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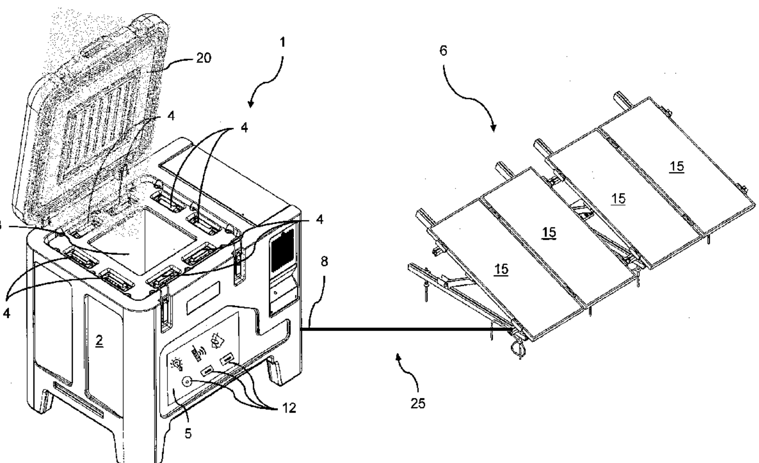

Fig. 2

(57) Abstract: A cooling device (1), in particular a freezer (2), comprising at least one closable refrigeration chamber (3), an electrically operated cooling circuit, and preferably a cold accumulator (4), wherein the at least one closable refrigeration chamber (3) and the cold accumulator (4) can be cooled by the electrically operated cooling circuit. The cooling device has a power distributor (5) for distributing electrical power from at least one renewable power source (6) to the electrically operated cooling circuit of the cooling device (1) and to at least one additional electrical consumer (7). The power distributor (5) also has a controller which has a computing unit (23), a memory (24), and a logic circuit. The logic circuit functions to preferably supply the electrically operated cooling circuit of the cooling device (1) with power during a lack of electrical power from the at least one renewable power source (6).

(57) Zusammenfassung:

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Kühlvorrichtung (1), insbesondere eine Kühltruhe (2), mit wenigstens einem verschließbaren Kühlraum (3), einem elektrisch betriebenen Kühlkreislauf und vorzugsweise einem Kältespeicher (4), wobei der wenigstens eine verschließbare Kühlraum (3) und der Kältespeicher (4) durch den elektrisch betriebenen Kühlkreislauf kühlbar sind. Die Kühlvorrichtung weist einen Stromverteiler (5) zur Verteilung von elektrischer Leistung von wenigstens einer regenerativen Stromquelle (6) an den elektrisch betriebenen Kühlkreislauf der Kühlvorrichtung (1) und an wenigstens einen weiteren elektrischen Verbraucher (7) auf. Zudem verfügt der Stromverteiler (5) über eine Regelung mit einer Recheneinheit (23), einem Speicher (24) sowie einer Vorranglogik. Die Vorranglogik dient dazu, bei einem Mangel an elektrischer Leistung der wenigstens einen regenerativen Stromquelle (6) den elektrisch betriebenen Kühlkreislauf der Kühlvorrichtung (1) bevorzugt mit Strom zu versorgen.

Cooling device

[01] The present invention relates to a cooling device, in particular a cooling device in the form of a freezer, having a closable cooling space, an electrically operated cooling circuit, and preferably a cold accumulator, wherein the at least one closable cooling space and the cold accumulator can be cooled by the electrically operated cooling circuit. Further, the invention relates to a first and a second method to operate a cooling device according to the present invention.

[02] Such cooling devices, in particular freezers, are employed i.a. in remote areas, in particular in developing countries, where a stable and safe and continuous energy supply, for example via a current supply system, cannot be ensured. Nevertheless, above all just in these areas, where often also extreme climatic conditions prevail, an uninterrupted cold chain for storing sensitive cooling goods is indispensable. Here, as sensitive cooling goods i.a. food and in particular medical products, such as for example vaccines, blood conserves, or also any other type of blood products are a possibility. In particular, storing the latter products under the manufacturer’s conditions to be met to maintain the usability and efficacy of the products is often difficult, what is considered to be one of the causes for the extremely poor living conditions of the people living there and significantly contributes to the high mortality rate.

[03] In known cooling devices the closable cooling space as well as an optionally present cold accumulator are cooled by the electric cooling circuit as long as current is available. By constructing the known cooling devices in an isolated manner in case of a failure of the energy or current supply, respectively, the closable cooling space and thus, also a cooling good present in the cooling space, such as for example food stuff or medical products, are protected by the cooling device against excessive heating.

[04] Moreover, there is the need, above all in the above-mentioned regions, where a stable, safe and continuous energy supply cannot be ensured, also to operate other electric devices, for example electrically operated lamps, cellphones, computers, medical devices, or the like as long as energy supply is given. It is known that here often the simultaneous operation of a plurality of consumers causes that the need for electric power strongly rises and thus, exceeds the capacity of the present energy supply, so that the supply of the present cooling device with electric current is no longer ensured.

[05] In order to avoid this, it is known to fall back on an intermediate storage of current by means of accumulators, wherein the accumulators in the period in which energy is available are continuously charged. Due to their capacity of storing electric energy the accumulators buffer peak loads generated upon switching on a plurality of electric consumers such that the accumulator is discharged as long as the need for electric power is higher than that which can be made available via the energy supply.

[06] These systems have proven to be extremely practicable in longstanding field experiments. However, for the safe operation of a cooling device the additional accumulators have to be carried along. Here, on the one hand, drawbacks result from the high weight of the accumulators during transport of the cooling device to its site of operation. Moreover, it has proven to be a problem that accumulators to ensure the energy supply of the cooling device have only a limited durability. Their renewal and disposal causes high costs and a considerable effort. Further, an improper disposal of accumulators results in hazards for health and environment.

[07] Thus, it is the problem of the present invention to provide a cooling device that ensures the desired cooling function and also allows the operation of additional consumers, wherein a safe and reliable operation of the cooling device, in particular under adverse conditions, without any impairments is possible, that is, that the cooling space as well as the cooling goods present in the cooling space are reliably stored in the desired temperature range and at the same time the supply of at least one further electric device with current is allowed.

[08] The solution of the problem is accomplished with a cooling device according to claim 1 as well as a method for operating a cooling device according to claim 10, claim 11, or claim 12. Practical developments of the cooling device and the methods for operating the same are described in the dependent claims.

[09] The cooling device according to the invention in contrast to the cooling devices known from the prior art is characterized in that the cooling device has a current distributor for distributing electric power of at least one regenerative current source to an electrically operated cooling circuit of the cooling device and to at least one further consumer, and that the current distributor has at least one power input, a first power output and at least one second power output, wherein the at least one power input can be connected to the at least one regenerative current source and the first power output is constructed as a cooling device connection for

connecting the electrically operated cooling circuit of the cooling device and wherein the at least one second power output is constructed as consumer connection for connecting the at least one further electric consumer. Moreover, the current distributor has an automatic control with a memory, an arithmetic unit, and a priority logic, wherein the priority logic in case of lacking electric power of the at least one regenerative current source first of all supplies the electrically operated cooling circuit of the cooling device with current.

[10] In the cooling device according to the invention there can be refrained from an additional accumulator for buffering peak loads without reducing the security that the cooling device is supplied with sufficient electric power. According to the invention this is achieved by the preferred supply of the electrically operated cooling circuit of the cooling device with current. This can be done automatically and without manual intervention of the operating personnel at the current distributor by the automatic control of the current distributor due to its priority logic. Moreover, the cooling device according to the invention ensures that the generated electric power of the at least one regenerative current source is effectively used, since the cooling device is preferred only in case of a lack of electric power of the at least one regenerative current source.

[11] The connection between the at least one regenerative current source, the current distributor, the electrically operated cooling circuit, and the at least one further electric consumer is preferably via a current conducting cable connection. In particular, the connection between the at least one further consumer and the current distributor can also be cableless. If the current distributor is arranged separate from the housing of the cooling device constructing the cooling device connection as a plug-in connection is useful, as well as those of the consumer connection and the power input at the current distributor. In this way, the at least one further electric consumer and the at least one regenerative current source can be easily connected to the current distributor. Further, also the current distributor of the cooling device can easily be replaced. However, if the current distributor is arranged integrated in the housing of the cooling device, so it can be refrained from constructing the cooling device connection as a plug-in connection.

[12] In a preferred embodiment of the cooling device the at least one regenerative current source is a solar collector or a wind-driven generator. Constructing the regenerative generator as

a solar collector or as a wind-driven generator has the advantage that on the one hand the cooling device as well as its electrically operated cooling circuit can be operated independent from the availability of a local current supply system. On the other hand, solar devices or wind-driven generators, respectively, can relatively easy be transported to and installed in remote areas. Since in addition in the preferred site of operation of the cooling device, in particular in developing countries, often regular and long-term insolation prevails or sufficient wind blows, respectively, solar collectors or wind-driven generators, respectively, are particularly suitable for application as regenerative current sources.

[13] In a suitable development of the cooling device the current distributor has at least one first sensor for determining the power consumption of the electrically operated cooling circuit of the cooling device. In this way, it can particularly effective be determined whether the cooling circuit of the cooling device is sufficiently supplied with current or whether fluctuations in the current supply of the cooling device prevail. Here, the first sensor can either directly or indirectly determine the power consumption of the electrically operated cooling circuit of the cooling device. In the indirect determination of the power consumption the sensor measures further electric parameters, for example the supply voltage applied to the cooling device and/or the current flow. If there is detected an insufficient supply of the electrically operated cooling circuit of the cooling device the automatic control of the current distributor having the priority logic first of all supplies the electrically operated cooling circuit with current over other consumers. In the context of the application, the power consumption of the electrically operated cooling circuit of the cooling device also means the power consumption of the entire cooling device, i.e. the power the cooling device consumes for maintaining the cooling function.

[14] In one development of the cooling device the current distributor has at least one second sensor for determining the density of available energy. It allows a prediction about how much electric power the at least one regenerative current source supplies and whether this is sufficient to also sufficiently supply the at least one further electric consumer with current in addition to the electrically operated cooling circuit of the cooling device. Here, the density of the available energy means the amount of energy acting on the at least one regenerative current source. In the case of a solar collector this for example is the intensity of the insolation acting on the solar collector. This can be determined by means of a photoelectric cell, for example. If a

wind-driven generator is used as the at least one regenerative current source the density of the available energy means the strength of the wind which can be determined by an anemometer, for example. The second sensor is preferably arranged such that it is exposed to the energy acting on the at least one regenerative current source as directly as possible in order to achieve exact measuring values. For example, it is suitable to connect the second sensor by a cabling to the current distributor and to position the second sensor as close as possible to the at least one regenerative current source.

[15] In a suitable development of the cooling device the current distributor disconnects the at least one further electric consumer from the at least one regenerative current source as soon as the produced electric power of the at least one regenerative current source falls below the power consumption of the cooling device and the at least one further electric consumer. By disconnecting the at least one further electric consumer from the at least one regenerative current source first of all the electrically operated cooling circuit can easily be supplied with current. In this way, the cooling of the closable cooling space is not adversely affected by other consumers even with a decreasing electric power of the at least one regenerative current source. Disconnecting the at least one further electric consumer from the at least one regenerative current source can be done for example by de-energizing the at least one second power output.

[16] In a preferred development of the cooling device the current distributor connects the at least one further electric consumer to the at least one regenerative current source as soon as the produced electric power of the at least one regenerative current source exceeds the power consumption of the electrically operated cooling circuit of the cooling device and the at least one further electric consumer. In this way, it is ensured that the electric power generated by the at least one regenerative current source is not wasted. Connecting the at least one electric consumer to the at least one regenerative current source can be done by energizing the at least one second power output by the automatic control of the current distributor.

[17] For operating the cooling device it is suitable that in case of operating a plurality of further electric consumers the current distributor performs disconnection from or connection to the at least one regenerative current source depending on the power consumption of the respective further electric consumer. In this way, an improved use of the excess energy is achieved that is not needed for the operation of the electrically operated cooling circuit. Here, it is

also conceivable that the automatic control of the current distributor either individually or in groups connects the plurality of further electric consumers to the at least one regenerative current source or disconnects them therefrom, respectively, depending on how much electric energy is available that the electrically operated cooling circuit does not need. Dividing the plurality of further electric consumers into groups can be done by the automatic control of the current distributor, so that the sum of the electric power needed by the plurality of the further electric consumers if possible corresponds to the not used electric power of the at least one regenerative current source.

[18] In a suitable development of the cooling device the current distributor supplies the at least one electric consumer with current in a state where the electrically operated cooling circuit of the cooling device does not consume electric power. This provides the advantage that the at least one regenerative current source required for the supply of the electrically operated cooling circuit can be designed with a lower electric power and thus, more compact and inexpensive. Since the electrically operated cooling circuit of the cooling device preferably works, namely cools the at least one cooling space, when the temperature in the at least one closable cooling space threatens to exceed the temperature range desired for the storing of the cooling goods this means that the electrically operated cooling circuit does not need electric current, so far as the temperature in the at least one closable cooling space corresponds to a desired temperature range. The then excess electric power of the at least one regenerative current source can be additionally supplied to the at least one further electric consumer for a period in which the electrically operated cooling circuit is not operated.

[19] In a preferred embodiment of the cooling device the consumer connection is constructed as a charging device for an accumulator-operated electric consumer, in particular a lamp and/or a mobile phone and/or a computer. However, all other types of electrically operated consumers, such as for example medical devices are also conceivable. By connecting an accumulator-operated electric consumer to a consumer connection the excess electric power of the at least one regenerative current source can be stored in the accumulator of the accumulator-operated electric consumer. Thus, for example also at night there is sufficient light available so that also in a remote area patients can be treated with medical products stored in a cooling device according to the invention or medical advice or help can be taken via

communication devices such as the computer or telephone, without having to provide an additional regenerative current source for the supply of the accumulator-operated electric consumer.

[20] A first inventive method for operating a cooling device according to the invention comprises the following processing steps:

a) first determination of the power consumption of the electrically operated cooling circuit of the cooling device by the first sensor before the at least one further electric consumer is connected to the at least one regenerative current source;

b) storing the first determination in the memory of the automatic control;

c) connecting the at least one further electric consumer to the at least one regenerative current source;

d) second determination of the power consumption of the electrically operated cooling circuit of the cooling device by the first sensor after the at least one further electric consumer has been connected to the at least one regenerative current source;

e) comparing the first determination with the second determination in the arithmetic unit;

f) disconnecting the at least one further electric consumer from the at least one regenerative current source, when the power consumption of the second determination is below the power consumption of the first determination;

g) periodic repetition of processing steps a) to f).

[21] The method is based on the finding that the power consumption of the electrically operated cooling circuit decreases as soon as the at least one further electric consumer is energized and the electric power produced by the at least one regenerative current source is not sufficient to sufficiently supply both the electrically operated cooling circuit and the at least one further electric consumer with current. Said decrease in the power consumption is determined by the first sensor of the current distributor and transferred to the automatic control of the current distributor. By means of the priority logic the automatic control then causes that the at least one further electric consumer is disconnected again from the at least one regenerative current source.

[22] However, if there is sufficient electric power of the at least one regenerative current source available for the operation of the electrically operated cooling circuit of the cooling device

as well as the at least one further electric consumer, so the power consumption of the electrically operated cooling circuit in the second determination does not decrease over the first determination. Accordingly, the at least one further electric consumer can be further operated.

[23] Since processing steps a) to f) are repeated periodically, i.e. regularly, on the one hand the automatic control of the current distributor detects an increase or decrease, respectively, of the electric power produced by the at least one regenerative current source and accordingly, the at least one further electric consumer is connected to or disconnected from the at least one regenerative current source, respectively. Moreover, the automatic control of the current distributor also considers a changed power consumption of the electrically operated cooling circuit, for example when in operation it cools the at least one closable cooling space or when the electrically operated cooling circuit is not operated. This makes it possible to deliver a maximum of excess electric power to the at least one further electric consumer.

[24] The second inventive method for operating a cooling device according to the invention comprises the following processing steps:

a) entering the maximum power consumption of the electrically operated cooling circuit of the cooling device, entering the performance characteristics of the regenerative current source, and entering the maximum power consumption of the at least one further electric consumer into the memory of the automatic control;

b) determining the density of the available energy by the second sensor;

c) calculating the available power of the regenerative current source in the arithmetic unit of the automatic control by mans of the performance characteristics of the regenerative current source and the density of the available energy;

d) connecting the at least one further electric consumer to the at least one regenerative current source, when the available power of the regenerative current source is greater than or equal to the sum of the maximum power consumption of the electrically operated cooling circuit of the cooling device and the maximum power consumption of the at least one further electric consumer;

e) disconnecting the at least one further electric consumer from the at least one regenerative current source, when the available power of the regenerative current source is smaller than the sum of the maximum power consumption of the electrically operated cooling circuit of the cooling device and the maximum power consumption of the at least one further electric consumer;

f) periodic repetition of processing steps b) to e).

[25] The second method provides the advantage that always a fixed amount of the electric power produced by the at least one regenerative current source is reserved for the operation of the electrically operated cooling circuit of the cooling device. In this way, certainly the electric power provided for the at least one further electric consumer is decreased, but at the same time the security of sufficient electric energy supply of the cooling device is increased. The method is based on the fact that it is predicted how much electric power the at least one regenerative current source produces and whether this is sufficient to also sufficiently supply the at least one further electric consumer with current in addition to the electrically operated cooling circuit of the cooling device. By means of the performance characteristics of the at least one regenerative current source and the determined density of the available energy the available power of the at least one regenerative current source is calculated. According to the invention, among the performance characteristics of the at least one regenerative current source there is calculated at which density of available energy the at least one regenerative current source actually provides how much electric power.

[26] If the amount of the available electric power of the regenerative current source is greater than or equal to the sum of the maximum power consumption of the electrically operated cooling circuit of the cooling device and the maximum power consumption of the at least one further electric consumer the automatic control connects the at least one further electric consumer to the at least one regenerative current source. However, if the available power of the regenerative current source is not sufficient the at least one further electric consumer is disconnected from the at least one regenerative current source by the automatic control or even not connected thereto.

[27] Since the determination of the density of the available energy as well as the subsequent processing steps are performed periodically, i.e. are regularly repeated, the automatic control of the current distributor ensures that even in case of a changeable density of the available energy always the maximum need of electric power is available for the electrically operated cooling circuit of the cooling device.

[28] The third inventive method for operating a cooling device according to the invention

comprises the following processing steps:

a) entering the operating voltage/desired voltage into the memory;

b) first voltage measurement of the supply voltage applied to the cooling device by the first sensor;

c) storing the value of the first voltage measurement in the memory of the automatic control;

d) comparing the operating voltage/desired voltage to the value of the first voltage measurement in the automatic control: if the value of the first voltage measurement is smaller than the operating voltage/desired voltage continue to processing step b), otherwise continue to processing step e);

e) connecting the at least one further electric consumer to the at least one regenerative current source;

f) second voltage measurement of the supply voltage applied to the cooling device by the first sensor after the at least one further electric consumer has been connected to the at least one regenerative current source;

g) comparing the operating voltage/desired voltage to the value of the second voltage measurement in the automatic control: if the value of the second voltage measurement is greater than or equal to the operating voltage/desired voltage continue to processing step f), otherwise continue to processing step h);

h) disconnecting the at least one further electric consumer from the at least one regenerative current source, when the operating voltage/desired voltage is greater than the value of the second voltage measurement;

i) periodic repetition of processing steps b) to h).

[29] The method is based on the finding that the electric supply voltage with which the electrically operated cooling circuit of the cooling device is supplied decreases as soon as the at least one further electric consumer is energized and the electric power produced by the at least one regenerative current source is not sufficient to sufficiently supply both the electrically operated cooling circuit and the at least one further electric consumer with current.

[30] Here, in the method according to the invention at first there is measured in a first voltage measurement how high the supply voltage is before energizing the at least one further electric consumer. If the measured value of the supply voltage from the first voltage

measurement is smaller than the operating voltage/desired voltage of the electrically operated cooling circuit of the cooling device the electric power produced by the at least one regenerative current source is not sufficient to also supply the at least one further electric consumer.

[31] If the measured value of the first voltage measurement is equal to or greater than the operating voltage/desired voltage the at least one further electric consumer can be energized. If in a subsequent second voltage measurement of the supply voltage it is found that the value of the second voltage measurement does not dip or decreases, respectively, over the operating voltage/desired voltage the electric power produced by the at least one regenerative current source is also sufficient to supply both the electrically operated cooling circuit of the cooling device and the at least one further electric consumer. However, if the supply voltage dips or decreases, respectively, the at least one further electric consumer again is disconnected from the at least one regenerative current source to ensure the preferred current supply of the electrically operated cooling circuit of the cooling device.

[32] Moreover, the above-described effect of dipping/decreasing of the supply voltage occurs also when the power consumption of the cooling device increases. For example, this may be the case when the electrically operated cooling circuit, for example after placing new cooling goods into the at least one closable cooling space, again starts to cool it and at the same time the electric power produced by the at least one regenerative current source is not sufficient to sufficiently supply the at least one further electric consumer.

[33] Since the processing steps b) to i) are repeated periodically, i.e. regularly, on the one hand a dipping of the electric supply voltage is detected as soon as on the one hand the power consumption of the electrically operated cooling circuit increases or the electric power produced by the at least one regenerative current source decreases. Accordingly, on the one hand there is ensured that the electrically operated cooling circuit of the cooling device is safely supplied with sufficient current and on the other hand a maximum of excessively produced electric power is provided for the at least one further electric consumer.

[34] In the following, the invention is explained in detail with the help of three examples of the cooling device illustrated in the figures. Here:

Fig. 1 shows a cooling device in a first embodiment;

Fig. 2 shows a cooling device in a second embodiment;

Fig. 3 shows a schematic arrangement of the components of a cooling device according to the first or second embodiment;

Fig. 4 shows a schematic arrangement of the components of a cooling device according to a third embodiment;

Fig. 5 shows a detail view of the current distributor for a cooling device according to the first or second embodiment;

Fig. 6 shows a perspective front view of the cooling device according to the first embodiment;

Fig. 7 shows a perspective rear view of a cooling device according to the first embodiment;

Fig. 8 shows a perspective rear view of the current distributor shown in Fig. 7;

Fig. 9 shows a flow chart with the processing steps of the first method;

Fig. 10 shows a flow chart with the processing steps of the second method; and

Fig. 11 shows a flow chart with the processing steps of the third method.

[35] The first embodiment of the cooling device 1 according to the invention shown in Fig. 1 is in the form of a freezer 2 and can be closed with a freezer lid 20. The cooling device 1 via a cabling 25 at the first power output 9 with its cooling device connection 11 is connected to the current distributor 5. The current distributor 5 in turn is connected to a regenerative current source 6 via a cabling 25 from its power input 8. Here, the regenerative current source 6 is comprised of four solar panels 15. Moreover, the current distributor has a second power output 10 having three consumer connections. A computer 18 and a telephone 19 as electric consumers 7 each are connected to two of the three consumer connections. In the first embodiment of the cooling device 1 the current distributor 5 is arranged separate from the cooling device 1 and is only connected to it via the cabling 25.

[36] In the second embodiment of the cooling device 1 according to the invention shown in Fig. 2 the cooling device is in the form of a freezer 2 in the inside of which there is the closable cooling space 3. Inside the freezer 2 eight cold accumulators 4 are arranged. The second embodiment of the cooling device 1 differs from the first embodiment in that the current distributor 5 is arranged integrated in the cooling device 1. Here, the cabling 25 extends from the at least one regenerative current source 6 directly via the power input 8 to the current distributor 5. The shown embodiment of the at least one regenerative current source 6 in Fig. 2 also comprises four solar panels 15. In the second embodiment of the cooling device 1 the cooling

device connection 11 of the first power output 9 that supplies the electrically operated cooling circuit of the cooling device 1 with electric current is arranged covered in the freezer 2 and thus, cannot be seen in the illustration of Fig. 2. In the second embodiment three consumer connections 12 of the current distributor 5 are arranged on the freezer 2 such that they are easily accessible, so that the at least one electric consumer 7 (not shown) can be connected to the current distributor 5.

[37] In the schematic illustration shown in Fig. 3 the individual components of the cooling device 1 in the first and the second embodiment are arranged relative to each other and connected via cablings 25. For the schematic illustration of the arrangement it is not relevant whether the current distributor 5 is integrated in the cooling device 1 or is arranged outside of the cooling device 1. As already shown in fig. 1 and fig. 2 the regenerative current source 6 on the power input 8 is connected to the current distributor 5 via a cabling 25. Moreover, also the cooling device 1 with its electrically operated cooling circuit is connected to the current distributor 5 via the cooling device connection 11 of the first power output 9 via the cabling 25. Further, it is illustrated in fig. 3 how two of the at least one further electric consumers 7 are connected to the current distributor 5 each via a cabling 25 and the consumer connections 12 of the second power output 10. The schematically shown first sensor 13 arranged inside the current distributor 5 serves for determining the power consumption of the electrically operated cooling circuit of the cooling device 1.

[38] The schematic illustration of a cooling device 1 of a third embodiment of the cooling device 1 shown in Fig. 4 differs from the first and second embodiment, respectively, of the cooling device 1 in that the current distributor 5 has a second sensor 14 which measures the density of the available energy acting on the at least one regenerative current source. Also in the shown third example the current distributor 5 can be integrated in the cooling device 1 or arranged outside the cooling device 1. However, the second sensor is arranged outside of the cooling device 1 close to the at least one regenerative current source 6. Moreover, the embodiment shown in Fig. 6 has two regenerative current sources 6 connected to the current distributor. Here, the arrangement of the further components in Fig. 4 corresponds to the schematic arrangement shown in Fig. 3.

[39] he current distributor 5 of the first embodiment of the cooling device 1 shown in Fig. 5 is

arranged outside of the cooling device 1. The current distributor 5 has a power input 8, a first power output 9 with a cooling device connection 11 as well as a second power output 10 having three consumer connections 12. The first sensor for determining the power consumption of the electrically operated cooling circuit of the cooling device 1 is installed inside the current distributor 5 (not visible).

[40] The inventive cooling device 1 according to the first embodiment shown in Fig. 6 has a current distributor 5 that is laterally attached to the cooling device 1. Here, the cooling device 1 is in the form of a freezer 2. It is closed by a freezer lid 20. The connection between the cooling device 1 and the current distributor 5 corresponds to the embodiment shown in Fig. 3, wherein the at least one regenerative current source 6 however is not shown. A lamp 17 as the at least one further electric consumer 7 is illustrated at the second power output 10. Moreover, the current distributor 5 has a place to put something 21 and four further consumer connections 12 at the second power output 10.

[41] In the cooling device 1 shown Fig. 7 the current distributor 5 is attached by means of a guide bar 22 on the rear of the freezer 2. The guide bar 22 laterally protrudes beyond the freezer 2, so that the current distributor 5 can be laterally arranged on the cooling device 1. The power input 8 and the first power output 9 are arranged on the rear of the current distributor 5. The first power output 9 is connected to the cooling device connection 11 via a cabling 25 on the rear of the freezer 2.

[42] The power input 8 shown in Fig. 8 and the first power output 9 of the current distributor 5 together with the cooling device connection 11 are constructed as a plug-in connection.

[43] Fig. 9 shows a flow chart about the course of the first method for operating a cooling device 1. Here, the first method is suitable for operating a cooling device 1 according to the first and second embodiment, respectively. First, a first determination P_1 of the power consumption of the electrically operated cooling circuit is performed. The value of the first determination P_1 is stored in the memory 24 of the automatic control of the current distributor 5. Subsequently, the at least one further electric consumer 7 is connected to the at least one regenerative current source 6. This is followed by a second determination P_2 of the power consumption of the electrically operated cooling circuit. In the arithmetic unit 23 of the current distributor 5 there is performed a comparison between the measured value of the first determination P_1 and the measured value of

the second determination P_2. If here, the measured value of the second determination P_2 is below the measured value of the first determination P_1 this means that the at least one regenerative current source 6 cannot provide sufficient electric power to sufficiently supply both the electrically operated cooling circuit of the cooling device 1 as well as the at least one further electric consumer 7 with current. Accordingly, the automatic control disconnects the at least one further electric current consumer 7 from the regenerative current source 6 to ensure the supply of the electrically operated cooling circuit. If however, the measured value of the first determination P_1 is equal to the measured value of the second determination P_2 this means that the regenerative current source 6 provides sufficient electric power to supply both the electrically operated cooling circuit of the cooling device 1 and the at least one further electric consumer 7 with current. Accordingly, the connection between the at least one regenerative current source 6 and the at least one further electric consumer 7 is not disconnected. After completion of the comparison between the measured value of the first determination P_1 and the measured value of the second determination P_2 the processing steps are repeated by a new determination of the measured value of the first determination P_1.

[44] Fig. 10 shows a flow chart about the processing steps of the second method for operating a cooling device 1. The second method for operating a cooling device 1 is suitable to operate a cooling device 1 according to the third embodiment. At first, in the process flow the maximum power consumption $P_{max(1)}$ of the electrically operated cooling circuit of the cooling device 1 as well as the maximum power consumption $P_{max(7)}$ of the at least one further electric consumer is stored in the memory 24 of the automatic control of the current distributor 5. Moreover, in the memory 24 of the automatic control also the performance characteristics $P_{max(6)}$ of the regenerative current source 6 are entered and stored. Subsequently, there is performed a determination of the density of the available energy Q by the second sensor 14. By means of the stored performance characteristics $P_{max(6)}$ of the at least one regenerative current source as well as the density of the available energy Q the available power P_{act} of the at least one regenerative current source 5 can be calculated in the arithmetic unit 23 of the automatic control.

[45] Subsequently, the available electric power P_{act} of the at least one regenerative current source 6 is compared to the sum of the maximum power consumption $P_{max(1)}$ required for the operation of the electrically operated cooling circuit of the cooling device and the maximum

power consumption $P_{max(7)}$ of the at least one further electric consumer 7. If the result of the comparison is that the available power P_{act} of the at least one regenerative current source 6 is greater than or equal to the sum of the maximum power consumption $P_{max(1)}$ of the electrically operated cooling circuit and the maximum power consumption $P_{max(7)}$ of the at least one further electric consumer 7, the one further electric consumer 7 is connected to the at least one regenerative current source 6. If otherwise the available electric power P_{act} of the regenerative current source is too low, the at least one further electric consumer 7 is disconnected from the at least one regenerative current source 6 or not connected thereto, respectively. After completion of the processing steps a new determination of the density of the available energy Q is performed and the method is executed again.

[46] Fig. 11 shows a flow chart about the processing steps of the third method for operating a cooling device 1. Here, the third method is suitable for operating a cooling device 1 according to the first or second embodiment, respectively. At first, in the process flow the operating voltage/desired voltage U_{op} of the electrically operated cooling circuit of the cooling device 1 is stored in the automatic control of the current distributor 5. Subsequently, there is performed a first voltage measurement U_1 of the supply voltage. The value of the first voltage measurement U_1 is stored in the memory 24 of the automatic control of the current distributor 5.

[47] Subsequently, as illustrated in Fig. 11, the measured value of the first voltage measurement U_1 is compared to the operating voltage/desired voltage U_{op} in the automatic control. If the result is that the measured value of the first voltage measurement U_1 is smaller than the operating voltage/desired voltage U_{op}, a new first voltage measurement U_1 is performed. However, if the measured value of the first voltage measurement U_1 is greater than or equal to the operating voltage/desired voltage U_{op}, the at least one further electric consumer 7 is connected to the at least one regenerative current source 6. Subsequently, in a second voltage measurement U_2 the supply voltage is measured and in the automatic control compared to the operating voltage/desired voltage U_{op}. If the result is that the measured value of the second voltage measurement U_2 is greater than or equal to the operating voltage/desired voltage U_{op}, a new second voltage measurement U_2 of the supply voltage and a new comparison between the measured value of the second voltage measurement U_2 and the operating voltage/desired voltage U_{op} are performed. If the measured value of the second voltage measurement U_2 is

smaller than the operating voltage/desired voltage U_{op}, the at least one further electric consumer 7 is disconnected from the at least one regenerative current source 6. After the at least one further electric consumer 7 has been disconnected from the at least one regenerative current source 6 a new first voltage measurement U_1 of the supply voltage is performed. Processing steps b) to h) are regularly repeated.

List of Reference Numbers

1: cooling device

2: freezer

3: closable cooling space

4: cold accumulator

5: current distributor

6: regenerative current source

7: electric consumer

8: power input

9: first power output

10: second power output

11: cooling device connection

12: consumer connection

13: first sensor

14: second sensor

15: solar collector

16: wind-driven generator

17: lamp

18: computer

19: telephone

20: freezer lid

21: place to put something

22: attaching device

23: arithmetic unit

24 memory

25: cabling

P_1: first determination

P_2: second determination

$P_{max(1)}$: maximum power consumption of the electrically operated cooling circuit

$P_{max(7)}$: maximum power consumption of the at least one further electric consumer

$P_{max(6)}$: performance characteristics of the at least one regenerative current source

P_{act}: available power of the at least one regenerative current source

Q: density of the available energy

U_{op}: operating voltage/desired voltage

U_1: first voltage measurement

U_2: second voltage measurement

Claims

1. A cooling device (1), in particular a freezer (2), having at least one closable cooling space (3), an electrically operated cooling circuit, and preferably a cold accumulator (4), wherein the at least one closable cooling space (3) and the cold accumulator (4) can be cooled by the electrically operated cooling circuit,
characterized in that
the cooling device (1) has a current distributor (5) for distributing electric power of at least one regenerative current source (6) to an electrically operated cooling circuit of the cooling device (1) and to at least one further electric consumer (7), and
the current distributor (5) has at least one power input (8), a first power output (9) and at least one second power output (10), wherein the at least one power input (8) can be connected to the at least one regenerative current source (6) and wherein the first power output (9) is constructed as a cooling device connection (11) for connecting the electrically operated cooling circuit of the cooling device (1) and wherein the at least one second power output (10) is constructed as consumer connection (12) for connecting the at least one further electric consumer (7) and wherein the current distributor (5) has an automatic control with an arithmetic unit (23), a memory (24), and a priority logic, wherein the priority logic in case of lacking electric power of the at least one regenerative current source (6) first of all supplies the electrically operated cooling circuit of the cooling device (1) with current.

2. The cooling device (1) according to claim 1,
characterized in that
the at least one regenerative current source (6) is a solar collector (15) or a wind-driven generator (16).

3. The cooling device (1) according to claim 1 or 2,
characterized in that
the current distributor (5) has at least one first sensor (13) for determining a power consumption of the electrically operated cooling circuit of the cooling device (1).

4. The cooling device (1) according to any one of the preceding claims,
characterized in that
the current distributor (5) has at least one second sensor (14) for determining the density of available energy.

5. The cooling device (1) according to any one of the preceding claims,
characterized in that
the current distributor (5) disconnects the at least one further electric consumer (7) from the at least one regenerative current source (6) as soon as the produced electric power of the at least one regenerative current source (6) falls below the power consumption of the cooling device (1) and the at least one further electric consumer (7).

6. The cooling device (1) according to any one of the preceding claims,
characterized in that
the current distributor (5) connects the at least one further electric consumer (7) to the at least one regenerative current source (6) as soon as the produced electric power of the at least one regenerative current source (6) exceeds the power consumption of the electrically operated cooling circuit of the cooling device (1) and the at least one further electric consumer (7).

7. The cooling device (1) according to claim 5 or 6,
characterized in that
in case of operating a plurality of further electric consumers (7) the current distributor (5) performs disconnection from or connection to the at least one regenerative current source (6) depending on the power consumption of the respective further electric consumer (7).

8. The cooling device (1) according to any one of the preceding claims,
characterized in that
the current distributor (5) supplies the at least one further electric consumer (7) with current in a state where the electrically operated cooling circuit of the cooling device (1) does not consume

electric power.

9. The cooling device (1) according to any one of the preceding claims, characterized in that the consumer connection (12) is constructed as a charging device for an accumulator-operated electric consumer, in particular a lamp (18) and/or a computer (18) and/or a telephone (19) or for an accumulator itself.

10. A method for operating a cooling device (1) according to any one of claims 1 to 9 with the following processing steps:

a) first determination (P_1) of the power consumption of the electrically operated cooling circuit of the cooling device (1) by the first sensor (13) before the at least one further electric consumer (7) is connected to the at least one regenerative current source (6);

b) storing the first determination (P_1) in the memory (24) of the automatic control;

c) connecting the at least one further electric consumer (7) to the at least one regenerative current source (6);

d) second determination (P_2) of the power consumption of the electrically operated cooling circuit of the cooling device (1) by the first sensor (13) after the at least one further electric consumer (7) has been connected to the at least one regenerative current source (6);

e) comparing the first determination (P_1) with the second determination (P_2) in the arithmetic unit;

f) disconnecting the at least one further electric consumer (7) from the at least one regenerative current source (6), when the power consumption of the second determination (P_2) is below the power consumption of the first determination (P_1);

g) periodic repetition of processing steps a) to f).

11. A method for operating a cooling device (1) according to any one of claims 1 to 9 with the following processing steps:

a) entering the maximum power consumption ($P_{max(1)}$) of the electrically operated cooling circuit of the cooling device (1), entering the performance characteristics ($P_{max(6)}$) of the regenerative current source (6), and entering the maximum power consumption ($P_{max(7)}$) of the at least one further electric consumer (7) into the memory (24) of the automatic control;

b) determining the density of the available energy (Q) by the second sensor (14);

c) calculating the available power (P_{act}) of the regenerative current source (6) in the arithmetic unit (23) of the automatic control by means of the performance characteristics ($P_{max(6)}$) of the regenerative current source (6) and the density of the available energy (Q);

d) connecting the at least one further electric consumer (7) to the at least one regenerative current source (6), when the available power (P_{act}) of the regenerative current source (6) is greater than or equal to the sum of the maximum power consumption of the electrically operated cooling circuit of the cooling device (1) and the maximum power consumption of the at least one further electric consumer (7);

e) disconnecting the at least one further electric consumer (7) from the at least one regenerative current source (6), when the available power (P_{act}) of the regenerative current source (6) is smaller than the sum of the maximum power consumption of the electrically operated cooling circuit of the cooling device (1) and the maximum power consumption of the at least one further electric consumer (7);

f) periodic repetition of processing steps b) to e).

12. A method for operating a cooling device (1) according to any one of claims 1 to 9 with the following processing steps:

a) entering the operating voltage/desired voltage (U_{op}) into the memory (24);

b) first voltage measurement (U_1) of the supply voltage applied to the cooling device (1) by the first sensor (13);

c) storing the value of the first voltage measurement (U_1) in the memory (24) of the automatic control;

d) comparing the operating voltage/desired voltage (U_{op}) to the value of the first voltage measurement (U_1) in the automatic control: if the value of the first voltage measurement (U_1) is smaller than the operating voltage/desired voltage (U_{op}) continue to processing step b), otherwise continue to processing step e);

e) connecting the at least one further electric consumer (7) to the at least one regenerative current source (6);

f) second voltage measurement (U_2) of the supply voltage applied to the cooling device (1) by the first sensor (13) after the at least one further electric consumer (7) has been connected to the at least one regenerative current source (6);

g) comparing the operating voltage/desired voltage (U_{op}) to the value of the second voltage measurement (U_2) in the automatic control: if the value of the second voltage measurement (U_2) is greater than or equal to the operating voltage/desired voltage (U_{op}) continue to processing step f), otherwise continue to processing step h);

h) disconnecting the at least one further electric consumer (7) from the at least one regenerative current source (6), when the operating voltage/desired voltage (U_{op}) is greater than the value of the second voltage measurement (U_2);

i) periodic repetition of processing steps b) to h).

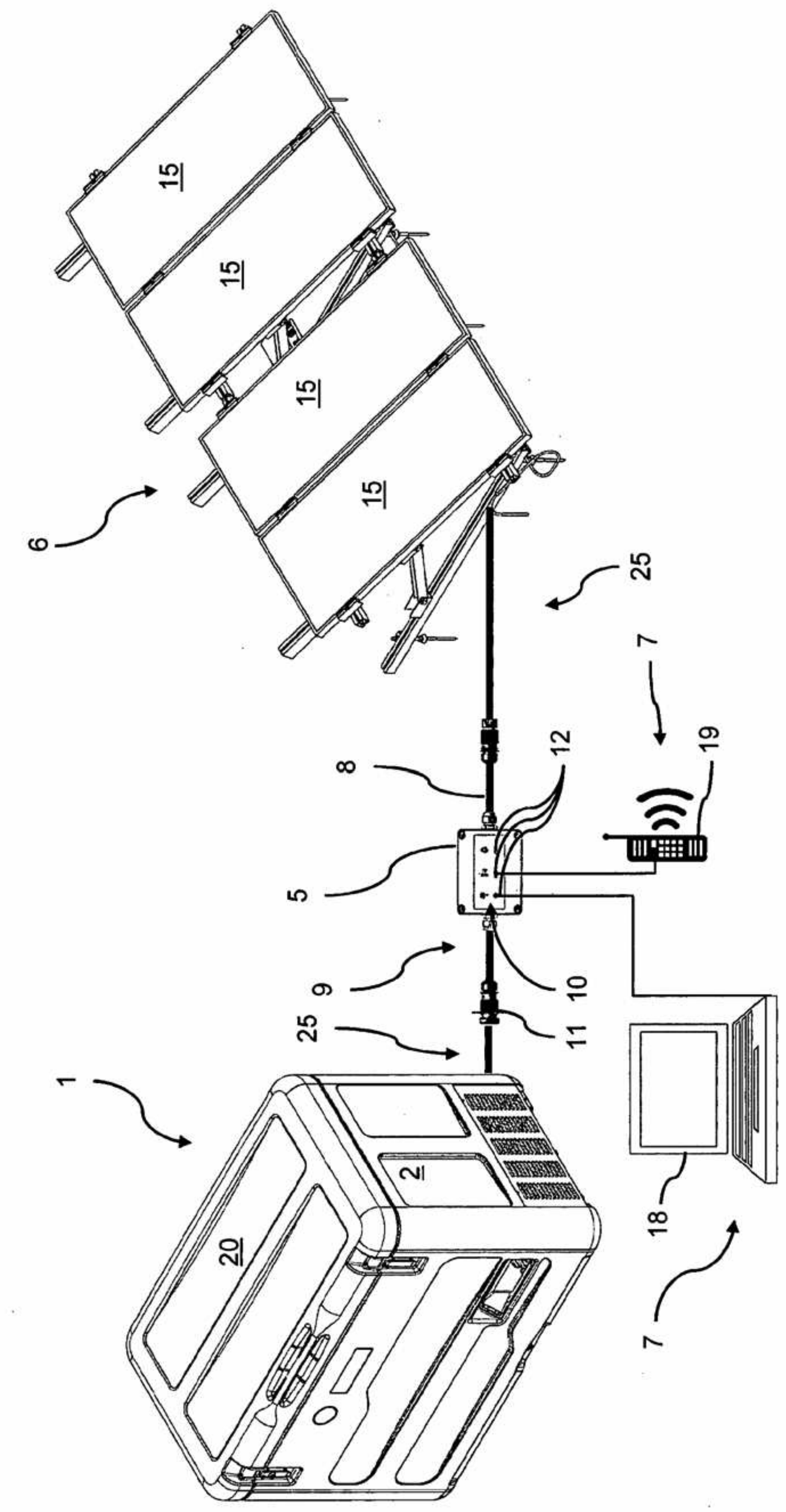

Fig. 1

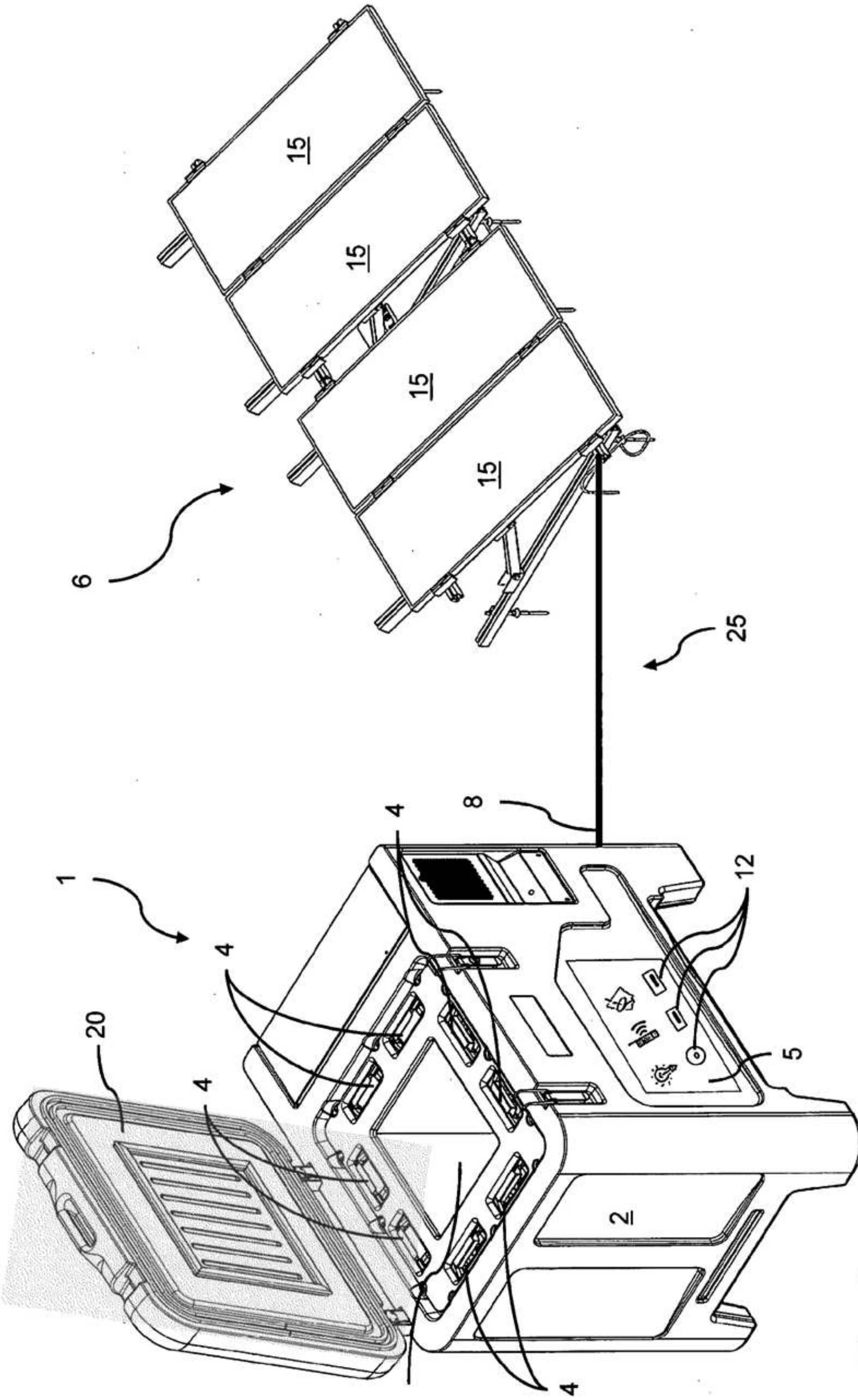

Fig. 2

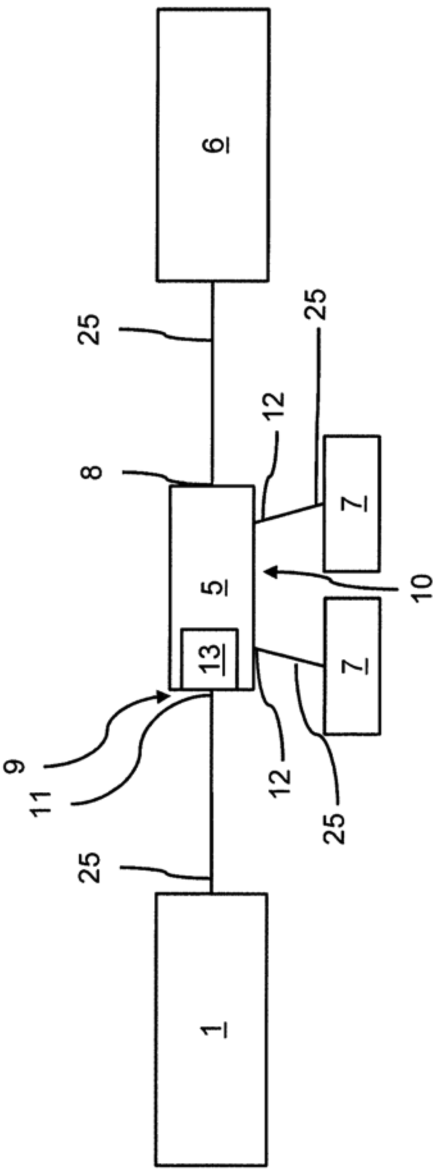

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Fig. 3

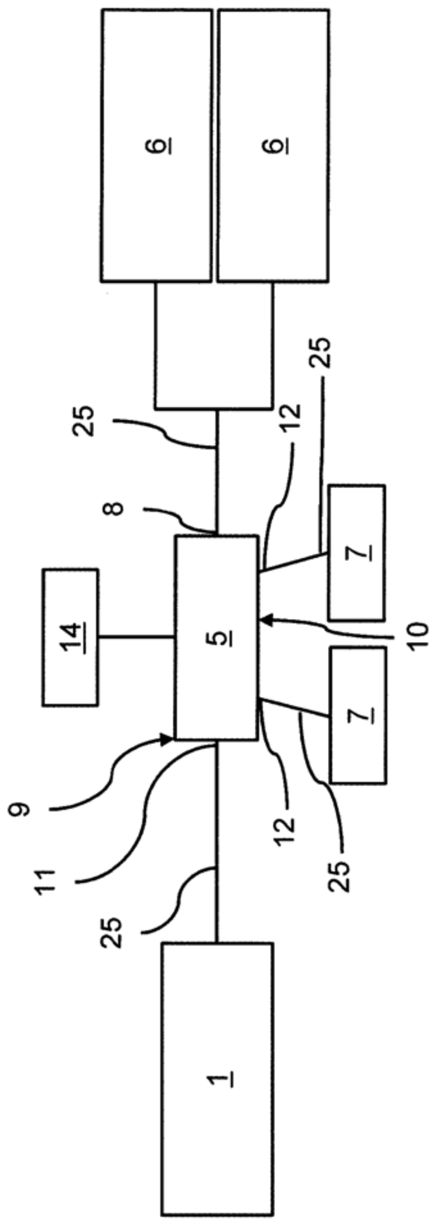

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Fig. 4

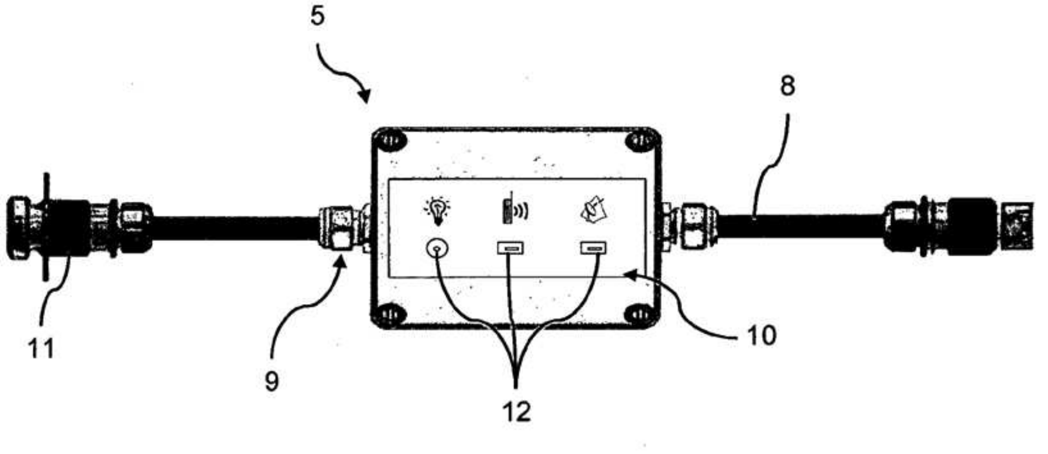

Fig. 5

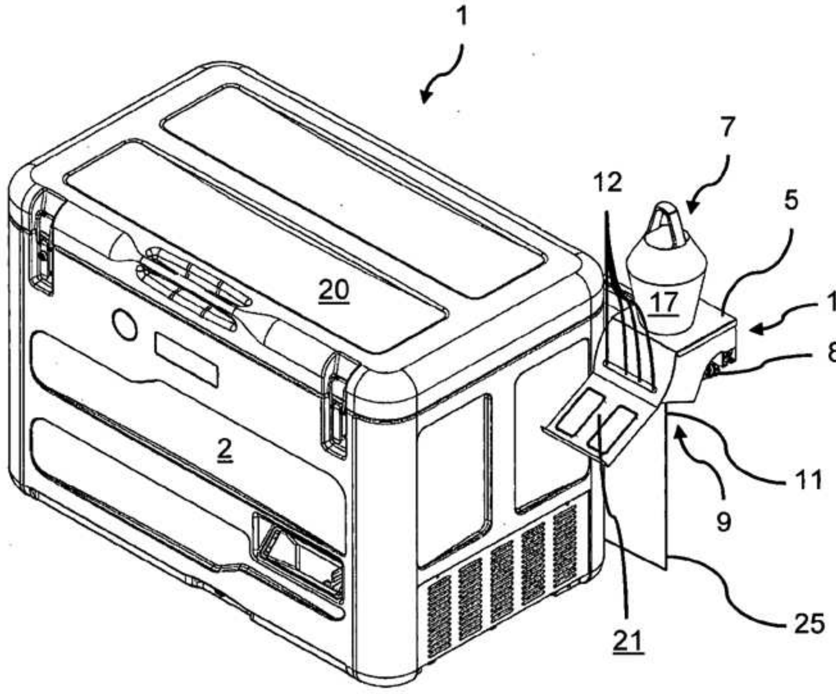

Fig. 6

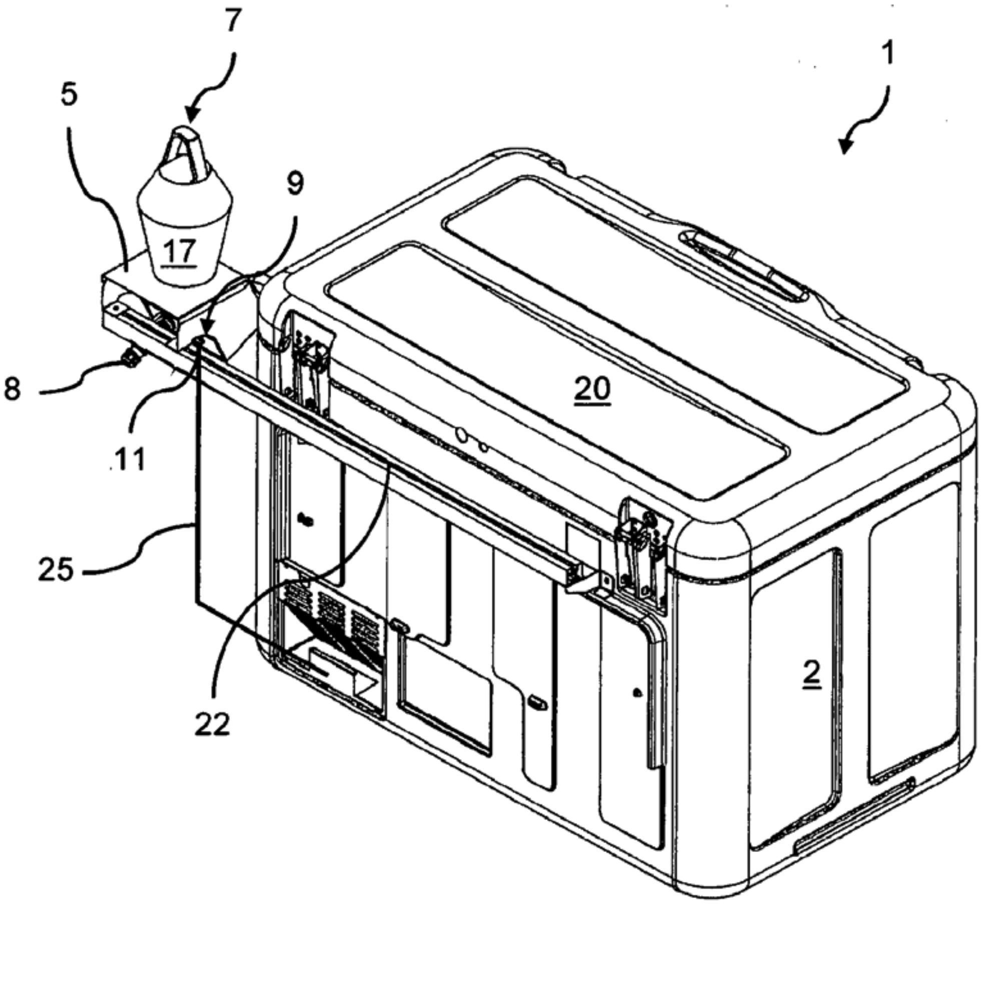

Fig. 7

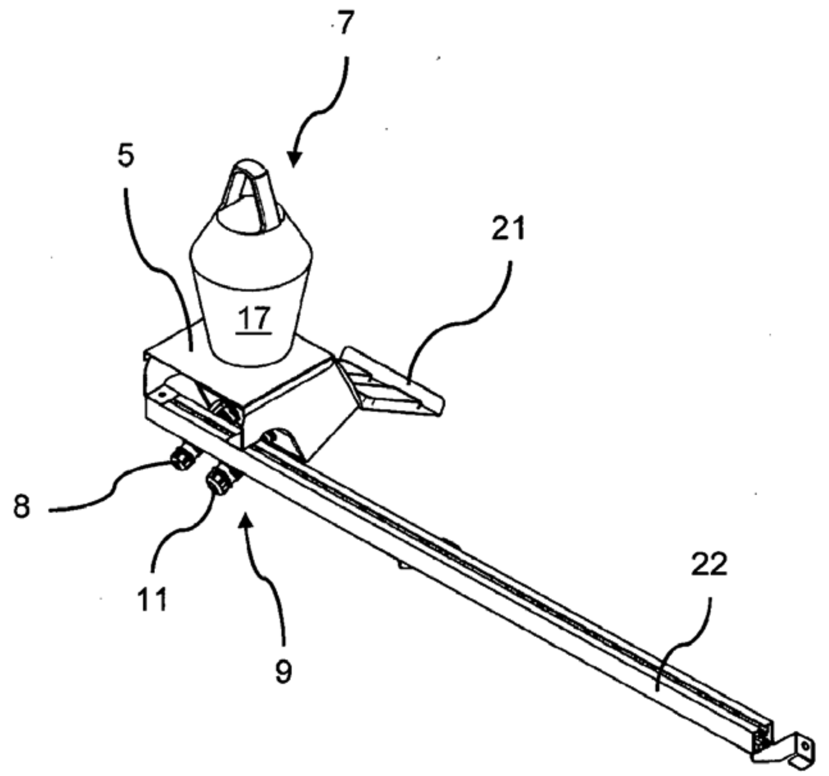

Fig. 8

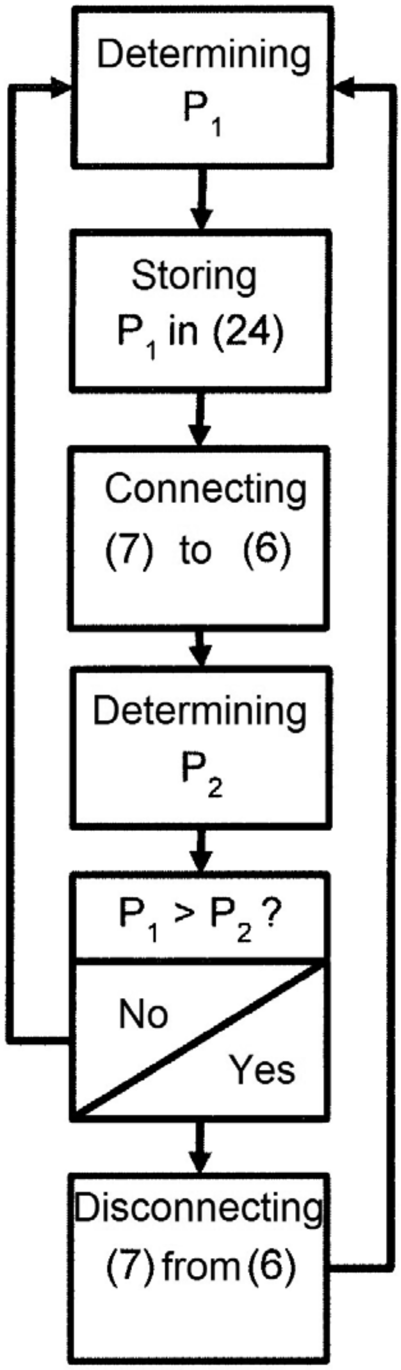
Determining
P1
Storing
P1 in (24)
Connecting
(7) to (6)
Determining
P2
P1 > P2 ?
No
Yes
Disconnecting
(7) from (6)

Fig. 9

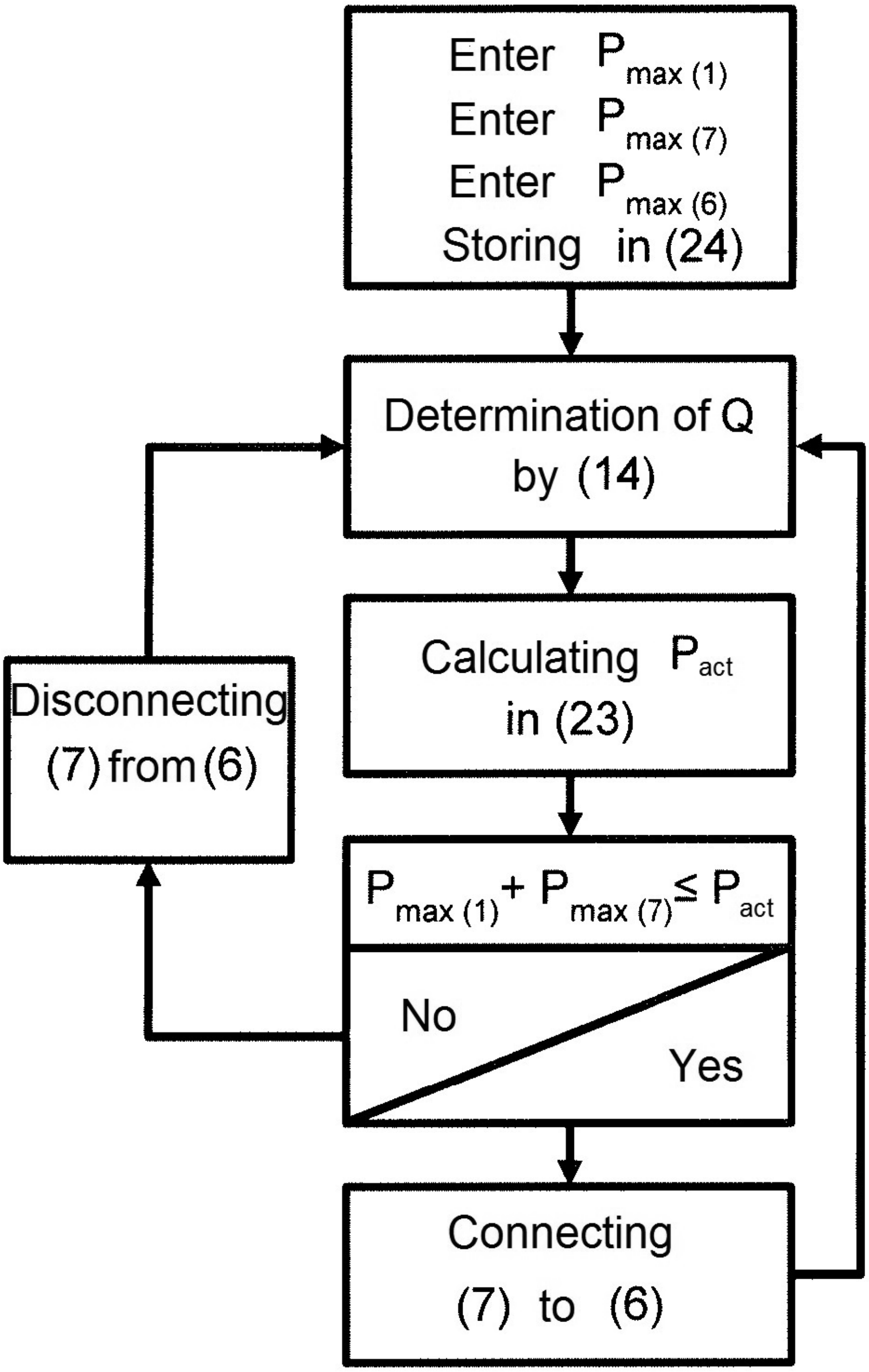
Enter $P_{max (1)}$
Enter $P_{max (7)}$
Enter $P_{max (6)}$
Storing in (24)
Determination of Q by (14)
Calculating P_{act} in (23)
$P_{max (1)} + P_{max (7)} \leq P_{act}$
No
Yes
Connecting (7) to (6)
Disconnecting (7) from (6)

Fig. 10

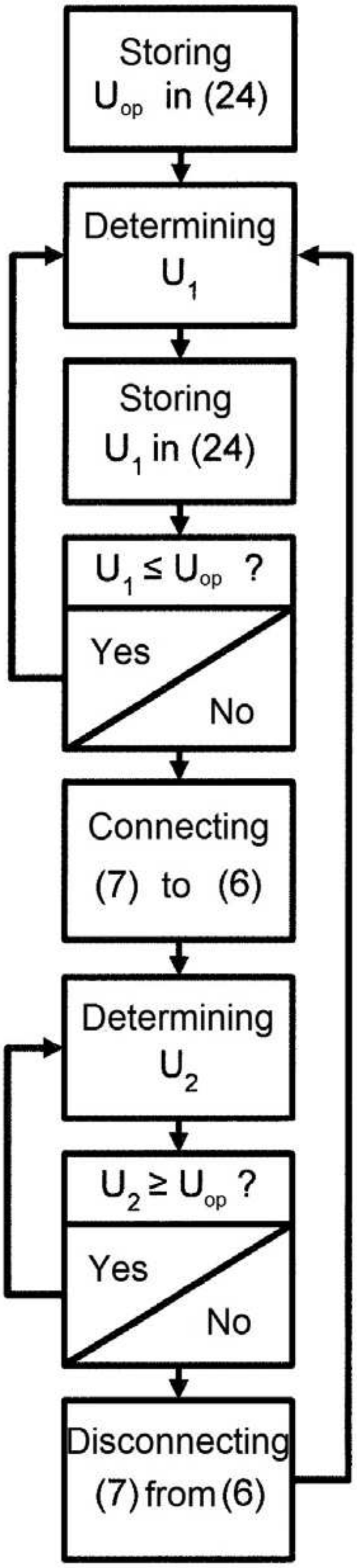
Storing
U_op in (24)
Determining
U_1
Storing
U_1 in (24)
U_1 ≤ U_op ?
Yes
No
Connecting
(7) to (6)
Determining
U_2
U_2 ≥ U_op ?
Yes
No
Disconnecting
(7) from (6)

Fig. 11