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(54) **COOLING DEVICE AND METHOD FOR CONTROLLING A COOLING DEVICE**

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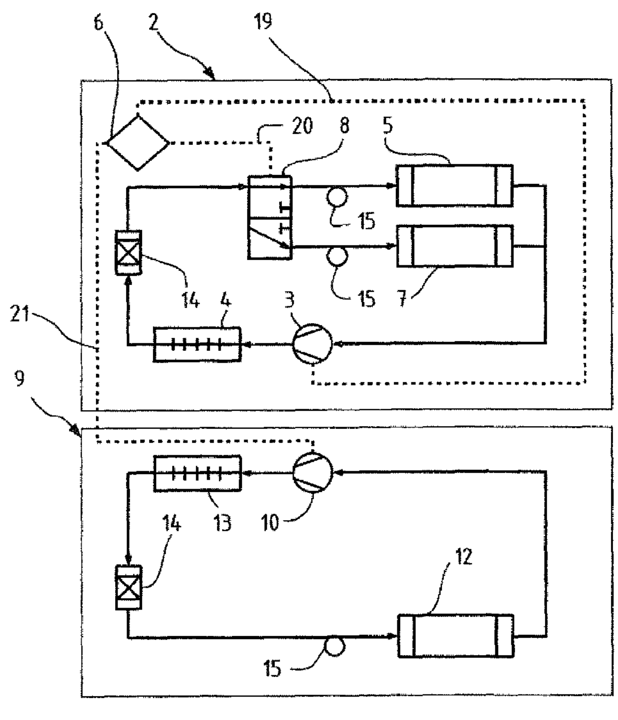
(57) **ABSTRACT**

The invention relates to a cooling device, comprising at least one re-generatively operated primary cooling circuit, in particular a solar-powered cooling circuit, wherein the cooling circuit has at least one compressor, at least one condenser, at least one evaporator, at least one cooling space, at least one temperature sensor for measuring the cooling space temperature ($T_{air}$) in the cooling space, and a controller. A desired temperature value (SET) of the cooling space and a comparison temperature value ($T_{SET}$) can be stored in the controller. The invention is characterised in that the cooling of the cooling space can be interrupted by the controller and the comparison temperature value ($T_{SET}$) can be changed by the controller depending upon the time and/or the cooling space temperature ($T_{air}$). The invention further relates to a method for controlling a cooling device, which is characterised in that the comparison temperature value ($T_{SET}$) corresponds to the desired temperature value (SET) when the controller is switched on, and the cooling of the cooling space is interrupted when the actual cooling space temperature ($T_{air}$) has reached the comparison temperature value ($T_{SET}$). In this connection, the comparison temperature value ($T_{SET}$) is reduced after a predetermined time period ($t_0$) by a stored correction value ($d_{SET}$), so long as the actual cooling space temperature ($T_{air}$) has not reached the comparison temperature value ($T_{SET}$) within the predetermined time period ($t_0$).



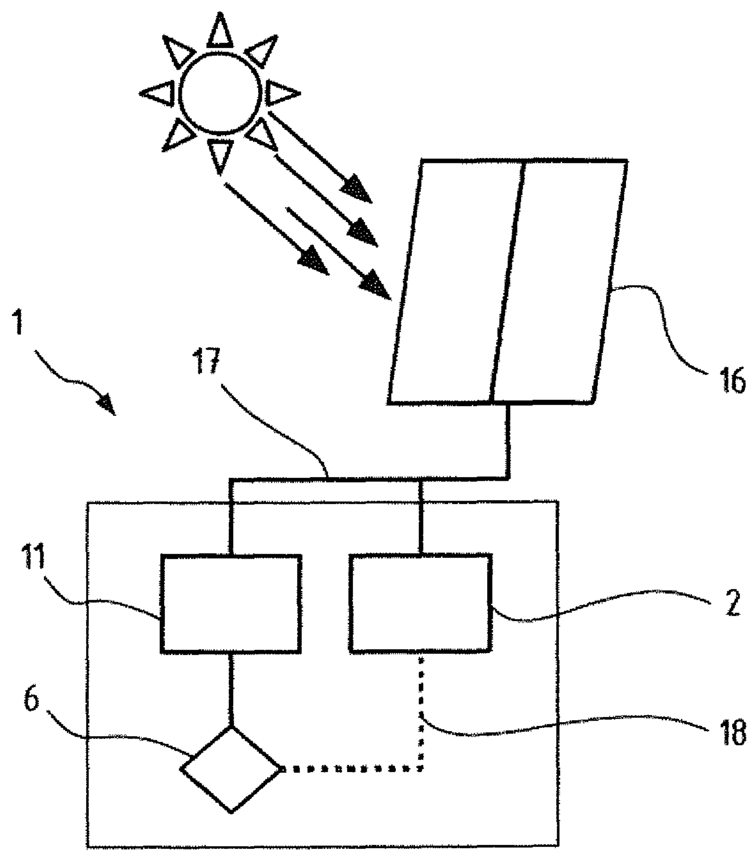



Fig. 1

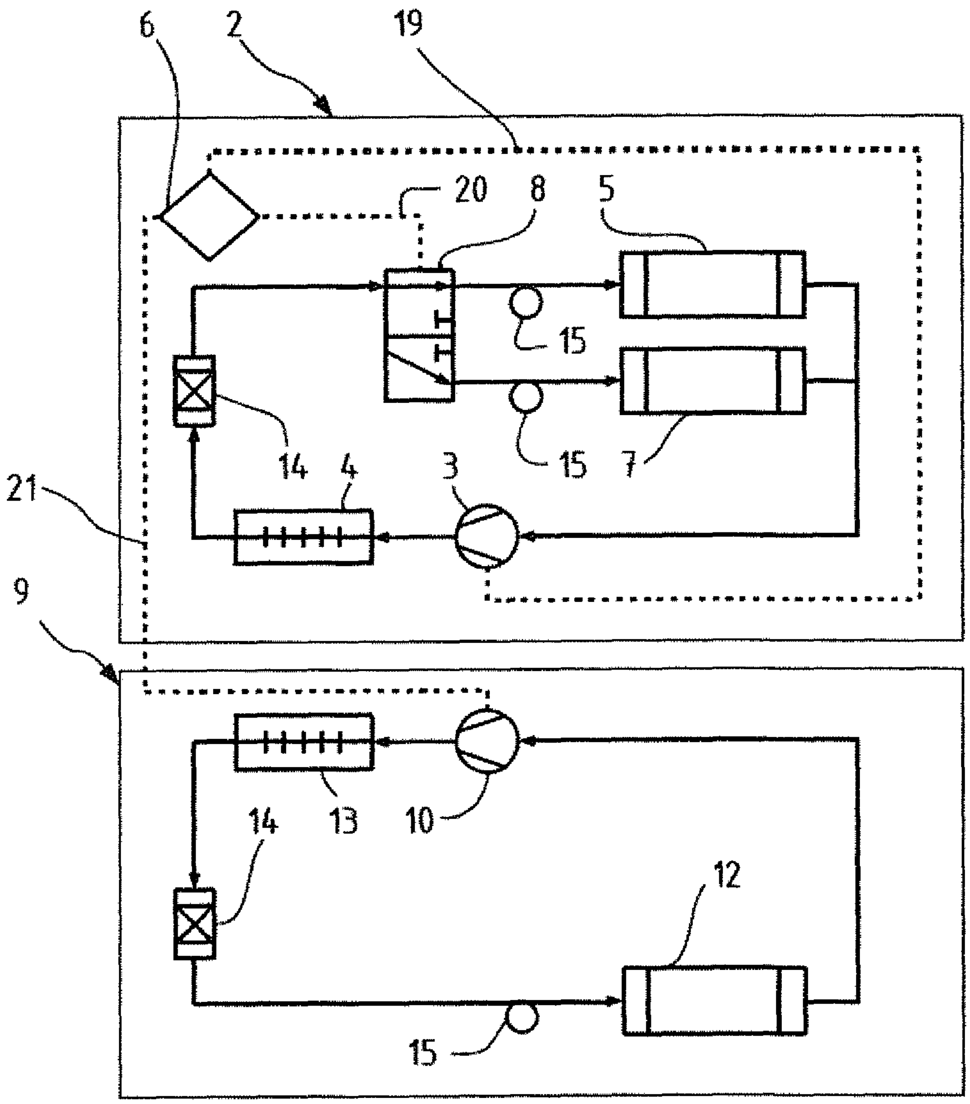



Fig. 2

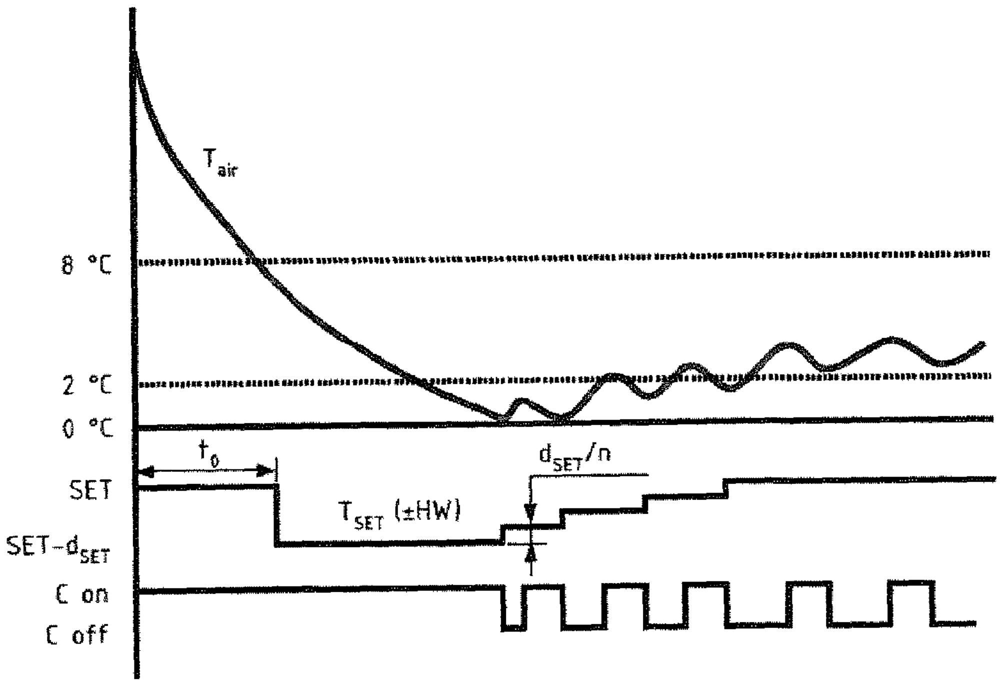



Fig. 3

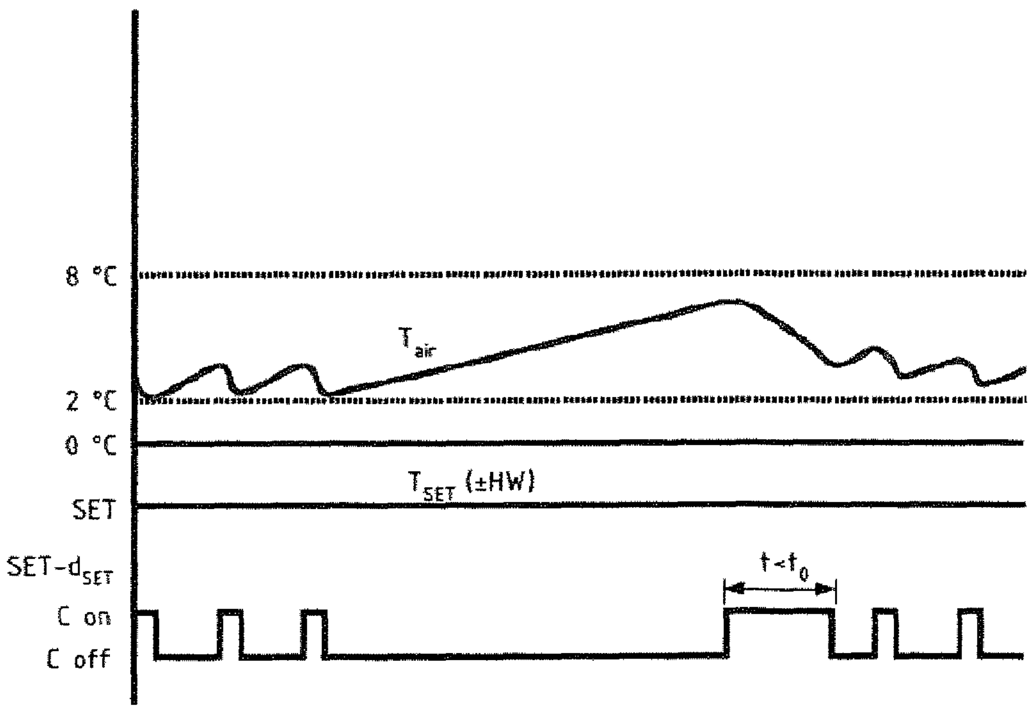



Fig. 4

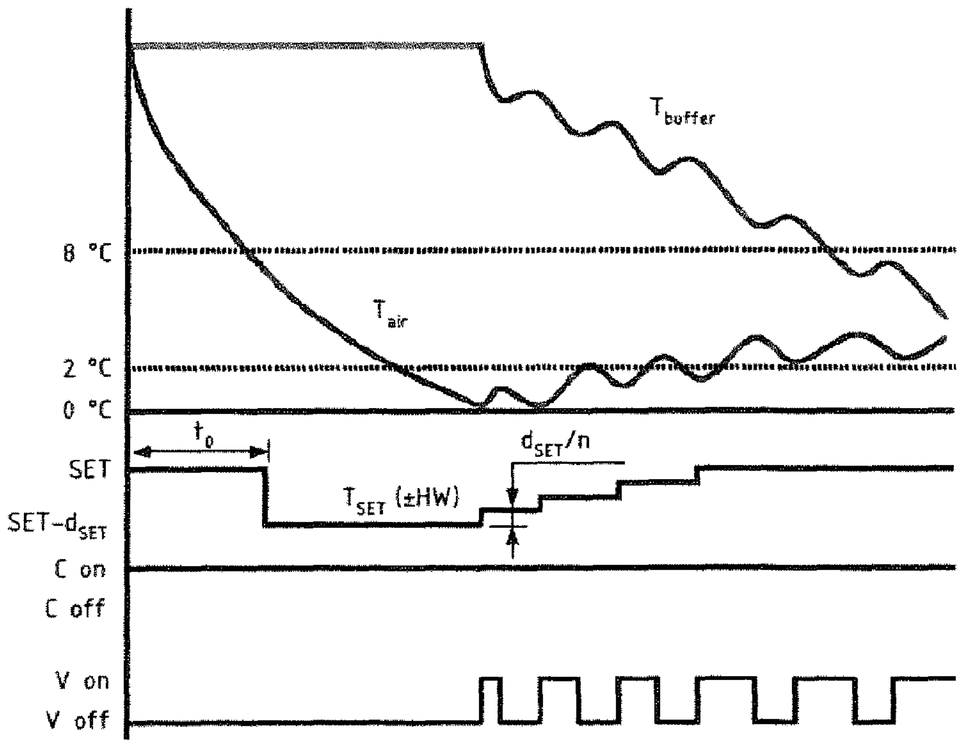

T buffer
8 °C
T air
2 °C
0 °C
t 0
SET
d SET /n
T SET (±HW)
SET-d SET
C on
C off
V on
V off

Fig. 5

# COOLING DEVICE AND METHOD FOR CONTROLLING A COOLING DEVICE

**[0001]** The present invention relates to a cooling device having at least one regeneratively operated primary cooling circuit, wherein the cooling circuit has at least one compressor, at least one condenser, at least one evaporator, at least one cooling space, at least one temperature sensor for measuring the cooling space temperature in the cooling space, and a controller, wherein a desired temperature value of the cooling space and a comparison temperature value can be stored in the controller. The present invention further relates to a method for controlling a cooling device.

**[0002]** Typically, such cooling devices are employed in remote areas, in particular in developing countries where a stable and safe energy supply under normal circumstances cannot be ensured. Here, it has been found to be feasible to generate the power required for operation in a photovoltaic manner since the solar insolation in most developing countries is sufficiently high throughout the year. Thus, also delicate goods, such as for example medical products or food that need to be cooled can be stored safely, whereby the quality of life of the local people can be improved.

**[0003]** For that, the World Health Organization (WHO) has made a catalogue with threshold criteria that has to be fulfilled by the used cooling device and the used cooling equipment for the transport and storage of medical products. Here, it is also a guideline that the cooling temperature is substantially in the range between +2° C. and +8° C., and this temperature range can be maintained over at least three days also independent from the power supply.

**[0004]** However, this also directly indicates the greatest disadvantage of the photovoltaically operated cooling devices, namely that cooling during the solar insolation-free time (e.g. at night or with clouds) is not possible or can only be ensured with the help of an external power source, respectively. However, just the latter is generally not possible. Also the use of batteries is not very practical, since these would significantly increase the first cost, the supply of spare parts and maintenance would turn out to be difficult, and an environmentally aware disposal of waste batteries is almost impossible to accomplish. Also, this results in a certain requirement on the controller of the actual cooling method, since the only limitedly available energy has to be used as intelligent as possible for cooling.

**[0005]** Thus, in the solutions known from the prior art it is built on a high thermal mass of the cooling elements for storing the cold. Here, at solar insolation, if present, the compressor permanently runs to maintain a sufficient refrigerating capacity. Then, the stored cold is often introduced via a fan into the actual cooling space, in which the medical products are stored. To prevent that here the cooling space temperature is falling below a temperature of 0° C. at which the medical products storing in the cooling device would be damaged, such cooling devices have a heating that provides thermal energy as needed.

**[0006]** This system has proved to be extremely practicable in longstanding field experiments. However, in these systems the storage capacity for the medical products is correspondingly limited by the required thermal mass for storing the cold. Moreover, a number of components is required, such as for example the heating device and the fan, the supply of spare parts and maintenance of which sometimes can involve problems. Moreover, it is also the fact that a uniform freezing of the thermal mass and the cooling elements used therefore, respectively, cannot arise or only after a very long operating period.

**[0007]** Thus, it is the problem of the present invention to provide a cooling device in which the above-mentioned criteria of the WHO can be fulfilled, wherein a sufficient storage capacity of the cooling device with renunciation of an additional heating can be provided and a uniform and complete freezing of the used cooling elements is ensured. Moreover, it is the problem of the present invention to provide a method for controlling such a cooling device.

**[0008]** The solution of the problem is accomplished with a cooling device according to claim **1** and a method for controlling a cooling device according to claim **7**. Practical developments are described in the dependent claims.

**[0009]** The cooling device according to the invention in contrast to the cooling devices known from the prior art is characterized in that the cooling of the cooling space can be interrupted by the controller and the comparison temperature value can be changed by the controller depending on the time and/or the cooling space temperature. This is advantageous in that there is no permanent cooling capacity, but the cooling can be interrupted when a desired cooling space temperature has been reached. This is achieved by comparison of the comparison temperature value with the cooling space temperature. When after a certain time there is still energy available or the desired temperature has not yet been reached, respectively, the controller can reduce the comparison temperature value such that a further cooling of the cooling space or the used cooling elements takes place, respectively. Here, in order not to come into a critical range in which a damage of the cooled good must be expected an interruption of the cooling is also made possible as a function of the actual cooling space temperature. Thus, with an existing energy there is a cooling that is however interrupted as soon as a damage of the cooled good by too low temperatures is to be expected.

**[0010]** Preferably, the primary cooling circuit has at least one extra cooling space and at least one extra evaporator assigned to the extra cooling space. The extra evaporator is connected to the primary cooling circuit via a valve, and the cooling of the cooling space can preferably be interrupted by switching the valve. Thus, with an existing energy despite already sufficiently low temperatures in the cooling space a further cooling can occur. Here, it is conceivable that the extra cooling space has a storage tank with which the cooling space can be cooled in the absence of energy. Alternatively, the extra cooling space may be a freezing compartment for cooling ice bags or the like. Latter may be used to transport medical products for shorts routes.

**[0011]** It may be advantageous if the cooling device has a second cooling circuit with a second compressor for cooling a second cooling space, wherein the second compressor can be supplied with energy via a switch. Thus, with a further excess of energy a second cooling circuit for cooling a further cooling space can be used. The second cooling space may have for example a storage tank or may be a freezing compartment.

**[0012]** Preferably, the cooling device has an additional circuit, wherein the controller can be supplied with energy via the additional circuit. So the energy supply of the controller is independent from the energy supply of the cooling circuit.

**[0013]** Here, it is advantageous if the additional circuit has a transformer. In this way, also with a drop in voltage in the input voltage a constant output voltage can be maintained. This prevents a switching-off of the controller also in a drop of voltage that can be conditional on the turn-on transient of the compressor, for example.

**[0014]** Preferably, the additional circuit has at least one condenser. In this way, the controller can be supplied with energy even if actually no energy is available any more, for example during a solar insolation-free time conditional on clouds.

**[0015]** In terms of the method, the solution of the problem is accomplished in that the comparison temperature value in switching on the controller corresponds to the desired temperature value, and the cooling of the cooling space is interrupted if the actual cooling space temperature has reached the comparison temperature value, wherein the comparison temperature value is reduced after a predetermined time period by a stored correction value as long as the actual cooling space temperature has not reached the comparison temperature value within a predetermined time period. That is, if the desired cooling space temperature has not yet been reached after the predetermined time period the comparison temperature value is reduced. Background here is that a non-reaching of the desired temperature value within the predetermined time period also indicates a relatively high initial or outdoor temperature, respectively, so that the cooling space preferably is cooled more and over a prolonged time period, so that the used cooling elements completely freeze. Here, it should be ensured that the correction value is not chosen so high that the temperature in the cooling space falls under a critical range in which the cooled good can be damaged.

**[0016]** Here, it can be suitable if the cooling of the cooling space is interrupted by switching off the compressor of the primary cooling circuit. It is particularly suitable if the compressor is switched off if the actual cooling space temperature falls below a comparison temperature value by a hysteresis value and the compressor is switched on if the actual cooling space temperature exceeds the comparison temperature value by a hysteresis value. In this way, an excessive cooling or an excessive heating, respectively, of the cooling space is prevented. In other words, the actual cooling space temperature oscillates by the comparison temperature value, wherein the variations correspond to the hysteresis value. Therefore, also a delayed response of the cooling circuit or the compressor, respectively, can be taken into account.

**[0017]** Preferably, the comparison temperature value is gradually increased by an amount of the stored correction value until the comparison temperature value corresponds to the desired temperature value with the comparison temperature value being increased in switching off the compressor by the next step. So it is ensured that the compressor runs as long as possible and cooling elements used for cooling the cooling space are completely frozen before the desired temperature value is reached.

**[0018]** It is suitable if the cooling of the cooling space is interrupted by switching the valve. It is particularly suitable if the valve is switched if the actual cooling space temperature falls below the comparison temperature value by a hysteresis value and the valve is switched if the actual cooling space temperature exceeds the comparison temperature value by the hysteresis value. That means, that by switching the valve the extra cooling space is cooled by the extra evaporator until the valve switches again and the evaporator again cools the cooling space. This is advantageous in that the compressor permanently runs and in phases wherein the cooling space must not be cooled the extra cooling space is cooled.

**[0019]** Here, it is advantageous if the comparison temperature value is increased by an amount of the stored correction value until the comparison temperature value corresponds to the desired temperature value, wherein in switching the valve the comparison temperature value is increased by the next step. This ensures that the compressor operating time is at the maximum and as much cold as possible can be stored.

**[0020]** Moreover, it is considered to be advantageous that the second compressor is supplied with energy if the compressor of the primary cooling circuit is switched off. If there is sufficient energy available it is particularly suitable if the compressor of the primary cooling circuit and the second compressor are simultaneously supplied with energy. So, a maximum cold yield from the available energy can be achieved.

**[0021]** Preferably, the output voltage of the additional circuit is maintained constant independent of the input voltage by the DC transformer. Thus, the controller does not switch off when the input voltage briefly drops for example by the turn-on transient of the compressor. This is in particular the case, if there is briefly not enough energy available, for example due to a cloud, and therefore the compressor switches off. This results in the advantage that the possibly already reduced or increased actually valid comparison temperature value stored in the controller is not lost. Moreover, this also ensures that the already elapsed time of the predetermined time period is maintained until the reduction of the comparison temperature value. Otherwise, this would cause that this period every time begins to run anew after switching off the controller. Thus, it can be prevented that the desired temperature value is reached before the cooling elements are completely frozen.

**[0022]** It is advantageous if the switch-off of the controller by the at least one condenser of the additional circuit during a critical time period is prevented. Here, by a critical time period the time period can be understood at which no energy is available despite solar insolation. This is in particular the case due to clouds or animals or vehicles standing in front of the solar module.

**[0023]** The capacity of the at least one condenser should be chosen such that a normally anticipated critical time period can be bridged.

**[0024]** It can be considered to be advantageous if in switching on the controller the comparison temperature value is set to the desired temperature value.

**[0025]** In the following, the invention is explained in detail by way of examples illustrated in the drawings. Here:

**[0026]** FIG. **1** schematically shows a principle sketch of the construction of the cooling device according to the invention;

**[0027]** FIG. **2** schematically shows an operation image of a cooling device according to the invention with a primary cooling circuit and a second cooling circuit;

**[0028]** FIG. **3** schematically shows a time chart for the cooling space temperature, the comparison temperature value, and the compressor operating time for a cooling device with a primary cooling circuit from putting into operation;

**[0029]** FIG. **4** schematically shows a time chart for the cooling space temperature, the comparison temperature value, and the compressor operating time for a cooling device with a primary cooling circuit after putting into operation; and

**[0030]** FIG. **5** schematically shows a time chart for the cooling space temperature, the comparison temperature value, the compressor operating time, and the valve position for a cooling device with a primary cooling circuit with two evaporators.

**[0031]** FIG. **1** shows a sketch of the principle construction of the cooling device **1** according to the invention. The illustrated cooling device **1** has a primary cooling circuit **2** (for that, see FIG. **2**), a controller **6**, and an additional circuit **11**. The controller **6** is connected to the various components of the cooling circuit **2** via control lines **18**. The represented cooling system **1** is re-generatively supplied with energy by a solar module **16** converting the light of the sun into electric energy. Then, the energy is supplied via power lines **17**, wherein the controller **6** is supplied with energy independently of the remaining cooling circuit **2** via the additional circuit **11**. For that, the additional circuit **11** has a DC transformer (not illustrated) and a plurality of condensers (not illustrated) to maintain the output voltage for supplying the controller **6** also in case of a drop of the input voltage. Also, the condensers permit an energy supply of the controller **6** when the insolation of the sun does not provide sufficient energy for operation. In particular, with the condensers thus a prolonged cloud period or the like can be bridged.

**[0032]** In FIG. **2**, an operation image of a cooling device according to the invention with a primary cooling circuit **2** and a second cooling circuit **9** is illustrated. The primary cooling circuit **2** consists of a compressor **3**, a condenser **4**, a filter drier **14** as well as two evaporators **5**, **7** that are connected to the cooling circuit **2** via a valve **8**. Between the valve **8** and the evaporators **5**, **7** each a throttle **15** arranged. Via the evaporator **5** the cooling space (not illustrated) is cooled and via the extra evaporator **7** the extra cooling space (not illustrated) is cooled. The latter may be for example a storage tank or a freezing compartment. The controller **6** is connected to the compressor **3** via a first control line **19**, so that the compressor **3** can be switched on and off by the controller. The valve **8**, which in particular is a three-way solenoid valve, is connected to the controller **6*a*** via a second control line **20**, so that the controller **6** can switch the cooling circuit either to the evaporator **5** or to the extra evaporator **7**. In other words, by switching the valve **8** with the controller **6** it can be decided whether the cooling space or the extra cooling space is to be cooled. For that, the controller **6** detects the actual temperature in the cooling spaces via temperature sensors to obtain an optimum cooling.

**[0033]** Moreover, in FIG. **2** a second cooling circuit **9** with a second compressor **10**, a second condenser **13**, a filter drier **14**, and a second evaporator **12** is illustrated. A throttle **15** is arranged upstream of the second evaporator **12**. This second cooling circuit **9** is used for cooling a second cooling space (not shown) that may be for example a storage tank or a freezing compartment. The second compressor **10** is connected to the controller **6** via a third control line **21**, so that the second compressor **10** can be switched on and off by the controller **6**. That is, in the example illustrated in FIG. **2** the controller **6** can control the cooling of three cooling spaces in total by switching on and off the compressors **3**, **10** and/or by switching the valve **8**.

**[0034]** FIG. **3** shows a time chart for the cooling of a cooling device with a primary cooling circuit and a cooling space when putting the cooling device into operation. When mounting the cooling device the temperature in the cooling space $T_{air}$ corresponds to the ambient temperature. As soon as the cooling device is put into operation the controller switches on the compressor (C on) and the cooling circuit begins to cool the cooling space whereby the cooling space temperature $T_{air}$ decreases. For that, a desired temperature value SET, a comparison temperature value $T_{SET}$ and a hysteresis value HW are stored in the controller. When putting into operation the comparison temperature value $T_{SET}$ corresponds to the desired temperature value SET. Further, the controller measures the temperature in the cooling space $T_{air}$ via a temperature sensor and matches it with the comparison temperature value $T_{SET}$. If the temperature in the cooling space $T_{air}$ after a predetermined time period $t_0$ has not yet reached the comparison temperature value $T_{SET}$, the controller reduces the comparison temperature value $T_{SET}$ by a stored correction value $d_{SET}$. The stored correction value $d_{SET}$ is chosen such that there is no reduction of the comparison temperature value $T_{SET}$ below 0° C. The cooling of the cooling space now is continued until the temperature in the cooling space $T_{air}$ has reached the now reduced comparison temperature value $T_{SET}$ minus the hysteresis value HW. The controller switches off the compressor (C off). Next, the comparison temperature value $T_{SET}$ is gradually increased. Here, each increase of the comparison temperature value $T_{SET}$ in n steps corresponds to the n-th part of the correction value $d_{SET}$. Since now there is no cooling the temperature in the cooling space $T_{air}$ rises. As soon as the temperature in the cooling space has reached the comparison temperature value $T_{SET}$ now increased by $d_{SET}/n$ plus the hysteresis value HW the compressor is switched on again (C on) and the cooling space is cooled again. The temperature in the cooling space $T_{air}$ drops. If this now has reached the comparison temperature value $T_{SET}$ minus the hysteresis value HW the compressor is switched off again (C off) and the comparison temperature value $T_{SET}$ is increased by the next amount $d_{SET}/n$. This process now repeats until the comparison temperature value $T_{SET}$ again corresponds to the desired temperature value SET. Since the controller has an energy supply independent of the compressor also in a brief switch-off of the compressor by lacking solar insolation the cycle is not restarted every time, but continued from the point of interruption. If at the end of the solar cycle, that is at nightfall, not all n steps should have been completed, then the comparison temperature value $T_{SET}$ for the next solar cycle is set back to the desired temperature value SET. In this way, the compressor operating time is maximized and ensured that the cooling elements do completely and homogeneous freeze.

**[0035]** In the following, the mode of operation is explained in detail by way of a numerical example. Here,

**[0036]** Cooling space temperature when putting into operation $T_{air}$: 30° C.

**[0037]** Desired temperature value SET: 5° C.

**[0038]** Comparison temperature value when putting into operation $T_{SET}$: 5° C.

**[0039]** Correction value $d_{SET}$: 2° C.

**[0040]** Hysteresis value HW: 0.1° C.

**[0041]** Number of steps n: 4

**[0042]** predetermined time period $t_0$: 6 h

**[0043]** When putting the cooling device into operation the compressor is switched on and the cooling space temperature $T_{air}$ of 30° C. starts to drop. When after 6 h the cooling space temperature $T_{air}$ is e.g. 9° C. and thus is higher than the comparison temperature value $T_{SET}$ of 5° C., the comparison temperature value $T_{SET}$ is reduced by the correction value $d_{SET}$ to 3° C. As soon as the cooling space temperature $T_{air}$ now has reached a value of 2.9° C. ($T_{SET}$−HW=3° C.−0.1° C.)

the compressor is switched off and the comparison temperature value is increased by 0.5° C. ($d_{SET}$/n=2° C./4) to 3.5° C. The cooling space temperature $T_{air}$ starts to rise. As soon as the cooling space temperature $T_{air}$ has reached a value of 3.6° C. ($T_{SET}$+HW=3.5° C. +0.1° C.) the compressor is switched on again and the cooling space temperature $T_{air}$ drops again. When the cooling space temperature has reached 3.4° C. ($T_{SET}$–HW=3.5° C.–0.1° C.) the compressor is switched off again and the comparison temperature value is increased to 4° C. ($T_{SET}$+$d_{SET}$/n=3.5° C.+2° C./4). This procedure repeats in total n=4 times until the comparison temperature value $T_{SET}$ again corresponds to the desired temperature value SET of 5° C. Then, the compressor is switched on at a temperature in the cooling space $T_{air}$ of 5.1° C. ($T_{SET}$+HW=5° C.+0.1° C.) and switched off at a cooling space temperature of 4.9° C. ($T_{SET}$–HW=5° C.–0.1° C.).

**[0044]** In FIG. **4**, a time chart is illustrated that continues the time chart of FIG. **3**. In this illustration, the comparison temperature value $T_{SET}$ is already again identical to the desired temperature value SET and the compressor is switched on and off as stated above. The temperature in the cooling space $T_{air}$ oscillates around the comparison temperature value $T_{SET}$. If now there is a longer interruption of the energy supply, for example at night, the compressor is switched off (C off) and the temperature in the cooling space $T_{air}$ rises. As soon as energy is available again the compressor is switched on (C on) and the cycle described in FIG. **3** is restarted. The comparison temperature value $T_{SET}$ corresponds to the desired temperature value SET. The cooling space temperature $T_{air}$ reaches the comparison temperature value $T_{SET}$ within the time t, wherein this time period t is less than the predetermined time period $t_0$. Thus, the comparison temperature value $T_{SET}$ is not reduced by the correction value $d_{SET}$, but remains identical to the desired temperature value SET.

**[0045]** FIG. **5** in principal shows the same time chart as in FIG. **3**, wherein in this example additionally an extra evaporator and an extra cooling space are provided that can be controlled by a valve (V). The temperature of the extra cooling space $T_{buffer}$ when putting into operation corresponds to the ambient temperature and thus the cooling space temperature $T_{air}$. In contrast to the time chart illustrated in FIG. **3** in this example the compressor is not switched off if the cooling space temperature $T_{air}$ corresponds to the comparison temperature value $T_{SET}$, but the valve is switched such that the extra cooling space (V on) is cooled and the temperature in the extra cooling space $T_{buffer}$ drops. When switching the valve also the comparison temperature value $T_{SET}$ is gradually increased by the n-th part of the correction value $d_{SET}$. As soon as the temperature in the cooling space $T_{air}$ corresponds to the now increased comparison temperature value $T_{SET}$ plus the hysteresis value HW the valve is switched off again (V off) and the cooling space is cooled, whereby the cooling space temperature $T_{air}$ drops again. The valve is only switched again when the cooling space temperature $T_{air}$ has reached the comparison temperature value $T_{SET}$ minus the hysteresis value HW. This process is then repeated for n times in total until the comparison temperature value $T_{SET}$ again corresponds to the desired temperature value SET. As can well be seen in this example, the compressor is not switched off during the whole cycle, but remains permanently switched on (C on).

LIST OF REFERENCE NUMBERS

**[0046]** **1** cooling device
**[0047]** **2** primary cooling circuit
**[0048]** **3** compressor
**[0049]** **4** condenser
**[0050]** **5** evaporator
**[0051]** **6** controller
**[0052]** **7** extra evaporator
**[0053]** **8** valve
**[0054]** **9** second cooling circuit
**[0055]** **10** compressor
**[0056]** **11** additional circuit
**[0057]** **12** second evaporator
**[0058]** **13** condenser
**[0059]** **14** filter drier
**[0060]** **15** throttle
**[0061]** **16** solar module
**[0062]** **17** line
**[0063]** **18** control line
**[0064]** **19** first control line
**[0065]** **20** second control line
**[0066]** **21** third control line
**[0067]** $T_{air}$ cooling space temperature
**[0068]** $T_{SET}$ comparison temperature value
**[0069]** $T_{buffer}$ storage tank temperature
**[0070]** SET desired temperature value
**[0071]** $d_{SET}$ correction value
**[0072]** $t_0$ predetermined time period
**[0073]** t time
**[0074]** n steps
**[0075]** C compressor switching
**[0076]** V valve switching

What is claimed is:

**1**. A cooling device comprising at least one regeneratively operated primary cooling circuit, in particular a solar-operated cooling circuit, wherein the cooling circuit has at least one compressor, at least one condenser, at least one evaporator, at least one cooling space, at least one temperature sensor for measuring the cooling space temperature in the cooling space, and a controller, wherein a desired temperature value of the cooling spaces and a comparison temperature value can be stored in the controller,

wherein the cooling of the cooling space can be interrupted by the controller,

and wherein the comparison temperature value can be changed by the controller depending upon the time and/or the cooling space temperature.

**2**. The cooling device of claim **1**,

wherein the primary cooling circuit has at least one extra cooling space and at least one extra evaporator assigned to the extra cooling space, wherein the extra evaporator is connected to the primary cooling circuit via a valve, and the cooling of the cooling space can be interrupted by switching the valve.

**3**. The cooling device of claim **2**,

wherein the cooling device has a second cooling circuit with a second compressor for cooling a second cooling space, and wherein the second compressor can be supplied with energy via a switch.

**4**. The cooling device of claim **3**,

wherein the cooling device has an additional circuit, and wherein the controller can be supplied with energy via the additional circuit.

**5**. The cooling device of claim **4**,
wherein the additional circuit has a DC transformer.

**6**. The cooling device of claim **5**,
wherein the additional circuit has at least one condenser.

**7**. A method for controlling the cooling device of claim **1**,
wherein when switching on the controller the comparison temperature value corresponds to the desired temperature value, and the cooling of the cooling space is interrupted when the actual cooling space temperature has reached the comparison temperature value, wherein the comparison temperature value is reduced after a predetermined time period by a stored correction value, as long as the actual cooling space temperature has not reached the comparison temperature value within the predetermined time period).

**8**. The method of claim **7**,
wherein the cooling of the cooling space is interrupted by switching off the compressor.

**9**. The method claim **8**,
wherein when the actual cooling space temperature falls below the comparison temperature value by a hysteresis value the compressor is switched off.

**10**. The method of claim **9**,
wherein when the actual cooling space temperature exceeds the comparison temperature values by the hysteresis value the compressor is switched on.

**11**. The method of claim **10**,
wherein the comparison temperature value is gradually increased by an amount of the stored correction value until the comparison temperature value corresponds to the desired temperature value, and wherein the comparison temperature value is increased by the next step when the compressor is switched off.

**12**. The method of claim **7**,
wherein the cooling of the cooling space is interrupted by switching the valve.

**13**. The method of claim **12**,
wherein when the actual cooling space temperature falls below the comparison temperature value by a hysteresis value the valve is switched.

**14**. The method of claim **13**,
wherein when the actual cooling space temperature exceeds the comparison temperature value by the hysteresis value the valve is switched.

**15**. The method of claim **14**,
wherein the comparison temperature value is gradually increased by an amount of the stored correction value until the comparison temperature value corresponds to the desired temperature value, and wherein the comparison temperature value is increased by the next step when the valve is switched.

**16**. The method of claim **15**,
wherein the second compressor is supplied with energy via a switch.

**17**. The method of claim **16**,
wherein the second compressor is supplied with energy when the compressor of the primary cooling circuit is switched off.

**18**. The method of claim **17**,
wherein with sufficient energy the second compressor and the compressor of the primary cooling circuit are simultaneously supplied with energy.

**19**. The method of claim **18**,
wherein the output voltage of the additional circuit is maintained constant by the DC transformer independent of the input voltage.

**20**. The method of claim **19**,
wherein switching off the controller during a critical time period by the at least one condenser of the additional circuit is prevented.

**21**. The method of claim **20**,
wherein when switching on the controller the comparison temperature value is set to the desired temperature value.

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