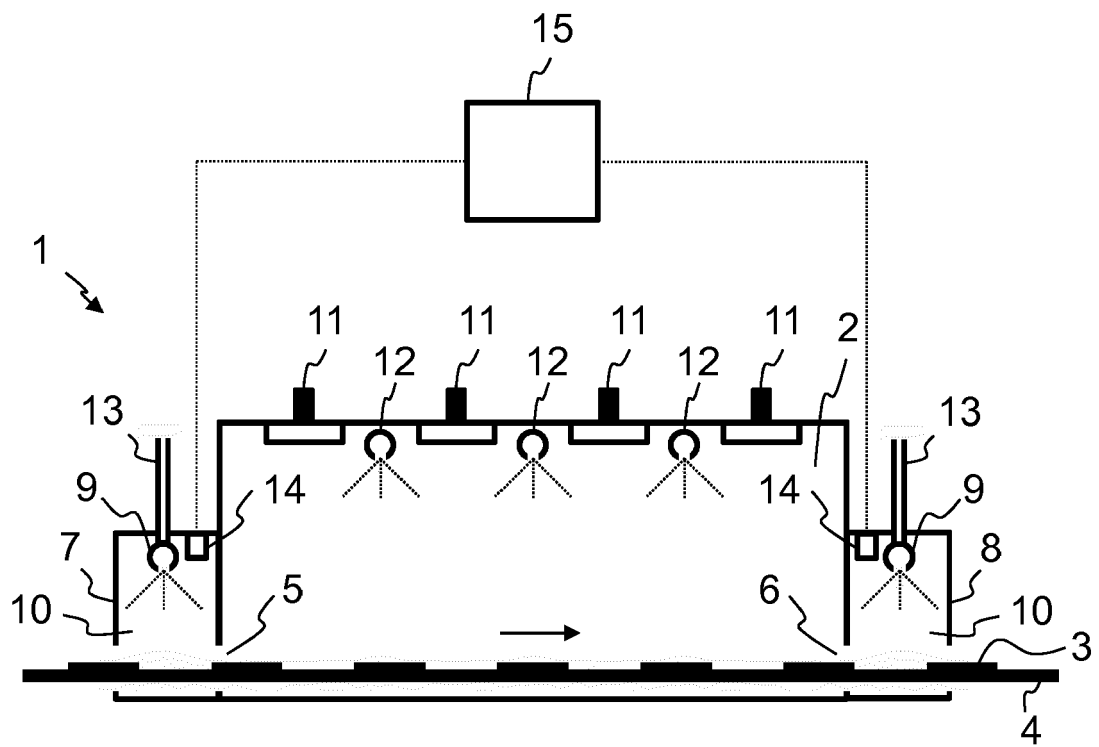


Fig. 1



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Application Number
EP 19 18 5851

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CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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