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Description

Described are a cooling system and a method for operating the cooling system. The cooling system comprises at least two cooling devices. A cooling device comprises a housing, which at least partly surrounds a goods space, wherein by way of a coolant conveying device a coolant is supplied to a heat exchanger, which brings about a cooling of the goods received in the goods space.

Generally, cooling devices comprise side walls, a back wall as well as a ceiling element and a floor element, wherein the goods space of the cooling device is accessible via the side located opposite the back wall. Such cooling devices are used for example as chiller cabinets in supermarkets. In the goods space, food products are stored which have to be cooled. Generally, food products which do not require deep freezing are stored in such chiller cabinets. For this purpose, cooling is performed in the positive degree range.

For cooling, the cooling device is supplied with a coolant via a coolant supply line, by way of which heat is extracted from the goods space, thus cooling the goods space.

In the cooling devices it is important that a cooling of the products received in the goods space is always carried out. Upon a failure of a coolant conveying device, the products received therein warmup and get spoiled. Apart from the economic damage incurred by the operating supermarket upon a failure of a coolant conveying device, a deterioration of the products can also occur when the coolant conveying device is still operational, but can no longer provide the required rate of coolant. In such a case, a warming-up of the products can occur as a result of which the same are stored above a permissible maximum temperature. In the process, a deterioration of the goods can occur, wherein the deterioration can only be recognized late or not at all. In this case, goods have already been taken out which were stored over a certain period of time above the permissible maximum

temperature.

From the prior art it is known to embody critical elements in cooling devices redundantly. Such a device is described for example in DE 10 2004 046 791 A1. A further relevant state of the art can be found in DE 10 2005 061 599 A1 and US 2004/221604 A1.

The mere provision of a second coolant conveying device solves the problem of the failure safeguard, but incurs disproportionately high costs. In a redundant embodiment a second coolant conveying device would only be employed in particular when a first coolant conveying device fails. Accordingly, the redundant coolant conveying device has to have at least the same coolant conveying capacity as the coolant conveying device to be safeguarded. The control provided for a failure safeguard of a simple design and activates the operation of the second coolant conveying device only in particular when the first coolant conveying device fails.

The object therefore is to state a cooling system and a method for operating the cooling system, which provide a safe operation of the cooling system, eliminate the disadvantages of the prior art and provide an economical operation of cooling devices with a failure safeguard.

The object is solved through a cooling system having the technical features stated in Claim 1 and through a method for operating the cooling system with the technical features stated in Claim 7. Advantageous further developments are stated in detail in the sub-claims.

A cooling system, which solves the abovementioned task, comprises at least two cooling devices with at least one housing each, which at least partially surrounds a goods space, a coolant conveying device and at least one heat exchanger, wherein the coolant conveying devices regulate the supply of a coolant to the at least one heat exchanger, and wherein the coolant

conveying devices are coupled to one another via a regulating unit.

5 The cooling system connects two cooling devices, which can be designed for example as chiller cabinets, by way of the regulating unit. A redundant embodiment of the coolant conveying device can thereby be omitted, wherein the failure safeguard is provided via the regulating unit.

10 By way of the regulating unit, coolant can be supplied to the respective other cooling device when one of the coolant conveying device fails or their conveying capacity drops below a minimum conveying rate. In addition to this, the coolant conveying rate can be increased via the regulating unit when the
15 required cooling capacity exceeds the maximum conveying capacity of the coolant conveying devices or new goods are introduced into at least one of the goods spaces of the cooling devices. Furthermore, the coolant supply to the heat exchangers of the cooling devices can take place in embodiment versions of the
20 technical teaching described herein solely via the regulating unit, when the required cooling capacity falls below a cooling requirement threshold value and the coolant conveying devices are not operated. Such a state relates for example to a night-time operation, wherein the goods spaces of the cooling devices
25 are closed and no goods exchange takes place. For this reason, only a low or no heat transfer between the goods spaces and the surroundings takes place so that the cooling capacity compared with a daytime operation is significantly reduced.

30 In an example, which is not a part of the invention, the regulating unit is a valve, wherein each of the coolant conveying devices comprises a separate coolant supply line and the valve is arranged in a connecting line which in the coolant flow direction interconnects line sections connected downstream of
35 the coolant conveying devices. Further, the line sections are connected with the at least one heat exchanger of the respective cooling device. When one of the coolant conveying devices fails or the conveying capacity of one of the coolant conveying devices

is below a minimum conveying rate, the valve is opened and coolant flows out of the coolant circuit of a first cooling device to the coolant circuit of a second cooling device. In order for the rate of coolant in both cooling circuits or for both cooling devices to be made available to an adequate degree, the conveying rate of coolant can be increased for the coolant conveying device that replaces the failed coolant conveying device.

According to the invention, the regulating unit is a further coolant conveying device, wherein the coolant conveying devices are connected in parallel and connected to a common coolant supply line. Line sections connected downstream of the coolant conveying devices in the coolant flow direction are connected to one another, wherein the line section, which is connected downstream of a first coolant conveying device, is connected to the at least one heat exchanger of a first cooling device and the line section, which is connected downstream of a second coolant conveying device, is connected to the at least one heat exchanger of a second cooling device. The cooling system with two cooling devices, which are designed for example as chiller cabinets, thus comprises three coolant conveying devices which provide the supply for the cooling devices. Each cooling device is assigned a coolant conveying device. The third coolant conveying device is primarily provided in order to supply coolant for the coolant circuit with the failed coolant conveying device upon a failure of one of the other two coolant conveying devices. In addition, additional coolant for both coolant circuits of the two cooling devices can be supplied via the third coolant conveying device in the case of a high cooling demand. In addition to this it is possible for example in a "night-time operation" to supply coolant to the coolant circuits of the two cooling devices only via the third coolant conveying device. In this operating mode, the two other coolant conveying devices are not operated, as a result of which the energy costs are also reduced. Alternatively, however, all three coolant conveying devices can be operated especially during night-time or in particular when the energy costs are low, so that the

goods spaces can be cooled quickly.

Provision of a third coolant conveying device for two cooling devices, wherein the third coolant conveying device is coupled and connected in parallel with the respective coolant conveying devices of the cooling devices, provides a failure safeguard, wherein compared with the state of the art half a coolant conveying device for each cooling device can be omitted. In addition it is possible compared with a cooling device from the prior art having two coolant conveying devices, to carry out the cooling of the two cooling devices dependent on requirement and in the process control the conveying rate of coolant by way of the control of the conveying rate and the state of the coolant conveying devices. The state includes an active state and an inactive state, wherein in the inactive state no conveying takes place and no energy is needed for operating the coolant conveying device.

In further embodiments, the coolant conveying devices can have a maximum conveying capacity that is distinct from one another or the same. The conveying line of a first coolant conveying device and of a second coolant conveying device can have a lower maximum conveying capacity compared with an embodiment without third coolant conveying device since in the case of an increased cooling requirement for both cooling circuits, the additional coolant rate can be provided by way of the third coolant conveying device. The first and the second coolant conveying device can be dimensioned so that their maximum conveying capacity substantially covers the average needed cooling requirement.

The coolant conveying devices can be pumps. The pumps can be speed-controlled pumps. By way of this, the operation of the pump can be easily regulated and adapted to the given circumstances and cooling specifications for operating the cooling devices of the cooling system. An advantage in the embodiment with a third coolant conveying device or third speed-controlled pump lies in that no valves have to be opened upon a

failure of one of the pumps. In terms of regulation, a simple coolant supply and a simple failure safeguard are thereby provided since the conveying rate can only be regulated via the speed.

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In the line sections connected downstream of the coolant conveying devices, flow regulating elements can be arranged, wherein the flow regulating elements in further embodiments can be non-return valves. The flow regulating element or the non-
10 return valve is designed so that a flow of coolant is only possible in one direction. In yet further embodiments, each of the line sections can comprise a flow regulating element which is connected downstream of the pumps in the coolant flow direction.

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In the embodiments with a third coolant conveying device or speed-controlled pump a flow regulating element each can be arranged in the line sections connected downstream of the coolant conveying devices between a first coolant conveying
20 device and the third coolant conveying device and between a second coolant conveying device and the third coolant conveying device. Here, the flow regulating elements can always allow only a coolant flow from the third coolant conveying device to the other two coolant conveying devices.

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The cooling system can comprise at least one control unit which regulates the supply of coolant via the regulating unit and the coolant conveying devices in accordance with operating states of the cooling devices, the loading state of the cooling devices,
30 of environmental influences, and/or the conveying capacity of the coolant conveying devices.

The control unit can be provided as central control unit or as decentral control unit. Furthermore, a control unit can also
35 comprise sub-units, wherein a cooling device designed as chiller cabinet comprises a central control unit and a separate control unit for each cooling region with a separate heat exchanger or group of cooling regions. Accordingly, the control unit can also

be designed as central control unit for the cooling system, wherein the cooling devices likewise comprise a control unit each.

- 5 The operating state of the cooling devices includes for example at least one daytime/night-time operation and an emergency running operation upon failure of a coolant conveying device or pump. The loading state of the cooling devices depends on whether goods are received in the goods spaces and in which quantities.
- 10 For example, a quick cooling can be also carried out when new goods are introduced into the cooling devices, wherein in embodiments with a third coolant conveying device all three coolant conveying devices are operated. When the coolant conveying devices are designed as speed-controlled pumps, the
- 15 speed of the same can be suitably increased in order to reach the temperatures to be achieved as quickly as possible. Environmental influences include for example the temperature of the room in which the cooling devices are installed, the solar radiation, humidity of the air and other parameters. The rated
- 20 capacity of the coolant conveying devices designed as pumps can be used for example as information for one of the other pumps in order to provide an adequate coolant supply upon a failure of a pump.
- 25 By activating coolant conveying devices designed as pumps, the operation of the cooling devices of the cooling system can be controlled, wherein via the three pumps, besides a failure safeguard, the operation of the cooling devices is also further improved. Accordingly it is possible through a simultaneous
- 30 operation of three pumps to increase the conveying rate of coolant. Here, the conveying rate of coolant can be continuously regulated in a wide range via the control of the speed of the pumps. In particular suddenly occurring temperature fluctuations, which are measured in return lines of the coolant, can be quickly
- 35 compensated for by a speed change of the pumps. Because of this, the control can be of a simple design since no valve control is required.

With the embodiments having a third coolant conveying device, the flow of the coolant can be regulated by way of the speed of coolant conveying devices designed as pumps, so that further adjusting elements can be omitted. In particular, a failure safeguard can also be simplified in that the pumps in terms of signalling are coupled to one another so that upon a failure of a pump, the third pump automatically assumes the function of the failed pump. In this context a status transmission among the respective pumps would be conceivable so that for the third pump, which serves as failure safeguard, the speed of the failed pump is also known. This makes possible a rapid response. For this purpose, the pumps can be mutually activated by way of a bi-directional communication.

In the embodiments having three coolant conveying devices, which are for example speed-controlled pumps, the supply of the heat exchanger with coolant is secured by way of the pumps, wherein both a failure safeguard and also a rapid cooling of the goods spaces can be realized. In a normal operation, each heat exchanger is supplied with a coolant by way of its assigned pump. Should one of the pumps that are assigned to the coolant circuits of the two cooling devices fail, the failure can be compensated for by the third pump. Here, the respective other pump regularly provided for the operation is not excessively loaded since the failure, for example, of the first pump is not compensated for by the second pump, but by the third pump. However, the third pump can also be designed so that upon the failure of the first and the second pump it provides an adequate coolant conveyance for the operation of the respective cooling regions. By way of the third pump, a "boost" function can also be achieved in which a very rapid cooling of the goods spaces of the respective cooling devices takes place. Then, the third pump conveys additional coolant into the line sections that are assigned to the heat exchangers.

Since coolant conveyed via the third pump automatically flows into the respective line sections even with flow regulating elements in the line sections, coolant, during the operation of

the third pump, is generally supplied both to the first heat exchanger and also to the second heat exchanger. However, when the two heat exchangers are to be supplied with coolant differently, the speed of the respectively assigned pumps in the cooling circuits of the two cooling devices is correspondingly reduced. Accordingly, for example, upon a failure of the first pump, the speed of the second pump can also be reduced since the coolant conveyed via the third pump flows both into the line section for the first heat exchanger and also into the line section for the second heat exchanger. Here, the operation of the individual pumps and in particular the speed of the pumps for conveying the coolant rate are adjusted to the desired cooling capacities by way of a control and/or regulating unit. This allows a quick and very accurate adjusting of temperatures within the goods spaces of the respective cooling devices and thus also a quick and accurate adjusting of the core temperature of goods received in the goods space.

In the versions described above, the three pumps can have a rated capacity that is the same or distinct from one another. For example, the rated capacity of the first and second pump can be lower than the rated capacity of the third pump, wherein for example during a daytime operation, only the first and the second pump are operated and during a night-time operation, the two cooling regions are only supplied via the third pump.

As already stated at the outset, the design of the pumps as speed-controlled pumps allows a simple and safe control of the coolant supply rate. A further advantage of the embodiments with three coolant conveying devices or speed-controlled pumps described herein is that when the coolant conveying rate is increased, the pumps assigned to the cooling devices need not be operated with their maximum speed, but the increase of the coolant conveying rate can be achieved by additionally activating the third pump. Advantageously, the control is designed so that upon an increase of a requested coolant rate the third pump already conveys coolant before the other two pumps are operated with their maximum speed. By way of this, a

continuous and accurately controllable coolant flow can be achieved. Thus, no jumps occur during the course of the conveyed coolant rate.

5 The cooling system and the associated cooling devices described herein further comprise measuring units which detect the coolant in the advance and in the return, the conveying rate of coolant as well as the temperature in the goods space and in other locations such as for example the surroundings of the cooling
10 devices. This information can be supplied to the at least one control unit which from this determines the loading state and the cooling requirement for the respective goods spaces and as a consequence of this regulates the speed of the coolant conveying devices designed as speed-controlled pumps.

15 In further embodiments, the housing of the cooling devices of the cooling system is designed so that the housing is accessible via an open front side. The open front sides can each be closed by way of a closing device of the cooling devices, which comprise
20 for example a roller shutter. In the case of a chiller cabinet in a supermarket, the roller shutter is lowered during night-time so that a lower or substantially no heat transfer between the goods space of the cooling device and the surroundings of the cooling device, for example a shop-floor, takes place. Since
25 with a closed roller shutter there is a lower heat transfer, a lower conveying rate of coolant is also required, which is likewise taken into account with the control. Accordingly, the coolant conveyance for example can only be provided via the third pump during such a night-time operation.

30 In further embodiments, as already stated, the cooling devices can comprise a central regulating/control unit, which controls the operation of the individual components and communicates with the individual components. The regulating/control unit can also
35 control the communication of the individual components with one another. Besides temperature detection devices, further measuring devices can be provided, such as for example devices for measuring the flow speed and the mass flow of the coolant.

The heat exchanger of the cooling devices of the versions described herein can be for example plate heat exchangers. In particular a brine is employed as coolant, wherein the brine can be a water-glycol mixture.

Further, the cooling devices can comprise fans which conduct air via the heat exchangers, as a result of which the air is cooled. The cooled air can be conducted via suitable ducts in a back wall arrangement, the ceiling element and the floor element as well as the side walls, and exit via a front air outlet region of the ceiling element and be sucked in via a front air inlet region of the floor element. The back wall arrangement can also have a plurality of ventilation slots via which cooled air flows out.

The object mentioned above is also solved through a method for operating a cooling system according to any one of the versions described above, wherein by way of the regulating unit

- coolant of the respectively other cooling devices is supplied when at least one of the coolant conveying device should fail or its conveying capacity falls below a minimum conveying rate,

- the coolant conveying rate is increased when the required cooling capacity exceeds the maximum conveying capacity of the coolant conveying devices or new goods are introduced into at least one of the goods rooms of the cooling devices, and/or

- the coolant supply to the heat exchangers of the cooling devices takes place when the required cooling capacity falls below a cooling requirement threshold value and the coolant conveying devices are not operated.

In the above description, various operating modes for cooling systems are stated. For this reason, the method steps for controlling the cooling systems should also be interpreted and

are designed according to these embodiments. Accordingly, a rapid cooling of the goods spaces or of the goods received in the goods spaces is achieved in that for example three coolant conveying devices designed as speed-controlled pumps are operated simultaneously. This can take place when new goods are introduced.

With a cooling system having two cooling devices, which each comprise a coolant conveying devices designed as speed-controlled pump and the pumps are coupled to one another via a valve, the pumps can alternatively also serve as failure safeguard, wherein for example each of the pumps is designed so that, upon the failure of the other pump, it can provide a corresponding minimum conveying rate of coolant.

The method for the control also includes method steps, according to which the advance and the return temperature of the coolant in each cooling region are detected, the cooling requirement resulting from this is determined, and the at least two pumps are controlled with respect to their speed accordingly, so that a rapid cooling takes place and/or a distinct cooling of different cooling regions, and/or a situation-adapted cooling without jumps in the conveying capacity of the coolant is carried out.

Further advantages, features and configuration possibilities are obtained from the following figure description of exemplary embodiments which should not be understood to be restrictive. In the drawings:

Fig. 1 shows a schematic view of a cooling device having a redundant conveying device;

Fig. 2 shows a schematic view of a first example of a cooling device which is not part of the invention; and

Fig. 3 shows a schematic view of a second embodiment of a cooling device.

Parts provided with same reference numbers in the drawings substantially correspond to one another unless otherwise stated. Further, describing constituent parts which are not substantial
5 for understanding the technical teaching disclosed here is omitted.

Fig. 1 shows a cooling device 100 from the prior art with a failure safeguard. The cooling device 100 comprises a housing
10 with side walls 114, a floor element 120 and a ceiling element 118. On the back side the cooling device 100 is closed by way of a back wall arrangement. By way of the front side, the cooling device 100 is designed to be at least temporarily open, so that the goods space 112 is accessible for removing goods such as
15 dairy products, poultry and meat products as well as fruit and vegetables. The cooling device 100 comprises a coolant supply line 122 and a coolant discharge line 124. The coolant supply line 122 and the coolant discharge line 124 are coupled to a central device that is arranged outside the cooling device 100,
20 which brings the coolant supplied via the coolant supply line 122 to an adjustable advance temperature. By way of the coolant discharge line 124, the coolant is again supplied to the device. Here, a brine is used as coolant. For example, the device can be a heat pump and be coupled and designed with further hydraulic
25 elements.

The supply line 132 of the cooling device 100 is divided into two parallel line sections. In a first line section 140, a first pump 136 and in a second line section 142 a second pump 138 is
30 arranged. The pump 136 is arranged in the line section 140 and the pump 138 in the line section 142. A non-return valve 144 as flow regulating element is connected downstream of the pump 136 in the flow direction of the coolant. A non-return valve 146 is connected downstream of the pump 138 in the flow direction of
35 the coolant. The line sections 140 and 142 lead into a common line section 148.

The common line section 148 is connected to a heat exchanger

150. The heat exchanger 150 is a plate-shaped heat exchanger 150. From the heat exchanger 150, a discharge line 134 leads to the central coolant discharge line 124. In the cooling region 130, at least one fan can also be additionally provided, which
5 conducts air via the heat exchanger 150, wherein the air is cooled. The cooled air is then circulated within the goods space 112 in order to cool goods received in the goods space 112.

The arrows indicate the flow direction of the coolant during the
10 operation of the cooling device 100. The coolant is conveyed via the pump 136 during a normal operation. Should the pump 136 fail, the pump 138 is activated which then supplies the coolant to the heat exchanger 150. The pump 138 serves as failure safeguard and is only operated when the pump 136 fails. To this end, the pump
15 138 is designed analogously to the pump 136 and has for example the same rated capacity.

Disadvantageous with the cooling device 100 is that the second pump 138 is not normally needed. Faults and failures during the
20 operation of the cooling devices 100 can occur rarely or not at all, so that the cost expenditure for the second pump 138 is not justified. However, a failure safeguard is necessary so that the goods received in the goods space 112 are always adequately cooled.

In order to make possible a failure safeguard without increased costs and an improved operation of cooling devices, the cooling system 200 of Fig. 2 comprises at least two cooling devices 202 and 204 as well as a regulating unit. In the cooling system 200,
30 two cooling devices 202 and 204 are coupled to one another via the regulating unit, wherein in an example which is not part of the invention the regulating unit is a valve 246. The cooling devices 202 and 204 are coupled to one another via a connecting line 244 and the valve 246, so that upon a failure of a pump 236
35 one of the two cooling devices 202 and 204, the respectively other pump 236 conveys coolant to the respective heat exchanger 242.

The cooling devices 202 and 204 substantially correspond to the cooling device 100, wherein individual components of the cooling devices 100, 202 and 204 are marked with the same reference numbers and differ only by the prefixed numbers. Accordingly, a supply line 132 substantially corresponds to a supply line 232 and a discharge line 134 to a discharge line 234 etc.

In the cooling system 200 shown in Fig. 2, the line sections 240 are connected to one another via a connecting line 244. In the connecting line 244, the valve 246, which makes possible a supply of coolant both from the line section 240 of the cooling device 202 to the line section 240 of the cooling device 204 and also from the line section 240 of the cooling device 204 to the line section 240 of the cooling device 202, is arranged. The connection of the two cooling devices 202 and 204 ensures that upon a failure of a pump 236 an adequate cooling of the goods spaces 212 of the respective cooling devices 202 and 204 can be carried out.

For providing a failure safeguard, the pumps 236 can have a greater rated capacity than a comparable pump 136 with the cooling device 100. The reason for this is that one of the pumps 236, upon failure of the other pump 236, has to convey coolant both to the heat exchanger 242 of the cooling device 202 and also to the heat exchanger 242 of the cooling device 204. However, an increase of the rated capacity of the pumps 236 is more favourable regarding the costs than providing a second pump each for the cooling devices 202 and 204. In addition, the selection of the pumps 236 can be made so that for example upon a failure of one of the pumps 236 merely an emergency cooling of the respective other cooling device 202 or 204 is carried out. In addition to this, the valve 246 can be additionally opened only so far that an emergency cooling is possible.

The cooling system 200 comprises a control unit which is not shown in Fig. 2, which controls the operation of the pumps 236 designed as speed-controlled pumps 236 and the opening and closing of the valve 246. In the coolant flow direction, a non-

return valve 238 each is connected downstream of the pumps 236, which prevents a backflow of coolant. However, the rate of the coolant that flows into the line sections 240 can be regulated via the pumps 236 alone. For this reason, non-return valves 238
5 can be omitted in further embodiments. The control unit is additionally connected to further devices, such as for example temperature detection devices for detecting the coolant temperature in the advance and in the return of the cooling devices 202 and 204 as well as in the coolant supply line 222
10 and in the coolant discharge line 224. Alternatively or additionally, the cooling devices 202 and 204 can also comprise a control unit each. These control units can likewise regulate the operation of the components assigned to the respective cooling devices 202 and 204 and receive information such as the
15 coolant temperature and coolant rate in the relevant lines via devices provided for this purpose and pass on this information to the central control unit.

In addition to this, the cooling devices 202 and 204 can comprise
20 further devices such as for example fans which conduct air via the heat exchangers 242 and circulate the cooled air in the goods spaces 212.

Fig. 3 shows a schematic view of a further cooling system 200
25 having two cooling devices 202 and 204 as well as a regulating unit of a second embodiment. The regulating unit, which couples the cooling devices 202 and 204 with one another, is a speed-controlled pump 254 in this embodiment.

30 Like the cooling system 200 shown in Fig. 2, the cooling system 200 comprises two cooling devices 202 and 204. As for the second embodiment shown in Fig. 2, the cooling devices can be for example chiller cabinets. Such chiller cabinets are erected for example in supermarkets and used as display furniture for goods
35 to be cooled. Here, reference is made to the explanations regarding Fig. 1.

The cooling devices 202 and 204 each have a housing with side

walls 214, a floor element 220 and a ceiling element 218 as well as a back wall arrangement. The cooling devices 202 and 204 are designed as separate cooling units and have a common coolant supply arrangement. The cooling system 200 has a common supply
5 line 232 for the cooling devices 202 and 204. The supply line 232 is supplied with a coolant from a central coolant supply line 322. By way of separate discharge lines 234, heated coolant is returned from the heat exchangers 242 to a central coolant discharge line 224. The coolant supply line 222 and the coolant
10 discharge line 224 are connected to a device for cooling the coolant conveyed via the same. For example, the device for cooling is a heat pump.

From the common supply line 232, coolant is supplied to an
15 arrangement having three pumps 250, 252 and 254 arranged in parallel. The pumps 250, 252 and 254 are speed-controlled pumps 250, 252 and 254. A first pump 252 is assigned to the cooling device 202 and, during a normal operation, conveys coolant to the heat exchanger 242 via the line sections 260 and 280. A
20 second pump 252 is assigned to the cooling device 204 and, during a normal operation, conveys coolant to the heat exchanger 242 via the line sections 262 and 280.

In order to provide a failure safeguard and achieve a demand-
25 dependent cooling of the cooling system 200, the third pump 254 is connected via a line section 264 to the line sections 260 and 262 via non-return valves 270 and 272. The non-return valves 270 and 272 are designed and arranged so that coolant can always flow only from the third pump 254 via the line section 264 into
30 the line section 260 and into the line section 262. A backflow via the non-return valves 270 and 272 is not possible.

In further embodiments which are not shown, no non-return valves 270 and 272 are provided, so that for example coolant conveyed
35 via the first pump 250 can also flow into the line section 262.

The pumps 250, 252 and 254 can have the same rated capacity. During a normal operation, for example a coolant is supplied via

the supply line 232 to the pumps 250 and 252, wherein the pumps 250 and 252 provide, as a function of their speed, a certain conveying rate of coolant for the heat exchangers 242. As a function of the conveyed coolant, the heat exchangers 242 cool the goods spaces 212 and the goods stored therein. As a function of the speed of the pumps 250 and 252, the goods spaces 212 of the cooling devices 202 and 204 can also be cooled with different intensities. In such an operating mode, the third pump 254 can be inactive and not convey any coolant.

The cooling devices 202 and 204 additionally comprise temperature detection devices for the temperature of the coolant in the advance and in the return as well as in the goods spaces 212. In addition to this, the cooling devices 202 and 204 can comprise fans which cool air via the heat exchangers 242 and circulate the same in the goods spaces 212.

Should one of the pumps 250 and 252 now fail, the third pump 254 is activated and coolant supplied via the connecting lines 260 or 262 into the line section 280 of the other cooling device 202 or 204. The non-return valves 270 and 272 are designed so that they allow a flow of coolant only in particular when a certain pressure is present at the non-return valves 270 and 272.

During a normal operation, the supply of coolant to the heat exchangers 242 is controlled via the speed of the pumps 250 and 252. Should one of the pumps 250 and 252 fail, the needed coolant is supplied to a corresponding extent to the heat exchanger 242 of the cooling device 202 or the heat exchanger of the cooling device 204 by adapting the speed of the pump 254. Should both pumps 250 and 252 fail, coolant can be supplied to the heat exchangers 242 via the pump 254 alone. In addition it is possible, when new goods are introduced into the goods spaces 212, to activate the third pump 254 in addition to the pumps 250 and 252, wherein a significantly greater rate of coolant is supplied to the heat exchangers 242 and thus a rapid cooling of the goods spaces 212 takes place. For example, all pumps 250, 252 and 254 can be operated with their maximum speed. However, it is also

possible by activating the pump 254 and by suitably controlling the speed of the pumps 250, 252 and 254, to supply additional coolant to only one of the heat exchangers 242. In particular in embodiments without non-return valves 270 and 272, the
5 controlling of the pumps 250, 252 and 254 takes place in such a manner that the total coolant rate or the coolant mass flow in the line sections 280 is so great that the desired cooling takes place via the heat exchangers 242.

10 When for example a loading of the goods spaces 212 of the cooling device 202 with new goods to be cooled takes place, the speed of the pump 254 can also be increased besides the increase of the speed of the pump 250, in order to achieve a rapid cooling. Introducing new goods into the goods spaces 212 can be either
15 communicated to a regulating unit or is measured via a temperature measurement in the goods spaces 212 or in the returns, in particular in the discharge lines 134. Both in embodiments with non-return valves 270, 272 and in embodiments without such, additional coolant can also flow into the line section 280 of
20 the cooling device 204 so that the heat exchanger 242 of the cooling device 204 is supplied more coolant than needed. In order to prevent "over cooling" because for example no new goods are introduced into the goods space 212 of the cooling device 204 and there is a low cooling demand, the speed of the pump 252
25 is reduced so that the total mass flow of coolant in the line section 280 of the cooling device 204 is not increased.

In particular when the goods spaces 212 are loaded with goods all-anew, a rapid cooling is necessary since the core
30 temperature of the goods must not exceed a certain temperature. In conventional cooling devices, based on a completely uncooled chiller cabinet with the goods space 112 substantially at room temperature, cooling times of up to four hours materialize for example for reaching a core temperature of 7 degrees for dairy
35 products. Generally, the chiller cabinet therefore has to be put into operation four hours prior to the initial loading and the goods space 112 cooled with a maximum coolant conveying rate. In the case of the cooling system 200 shown in Fig. 3 this is

possible for example in less than two hours since by way of the pumps 250, 252 and 254 a significantly greater rate of coolant can be supplied. By way of the third pump 254, a rapid cooling of the goods in the goods spaces 212 is achieved without having to increase the advanced temperature in the coolant supply line 222. Because of a greater conveying rate of coolant, the temperature in the return also rises less severely than with cooling devices 100 from the prior art. For this reason, the centrally provided device, which is provided for cooling the coolant, can be substantially operated constantly. Minor fluctuations in the required cooling capacity of the device for cooling the coolant cannot be excluded, but the range, in which the return temperature of the coolant is situated during the operation of the cooling devices 200 and 204, is significantly lower than in the case of chiller cabinets from the prior art. For this reason, the device for cooling the coolant for the cooling devices 202 and 204 can also be operated more economically.

In addition it is possible for example during a night-time operation with a closed front side of the cooling devices 202 and 204, to control the cooling via both heat exchangers 242 only by way of a coolant supply via the pump 254. During a night-time operation, the cooling devices 202 and 204 are closed via a closure device with a roller shutter. The pumps 250 and 252 can be deactivated for example during the night-time operation or in an operating mode with a low cooling requirement, wherein the total power consumption for the cooling system 200 is reduced. A "boost" function with a rapid cooling of the goods spaces 212 can be carried out for example also in particular when the energy costs for the operation of the pumps 250, 252 and 254 are low. When the energy costs rise, the cooling of the goods spaces 212 can be achieved by a coolant supply solely via the pump 254 or via the pumps 250 and 252.

The control of the cooling in the cooling system 200 with the cooling devices 202 and 204 takes place via a central control and regulating device, which is not shown in Fig. 3. Measuring

devices for the temperature and the flow rate of the coolant in the advance and return as well as in the goods spaces 212 are not shown either. The central control and regulating unit controls the cooling of the respective goods spaces 212 as a function of the detected values and as a function of the speed of the pumps 250, 252, 254. To this end, signal and control lines which are not shown are provided. The control and regulating unit pre-sets the speed of the pumps 250, 252 and 254 so that as a function of the detected temperatures and the speed actually present, the speed of the pumps 250, 252 and 254 is regulated and thus a rapid cooling provided. In addition, a failure safeguard is provided, wherein via the pump 254 an adequate cooling through coolant supply to the heat exchangers 242 can also be achieved in particular when both the pump 250 and also the pump 252 should fail. The capacities of the pumps 250, 252 and 254 should be selected accordingly.

List of reference numbers

	100	Cooling device
	112	Goods space
5	114	Side wall
	118	Ceiling element
	120	Flow element
	122	Coolant supply line
	124	Coolant discharge line
10	132	Supply line
	134	Discharge line
	136	Pump
	138	Pump
	140	Line section
15	142	Line section
	144	Non-return valve
	146	Non-return valve
	148	Line section
	150	Heat exchanger
20	200	Cooling system
	202	Cooling device
	204	Cooling device
	212	Goods space
	214	Side wall
25	218	Ceiling element
	220	Floor element
	222	Coolant supply line
	224	Coolant discharge line
	232	Supply line
30	234	Discharge line
	236	Pump
	238	Non-return valve
	240	Line section
	242	Heat exchanger
35	244	Connecting line
	246	Valve
	250	Pump
	252	Pump

	254	Pump
	260	Line section
	262	Line section
	264	Line section
5	270	Non-return valve
	272	Non-return valve
	280	Line section

Patentkrav

1. Kølesystem, som i det mindste har to separate køleindretninger (202, 204) med i det mindste hver især et hus, 5 som i det mindste delvist omgiver et varerum (212), en kølemiddeltransportindretning og i det mindste en varmeveksler (242), hvor de separate køleindretningers (202, 204) kølemiddeltransportindretninger regulerer tilførslen af et kølemiddel til den i det mindste ene varmeveksler (242), hvor 10 - kølemiddeltransportindretningerne er koblet med hinanden via en reguleringsenhed, - reguleringsenheden er en kølemiddeltransportindretning, - kølemiddeltransportindretningerne er koblet parallelt og er forbundet med en fælles kølemiddeltilførselsledning, 15 - ledningsafsnit (260, 262, 264), som i kølemiddelstrømningsretningen er efterkoblet kølemiddeltransportindretningerne, er forbundet med hinanden før de respektive varmevekslere (242), - det ledningsafsnit (260), som er efterkoblet en første 20 kølemiddeltransportindretning, er forbundet med den i det mindste ene varmeveksler (242) i en første køleindretning (202), og - det ledningsafsnit (262), som er efterkoblet en anden kølemiddeltransportindretning, er forbundet med den i det 25 mindste ene varmeveksler (242) i en anden køleindretning (204).
2. Kølesystem ifølge krav 1, hvor kølemiddeltransportindretningerne har en fra hinanden forskellig eller en ens maksimal transportkapacitet. 30
3. Kølesystem ifølge et af kravene 1 til 2, hvor kølemiddeltransportindretningerne er omdrejningstalstyrede pumper (236; 250, 252, 254).
- 35 4. Kølesystem ifølge et af kravene 1 til 3, hvor der i de til kølemiddeltransportindretningerne efterkoblede ledningsafsnit (240; 260, 262, 264) er anbragt elementer til gennemstrømningsregulering.

5. Kølesystem ifølge krav 4, hvor elementerne til gennemstrømningsregulering er kontraventiler (238; 270, 272).

- 5 6. Kølesystem ifølge et af kravene 1 til 5, som har i det mindste en styreenhed, som i henhold til
- køleindretningernes (202, 204) driftstilstande,
 - køleindretningernes (202, 204) belastningstilstand,
 - miljøpåvirkninger og/eller
- 10 - kølemiddeltransportindretningernes transportkapacitet via reguleringsenheden og kølemiddeltransportindretningerne regulerer tilførslen af kølemiddel.

7. Fremgangsmåde til drift af et kølesystem ifølge et af
- 15 kravene 1 til 6, hvor via reguleringsenheden
- kølemiddel tilføres til den hver gang anden køleindretning (202, 204), hvis i det mindste en af de respektive køleindretningers (202, 204) kølemiddeltransportindretning svigter, eller dens transportkapacitet falder ned under
- 20 minimumstransportmængden,
- kølemiddeltransportmængden forøges, hvis den nødvendige kølekapacitet overstiger den maksimale transportkapacitet for de respektive køleindretningers (202, 204) kølemiddeltransportindretninger, eller der indbringes nye varer
- 25 i i det mindste et af køleindretningernes (202, 204) varerum (212), og/eller
- kølemiddeltilførslen til køleindretningernes (202, 204) varmevekslere (242) sker, når den nødvendige kølekapacitet underskrider en kølebehovs-tærskelværdi, og de respektive
- 30 køleindretningers (202, 204) kølemiddeltransportindretninger ikke drives.

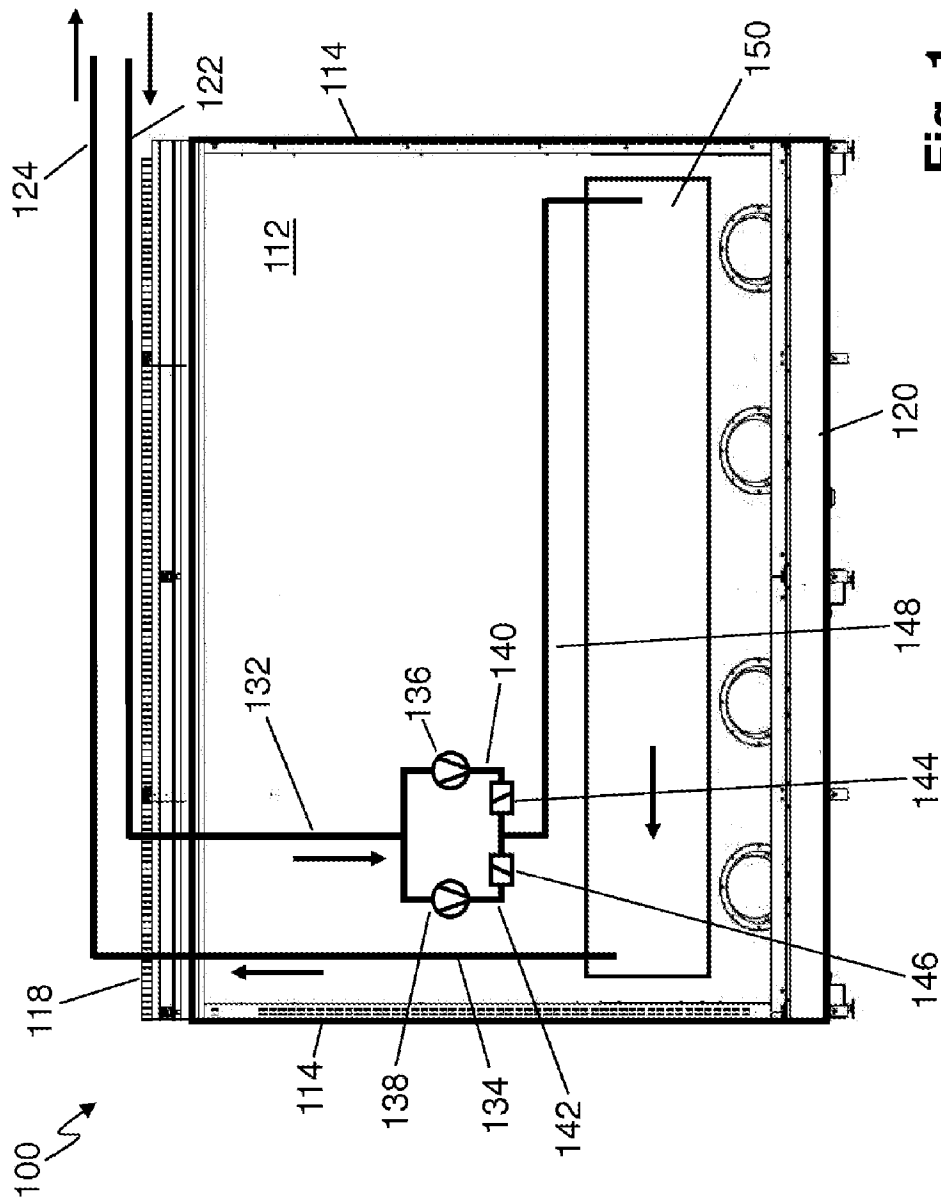


Fig. 1

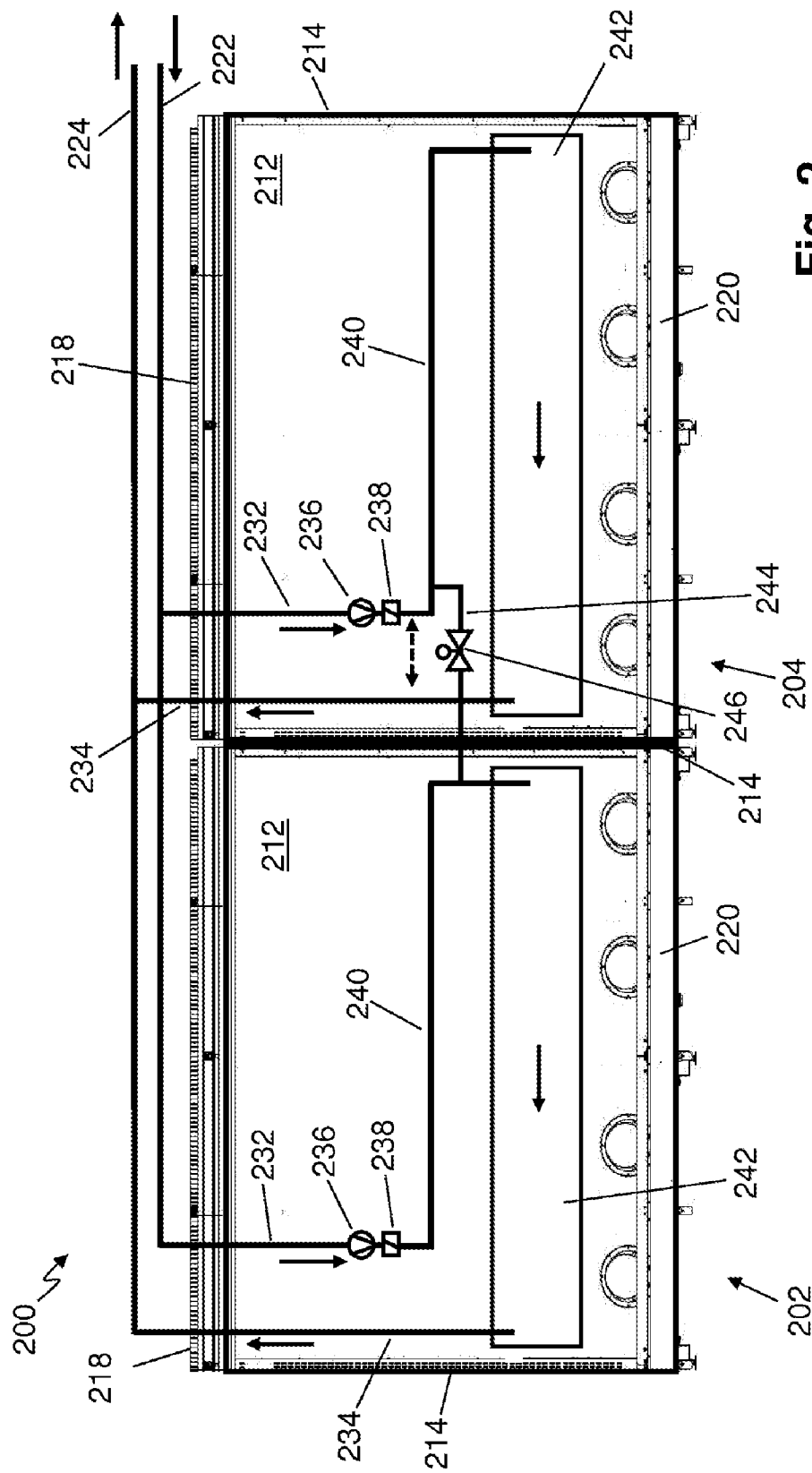


Fig. 2

