

Direct liquid cooling with a coolant distribution channel comprising a sensor

The invention is based on a direct liquid cooling (DLC) for an IT infrastructure with at least one component requiring cooling, wherein the direct liquid cooling comprises a coolant distribution unit (CDU) and a coolant distribution channel, which is supplied with cooled liquid by the coolant distribution unit (CDU). Such an arrangement is described in US 2007/0274043 A1.

US 2023/240053 A1 describes a direct liquid cooling, in which the coolant distribution channel comprises at least one sensor. Further direct liquid coolings are known from US 2022/0039291 A1, US 2023/0060854 A1 and US 2023/0060854 A1.

U.S. Pat. No. 9,668,382 B2, U.S. Pat. No. 11,310,939 B2 and U.S. Pat. No. 11,395,443 B2 describe known coolant distribution units (CDU), in which the components required for providing and supplying the coolant distribution channel with cooled liquid are accommodated in a housing designed as a slide-in unit, e.g. including, but not limited to: at least one pump, preferably a plurality of redundant pumps, a heat exchanger, an expansion vessel, pressure, flow and/or temperature sensors, a three-way valve with a bypass valve, an AC power supply, a control unit, a service valve, a filter, an automatic deaerator, a pressure limiting valve or a flow rate control valve. For the recooling, the coolant distribution unit can comprise a liquid-liquid heat exchanger as well as connections for the flow and the return of a cooling liquid, e.g. water. The cooling liquid can be provided by a cold water set, a chiller or the like. Instead of a liquid-liquid heat exchanger, an air-liquid heat exchanger can be provided, which is supplied with air from the surroundings of the coolant distribution unit with a fan, preferably a filter fan, for the recooling of the cooling liquid of the direct liquid cooling.

The known coolant distribution units (CDU) have the disadvantage that they are provided as a single assembly, for example as a slide-in unit for the installation in a 19-inch installation frame of an IT rack, which combines a plurality of components susceptible to faults. In the event of failure of one of these components, in particular one of the mentioned sensors, the entire coolant distribution unit has to be replaced. This is often associated with an interruption of the cooling provided by the CDU. This in turn can cause the failure of the IT infrastructure, for example of servers.

It is therefore the object of the invention to propose a direct liquid cooling which has a high degree of maintenance-friendliness and in particular allows the replacement of sensors of a CDU. This object is achieved by a direct liquid cooling (DLC) with the features of claim 1. The dependent claims each relate to advantageous embodiments of the invention.

Accordingly, it is provided that the coolant distribution channel comprises at least one sensor, with which at least one physical measurement variable relating to the liquid in the coolant distribution channel is determined.

In particular, it can be provided that the sensor replaces a sensor or is a sensor which would otherwise have to be provided in the CDU, in particular in a housing of the CDU. The sensor can be, for example, a temperature sensor, a pressure sensor, a flow sensor and/or a sensor for determining the electrical conductivity of the liquid. However, the sensor is not restricted to these embodiments. In particular, the sensor can be any possible sensor of a CDU, which is configured to determine a physical measurement variable relating to the cooling liquid, for example relating to a flow and/or a return of an inner circuit of the CDU, which forms a liquid circuit with the coolant distribution channel.

The IT rack can comprise a frame of a switch cabinet, consisting of four vertical struts and eight horizontal struts. A plurality of IT racks can form a switch cabinet row. The DLC can be designed as a single cabinet solution or as a solution for supplying a switch cabinet row with cooled liquid. The DLC can be arranged in the same IT rack as the components requiring cooling, for example server inserts. The DLC can also be configured to take up, with its components, for example pump units, heat exchangers, control units, etc., if these are not part of a CDU, or at least one CDU, etc., an entire IT rack, which consequently has the function of a cooling rack. The cooling device can be lined up in a row of switch cabinets or IT racks and supply components requiring cooling, for example server inserts, installed in the adjacent IT racks with cooled liquid. Each of the IT racks supplied with cooling liquid can comprise a coolant distribution channel, which is supplied with cooled liquid by a CDU of the cooling rack. In a data center, the switch cabinet row can separate a hot aisle from a cold aisle.

The coolant distribution channel can be arranged in a vertical extent in an IT rack, for example in the region of a rear side of the IT rack. The coolant distribution channel can be arranged on a vertical strut of the IT rack, in particular on a rear-side vertical strut of

the IT rack. In the IT rack, the IT infrastructure can be provided in the form of slide-in units, for example as server inserts, which are mounted for example in a 19-inch installation frame. The CDU can likewise be designed as a slide-in unit.

The coolant distribution channel can be arranged on a front side, a rear side or a vertical side wall of an IT rack, in particular accessible from one of the mentioned sides of the IT rack. This in turn causes the sensor provided with the coolant distribution channel to be particularly easily accessible, for example in order to be able to replace it particularly easily in the event of failure. The sensor can be mounted for example with a quick-release coupling, preferably a drip-free quick-release coupling, on the coolant distribution channel, preferably on a feed line or a return line, particularly preferably mounted so as to be accessible from the outer side. In the installed state, the sensor can be in sensory contact with the coolant distribution channel with its measurement variable recorder, for example with a liquid or gas atmosphere guided in the coolant distribution channel, for example in a feed line or a return line of the coolant distribution channel. The at least one sensor can be integrated into the coolant distribution channel, but is preferably not completely accommodated in the interior of the coolant distribution channel. It is preferably accessible from an outer side of the coolant distribution channel and therefore easily exchangeable. The at least one sensor can be mounted in particular directly on an outer side or through an outer side of the coolant distribution channel on or in the coolant distribution channel, for example in a feed line or a return line.

However, the at least one sensor can also be arranged in a connecting line of the coolant distribution channel, preferably directly in front of an opening of the connecting line into the coolant distribution channel. The connecting line can be designed to fluidically connect the coolant distribution channel to the CDU. A connecting line for a feed line and a return line of the coolant distribution channel can be provided in each case. At least one connecting fitting can be provided, via which the connecting line is connected to the coolant distribution channel, in particular to a feed line or a return line of the coolant distribution channel, wherein the at least one sensor can be integrated into the fitting. A separate connecting fitting for connecting a first connecting line to a feed line of the coolant distribution channel and a second connecting fitting for connecting a second connecting line to a return line of the coolant distribution channel are preferably provided in each case.

The fitting can be integrated into the connecting line or connected thereto by quick-release couplings. Alternatively, the fitting can be connected with quick-release couplings on the one hand to the coolant distribution channel, in particular a feed line and/or a return line, and on the other hand to the connecting line. However, the fitting can also be connected to the coolant distribution channel without a quick-release coupling, for example via a screw connection or via a cohesive joined connection. In this case, it is preferred that the at least one sensor is connected to the fitting via a quick-release coupling.

The coolant distribution channel can be of multi-part design, in particular comprise a feed line and a return line which are designed as lines or channels which are separate from one another. It can be provided that the two lines or channels which are designed separately from one another are arranged on opposite vertical struts of an IT rack, in particular are fastened thereto, for example on a rear side of an IT rack. The lines or channels can be fastened, for example screwed, to a system perforation of a vertical strut. At least one of the feed line and return line can comprise the at least one sensor. The two lines preferably each comprise a sensor, for example a temperature sensor, a pressure sensor, a flow sensor and/or a sensor for determining the electrical conductivity of the cooling liquid. The control of the CDU can depend on a difference between the measurement values determined by the two sensors. Both the feed line and the return line preferably comprise sensors of the same type, as a result of which a difference measurement relating to a detected measurement variable is made possible. For example, a pumping capacity of a pump unit of the CDU, a cooling capacity of a heat exchanger of the CDU, an opening cross section of a valve of the CDU or another variable operating parameter of the CDU can depend on the determined measurement value difference.

It can be provided that, apart from the at least one sensor which the coolant distribution channel comprises, all other functional components are accommodated in a single built-in unit. This allows the use of coolant distribution units (CDU) which, apart from the at least one sensor, comprise all components of a CDU which are otherwise required.

Independently of the sensor system provided with the coolant distribution channel, at least one further functional component of a CDU can also be provided as a component which is independent of the remaining CDU, in particular a housing of the CDU. This can be, for example, but not restrictively, a heat exchanger, a storage container for

cooling liquid, a control unit, a power supply (power supply unit) or at least one pump unit. It is thus possible, for instance, for at least one pump unit, preferably a plurality of pump units, to be provided independently of the CDU. A plurality of pump units can have a redundancy, with the result that, in the event of failure of one of the plurality of pump units, the DLC can continue to be operated, if appropriate with reduced pumping capacity. For the replacement of a defective pump unit, the operation of the DLC and thus of the IT infrastructure, for example of servers, does not have to be interrupted.

Optionally, it can be provided that the IT rack comprises a power distribution. If the coolant distribution channel is arranged on a rear side of the IT rack, it can be arranged in the same mounting plane as the power distribution of the IT rack, in particular as a busbar for providing a DC voltage for installations of the IT rack, for example slide-in units, for example servers and/or slide-in units of the direct liquid cooling, for example of a CDU. Instead of in the same mounting plane, the coolant distribution channel and the busbar can also be arranged in closely adjacent, in particular parallel planes on the rear side of the IT rack. The busbar can extend parallel to the coolant distribution channel. In particular, the busbar and the coolant distribution channel can extend vertically. If the coolant distribution channel comprises a feed line and a return line which are designed as lines which are separate from one another, the busbar can be arranged between the two lines of the coolant distribution channel, in particular in the same mounting plane. The two lines can be arranged on opposite vertical struts of the IT rack, in particular on rear-side vertical struts of the IT rack, while the busbar is arranged centrally therebetween. A connecting line of the coolant distribution channel can be arranged in the same mounting plane as the coolant distribution channel or a feed line and a return line of the coolant distribution channel, if appropriate furthermore in the same mounting plane as a busbar for a voltage supply of the IT rack, in particular a DC voltage supply.

The coolant distribution channel can comprise a feed line with a plurality of outlets for cooled cooling liquid and a return line with a plurality of inlets for heated cooling liquid. At least one of the feed line and return line can comprise the at least one sensor. Both the feed line and the return line preferably each comprise a sensor. Particularly preferably, the two sensors are designed for a difference measurement of a measurement value. For this purpose, the sensors can preferably be of the same type, at least in relation to the determined measurement variable. A determined difference between the measurement values can be taken into account for the control of the DLC, in particular of a cooling capacity provided by the CDU. For example, a pumping

capacity and/or a coolant volume flow through the coolant distribution channel can be set depending on the measured difference value.

When the at least one sensor is arranged in or on a feed line of the coolant distribution channel, a measurement variable recorder of the at least one sensor can be configured to record a measurement variable relating to a cooled cooling liquid in the feed line.

When the at least one sensor is arranged in or on a return line of the coolant distribution channel, the measurement variable recorder can be configured to record a measurement variable relating to a heated cooling liquid in the return line.

The feed line can comprise a first temperature sensor, which is configured to determine the temperature of the cooling liquid conducted in the feed line. The return line can comprise a second temperature sensor, which is configured to determine the temperature of the cooling liquid conducted in the return line.

The at least one sensor can be arranged at a coolant inlet of the feed line of the coolant distribution channel or at a coolant outlet of the return line of the coolant distribution channel. A first sensor is preferably provided at the coolant inlet of the feed line and a second sensor is preferably provided at the coolant outlet of the return line, preferably for the above-described control of the DLC, in particular of a CDU, depending on a determined measurement value difference.

The at least one sensor can be arranged at a coolant inlet of the feed line of the coolant distribution channel or at a coolant outlet of the return line of the coolant distribution channel. Alternatively or additionally, the at least one sensor can be arranged on or on an outer side of the coolant distribution channel or can be accessible from the outer side of the coolant distribution channel.

The coolant distribution channel preferably comprises a feed line with a plurality of outlets for cooled cooling liquid and a return line with a plurality of inlets for heated cooling liquid. At least one of the feed line and the return line preferably comprises a fitting, via which the respective line is fluidically connected to the coolant distribution unit. The fitting can comprise the at least one sensor. The at least one sensor can be detachably connected to the fitting, for example via a quick-release coupling. However, the sensor can also be non-detachably connected to the fitting. In this embodiment, the fitting should be detachably connected to the feed line and/or return line, preferably via a quick-release coupling, in order to enable a rapid replacement of the fitting in the

event of maintenance, for example in the event of failure of the at least one sensor. The fitting can be arranged directly at the inlet of the feed line and/or at the outlet of the return line. The fitting can be fluidically connected directly to the inlet and/or to the outlet with a quick-release coupling. The at least one sensor can be fluidically connected to the fitting via a quick-release coupling.

Preferably, at least one sensor, particularly preferably at least one pressure sensor, is installed with a quick-release coupling on the coolant distribution channel. Particularly preferably, at least one sensor, preferably a pressure sensor, is installed in each case on a feed line and on a return line of the coolant distribution channel with a quick-release coupling in each case.

The coolant distribution channel can comprise a cable guide, preferably a cable channel, with which a sensor cable of the at least one sensor is guided along the coolant distribution channel, preferably on an outer side of the coolant distribution channel. In addition to the replacement of the sensor, this likewise enables the simple replacement of the sensor cable, consequently of a signal line, which can possibly be the cause of a fault in the direct liquid cooling, in the event of maintenance.

The above-described direct liquid cooling proposes a maintenance-friendly system with high reliability, with which a coolant, for example 24/7/365, IT components requiring cooling can be supplied, for example plate heat exchangers for the cooling of CPUs, GPUs and the like, or built-in units of an IT infrastructure, for example server built-in units.

The distribution of the cooling liquid to the units of the IT infrastructure is taken over by the CDU (cooling distribution unit). The CDU separates the coolant provided by a recooling, for example a refrigerator or a free-cooling system (e.g. facility water—primary circuit) and the cooling liquid which flows through the units of the IT infrastructure (secondary circuit) into two circuits. The CDU is usually set up to supply the cooling liquid in the secondary circuit with a setpoint temperature and a setpoint pressure to the components requiring cooling, for example the units of the IT infrastructure, and to guide it through them. CDUs which are used in data centers are often difficult to repair and are inflexible when it comes to increasing the performance of the CDU. Instead of integrating the at least one sensor, for example a temperature, pressure, flow or other sensor, into the CDU, in particular a housing of the CDU, it is proposed to provide the at least one sensor in conjunction with the coolant distribution

channel or to provide it thereon, preferably so as to be easily accessible from the outer side of the coolant distribution channel, or to provide it in conjunction with a connecting system for the coolant distribution channel, for example a fitting, as a result of which the sensor is easily accessible and therefore easily exchangeable in the event of maintenance.

In one embodiment, at least one temperature sensor and/or at least one pressure sensor can each be provided in a fitting or on a fitting in the flow direction of the coolant upstream of a coolant inlet or in the flow direction downstream of a coolant outlet of the coolant distribution channel.

The at least one sensor, in particular at least one pressure sensor, can be installed by means of a (leak-proof) quick-release coupling or a so-called non-spill quick-release coupling on the coolant distribution channel or in a fitting or on a fitting. In one embodiment, this enables a simple and rapid replacement of the sensors, possibly without the direct liquid cooling having to be interrupted.

Further details of the invention are explained with reference to the figures. However, the invention is not intended to be restricted to the embodiments which are shown in the figures and which can have features which go beyond the features which are essential for the invention. In the figures:

FIG. 1 shows a schematic illustration of a direct liquid cooling;

FIG. 2 shows a coolant distribution unit (CDU) with a reduced functional scope;

FIG. 3 shows an IT rack with a direct liquid cooling (DLC) accommodated therein;

FIG. 4 shows an exemplary embodiment of a coolant distribution channel; and

FIG. 5 shows a further embodiment of a coolant distribution channel.

FIG.1 shows a schematic illustration of a direct liquid cooling (DLC). Cooled liquid is provided by a recooler 16, which can be designed for example as a chiller, with or without a refrigerator. For this purpose, the recooler 16 comprises, for example, an air-liquid heat exchanger and at least one fan, with which ambient air is transported

through the air-liquid heat exchanger. The cooled liquid provided by the recooling unit is supplied to a coolant distribution unit (CDU), in particular via the flow of an outer circuit of the CDU. Via a return of the outer circuit, the liquid provided by the recooling unit leaves the CDU as heated liquid. The outer circuit of the CDU, which at the same time forms the liquid circuit of the recooling unit 16, is identified by the reference numeral 17.

The coolant distribution unit CDU comprises in particular a liquid-liquid heat exchanger as well as at least one pump, in order to transport liquid through the inner circuit 15 of the CDU. The flow of the inner circuit of the CDU is connected to a return of a coolant distribution channel 7 and the return of the inner circuit 15 of the CDU is connected to a flow of the coolant distribution channel 7. The coolant distribution channel 7 can comprise, spaced apart from one another in the longitudinal direction, consequently in the vertical direction, a plurality of connections on the one hand to a flow of the coolant distribution channel 7, via which cooled cooling liquid is provided, and on the other hand to a return of the coolant distribution channel 7, via which heated cooling liquid is discharged. The slide-in units 2 can be, for example, server inserts of an IT infrastructure, which are connected to the coolant distribution channel 7 for example in the manner known from US 2007/0274043 A1. In the slide-in units, the cooling liquid, which is preferably an electrically non-conductive refrigerant, flows over the components requiring cooling, for example CPUs or GPUs, or another component, which has a high power loss and otherwise a high temperature sensitivity, so that air cooling is unsuitable due to the lower thermal conductivity of air compared to liquid.

FIG. 2 shows an exemplary embodiment of a CDU which has a reduced functionality compared to the CDUs known from the prior art. In particular, the CDU does not comprise the at least one sensor which is assigned according to the invention to the coolant distribution channel of the DLC. As a result, the CDU has a lower susceptibility to faults and the DLC as a whole has an increased degree of maintenance-friendliness.

The slide-in unit 2.1 comprises a housing 13, which can be standardized for example in relation to its dimensions, for example at least to the effect that, when the slide-in unit 2.1 is inserted into a slide-in unit of an IT rack, both a contacting of the first and of the second blind coupling plug-in connection 6.1, 6.2 for an electrical contacting of a power distribution on the one hand and the fluidic connection to the direct liquid cooling, in particular a coolant distribution channel, can take place automatically, that is to say in particular without tools. The blind coupling plug-in connections for the electrical and/or fluidic connection of the unit are optional. In the housing 13, three

redundant pumps 14 are arranged, which are connected in particular parallel to one another. Furthermore, a heat exchanger 12, in particular a liquid-liquid heat exchanger, is arranged in the housing 13. The embodiment according to FIG. 2 comprises no sensor system in the housing 13 for the detection of a physical measurement variable relating to the cooling liquid. The unit shown in FIG. 2 therefore has a high failure insensitivity. Due to the use of the first and of the second blind coupling plug-in connectors 6.1, 6.2, the entire unit, that is to say the slide-in unit 2.1, can be replaced quickly and without relevant downtimes in the event of failure of all pumps or in the event of decreasing pump power. further redundancy of the direct liquid cooling (DLC) can be achieved by a plurality of the slide-in units 2.1 which are shown in FIG. 2 being provided at the same time, which slide-in units 2.1 are in turn connected in parallel with one another, with the result that, even in the event of failure of all of the three pumps 14 in the present case of one of the plurality of slide-in units 2.1, the continued operation of the DLC is ensured and downtimes can be substantially completely avoided.

FIG. 3 shows an exemplary IT rack 1 in a perspective front view. The IT rack 1 comprises a frame consisting of four vertical struts and eight horizontal struts, which in each case form rectangular profile frames. On a rear-side profile frame, a coolant distribution channel 7 is arranged on the opposite vertical struts, in particular a feed line 7.1 on a first of the opposite vertical struts and a return line 7.2 on a second of the opposite vertical struts. As a result of the spatial separation, there is no thermal short circuit between the flow and the return, as a result of which the efficiency of the coolant distribution channel 7 is increased.

The embodiment shown in FIG. 3 furthermore shows a DC voltage supply 5 with a busbar which extends along the rear side of the IT rack 1, consequently on the rear side on which the coolant distribution channel 7 is also arranged. In particular, the voltage supply 5, in particular the busbar, is arranged between the feed line 7.1 and the return line 7.2, in particular centrally between the mentioned lines. While the feed line 7.1 and the return line 7.2 are each fastened to a vertical profile, the busbar can be fixed with its opposite ends and electrically insulated on a roof-side and a floor-side frame, in particular on respective horizontal struts.

The feed line 7.1 (and analogously the return line 7.2, but not shown) comprises a plurality of outlets 7.3 (and the return line analogously a plurality of inlets 7.4 — compare FIGS. 4 and 5). Both the components requiring cooling 2, in the present case

server inserts, and the CDU are designed as slide-in units. An uninterruptible power supply BBU, which supplies the busbar 5 with a DC voltage, is likewise designed as a slide-in unit. Beyond the slide-in units 2, CDU, BBU shown in FIG. 3, further slide-in units can be installed over the entire height dimension of the IT rack 1. Cooled liquid can be provided via the outlets 7. 4 or the inlets of the return line 7. 2, not shown, over the entire height dimension.

Exemplary embodiments of a coolant distribution channel 7 are shown in FIGS. 4 and 5. The coolant distribution channel 7 is of two-part design and comprises a feed line 7.1 and a return line 7. 2. The feed line 7.1 comprises coolant outlets 7. 3 distributed over its entire length at regular or irregular intervals and the return line 7. 2 comprises coolant inlets 7. 4 in an analogous manner. The feed line 7.1 and the return line 7. 2 can be fastened, for example in the manner shown with reference to FIG. 3, to a vertical strut of a frame.

The feed line and the return line 7.1, 7. 2 each comprise a connecting line 7. 7, via which they can be fluidically connected to a CDU (compare FIG. 3). In particular, the feed line can be connected to the return of the inner circuit of the CDU. The connecting line 7. 7 of the return line 7. 2 can be connected to a feed line of the inner circuit of the CDU.

sensor 300 is arranged in the region of a coolant outlet 7. 5 of the connecting line 7. 7 into the feed line 7.1 in the embodiment shown in FIG. 4. A further sensor 300 is arranged at a coolant outlet 7. 6, in which a further connecting line 7. 7 opens into the return line 7. 2. The sensors can be, for example, temperature sensors, pressure sensors, flow sensors or sensors for determining an electrical conductivity of a coolant conducted in the feed line 7.1 or the return line 7. 2. However, the sensors 300 are not restricted to the described embodiments and can be all sensors 300 which are suitable for determining a physical measurement variable relating to a cooling liquid and which are suitable for the control of a CDU. The sensors 300 are each connected to the feed line 7.1 or the return line 7.2 via a drip-free quick-release coupling 310. It is thereby achieved that the sensors can be replaced, for example in the event of failure during ongoing operation of the direct liquid cooling. Since the feed line 7.1 and the return line 7.2 are often arranged on the rear side of an IT rack, the sensors 300 mounted thereon are easily accessible, in particular more easily accessible, than in the case of direct liquid cooling according to the prior art, in which the sensors are often arranged in a cooling distribution unit (CDU) for the recooling of the coolant, in particular within a

housing of the CDU, with the result that, in the event of failure, the entire CDU for the repair has to be removed from the IT rack and/or completely replaced by a functional CDU.

In the embodiment shown in FIG. 5, the sensors 300 are arranged in a fitting 400 instead of on or in the feed line 7.1 or the return line 7.2. The respective connecting line 7.7 of the feed line 7.1 and return line 7.2 is connected to the respective feed line 7.1 or return line 7.3 via the fitting 400. The sensor 300 can be fixedly connected to the fitting 400 or be exchangeable, for example via a quick-release coupling. Analogously, in the embodiment shown in FIG. 4, the respective sensor 300 can also be connected to the feed line 7.1 or the return line 7.2 via a quick-release coupling, for example through an outer wall of the respective line 7.1, 7.2 and preferably in fluidic connection with the cooling liquid guided in the respective line 7.1, 7.2.

The features given in the above-mentioned description can be relevant in any desired combination for the realization of embodiments of the invention, wherein the scope of protection is determined solely by the claims.

List of reference symbols:

1	IT rack
2	Slide-in unit/component requiring cooling
5	busbar
6.1	first blind coupling plug-in connector
6.2	second blind coupling plug-in connector
7	coolant distribution channel
7.1	feed line
7.2	return line
7.3	outlet
7.4	inlet
7.5	coolant inlet
7.6	coolant outlet
7.7	connecting line
7.7	connecting line
9	control unit
12	heat exchanger
13	housing
14	pump
15	inner circuit
16	recooler
17	outer circuit
300	sensor
310	(drip-free) quick-release coupling
400	fitting
BBU	Uninterruptible power supply
CDU	Coolant distribution unit
DLC	direct liquid cooling
z	height direction

Claims:

1. Direct liquid cooling (DLC) for an IT infrastructure with at least one component (2) requiring cooling, wherein the direct liquid cooling comprises a coolant distribution unit (CDU) and a coolant distribution channel (7), which is supplied with cooled liquid by the coolant distribution unit (CDU), characterized in that the coolant distribution channel (7) comprises at least one sensor (300), with which at least one physical measurement variable relating to the liquid in the coolant distribution channel (7) is determined.
2. Direct liquid cooling (DLC) according to claim 1, wherein the sensor (300) is a temperature sensor, a pressure sensor, a flow sensor and/or a sensor for determining the electrical conductivity of the liquid.
3. Direct liquid cooling (DLC) according to claim 1 or 2, wherein the coolant distribution channel (7) is configured to be fastened in an IT rack (1), wherein the coolant distribution channel (7) extends with its longitudinal direction in the vertical direction.
4. Direct liquid cooling (DLC) according to one of the preceding claims, wherein the coolant distribution unit (CDU) is configured to control an operating parameter of the coolant distribution unit (CDU) depending on a physical measurement variable determined with the at least one sensor (300), preferably a cooling capacity for cooling the liquid and/or a pumping capacity of at least one pump (14) for supplying the coolant distribution channel (7) with the liquid.
5. Direct liquid cooling (DLC) according to one of the preceding claims, wherein the coolant distribution channel (7) comprises a feed line (7.1) with a plurality of outlets (7.2) for cooled cooling liquid and a return line (7.3) with a plurality of inlets (7.4) for heated cooling liquid, of which at least one of the feed line (7.1) and the return line (7.3) comprises the at least one sensor (300).
6. Direct liquid cooling (DLC) according to one of the preceding claims, wherein a measurement variable recorder of the at least one sensor (300) is configured to record a measurement variable relating to a cooled cooling liquid in the feed line (7.1) when the at least one sensor (300) is arranged in or on the feed line

(7.1), or to record a measurement variable relating to a heated cooling liquid in the return line (7.3) when the at least one sensor (300) is arranged in or on the return line (7.3).

7. Direct liquid cooling (DLC) according to claim 5 or 6, wherein the feed line (7.1) comprises a first temperature sensor, which is configured to determine the temperature of the cooling liquid conducted in the feed line (7.1), and wherein the return line (7.3) comprises a second temperature sensor, which is configured to determine the temperature of the cooling liquid conducted in the return line (7.3).
8. Direct liquid cooling (DLC) according to one of claims 5 to 7, wherein the at least one sensor (300) is arranged at a coolant inlet (7.5) of the feed line (7.1) of the coolant distribution channel (7) or at a coolant outlet (7.6) of the return line (7.3) of the coolant distribution channel (7).
9. Direct liquid cooling (DLC) according to one of the preceding claims, wherein at least one sensor (300) is arranged on or on an outer side of the coolant distribution channel (7) or is accessible from the outer side of the coolant distribution channel (7).
10. Direct liquid cooling (DLC) according to one of the preceding claims, wherein the coolant distribution channel (7) comprises a feed line (7.1) with a plurality of outlets for cooled cooling liquid and a return line (7.3) with a plurality of inlets for heated cooling liquid, of which at least one of the feed line (7.1) and the return line (7.3) comprises a fitting, via which the respective line is fluidically connected to the coolant distribution unit (CDU), wherein the fitting comprises the at least one sensor (300).
11. Direct liquid cooling (DLC) according to claim 10, wherein the fitting is arranged directly at the inlet of the feed line (7.1) and/or at the outlet of the return line (7.3).
12. Direct liquid cooling (DLC) according to claim 11, wherein the fitting is fluidically connected to the inlet and/or to the outlet with a quick-release coupling.

13. Direct liquid cooling (DLC) according to claim 11 or 12, wherein the at least one sensor (300) is fluidically connected to the fitting via a quick-release coupling.
14. Direct liquid cooling (DLC) according to one of the preceding claims, wherein at least one sensor (300), preferably at least one pressure sensor, is installed with a quick-release coupling on the coolant distribution channel (7).
15. Direct liquid cooling (DLC) according to one of the preceding claims, wherein the coolant distribution channel (7) comprises a cable guide, preferably a cable channel, with which a sensor cable of the at least one sensor (300) is guided along the coolant distribution channel (7), preferably on an outer side of the coolant distribution channel (7).