

(19)



(11)

EP 3 450 886 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
26.05.2021 Bulletin 2021/21

(51) Int Cl.:
F25D 3/10 ^(2006.01) **F25D 3/12** ^(2006.01)
F25D 19/00 ^(2006.01)

(21) Application number: **17188206.1**

(22) Date of filing: **28.08.2017**

(54) **COOLING DEVICE FOR COOLING A STORAGE SPACE OF A COOLING CONTAINER AND A RESPECTIVE COOLING CONTAINER**

KÜHLVORRICHTUNG ZUM KÜHLEN EINES LADERAUMS EINES KÜHLBEHÄLTERS UND
ENTSPRECHENDER KÜHLBEHÄLTER

DISPOSITIF DE REFROIDISSEMENT POUR REFROIDIR UN ESPACE DE STOCKAGE D'UN
RÉCIPIENT DE REFROIDISSEMENT ET RÉCIPIENT DE REFROIDISSEMENT RESPECTIF

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

(43) Date of publication of application:
06.03.2019 Bulletin 2019/10

(73) Proprietors:
• **Air Liquide Deutschland GmbH
40235 Düsseldorf (DE)**
Designated Contracting States:
DE
• **L'Air Liquide Société Anonyme pour l'Etude et
l'Exploitation des Procédés Georges Claude
75007 Paris (FR)**
Designated Contracting States:
**AL AT BE BG CH CY CZ DK EE ES FI FR GB GR
HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL
PT RO RS SE SI SK SM TR**

(72) Inventors:
• **Brouns, Marcel
47906 Kempen (DE)**
• **Lürken, Franz
47906 Kempen (DE)**

(74) Representative: **Keenway Patentanwälte
Neumann Heine Taruttis
PartG mbB
Postfach 10 33 63
40024 Düsseldorf (DE)**

(56) References cited:
WO-A1-2004/042298 DE-A1- 19 840 262
FR-A- 844 771 US-A- 1 897 095
US-A- 1 921 147 US-A- 2 196 310
US-A- 3 906 744

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 3 450 886 B1

Description

[0001] The present invention is directed to a cooling device for cooling a storage space of a cooling container and a respective cooling container.

[0002] Several goods such as food products require cooling. In particular for transporting such goods, a variety of cooling containers is known. Commonly, a cooling container comprises a thermally isolated space, in which the goods can be kept during transport. Thereby, the temperature within the cooling container can be maintained below a temperature threshold merely due to the thermal isolation from the environment. However, such passive methods for maintaining a low temperature are not sufficient, e. g. depending on the ambient temperature and/or for products that are particularly heat-sensitive. In particular, with such cooling containers, a temperature cannot be maintained below a threshold over a long period of time.

[0003] It is also known to use active means for cooling within cooling containers. These active means can comprise, for example, electrically and/or mechanically driven cooling apparatuses. However, such cooling apparatuses consume energy, which may not be available in particular during transport. As an alternative, coolants such as solid carbon dioxide are used for (active) cooling. By introducing solid carbon dioxide into a thermally isolated cooling container, a low temperature within the cooling container can be maintained over a longer period of time. However, using solid carbon dioxide is often energetically inefficient. Cooling over a sufficiently long period of time may be achieved only by such a high initial cooling power that the temperature in the cooling container might be reduced more than necessary and/or desired. Due to such an unnecessary cooling energy is wasted. Also, the goods that are cooled can be damaged if the temperature falls below a lower threshold. Further, for some applications even with carbon dioxide a sufficient cooling over a sufficiently long period of time cannot be achieved according to prior art approaches, such as shown in US2196310, US3906744, DE19840262 and US1897095.

[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 cooling device for cooling an interior of a cooling container, wherein a cooling effect can be obtained particularly energy efficient and over a particularly long period of time. These objects are solved by the features of the independent claims. Dependent claims are directed to preferred embodiments of the present invention.

[0005] A cooling device is provided as defined in claim 1.

[0006] The term "cooling container" may be understood broadly in this context. Any device having a storage space for receiving goods that are supposed to be cooled can be considered a cooling container. In particular, the cooling container can be suitable for cooling and trans-

porting food products. The storage space is situated in the interior of the cooling container. Also, the cooling container preferably comprises container walls that confine the storage space. Preferably, the cooling walls are thermally isolated.

[0007] The cooling device can be arranged within the storage space or adjacent to the storage space. The cooling device is in particular capable of cooling the storage space. Thereby, the cooling device may be attached fixedly to the cooling container or may be attached removably to the cooling container. The cooling device is particularly suitable for receiving a coolant. The coolant can be, for example, solid carbon dioxide or carbon dioxide snow. The coolant can cool the storage space of the cooling container. The amount of coolant used may be chosen depending on the size of the storage space, the amount of goods placed therein, a temperature of the environment, a threshold under which the temperature within the storage space is to be maintained and/or a desired period of time over which the temperature is supposed to be maintained below the threshold.

[0008] The coolant space is confined at least partly by the housing walls of the cooling device. Preferably, the coolant space is confined entirely by the housing walls of the cooling device. In that case, the housing walls preferably comprise an opening, via which the coolant can be introduced into the coolant space and which can be closed, for example, by a cover or by a hatch. Alternatively, it is preferred that the coolant space is confined by the housing walls except for one side of the coolant space. This may be the case, for example, if the housing walls constitute a trough or a bucket. In that case, the cooling device is preferably attached to the cooling container such that the open side of the coolant space is closed by a container wall.

[0009] The housing walls are preferably divided into the main heat transfer zone and the thermal isolation zone. Alternatively, there may be further zones with a different function. A zone is to be understood as a section of the housing walls that is intended and equipped for a certain purpose. Therefore, the housing walls may have different properties in the different zones, in particular different heat transfer coefficients.

[0010] A zone may comprise a single area of the housing walls. Such a zone is a connected, that is, contiguous, area of the housing walls. Also, a zone may comprise multiple areas of the housing walls that are not connected, that is, not contiguous. Areas of the housing walls with the same properties that are intended for the same purpose constitute a single zone, regardless if it is one single connected area or multiple areas that are not connected.

[0011] The thermal isolation zone ideally does not allow any heat transfer between the coolant space of the cooling device and the storage space of the cooling container. However, for practical reasons, a minor heat transfer may be allowed. In particular, it might be unreasonable to provide a thermal isolation that is capable of suppress-

ing any measurable heat transfer. Such a thermal isolation might be large, heavy and/or expensive. Hence, it is preferred that the thermal isolation zone suppresses the heat transfer between the coolant space of the cooling device and the storage space of the cooling container as far as this is reasonably achievable. Therefore, the first heat transfer coefficient of the thermal isolation zone may be as low as reasonably achievable. In the thermal isolation zone the housing walls of the cooling device may comprise a thermally isolating material. The thermally isolating material may be added to the housing walls as a thermal isolation layer. Alternatively, the housing walls can be formed by a thermally isolating material in the thermal isolation zone.

[0012] The main heat transfer zone is supposed to allow heat transfer between a coolant provided within the coolant space of the cooling device and an outside of the cooling device, e. g. the storage space of the cooling container. Therefore, the second heat transfer coefficient of the main heat transfer zone may be as high as reasonably achievable or as being appropriate for the desired use of the cooling device, e. g. depending on the temperature threshold(s), the necessary duration of cooling etc.. For example, at least in the main heat transfer zone the housing walls of the cooling device can be made with a plastic and/or a metal.

[0013] The cooling effect that is achievable with the coolant has two major parameters: the cooling power and the total cooling energy. The cooling power is a measure for a momentarily achievable cooling effect. The higher the cooling power of the coolant is, the more can a temperature of the storage space be affected. If a particularly low temperature is desired for the storage space, for example to provide cooling for frozen food products, a particularly high cooling power is required. The cooling energy is the cooling power integrated over time, in particular over a period of time. In particular, this period of time covers the whole time over which the coolant can provide a cooling effect. The longer a low temperature is supposed to be maintained and/or the lower the temperature is supposed to be maintained, the higher the cooling energy has to be.

[0014] The cooling power depends highly on the surface of the coolant, via which heat can be transferred from the storage space of the cooling container to the coolant. The cooling energy depends highly on the total volume of the coolant that is provided. That is, a high volume of a coolant with a small surface can provide a low cooling effect over a long time, while a small volume of a coolant with a large surface can provide a high cooling effect over a short time. Thereby, however, the ratio of volume to surface can only be chosen within geometrical limits. In particular, no geometrical object has a larger surface to volume ratio than a sphere. That is, by merely placing a coolant into a cooling container, the ratio between the cooling energy and the cooling power cannot be chosen limitless. The cooling power therefore cannot be restricted to a particularly low value merely by

providing the coolant in a particular shape. The cooling power will always be at least as high as for a spherical coolant.

[0015] Also, the cooling power is not constant over time. The higher the cooling power, the higher the heat transfer of the coolant and, hence, the faster the coolant evaporates and/or melts. Thus, a high cooling power coincides with a high coolant consumption.

[0016] Ideally, the cooling power is high and constant over a (long) period of time. That way, the temperature in the storage space of the cooling container can be maintained at the same or at a similar value over a long period of time. By merely placing a coolant into a cooling container, a high cooling power after a particularly long period of time can only be achieved by initially providing a particularly high amount of coolant. Due to the described limited surface-to-volume-ratio and due to the consumption of coolant, initially the cooling power must thereby be higher than required. Hence, energy would be wasted by merely placing the coolant into the cooling container. Also, the high initial cooling power may reduce the temperature within the storage space below a desired lower threshold, potentially causing damage to the goods stored therein.

[0017] With the described cooling device, cooling can be achieved which is particularly close to the ideal situation with a high cooling efficiency considering the consumption (evaporation, melting) of coolant. Therefore, the surface via which heat can be transferred is reduced by the thermal isolation zone. As the coolant is provided within the coolant space, heat between the coolant and the storage space of the cooling container can be transferred mainly via the main heat transfer zone and in particular not or to a negligible degree via the thermal isolation zone. Thus, a ratio between the surface for heat transfer and the volume of the coolant can be reduced in particular beyond what is achievable when merely placing a coolant into a cooling container. This may be particularly achieved if the thermal isolation zone and the main heat transfer zone are sized accordingly.

[0018] With the reduced surface for heat transfer, the cooling device can provide a cooling effect with a cooling power that drops particularly slowly over time. Hence, a particularly high cooling power can be achieved even after a particularly long period of time. Therefore, no high initial cooling power is required so the consumption of coolant is reduced compared to prior art approaches. Also, a particular constant cooling power can prevent damage from the goods stored within the storage space as the temperature can be prevented from dropping too low.

[0019] Also, the eutectic material can contribute to the described advantages. The eutectic material is a material which is particularly capable of storing cooling energy. Hence, the eutectic material can incorporate cooling energy, store the cooling energy and emit the cooling energy later. The eutectic material is provided within the cooling space. Preferably, the eutectic material is enclosed within a casing such that the eutectic material can

be brought into contact with the coolant only thermally, not physically. The coolant and the eutectic material can, hence, exchange heat, but do not get mixed. Despite such a casing, the eutectic material is considered being arranged within the coolant space.

[0020] It is particularly preferred that the eutectic material is enclosed in the cooling device and/or in the casing such that the eutectic material cannot leak from the cooling device and cannot come into contact with the goods stored in the storage space. This is particularly advantageous if food products are stored in the storage space and/or if the eutectic material can be harmful to health. It is, however, particularly preferred to choose an eutectic material is not harmful to health

[0021] The eutectic material can be cooled in particular by the initial cooling power of the coolant. It is assumed that the coolant is placed into the cooling device at the beginning of a cooling process. The eutectic material thereby is assumed to have a relatively high initial temperature, e. g. having a temperature in the range of the ambient temperature outside the cooling container. In that case the coolant can cool the storage space of the cooling container as well as reduce the temperature of the eutectic material. Hence, the eutectic material can incorporate the cooling energy emitted by the coolant in particular during an initial phase of the cooling. In particular in this phase, the initial cooling power may be higher than required as discussed above. This excessively high initial cooling power could reduce the efficiency of coolant consumption. Thus, the eutectic material can contribute to saving energy by storing the cooling energy in the initial phase of the cooling. The energy liberated by the consumption of the coolant is not wasted i. e. resulting in an unnecessary strong cooling of the cooling container but stored by the eutectic material instead. In a later phase of the cooling process, the cooling energy stored within the eutectic material may be released such that the coolant and/or the interior of the cooling container are cooled. Hence, with the eutectic material, the cooling power provided by the cooling device can be increased in particular in the later phase of the cooling. In the later phase of the cooling the cooling power of the coolant may be reduced significantly due to consumption of the coolant.

[0022] The higher the difference between the first heat coefficient and the second heat coefficient, the more pronounced the described advantages of the described cooling device are.

[0023] Also, the described advantages can be achieved in particular if the thermal isolation zone has covers larger surface area of the housing walls than the main heat transfer zone. In experiments it was found that for practical reasons an embodiment of the cooling device is preferred, wherein the thermal isolation zone has a thermal isolation surface area and the main heat transfer zone has a main heat transfer surface area, wherein the thermal isolation surface area is at least twice as large as the main heat transfer surface area.

[0024] The thermal isolation surface area is the surface

area of the housing walls covered by the thermal isolation zone. The main heat transfer surface area is the surface area of the housing walls covered by the main heat transfer zone.

[0025] In the invention, the cooling device housing walls further comprise an auxiliary heat transfer zone, in which the eutectic material adjoins the housing walls so that the eutectic material can cause a cooling of the storage space of the cooling container via the auxiliary heat transfer zone.

[0026] The housing walls are preferably divided into three zones: the main heat transfer zone, the thermal isolation zone and the auxiliary heat transfer zone. Via the thermal isolation zone, preferably no or only an acceptable amount of heat can be transferred between the coolant and the storage space of the cooling container. Via the main heat transfer zone, heat can be transferred between the coolant and the storage space. This is particularly relevant in an initial phase of the cooling. Over time, the cooling power provided by the coolant decreases so that less heat can be transferred via the main heat transfer zone. The eutectic material can provide cooling also in a late phase of the cooling. That is, in particular in the late phase of the cooling, the eutectic material is relevant for providing cooling power. Heat can be transferred between the storage space of the cooling container and the eutectic material via the auxiliary heat transfer zone. That is, the heat transferred between the storage space of the cooling container mainly takes place via the main heat transfer zone, wherein heat is exchanged with the coolant. In addition, heat can be exchanged between the storage space and the eutectic material via the auxiliary heat transfer zone. The cooling provided by the eutectic material can be considered an indirect cooling as cooling energy provided by the coolant is stored and subsequently emitted by the eutectic material. Also, the cooling by the eutectic material is an additional cooling that enhances the effect of the cooling provided by the coolant. For these reasons, the heat transfer zone for transferring heat between the eutectic material and the storage space is referred to as the auxiliary heat transfer zone.

[0027] The described advantages can be achieved in particular if the main heat transfer zone is larger than the auxiliary heat transfer zone. In experiments it was found that for practical reasons an embodiment of the cooling device is preferred, wherein the auxiliary heat transfer zone has an auxiliary heat transfer surface area, wherein the main heat transfer surface area is at least twice as large as the auxiliary heat transfer surface area.

[0028] The auxiliary heat transfer surface area is the surface area of the housing walls covered by the auxiliary heat transfer zone.

[0029] It is even more preferred that the main heat transfer surface area is larger than the auxiliary heat transfer surface area by a factor of at least three, in particular of at least four.

[0030] In a further preferred embodiment of the cooling

device the housing walls comprise a first trough, which is thermally isolated in the thermal isolation zone, and a second trough, which is smaller than the first trough, and which is inserted into the first trough, thereby confining the eutectic material between the second trough and the first trough.

[0031] A trough in the definition applied here is a casing which is closed at all but one sides, in particular being closed at the bottom and on all lateral sides, but being open at the top. Therein the terms bottom and top are used to describe the trough if provided in a usual orientation. The troughs can be described particularly well if a usual orientation is assumed. In the following description, thus, such an orientation will be assumed. Preferably, the troughs are provided in this orientation within the cooling container while the latter is in the orientation in which it is ordinarily stored and transported. However, this does not mean that the troughs may only be provided in this particular orientation. It is also possible to provide the troughs in any other orientation within the cooling container.

[0032] The first trough and the second trough together form the housing walls of the cooling device. Thereby, the housing walls can be made of walls of the first trough and/or of the second trough. The first trough and/or the second trough are preferably made with a material such as a plastic and/or a metal.

[0033] For practical reasons it is preferred that the bottom of the first trough is at least partly thermally isolated so as to constitute the thermal isolation zone. Adjacent to the thermally isolated bottom the eutectic material can be arranged, wherein the eutectic material can be provided as a layer covering preferably the whole thermal isolation zone. Preferably, the eutectic material is in contact with lateral sides of the first trough, thereby forming the auxiliary heat transfer zone. It is preferred that in the thermal isolation zone and in the auxiliary heat transfer zone the housing walls of the cooling device are formed by the first trough only and not by the second trough. In that case the second trough can be inserted into the first trough in such a way that the eutectic material is enclosed between the thermally isolated bottom of the first trough, the lateral sides of the first trough and the bottom of the second trough. In the main heat transfer zone the housing walls are preferably formed by the lateral walls of the first trough and by the lateral walls of the second trough.

[0034] The embodiment of the cooling device is particularly preferred, wherein in the main heat transfer zone the first trough and the second trough contact each other gaplessly.

[0035] The term gapless is in particular understood such that there is no gap between the first trough and the second trough. Thus, in this embodiment the housing walls in the main heat transfer zone each are realized as a double wall comprising a lateral wall of the first trough and a lateral wall of the second trough. Thereby, heat can be exchanged between the storage space of the cooling container and the coolant in the coolant space par-

ticularly efficiently. Any gap between the first trough and the second trough could reduce the second heat transfer coefficient.

[0036] In a further preferred embodiment of the cooling device the housing walls comprise a first trough, which is thermally isolated in the thermal isolation zone, and wherein the eutectic material is provided as an eutectic element that is arranged adjacent to the thermal isolation zone.

[0037] This embodiment is an alternative to the previously described embodiments comprising the first trough and the second trough. Here, only the first trough is provided. Thus, the housing walls are formed by the first trough. Here, the eutectic material is not enclosed between the first trough and the second trough, but as an eutectic element instead. The eutectic element preferably comprises a casing, in which the eutectic element is enclosed. The casing is preferably made with a material such as a plastic and/or a metal.

[0038] For practical reasons it is preferred that the bottom of the first trough is at least partly thermally isolated so as to constitute the thermal isolation zone. Adjacent to the thermal isolation zone the eutectic element can be placed. The eutectic element is preferably in contact with lateral walls of the first trough, thus forming the auxiliary heat transfer zone.

[0039] In a further preferred embodiment of the cooling device the thermal isolation zone covers a bottom of the first trough entirely. This embodiment is a refinement of the previously described embodiment comprising the first trough and the second trough and also of the previously described embodiment comprising the first trough only.

[0040] If the whole bottom of the first trough is thermally isolated, the eutectic material or the eutectic element can be provided covering the whole bottom of the first trough.

[0041] As a further aspect a cooling container is provided having a cooling device as described.

[0042] The details and advantages disclosed for the cooling device can be applied to the cooling container, and vice versa.

[0043] In a preferred embodiment of the cooling container the coolant space of the cooling device is partly confined by at least one container wall of the cooling container.

[0044] In this embodiment, the coolant space is preferably closed on all sides except for one side. This can be the case in particular if the cooling device comprises the first trough and optionally the second trough as the housing walls. In this case the cooling device is open at the top side of the troughs. Through this opening, the coolant can be filled into the coolant space in a particularly simple way. The open side could be closed by a cover or by a hatch. However, in this embodiment, no such cover or hatch is required. Instead, the cooling device can be attached to the cooling container in such a way that the open side of the coolant space is closed by a container wall. In particular, the cooling device can be attached to a top side of the storage space of the cooling

container. Thereby, the top side of the coolant space can be closed by a top wall of the storage space of the cooling container. However, it is possible to attach the cooling device to a side wall or to a bottom of the cooling container as well. Thereby, the cooling device is preferably oriented accordingly such that, for example, the top side of the troughs faces the side wall or the bottom of the cooling container, respectively.

[0045] In a further preferred embodiment of the cooling container the cooling device can be removably attached to at least one container wall of the cooling container.

[0046] The coolant can be filled into the coolant space in a particularly simple way if the cooling device is detached from the cooling container. Subsequently, the cooling device can be attached to the cooling device. This is particularly useful if one side of the coolant space is partly confined by a container wall. If that is the case, the coolant space can be closed by attaching the cooling device to the container wall. In a further preferred embodiment of the cooling container the cooling device can be attached to a container wall of the cooling container by means of attachment rails.

[0047] With the attachment rails, the cooling device can preferably be attached to the cooling container in the manner of a drawer. It is preferred that the cooling device is detachable from the attachment rails. Alternatively, it is preferred that the cooling device merely can be moved along the attachment rails, for example between respective stops.

[0048] The specification, in particular in connection with the figure, explains the invention further and specifies particularly preferred embodiments of the invention. Particularly preferred variants of the invention and also the technical field will now be explained in more detail on the basis of 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 schematic cross section view of a cooling container with a cooling device for cooling a storage space of the cooling container.

[0049] Fig. 1 shows a cooling container 1 with a cooling device 2 for cooling a storage space 13 of the cooling container 1. The storage space 13 of the cooling container 1 may be filled with goods such as food products. These goods can be transported within the cooling container 1. The cooling device 2 comprises a coolant space 3 for receiving a coolant such as carbon dioxide snow, which is confined partly by housing walls 4 of the cooling device 2 and partly by a container wall 11. The housing walls 4 comprise a thermal isolation zone 7 having a first heat transfer coefficient and a main heat transfer zone 6 having a second heat transfer coefficient being larger than the first heat transfer coefficient. In the thermal isolation zone 7 a thermally isolating material is added to the housing walls 4 as a thermal isolation layer 14. The cooling device 2 further comprises an eutectic material 5 provided within a part of the coolant space 3. Also, the

housing walls 4 comprise an auxiliary heat transfer zone 8, in which the eutectic material 5 adjoins the housing walls 4 so that the eutectic material 5 can cause a cooling of the storage space 13 of the cooling container 1 via the auxiliary heat transfer zone 8.

[0050] The thermal isolation zone 7 has a thermal isolation surface area 16, the main heat transfer zone 6 has a main heat transfer surface area 15 and the auxiliary heat transfer zone 8 has an auxiliary heat transfer surface area 17. The thermal isolation surface area 16 is twice as large as the main heat transfer surface area 15 and the main heat transfer surface area 15 is twice as large as the auxiliary heat transfer surface area 17. Thereby, it should be noted that the figure may not be to scale.

[0051] The housing walls 4 comprise a first trough 9, which is thermally isolated in the thermal isolation zone 7, and a second trough 10, which is smaller than the first trough 9, and which is inserted into the first trough 9, thereby confining the eutectic material 5 between the second trough 10 and the first trough 9. In the main heat transfer zone 6 the first trough 9 and the second trough 10 contact each other gaplessly. The thermal isolation zone 7 covers a bottom of the first trough 9 entirely.

[0052] The cooling device 2 can be removably attached to the container wall 11 of the cooling container 1. Therefore, attachment rails 12 are provided at the container wall 11.

[0053] A coolant in the coolant space 3 can affect the storage space 13 of the cooling container 1 only with a reduced cooling power due to the thermal isolation zone 7. Thereby, a particularly constant cooling power can be achieved. Also, an initial cooling power of the coolant can be used to store cooling energy in the eutectic material 5. Thereby, the cooling efficiency is increased as an excessively high initial cooling power is avoided.

[0054] The storage space 13 of the cooling container 1 can be cooled by the cooling device 2 particularly energy efficiently and over a particularly long period of time. With heat transfer being suppressed in the thermal isolation zone 7 and with the eutectic material 5, the cooling device 2 can provide a cooling with a cooling power that drops particularly slowly over time.

List of reference numerals

[0055]

1	cooling container
2	cooling device
3	coolant space
4	housing wall
5	eutectic material
6	main heat transfer zone
7	thermal isolation zone
8	auxiliary heat transfer zone
9	first trough
10	second trough
11	container wall

- 12 attachment rails
- 13 storage space
- 14 thermal isolation layer
- 15 main heat transfer surface area
- 16 thermal isolation surface area
- 17 auxiliary heat transfer surface area

Claims

1. Cooling device (2) for cooling a storage space (13) of a cooling container (1), wherein the cooling device (2) comprises at least:

- a coolant space (3) for receiving a coolant, which is confined at least partly by housing walls (4) of the cooling device (2), the housing walls (4) comprising at least two zones (6, 7, 8):

- a thermal isolation zone (7) having a first heat transfer coefficient; and
- a main heat transfer zone (6) having a second heat transfer coefficient being larger than the first heat transfer coefficient; and

- an eutectic material (5) provided within a part of the coolant space (3), **characterized in** the housing walls further comprising an auxiliary heat transfer zone (8), so that the eutectic material can cause a cooling of the storage space of the cooling container via the auxiliary heat transfer zone (8).

2. Cooling device (2) according to claim 1, wherein the thermal isolation zone (7) has a thermal isolation surface area (16) and the main heat transfer zone (6) has a main heat transfer surface area (15), wherein the thermal isolation surface area (16) is at least twice as large as the main heat transfer surface area (15).

3. Cooling device (2) according to claim 1 or 2, wherein the auxiliary heat transfer zone (8) has an auxiliary heat transfer surface area (17), wherein the main heat transfer surface area (15) is at least twice as large as the auxiliary heat transfer surface area (17).

4. Cooling device (2) according to one of the preceding claims, wherein the housing walls (4) comprise a first trough (9), which is thermally isolated in the thermal isolation zone (7), and a second trough (10), which is smaller than the first trough (9), and which is inserted into the first trough (9), thereby confining the eutectic material (5) between the second trough (10) and the first trough (9).

5. Cooling device (2) according to claim 4, wherein in

the main heat transfer zone (6), the first trough (9) and the second trough (10) contact each other gaplessly.

6. Cooling device (2) according to one of the claims 1 to 4, wherein the housing walls (4) comprise a first trough (9), which is thermally isolated in the thermal isolation zone (7), and wherein the eutectic material (5) is provided as an eutectic element that is arranged adjacent to the thermal isolation zone (7).

7. Cooling device (2) according to one of the claims 4 to 6, wherein the thermal isolation zone (7) covers a bottom of the first trough (9) entirely.

8. Cooling container (1) with a cooling device (2) according to one of the preceding claims.

9. Cooling container (1) according to claim 8, wherein the coolant space (3) of the cooling device (2) is partly confined by at least one container wall (11) of the cooling container (1).

10. Cooling container (1) according to claim 8 or 9, wherein the cooling device (2) can be removably attached to at least one container wall (11) of the cooling container (1).

11. Cooling container (1) according to one of the claims 8 to 10, wherein the cooling device (2) can be attached to a container wall (11) of the cooling container (1) by means of attachment rails (12).

Patentansprüche

1. Kühlvorrichtung (2) zum Kühlen eines Laderaums (13) eines Kühlbehälters (1), wobei die Kühlvorrichtung (2) mindestens folgende Elemente umfasst:

- einen Kühlmittelraum (3) zur Aufnahme eines Kühlmittels, der zumindest teilweise von Gehäusewänden (4) der Kühlvorrichtung (2) begrenzt ist, wobei die Gehäusewände (4) mindestens zwei Zonen (6, 7, 8) umfassen:

- eine thermische Isolationszone (7) mit einem ersten Wärmeübergangskoeffizienten; und
- eine Hauptwärmeübertragungszone (6) mit einem zweiten Wärmeübertragungskoeffizienten, der größer ist als der erste Wärmeübertragungskoeffizient; und

- ein eutektisches Material (5), das innerhalb eines Teils des Kühlmittelraums (3) bereitgestellt ist, **dadurch gekennzeichnet, dass** die Gehäusewände ferner eine Hilfswärmeübertragungs-

zone (8) umfassen, so dass das eutektische Material eine Kühlung des Laderaums des Kühlbehälters über die Hilfwärmeübertragungszone (8) bewirken kann.

2. Kühlvorrichtung (2) nach Anspruch 1, wobei die thermische Isolationszone (7) einen thermischen Isolationsflächenbereich (16) aufweist und die Hauptwärmeübertragungszone (6) einen Hauptwärmeübertragungsflächenbereich (15) aufweist, wobei der thermische Isolationsflächenbereich (16) mindestens doppelt so groß ist wie der Hauptwärmeübertragungsflächenbereich (15).
3. Kühlvorrichtung (2) nach Anspruch 1 oder 2, wobei die Hilfwärmeübertragungszone (8) einen Hilfwärmeübertragungsflächenbereich (17) aufweist, wobei der Hauptwärmeübertragungsflächenbereich (15) mindestens doppelt so groß ist wie der Hilfwärmeübertragungsflächenbereich (17).
4. Kühlvorrichtung (2) nach einem der vorhergehenden Ansprüche, wobei die Gehäusewände (4) eine erste Mulde (9), die in der thermischen Isolationszone (7) thermisch isoliert ist, und eine zweite Mulde (10), die kleiner als die erste Mulde (9) ist und in die erste Mulde (9) eingesetzt ist, umfassen, wodurch das eutektische Material (5) zwischen der zweiten Mulde (10) und der ersten Mulde (9) eingeschlossen wird.
5. Kühlvorrichtung (2) nach Anspruch 4, wobei in der Hauptwärmeübertragungszone (6) die erste Mulde (9) und die zweite Mulde (10) spaltfrei aneinander anliegen.
6. Kühlvorrichtung (2) nach einem der Ansprüche 1 bis 4, wobei die Gehäusewände (4) eine erste Mulde (9) umfassen, die in der thermischen Isolationszone (7) thermisch isoliert ist, und wobei das eutektische Material (5) als ein eutektisches Element bereitgestellt ist, das angrenzend an die thermische Isolationszone (7) angeordnet ist.
7. Kühlvorrichtung (2) nach einem der Ansprüche 4 bis 6, wobei die thermische Isolationszone (7) einen Boden der ersten Mulde (9) vollständig bedeckt.
8. Kühlbehälter (1) mit einer Kühlvorrichtung (2) nach einem der vorhergehenden Ansprüche.
9. Kühlbehälter (1) nach Anspruch 8, wobei der Kühlmittelraum (3) der Kühlvorrichtung (2) teilweise von mindestens einer Behälterwand (11) des Kühlbehälters (1) begrenzt wird.
10. Kühlbehälter (1) nach Anspruch 8 oder 9, wobei die Kühlvorrichtung (2) an mindestens einer Behälterwand (11) des Kühlbehälters (1) abnehmbar befestigt werden kann.

tigt werden kann.

11. Kühlbehälter (1) nach einem der Ansprüche 8 bis 10, wobei die Kühlvorrichtung (2) mittels Befestigungsschienen (12) an einer Behälterwand (11) des Kühlbehälters (1) befestigt werden kann.

Revendications

1. Dispositif de refroidissement (2) destiné à refroidir un espace de stockage (13) d'un récipient de refroidissement (1), le dispositif de refroidissement (2) comprenant au moins :

- un espace à réfrigérant (3) destiné à recevoir un réfrigérant, qui est confiné au moins partiellement par des parois de caisson (4) du dispositif de refroidissement (2), les parois de caisson (4) comprenant au moins deux zones (6, 7, 8) :

- une zone d'isolation thermique (7) ayant un premier coefficient de transfert de chaleur ; et

- une zone de transfert de chaleur principale (6) ayant un deuxième coefficient de transfert de chaleur supérieur au premier coefficient de transfert de chaleur ; et

- un matériau eutectique (5) disposé à l'intérieur d'une partie de l'espace à réfrigérant (3),

caractérisé en ce que

les parois de caisson comprennent en outre une zone de transfert de chaleur auxiliaire (8), de telle sorte que le matériau eutectique peut provoquer un refroidissement de l'espace de stockage du récipient de refroidissement par le biais de la zone de transfert de chaleur auxiliaire (8).

2. Dispositif de refroidissement (2) selon la revendication 1, dans lequel la zone d'isolation thermique (7) a une superficie d'isolation thermique (16) et la zone de transfert de chaleur principale (6) a une superficie de transfert de chaleur principale (15), la superficie d'isolation thermique (16) étant au moins deux fois plus grande que la superficie de transfert de chaleur principale (15).
3. Dispositif de refroidissement (2) selon la revendication 1 ou 2, dans lequel la zone de transfert de chaleur auxiliaire (8) a une superficie de transfert de chaleur auxiliaire (17), la superficie de transfert de chaleur principale (15) étant au moins deux fois plus grande que la superficie de transfert de chaleur auxiliaire (17).
4. Dispositif de refroidissement (2) selon une des re-

vendications précédentes, dans lequel les parois de caisson (4) comprennent un premier bac (9), qui est isolé thermiquement dans la zone d'isolation thermique (7), et un deuxième bac (10), qui est plus petit que le premier bac (9), et qui est inséré à l'intérieur du premier bac (9), confinant ainsi le matériau eutectique (5) entre le deuxième bac (10) et le premier bac (9). 5

5. Dispositif de refroidissement (2) selon la revendication 4 dans lequel, dans la zone de transfert de chaleur principale (6), le premier bac (9) et le deuxième bac (10) sont en contact intégral. 10
6. Dispositif de refroidissement (2) selon une des revendications 1 à 4, dans lequel les parois de caisson (4) comprennent un premier bac (9), qui est isolé thermiquement dans la zone d'isolation thermique (7), et dans lequel le matériau eutectique (5) est fourni sous la forme d'un élément eutectique qui est disposé au voisinage de la zone d'isolation thermique (7). 15 20
7. Dispositif de refroidissement (2) selon une des revendications 4 à 6, dans lequel la zone d'isolation thermique (7) couvre entièrement un fond du premier bac (9). 25
8. Récipient de refroidissement (1) avec un dispositif de refroidissement (2) selon une des revendications précédentes. 30
9. Récipient de refroidissement (1) selon la revendication 8, dans lequel l'espace à réfrigérant (3) du dispositif de refroidissement (2) est partiellement confiné par au moins une paroi de récipient (11) du récipient de refroidissement (1). 35
10. Récipient de refroidissement (1) selon la revendication 8 ou 9, dans lequel le dispositif de refroidissement (2) peut être fixé de façon amovible à au moins une paroi de récipient (11) du récipient de refroidissement (1). 40
11. Récipient de refroidissement (1) selon une des revendications 8 à 10, dans lequel le dispositif de refroidissement (2) peut être fixé à une paroi de récipient (11) du récipient de refroidissement (1) au moyen de rails de fixation. 45

50

55

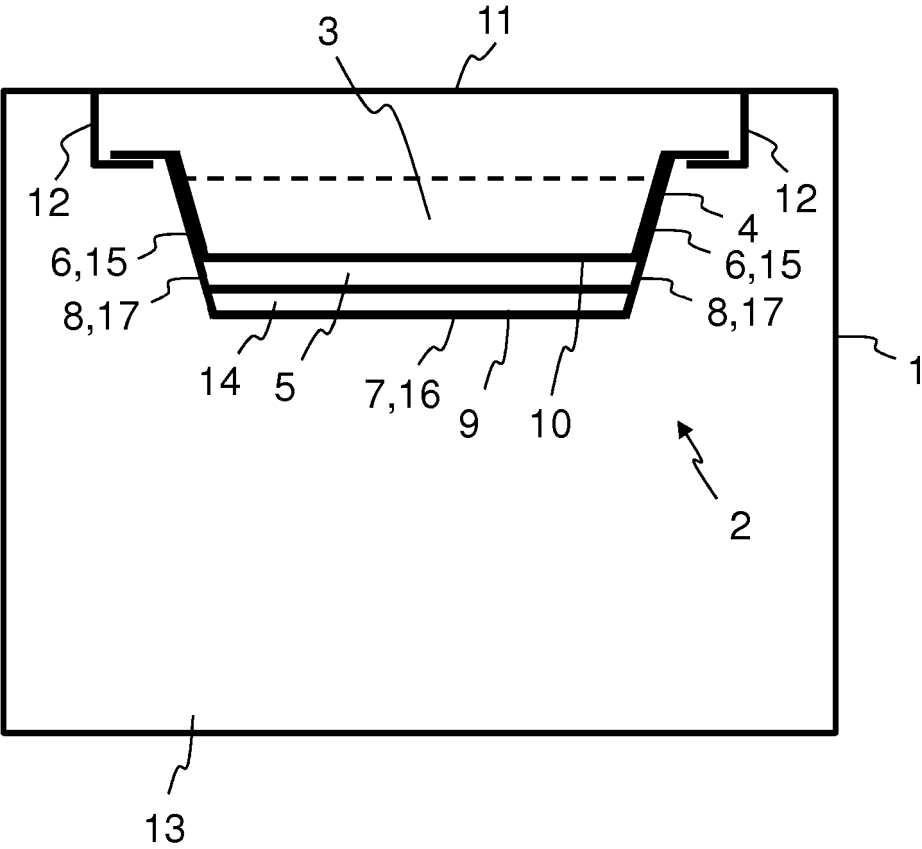


Fig. 1

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 2196310 A [0003]
- US 3906744 A [0003]
- DE 19840262 [0003]
- US 1897095 A [0003]