COLD PLATE LIQUID COOLING ASSEMBLY FOR OPTICAL MODULES AND NETWORK SWITCHING DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to a Chinese Patent Application No. 202410317997.7, filed to the China National Intellectual Property Administration on March 19, 2024, entitled "Cold Plate Liquid Cooling Assembly for Optical Modules and Network Switching Device", the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

The present disclosure relates to the technical field of heat dissipation for network devices, and in particular, to a cold plate liquid cooling assembly for optical modules and a network switching device.

BACKGROUND

Optical modules are optoelectronic devices implementing photoelectric and electro-optical conversion, and serve as important components of a 4G/5G communication device and a data center. With continuous increase of communication speed and load, power consumption and a mounting number of the optical modules keep rising, making heat dissipation of the optical modules particularly critical.

In the related art, air cooling mode is generally adopted to dissipate heat of optical modules. The optical modules are mounted into an optical module connector. An opening is formed at the top of the optical module connector, so that a part of the optical modules are in contact with a heat sink. Heat is conducted from the optical modules to a cooling fin of the heat sink, and then dissipated to an external environment by air flow flowing over surfaces of the cooling fin.

However, an air-cooled heat dissipation mode for optical modules is low in heat dissipation efficiency and poor in heat dissipation effect.

SUMMARY

The present disclosure provides a cold plate liquid cooling assembly for optical modules and a network switching device. The cold plate liquid cooling assembly for optical modules is

in tight contact with optical modules inserted into multiple connectors of the network switching device. Heat generated by the optical modules during operation is smoothly and timely conducted, with high heat dissipation efficiency and excellent heat dissipation effect.

According to an aspect of the present disclosure, a cold plate liquid cooling assembly for optical modules is provided, including:

a cold plate body, extending along a first direction and including a first side and a second side opposite to each other;

multiple floating heat conduction blocks, connected with the first side of the cold plate body and capable of floating along a second direction perpendicular to the first direction, where the multiple floating heat conduction blocks are arranged at intervals along the first direction, and the multiple floating heat conduction blocks are configured to be in contact with optical modules sequentially arranged along the first direction;

a thermal pad, arranged between the cold plate body and the multiple floating heat conduction blocks, and in contact with the cold plate body and the multiple floating heat conduction blocks; and

at least one liquid cooling tube, arranged on the second side of the cold plate body.

The cold plate liquid cooling assembly for optical modules provided by the present disclosure includes the cold plate body, the multiple floating heat conduction blocks, the thermal pad, and the at least one liquid cooling tube. The cold plate body extends along the first direction. The multiple floating heat conduction blocks are arranged on the first side of the cold plate body and arranged at intervals along the first direction. The thermal pad is attached between the multiple floating heat conduction blocks and the cold plate body. The at least one liquid cooling tube is arranged on the second side of the cold plate body. Each floating heat conduction block comes into contact with each optical module. Heat generated by the optical modules is conducted to the cold plate body via the multiple floating heat conduction blocks and the thermal pad, and is then carried away by cooling liquid inside the at least one liquid cooling tube to realize heat dissipation of the optical modules. The multiple floating heat conduction blocks are capable of floating along the second direction perpendicular to the first direction. The thermal pad deforms following movement of the multiple floating heat conduction blocks and remains to be tightly attached to the multiple floating heat conduction blocks and the cold plate body all the time. In this way, based on a

liquid cooling mode for heat dissipation of the optical modules, a permanent tight contact between the multiple floating heat conduction blocks and the optical modules is ensured, contact thermal resistance between the cold plate liquid cooling assembly for optical modules and the optical modules is reduced, and heat dissipation efficiency and heat dissipation effects are improved.

In some possible implementations, the cold plate liquid cooling assembly for optical modules further includes:

elastic members, connected between each floating heat conduction block and the cold plate body, and extendable and contractible along the second direction.

The elastic members are arranged between each floating heat conduction block and driving the multiple floating heat conduction blocks to float along the second direction by virtue of the elastic members. The elastic members, with high elastic force and excellent elastic deformability, reliably drive the multiple floating heat conduction blocks to move, and increase pressure between the multiple floating heat conduction blocks and the optical modules, so as to ensure tight contact between the multiple floating heat conduction blocks and the optical modules.

In some possible implementations, two elastic members are connected between each floating heat conduction block and the cold plate body, the two elastic members are respectively located at two ends of each floating heat conduction block, and the thermal pad is located between the two elastic members.

The two elastic members are connected with two ends of each floating heat conduction block. The two elastic members apply large and balanced elastic force to each floating heat conduction block, so as to ensure good contact between the multiple floating heat conduction blocks and the cold plate body. In addition, the thermal pad is arranged between the two elastic members. This arrangement enables the thermal pad to occupy sufficient space and be attached to a body area of each floating heat conduction block, thereby the heat conduction efficiency and heat conduction effect of the thermal pad are improved.

In some possible implementations, the cold plate body includes:

a main support plate, extending along the first direction, where the multiple floating heat conduction blocks are located on a first side of the main support plate, and the at least one liquid cooling tube is located on a second side of the main support plate; and

a stop assembly, connected with an outer side of the main support plate and jointly defining floating grooves with the main support plate, where the floating grooves are located on two sides of the main support plate, groove openings of the floating grooves on the two sides face each other, and two ends of each floating heat conduction block are inserted into the floating grooves on the two sides.

The cold plate body is composed of the stop assembly and the main support plate. The floating grooves defined therebetween form a mounting base for the multiple floating heat conduction blocks, so that the multiple floating heat conduction blocks are fixed on the cold plate body, and movement travel of the multiple floating heat conduction blocks is limited. In addition, this facilitates machining design of the main support plate and assembly of the cold plate body, and reduces costs of machining, assembly, and other procedures of the cold plate body.

In some possible implementations, the stop assembly includes stop members connected with two opposite sides of the main support plate, and the second side of the main support plate is exposed.

The stop members are arranged on two opposite sides of the main support plate. The stop members on the two opposite sides and the main support plate jointly define the floating grooves on two sides to fix and limit the multiple floating heat conduction blocks. In addition, the second side of the main support plate is exposed, which facilitates the mounting of the at least one liquid cooling tube. The liquid cooling assembly for optical modules has a short overall heat conduction path and high heat conduction efficiency.

In some possible implementations, each stop member includes a body portion and a stop portion connected with each other, the body portion is connected with the main support plate, and the stop portion abuts against an end of the at least one floating heat conduction block.

In some possible implementations, multiple stop members are arranged at intervals along the first direction, and each stop member stops at least one floating heat conduction block.

In some possible implementations, one liquid cooling tube is provided, and the one liquid cooling tube penetrates two ends of the cold plate body along the first direction.

In some possible implementations, the one liquid cooling tube extends in a wavy line from one end of the cold plate body to the other end of the cold plate body.

According to another aspect of the present disclosure, a network switching device is provided, including:

at least one board card;

at least one connector group, where each connector group includes multiple connectors sequentially arranged along the first direction, each connector is electrically connected with the at least one board card, each connector in the at least one connector group is provided with a contact window, and the contact window is located on a mounting side of the connector group; and

at least one cold plate liquid cooling assembly for optical modules as described above, where the at least one cold plate liquid cooling assembly for optical modules is arranged on the mounting side of the at least one connector group, and each floating heat conduction block of the cold plate liquid cooling assembly for optical modules is configured to pass through the contact window and come into contact with optical modules inserted into each connector.

The network switching device provided by the present disclosure includes the at least one board card, the at least one connector group, and the at least one cold plate liquid cooling assembly for optical modules. The multiple connectors in each connector group are sequentially arranged along the first direction and each connector is electrically connected with the at least one board card. Each connector in at least one connector group is provided with a contact window on a mounting side of the at least one connector group, and the at least one cold plate liquid cooling assembly for optical modules is arranged on the mounting side of the at least one connector group. The at least one cold plate liquid cooling assembly for optical modules includes the cold plate body, the multiple floating heat conduction blocks, the thermal pad, and the at least one liquid cooling tube. The cold plate body extends along the first direction. The multiple floating heat conduction blocks are arranged on the first side of the cold plate body and arranged at intervals along the first direction. The thermal pad is attached between the multiple floating heat conduction blocks and the cold plate body. The at least one liquid cooling tube is arranged on the second side of the cold plate body. Each floating heat conduction block passes through the contact window on each connector and comes into contact with each optical module. Heat generated by the optical modules is conducted to the cold plate body via the multiple floating heat conduction blocks and the thermal pad, and is then carried away by cooling liquid inside the at least one liquid cooling

tube to realize heat dissipation of the optical modules. The multiple floating heat conduction blocks are capable of floating along the second direction perpendicular to the first direction. The thermal pad deforms following the movement of the multiple floating heat conduction blocks and remains to be tightly attached to the multiple floating heat conduction blocks and the cold plate body all the time. In this way, based on a liquid cooling mode for heat dissipation of the optical modules, a permanent tight contact between the multiple floating heat conduction blocks and the optical modules is ensured, contact thermal resistance between the cold plate liquid cooling assembly for optical modules and the optical modules is reduced, and heat dissipation efficiency and heat dissipation effects are improved.

In some possible implementations, at least two connector groups are arranged at intervals along a second direction perpendicular to the first direction, the multiple connectors in each connector group are respectively provided with the contact window, and one cold plate liquid cooling assembly for optical modules is arranged for each connector group.

When the at least two connector groups are arranged at intervals along the second direction, the one cold plate liquid cooling assembly for optical modules is arranged for each connector group, and each contact window is arranged on each connector in each connector group. The floating heat conduction blocks of the one cold plate liquid cooling assembly for optical modules pass through each contact window on each connector in each connector group corresponding to the one cold plate liquid cooling assembly for optical modules and come into contact with the optical modules inserted into each connector. In this way, heat is quickly carried away from all optical modules in time, with excellent heat dissipation effect for each optical module.

In some possible implementations, one board card is provided. The at least two connector groups include two inner connector groups and two outer connector groups. The two inner connector groups are respectively connected with two side surfaces of the one board card, the two outer connector groups are respectively located on sides of the two inner connector groups facing away from the one board card, and the two outer connector groups are both electrically connected with the one board card.

Four cold plate liquid cooling assemblies for optical modules are provided, which are respectively arranged on the mounting side of each connector group.

Four connector groups are electrically connected with the one board card. An optoelectronic connection module is provided with a large number of the multiple connectors,

a large number of the optical modules are inserted, and capacity and transmission power of the optoelectronic connection module are improved. In addition, adoption of only one board card simplifies control mode of the optoelectronic connection module and enhances signal transmission efficiency.

In some possible implementations, the mounting side of each connector group is a side of the at least one connector group facing away from the one board card, and the cold plate liquid cooling assemblies for optical modules include two inner liquid cooling assemblies and two outer liquid cooling assemblies.

The two inner liquid cooling assemblies are respectively located between an inner connector group and an outer connector group on each side, and the two inner liquid cooling assemblies are configured to be in contact with optical modules inserted into the inner connector group. The two outer liquid cooling assemblies are respectively located on each side of the outer connector group facing away from the one board card, and the two outer liquid cooling assemblies are configured to be in contact with optical modules inserted into the outer connector group.

The side of each connector group facing away from the one board card is defined as the mounting side of each connector group. The contact window of each connector is located on the side of each connector group facing away from the one board card, and each liquid cooling assembly is arranged on the side of the connector group corresponding to each liquid cooling assembly facing away from the one board card. The one board card does not interfere with mounting space for the contact windows of the multiple connectors and liquid cooling assemblies, so as to ensure stable contact between the liquid cooling assemblies and the optical modules inserted into the multiple connectors. The liquid cooling assemblies include the two inner liquid cooling assemblies and the two outer liquid cooling assemblies.

In addition, the two inner liquid cooling assemblies are respectively sandwiched between the inner connector group and the outer connector group on each side, and the two outer liquid cooling assemblies are respectively located on the opposite outer sides of the two outer connector groups on two sides. Each liquid cooling assembly applies pressure toward the one board card to ensure reliable contact between each liquid cooling assembly and the optical modules inserted into the connector groups. Moreover, the pressure applied by the liquid cooling assemblies on two sides counterbalances each other, so that the overall force balance of the entire optoelectronic connection module is ensured.

In some possible implementations, each connector in the two outer connector groups is provided with a bracket, the bracket extends toward the one board card and is connected with the one board card, and the two outer liquid cooling assemblies cover at least part of the bracket.

Each connector in the two outer connector groups is connected with the one board card through the bracket, which increases surface area of each connector in the two outer connector groups. The two outer liquid cooling assemblies cover at least part of the bracket, so that the two outer liquid cooling assemblies have a larger heat conduction area, along with higher heat dissipation efficiency and better heat dissipation effect. In addition, contact area between the two outer liquid cooling assemblies and the two outer connector groups is increased, and pressure applied by the two outer liquid cooling assemblies to the two outer connector groups is enhanced, which improves overall stability and reliability of the optoelectronic connection module.

In addition to the described technical problems solved by embodiments of the present disclosure, technical features constituting the technical solutions, and beneficial effects brought by the technical features of the technical solutions, the present disclosure provides further technical problems addressable by the network switching device, along with additional technical features included in the technical solutions and the beneficial effects of the technical features. These aspects are described in further detail in specific implementations.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to more clearly describe embodiments of the present disclosure or the technical solutions in the related art, the following briefly describes the drawings required for describing the embodiments or the related art. Apparently, the drawings in the following descriptions show some embodiments of the present disclosure, and a person of ordinary skill in the art derives other drawings from the drawings without creative efforts.

FIG. 1 is a schematic structural diagram of a network switching device according to embodiments of the present disclosure.

FIG. 2 is an exploded structural view of the network switching device shown in FIG. 1.

FIG. 3 is a partial structural view of the network switching device shown in FIG. 1.

FIG. 4 is a schematic structural diagram of an optoelectronic connection module according to embodiments of the present disclosure.

FIG. 5 is a schematic structural diagram of an optoelectronic connection module according to embodiments of the present disclosure with a mounting frame removed.

FIG. 6 is an exploded structural view of the optoelectronic connection module in FIG. 5 from one perspective.

FIG. 7 is an exploded structural view of the optoelectronic connection module in FIG. 5 from another perspective.

FIG. 8 is a schematic structural diagram of an outer liquid cooling assembly according to embodiments of the present disclosure from one perspective.

FIG. 9 is a schematic structural diagram of the outer liquid cooling assembly in FIG. 8 from another perspective.

FIG. 10 is a partial sectional structural view of the outer liquid cooling assembly in FIG. 8.

FIG. 11 is a schematic structural diagram of an inner liquid cooling assembly according to embodiments of the present disclosure from one perspective.

FIG. 12 is a schematic structural diagram of the inner liquid cooling assembly in FIG. 11 from another perspective.

FIG. 13 is a partial sectional structural view of the inner liquid cooling assembly in FIG. 11.

Reference Numerals:

10: network switching device;

100: chassis;

110: mounting opening;

200: optoelectronic connection module;

210: board card; 220: connector group; 220a: inner connector group; 220b: outer connector group; 230: liquid cooling assembly; 230a: inner liquid cooling assembly; 230b: outer liquid cooling assembly; 240: mounting frame;

221: connector; 231: liquid cooling tube; 232: cold plate body; 233: floating heat conduction block; 234: thermal pad; 235: elastic member; 241: main frame; 242: front frame;

2211: contact window; 2212: bracket; 2321: main support plate; 2322: stop assembly; 2322a: stop member; 2323: floating groove; 2421: holding portion;

23221: body portion; 23222: stop portion;

300: control module;

310: control board; 320: baseboard management controller; 330: bus bar;

400: heat dissipation module;

410: fan.

DETAILED DESCRIPTION

The terms used in implementations of the present disclosure are only intended to explain specific embodiments of the present disclosure, and shall not be construed as limiting the present disclosure.

An optical module is composed of an optoelectronic device, a functional circuit, an optical interface, and the like, and serves as a device for implementing photoelectric and electro-optical conversion. The optical module includes a transmitter and a receiver. The transmitter converts an electrical signal into an optical signal which is transmitted via an optical fiber, and the receiver converts the optical signal back into the electrical signal.

As described in the related art, the optical modules are generally cooled in the air cooling mode currently. The opening is formed at the top of the optical module connector arranged on a switch, so that a part of the optical module inserted into the optical module connector comes into contact with the heat sink. Heat generated by the optical modules is conducted to the cooling fin of the heat sink, and then dissipated to the external environment by air flow flowing over surfaces of the cooling fin.

However, with the continuous increase in power consumption and a mounting number of the optical modules, the air cooling mode in which overall thermal resistance performance has approached the limit, and no longer meets a heat dissipation requirement of the optical modules. In addition, the optical modules and the heat sink are fixedly fitted with each other with a small contact area therebetween, resulting in high thermal resistance between the

optical modules and the heat sink, and a phenomenon of temperature rise. Furthermore, when a large number of the optical modules are mounted in a limited space, especially optical modules arranged in multiple rows, the available mounting space for the heat sink is restricted, which leads to low heat dissipation efficiency and poor heat dissipation effect.

In view of this, embodiments of the present disclosure provide a cold plate liquid cooling assembly for optical modules and a network switching device. The cold plate liquid cooling assembly for optical modules includes a cold plate body, multiple floating heat conduction blocks, a thermal pad, and at least one liquid cooling tube. The cold plate body extends along a first direction. The multiple floating heat conduction blocks are arranged on a first side of the cold plate body and arranged at intervals along the first direction. The thermal pad is attached between the multiple floating heat conduction blocks and the cold plate body. The at least one liquid cooling tube is arranged on a second side of the cold plate body. Each floating heat conduction block comes into contact with each optical module. Heat generated by the optical modules is conducted to the cold plate body via the multiple floating heat conduction blocks and the thermal pad, and is then carried away by cooling liquid inside the at least one liquid cooling tube to realize heat dissipation of the optical modules. The multiple floating heat conduction blocks are capable of floating along a second direction perpendicular to the first direction. The thermal pad deforms following the movement of the multiple floating heat conduction blocks and remains to be tightly attached to the multiple floating heat conduction blocks and the cold plate body all the time. In this way, based on a liquid cooling mode for heat dissipation of the optical modules, a permanent tight contact between the multiple floating heat conduction blocks and the optical modules is ensured, contact thermal resistance between the cold plate liquid cooling assembly for optical modules and the optical modules is reduced, and heat dissipation efficiency and heat dissipation effects are improved.

To make objectives, technical solutions, and advantages of the embodiments of the present disclosure clearer, the technical solutions in the embodiments of the present disclosure is described clearly and completely below in conjunction with the drawings in the embodiments of the present disclosure. Apparently, the described embodiments are merely a part rather than all of the embodiments of the present disclosure. All other embodiments obtained by the person of ordinary skill in the art, based on the embodiments of the present disclosure without creative efforts shall fall within the protection scope of the present disclosure.

Embodiments of the present disclosure provide a network switching device. The network switching device is any type of switch, such as an access layer switch, an aggregation layer switch, or a core layer switch. By way of example, the network switching device is a 4U-height switch. U is a unit for external dimension. 1U is equal to 4.445 centimeters, and 4U is equal to 17.78 centimeters. In addition, the network switching device in the embodiments of the present disclosure is applied to any scenario requiring a network system, for example, a data center.

In an example where the network switching device is the aggregation layer switch applied to a data center, the network switching device and a cold plate liquid cooling assembly for optical modules according to the embodiments of the present disclosure is described below in detail.

FIG. 1 is a schematic structural diagram of a network switching device according to embodiments of the present disclosure. FIG. 2 is an exploded structural view of the network switching device shown in FIG. 1. FIG. 3 is a partial structural view of the network switching device shown in FIG. 1.

Referring to FIG. 1 and FIG. 2, a network switching device 10 according to embodiments of the present disclosure includes a chassis 100 and an optoelectronic connection module 200. The chassis 100 serves as a mounting base. All other components of the network switching device 10 are all arranged on the chassis 100, so that the network switching device 10 is assembled into an integral unit through the chassis 100. This facilitates movement and deployment of the network switching device 10 in a data center. The optoelectronic connection module 200 is mounted in the chassis 100. The optoelectronic connection module 200 is configured to connect the optical modules (not shown in the figures) to the network switching device 10, so as to realize data transmission between the network switching device 10 and other network devices (e.g., servers or transceivers).

The optoelectronic connection module 200 includes at least one board card 210 and multiple connectors 221. The multiple connectors 221 are all arranged on a surface of the at least one board card 210. The multiple connectors 221 are configured to plug the optical modules to connect the optical modules with the network switching device 10. As a bearing basis for the multiple connectors 221, the at least one board card 210 is configured to fix the multiple connectors 221 and also configured to provide electrical signals to the multiple connectors 221. An end of the multiple connectors 221 facing out of the chassis 100 is

determined as an interface end. The optical modules are inserted into interface ends of the multiple connectors 221 to establish electrical connection between the optical modules and the optoelectronic connection module 200.

Chips and electrical channels are arranged on the at least one board card 210. The electrical channels are electrically connected with the chips, and each connector 221 arranged on the at least one board card 210 is electrically connected with the electrical channels. Accordingly, signals are transmitted between the chips and the multiple connectors 221 through the electrical channels. When the optical modules are inserted into the multiple connectors 221, signal transmission is realized between the optical modules and the optoelectronic connection module 200.

By way of example, the optoelectronic connection module 200 includes one board card 210. All the multiple connectors 221 are arranged on the at least one board card 210, and the electrical channels connected with the multiple connectors 221 are all laid out on the at least one board card 210. Alternatively, the optoelectronic connection module 200 includes two or more board cards 210. The multiple connectors 221 are respectively arranged on each board card 210, and the electrical channels connected with the multiple connectors 221 are laid out on the two or more board cards 210 corresponding to the electrical channels.

The at least one board card 210 is a printed circuit board (PCB). A metal conductive layer is arranged inside the PCB, and the metal conductive layer forms the electrical channels connected between the chips and the multiple connectors 221. The metal conductive layer is made of conductive materials including but not limited to copper, aluminum, copper alloy, and aluminum alloy. This is not specifically limited in some embodiments.

As shown in FIG. 2, the optoelectronic connection module 200 in some embodiments is configured as a removable switch module (RSM). As an independent module, the entire optoelectronic connection module 200 is detachably arranged on the chassis 100. With this arrangement, a universal chassis 100 is designed for the network switching device 10 to match different types of optoelectronic connection modules 200. Different optoelectronic connection modules 200 are replaced for the network switching device 10, based on different application scenarios without designing and manufacturing additional chassis 100, thereby the costs of design, production, and testing of the chassis 100 are reduced.

Different types of optoelectronic connection modules 200 refer to the optoelectronic connection modules 200 differing in the number and model of the multiple connectors 221,

and the different optoelectronic connection modules 200 have different transmission power.

One end of the chassis 100 is open, and this end of the chassis 100 forms a mounting opening 110 for the optoelectronic connection module 200. The optoelectronic connection module 200 is mounted into the chassis 100 through the mounting opening 110, and the interface end of each connector 221 on the optoelectronic connection module 200 is exposed outside the chassis 100, for plugging the optical modules to the interface ends of the multiple connectors 221. In an example where the chassis 100 is of a rectangular structure, the mounting opening 110 for the chassis 100 is, for example, located at one end along a length direction of the chassis 100, and the optoelectronic connection module 200 is mounted at the end along the length direction of the chassis 100.

As shown in FIG. 3, the network switching device 10 further includes a control module 300. The control module 300 is arranged inside the chassis 100. The optoelectronic connection module 200 is electrically connected with the control module 300, so that the operation of the optoelectronic connection module 200 is controlled by the control module 300. The at least one board card 210 of the optoelectronic connection module 200 is electrically connected with the control module 300, and signal transmission between the control module 300 and each connector 221 is realized through the at least one board card 210. The control module 300 includes a control board 310, as well as components arranged on the control board 310 such as a BMC 320 and a bus bar 330. The control board 310 is, for example, a PCB.

In addition, the network switching device 10 further includes a heat dissipation module 400. The heat dissipation module 400 is mainly configured to dissipate heat from heat-generating components inside the chassis 100 and also from the optoelectronic connection module 200, so as to ensure normal operation of the network switching device 10. By way of example, the heat dissipation module 400 includes at least one fan 410. As shown in FIG. 3, the heat dissipation module 400 includes three fans 410. The high-speed rotation of the fans 410 effectively dissipates heat generated by the network switching device 10 to the external environment in time.

The heat dissipation module 400 is arranged close to an edge of the chassis 100. In other words, the heat dissipation module 400 is arranged at a side edge of the chassis 100. This arrangement facilitates communication between the heat dissipation module 400 and the outside for heat dissipation of the network switching device 10. In addition, since the heat

dissipation module 400 is located at an edge area of the chassis 100, a large internal space of the chassis 100 is reserved to facilitate internal layout of the chassis 100. By way of example, the heat dissipation module 400 is opposite to the optoelectronic connection module 200, and the heat dissipation module 400 and the optoelectronic connection module 200 are respectively located at two ends of the chassis 100.

FIG. 4 is a schematic structural diagram of an optoelectronic connection module according to embodiments of the present disclosure. Referring to FIG. 4, in the optoelectronic connection module 200 of some embodiments, the multiple connectors 221 are regularly arranged in a form of connector groups 220. The optoelectronic connection module 200 includes at least one connector group 220. Each connector group 220 includes the multiple connectors 221 sequentially arranged along a first direction (Y direction in the figure), and each connector 221 is electrically connected with the at least one board card 210. When the optoelectronic connection module 200 includes two or more connector groups 220, the two or more connector groups 220 are arranged at intervals along a second direction (Z direction in the figure), and the second direction is perpendicular to the first direction.

In an example where the optoelectronic connection module 200 is mounted at one end along the length direction of the chassis 100, the first direction along which the multiple connectors 221 in each connector group 220 are sequentially arranged is a width direction of the chassis 100, and the second direction along which the two or more connector groups 220 are arranged at intervals is a height direction of the chassis 100.

When multiple connector groups 220 are arranged at intervals along the second direction in the optoelectronic connection module 200, the optoelectronic connection module 200 is provided with only one board card 210, and all multiple connector groups 220 are connected with the at least one board card 210. Alternatively, the optoelectronic connection module 200 may be provided with two or more board cards 210, and the multiple connector groups 220 are respectively connected with different board cards 210.

Still referring to FIG. 4, to configure the optoelectronic connection module 200 as an independent detachable module, the optoelectronic connection module 200 further includes a mounting frame 240. The at least one board card 210 is fixedly connected with the mounting frame 240, and the at least one board card 210, the multiple connectors 221 arranged on the at least one board card 210, and the mounting frame 240 are jointly assembled to form the optoelectronic connection module 200. Arrangement of the mounting frame 240 enables the

optoelectronic connection module 200 to be formed as an independent structure. In particular, when the optoelectronic connection module 200 includes multiple board cards 210, the mounting frame 240 assembles the multiple board cards 210 into an integral unit.

In addition, the mounting frame 240 also facilitates assembly between the optoelectronic connection module 200 and the chassis 100. In other words, the optoelectronic connection module 200 is arranged on the chassis 100 by connecting the mounting frame 240 to the mounting opening 110 for the chassis 100, so as to complete assembly of the network switching device 10.

By way of example, the mounting frame 240 is provided with a holding portion 2421. The holding portion 2421 extends, for example, out of a side surface of the optoelectronic connection module 200 facing away from the interior of the chassis 100. An operator grips the holding portion 2421 on the mounting frame 240 to move the optoelectronic connection module 200, so as to facilitate mounting of the optoelectronic connection module 200 on the chassis 100, and removal of the optoelectronic connection module 200 from the chassis 100.

For example, the mounting frame 240 includes a main frame 241 and a front frame 242. The main frame 241 is arranged corresponding to the at least one board card 210, and the at least one board card 210 is fixedly connected with the main frame 241. When the optoelectronic connection module 200 includes multiple board cards 210, the main frame 241 fixes the multiple board cards 210 together to form an integral structure. The front frame 242 is connected with a side of the main frame 241 facing away from the interior of the chassis 100, and the front frame 242 is exposed within the mounting opening 110 for the chassis 100. Interface end of each connector 221 extends out of a front end of the at least one board card 210 and is received in a mounting groove (not shown) formed on the front frame 242. The front frame 242 abuts against the front end of the at least one board card 210 to protect the at least one board card 210, and the front frame 242 surrounds outer periphery of the interface ends of each connectors 221 to shield and protect the interface end of each connector 221, and also improves appearance effect of the optoelectronic connection module 200. The holding portion 2421 is arranged on the front frame 242.

FIG. 5 is a schematic structural diagram of an optoelectronic connection module according to embodiments of the present disclosure with a mounting frame removed. FIG. 6 is an exploded structural view of the optoelectronic connection module in FIG. 5 from one perspective. FIG. 7 is an exploded structural view of the optoelectronic connection module in

FIG. 5 from another perspective.

Referring to FIG. 5, while the heat dissipation module 400 is arranged in the chassis 100 to maintain a proper operating temperature for the optical modules, some embodiments further adopt liquid cooling mode to dissipate heat from the optical modules, so as to carry away heat generated by the optical modules and keep operating temperature of the optical modules within a proper range. Heat dissipation for optical modules through the liquid cooling mode is as follows: when the optical modules are inserted into the multiple connectors 221 of the optoelectronic connection module 200, cooling liquid carries away heat from the optical modules to realize heat dissipation and temperature reduction for the optical modules.

Specifically, the optoelectronic connection module 200 further includes at least one cold plate liquid cooling assembly for optical modules (hereinafter referred to as a liquid cooling assembly). At least one liquid cooling assembly 230 are arranged corresponding to the at least one connector group 220, and the at least one liquid cooling assembly 230 dissipate heat for each connector 221 in the at least one connector group 220 corresponding to the at least one liquid cooling assembly 230. For the at least one connector group 220 with the at least one liquid cooling assembly 230, when the optical modules are inserted into the multiple connectors 221 in the at least one connector group 220, the at least one liquid cooling assembly 230 is in contact with the optical modules. Heat generated by the optical modules is conducted to the at least one liquid cooling assembly 230 and then carried away by cooling liquid flowing inside the at least one liquid cooling assembly 230, so as to realize heat dissipation of the optical modules.

The at least one liquid cooling assembly 230 is arranged on a side along an extending direction of the at least one connector group 220, and the at least one liquid cooling assembly 230 extends along the extending direction of the at least one connector group 220. When each connector 221 in the at least one connector group 220 is arranged along the first direction, it is equivalent that the at least one connector group 220 extends along the first direction. In this case, the at least one liquid cooling assembly 230 also extends along the first direction. In an example where the optoelectronic connection module 200 is arranged at the end along the length direction of the chassis 100, when the at least one connector group 220 extends along the width direction of the chassis 100, the at least one liquid cooling assembly 230 also extends along the width direction of the chassis 100, and the at least one liquid cooling

assembly 230 is arranged on a side of the at least one connector group 220 in the height direction of the chassis 100.

It should be noted that to reserve sufficient mounting space for the at least one liquid cooling assembly 230, and ensure that the at least one liquid cooling assembly 230 is arranged on a side of the at least one connector group 220, the multiple connectors 221 in some embodiments are arranged on the at least one board card 210 along a board surface of the at least one board card 210. In other words, an extending direction of the multiple connectors 221 is parallel to the board surface of the at least one board card 210, and insertion and extraction directions of the optical modules are parallel to the board surface of the at least one board card 210. This avoids space limitation on two sides of the at least one connector group 220 caused by the at least one board card 210, and reserves enough space beside the at least one connector group 220 for mounting the at least one liquid cooling assembly 230.

For convenience of description, a side where the at least one liquid cooling assembly 230 is located is defined as a mounting side of the at least one connector group 220 in some embodiments. Referring to FIG. 6 or FIG. 7, for the at least one connector group 220 with the at least one liquid cooling assembly 230, to enable the at least one liquid cooling assembly 230 to be in contact with the optical modules inserted into the multiple connectors 221, each connector 221 in the at least one connector group 220 is provided with a contact window 2211. The contact window 2211 is located on the mounting side of the at least one connector group 220. The at least one liquid cooling assembly 230 passes through the contact window 2211 of each connector 221 and comes into contact with the optical modules inserted into the multiple connectors 221.

When the optoelectronic connection module 200 is provided with multiple connector groups 220, a liquid cooling assembly 230 is arranged for each connector group 220, and each liquid cooling assembly 230 is in contact with an optical module inserted into each connector group 220. In this way, all optical modules inserted into the optoelectronic connection module 200 are in direct contact with liquid cooling assemblies 230. Heat is quickly carried away from the optical modules in time, with excellent heat dissipation effect for each optical module.

Specifically, when at least two connector groups 220 are arranged at intervals along the second direction in the optoelectronic connection module 200, one liquid cooling assembly

230 is arranged on the mounting side of each connector group 220. The multiple connectors 221 in each connector group 220 are respectively provided with a contact window 2211. The contact window 2211 is located on the mounting side of the at least one connector group 220. The one liquid cooling assembly 230 passes through the contact window 2211 of each connector 221 and comes into contact with an optical module inserted into each connector 221.

Still referring to FIG. 6 and FIG. 7, as a specific implementation, the optoelectronic connection module 200 is provided with one board card 210 and four connector groups 220. The four connector groups 220 include two inner connector groups 220a and two outer connector groups 220b. The two inner connector groups 220a are respectively connected with two side surfaces of the at least one board card 210, the two outer connector groups 220b are respectively located on sides of the two inner connector groups 220a facing away from the at least one board card 210, and the two outer connector groups 220b are both electrically connected with the at least one board card 210.

Four connector groups 220 are electrically connected with one board card 210. The optoelectronic connection module 200 is provided with a large number of the multiple connectors 221, a large number of the optical modules of the optoelectronic connection module 200 are inserted, and the capacity and transmission power of the optoelectronic connection module 200 are improved. In addition, since only one board card 210 is provided, it is only necessary to electrically connect the one board card 210 to the control module 300 inside the chassis 100, to realize control of the control module 300 over the optoelectronic connection module 200. The control mode is simple, and the signal transmission efficiency is high.

Since the two outer connector groups 220b are arranged on the sides of the two inner connector groups 220a facing away from the one board card 210, the two outer connector groups 220b are connected with the one board card 210 through brackets 2212 to realize connection between the two outer connector groups 220b and the one board card 210. Each connector 221 in the two outer connector groups 220b is provided with a bracket 2212, the bracket 2212 of each connector 221 extends toward the one board card 210, and each connector 221 is connected with the one board card 210 via the bracket 2212.

Since an end of each connector 221 extending out of the one board card 210 serves as the interface end, to prevent the bracket 2212 from blocking the interface end of each connector

221, the bracket 2212 is connected with an end of each connector 221 facing the one board card 210. In this case, when a liquid cooling assembly 230 is arranged between an outer connector group 220b and an inner connector group 220a, a liquid cooling assembly 230 is arranged at a front end of the bracket 2212 of each connector 221 in the outer connector group 220b, so that the liquid cooling assembly 230 corresponds to a body part of each connector 221, and contact between the liquid cooling assembly 230 and the optical module inserted into each connector 221 is ensured.

Correspondingly, four liquid cooling assemblies 230 are provided for the connector groups 220. Each liquid cooling assembly 230 is arranged on the mounting side of each connector group 220, and each liquid cooling assembly 230 is attached to the connector group 220 corresponding to each liquid cooling assembly 230, so that each liquid cooling assembly 230 is in contact with the optical module inserted into each connector 221 of the at least one connector group 220. For a connector group 220 on a single side of the one board card 210, a gap is reserved between the outer connector group 220b and the inner connector group 220a, so that the liquid cooling assembly 230 is arranged between the outer connector group 220b and the inner connector group 220a.

In some examples, the mounting side of each connector group 220 is defined as a side of the at least one connector group 220 facing away from the one board card 210. To be specific, the contact window 2211 on each connector 221 in the at least one connector group 220 is located on the side of the at least one connector group 220 facing away from the one board card 210.

The contact windows 2211 on the multiple connectors 221 in the two inner connector groups 220a face away from each other, and are both located on the side of the at least one connector group 220 facing away from the one board card 210. In this way, the liquid cooling assemblies 230 corresponding to the two inner connector groups 220a are respectively arranged on two sides of the one board card 210. The one board card 210 does not cause interference to the liquid cooling assemblies 230, and sufficient space is reserved between the inner connector group 220a and the outer connector group 220b on the same side for arrangement of the liquid cooling assemblies 230. In addition, the one board card 210 does not cause interference to the contact windows 2211 on the multiple connectors 221 in the inner connector groups 220a. The contact windows 2211 are fully exposed on the sides of the multiple connectors 221 facing away from the one board card 210, which guarantees stable

contact between the liquid cooling assemblies 230 and the optical modules inserted into the multiple connectors 221.

The contact windows 2211 on the multiple connectors 221 in the two outer connector groups 220b face away from each other, and orientations of the contact windows 2211 on the multiple connectors 221 in the two outer connector groups 220b are the same as orientations of the contact windows 2211 on the multiple connectors 221 in the two inner connector groups 220a on the same side. In this way, the liquid cooling assemblies 230 corresponding to the two outer connector groups 220b are respectively arranged on the sides of the two outer connector groups 220b facing away from the one board card 210.

For the convenience of description, the liquid cooling assemblies 230 arranged corresponding to the two inner connector groups 220a are defined as two inner liquid cooling assemblies 230a in some embodiments. The two inner liquid cooling assemblies 230a are located between the inner connector group 220a and the outer connector group 220b arranged on the same side. The liquid cooling assemblies 230 arranged corresponding to the two outer connector groups 220b are defined as two outer liquid cooling assemblies 230b. The two outer liquid cooling assemblies 230b are located on the sides of the two outer connector groups 220b facing away from the two inner connector groups 220a on the same side.

With this arrangement, the two inner liquid cooling assemblies 230a are respectively sandwiched between the inner connector group 220a and the outer connector group 220b on each side, and the two outer liquid cooling assemblies 230b are respectively located on the opposite outer sides of the two outer connector groups 220b on two sides. The two inner liquid cooling assemblies 230a are clamped between the inner connector group 220a and the outer connector group 220b on the same side, and the two outer liquid cooling assemblies 230b are attached to the two outer connector groups 220b. Both an inner liquid cooling assembly 230a and an outer liquid cooling assembly 230b on the same side apply pressure toward the one board card 210, which ensures reliable contact between the liquid cooling assemblies 230 and the optical modules inserted into the multiple connector groups 220 corresponding to the liquid cooling assemblies 230. In addition, pressure applied by the liquid cooling assemblies 230 on two sides counterbalances each other, so that stress balance of the entire optoelectronic connection module 200 is ensured, and the stability and reliability of the optoelectronic connection module 200 are improved.

When the multiple connectors 221 in the two outer connector groups 220b are connected

with the one board card 210 through the brackets 2212, the two outer liquid cooling assemblies 230b cover at least part of the brackets 2212. Since the brackets 2212 are additional parts in the multiple connectors 221, the brackets 2212 increase surface area of each connector 221 in the two outer connector groups 220b. Therefore, the area of the two outer liquid cooling assemblies 230b is larger than the area of the two inner liquid cooling assemblies 230a. Thus, the two outer liquid cooling assemblies 230b have a larger heat conduction area, along with higher heat dissipation efficiency and better heat dissipation effect. In addition, for the outermost outer liquid cooling assembly 230b, the contact area between the outermost outer liquid cooling assembly 230b and the outer connector group 220b is larger, and the pressure applied by the outermost outer liquid cooling assembly 230b to the outer connector group 220b is also larger. The contact between the outermost outer liquid cooling assembly 230b and the optical modules inserted into the multiple connectors 221 is tighter, and the overall stability and reliability of the optoelectronic connection module 200 are higher.

The at least one liquid cooling assembly 230 inside the optoelectronic connection module 200 is described in detail below.

FIG. 8 is a schematic structural diagram of an outer liquid cooling assembly according to embodiments of the present disclosure from one perspective. FIG. 9 is a schematic structural diagram of the outer liquid cooling assembly in FIG. 8 from another perspective. FIG. 10 is a partial sectional structural view of the outer liquid cooling assembly in FIG. 8.

Referring to FIG. 8 and FIG. 9, an outer liquid cooling assembly 230b includes a liquid cooling plate and at least one liquid cooling tube 231. A side surface of the liquid cooling plate faces the outer connector group 220b corresponding to the liquid cooling plate, and the side surface of the liquid cooling plate is configured to be in contact with the optical modules inserted into the multiple connectors 221 of the outer connector group 220b. The at least one liquid cooling tube 231 is arranged on the other side surface of the liquid cooling plate, and the at least one liquid cooling tube 231 is configured to provide flow space for cooling liquid. Heat generated by the optical modules is conducted to the liquid cooling plate, the liquid cooling plate conducts the heat to the at least one liquid cooling tube 231, and the cooling liquid inside the at least one liquid cooling tube 231 performs heat exchange with the liquid cooling plate and absorbs heat, so as to realize heat dissipation for the optical modules.

Referring to FIG. 9, in some implementations, the outer liquid cooling assembly 230b

includes one liquid cooling tube 231. The one liquid cooling tube 231 extends along the first direction in which the liquid cooling plate extends, and penetrates two ends of the liquid cooling plate. In this way, the one liquid cooling tube 231 passes through each area in an extending direction of the liquid cooling plate, and heat from each area of the liquid cooling plate is quickly conducted to the one liquid cooling tube 231. The heat dissipation efficiency of the one liquid cooling assembly 230 is improved, and uniform heat dissipation of the one liquid cooling assembly 230 is ensured.

By way of example, in the first direction of extension of the liquid cooling plate, the one liquid cooling tube 231 extends in a wavy line from one end of the liquid cooling plate to the other end of the liquid cooling plate. In this way, extension length of the one liquid cooling tube 231 on the liquid cooling plate is increased. The one liquid cooling tube 231 uniformly covers a central area and an edge area of the liquid cooling plate, so that the heat transfer efficiency between the liquid cooling plate and the one liquid cooling tube 231 is higher, and the heat transfer is more uniform, which improves the heat dissipation efficiency and heat dissipation effect of the outer liquid cooling assembly 230b.

In other implementations, the outer liquid cooling assembly 230b includes at least two liquid cooling tubes 231. The at least two liquid cooling tubes 231 are sequentially arranged, so that all the at least two liquid cooling tubes 231 cover each area in the first direction of extension of the liquid cooling plate, and ensure the heat dissipation effect of the outer liquid cooling assembly 230b.

Referring to FIG. 10, the liquid cooling plate includes a cold plate body 232, multiple floating heat conduction blocks 233, and a thermal pad 234. The cold plate body 232 is a body supporting structure of the liquid cooling plate. The cold plate body 232 extends along the first direction, and the first direction is namely the extending direction of the at least one connector group 220. Two sides in thickness direction of the cold plate body 232 are defined as a first side and a second side respectively. The multiple floating heat conduction blocks 233 are all arranged on the first side of the cold plate body 232, and the multiple floating heat conduction blocks 233 are arranged at intervals along the first direction. Each floating heat conduction block 233 corresponds to each connector 221 in the at least one connector group 220. Each floating heat conduction block 233 is configured to pass through the contact window 2211 on each connector 221 and come into contact with the optical modules inserted into each connector 221. The thermal pad 234 is arranged between the cold plate body 232

and each floating heat conduction block 233, and two side surfaces of the thermal pad 234 are in contact with the cold plate body 232 and the floating heat conduction block 233 respectively. The at least one liquid cooling tube 231 is arranged on the second side of the cold plate body 232.

The multiple floating heat conduction blocks 233 are capable of floating along a second direction. The second direction is perpendicular to the first direction, and the second direction is thickness direction of the liquid cooling plate. The thermal pad 234 arranged between the multiple floating heat conduction blocks 233 and the cold plate body 232 has elasticity. The thermal pad 234 deforms along with the movement of the multiple floating heat conduction blocks 233, so that two sides of the thermal pad 234 are always attached to the cold plate body 232 and the multiple floating heat conduction blocks 233.

This arrangement enables a large pressure to be generated between the multiple floating heat conduction blocks 233 and the optical modules inserted into the multiple connectors 221, ensures tight contact between the multiple floating heat conduction blocks 233 and the optical modules, reduces the contact thermal resistance between the liquid cooling plate and the optical modules, and improves the heat dissipation efficiency and heat dissipation effect of the at least one liquid cooling assembly 230. In addition, since the multiple floating heat conduction blocks 233 is capable of floating up and down, the liquid cooling plate matches optical modules of different models and sizes, which expands application range of the at least one liquid cooling assembly 230 and enhances universality of the at least one liquid cooling assembly 230.

Furthermore, by arranging a compressible thermal pad 234 between the multiple floating heat conduction blocks 233 and the cold plate body 232, the multiple floating heat conduction blocks 233, the thermal pad 234, and the cold plate body 232 are in tight contact with one another to form a stable and reliable heat conduction path. Heat generated by the optical modules is sequentially conducted to the cold plate body 232 via the multiple floating heat conduction blocks 233 and the thermal pad 234, then conducted to the at least one liquid cooling tube 231 via the cold plate body 232, and finally carried away by the cooling liquid inside the at least one liquid cooling tube 231.

The multiple floating heat conduction blocks 233 are arranged to be in contact with the optical modules inside the multiple connectors 221, and the thermal pad 234 is arranged between the cold plate body 232 and the multiple floating heat conduction blocks 233. The

multiple floating heat conduction blocks 233 have high structural strength, and the multiple floating heat conduction blocks 233 are not damaged even after long-term repeated plugging of the optical modules, thereby stable and reliable contact between the multiple floating heat conduction blocks 233 and the optical modules is ensured. In addition, the cold plate body 232 and the multiple floating heat conduction blocks 233 surround the thermal pad 234 inside, so as to protect the thermal pad 234 and prolong a service life of the thermal pad 234.

As an implementation, the liquid cooling plate includes an integrated thermal pad 234, and all floating heat conduction blocks 233 are in contact with the thermal pad 234. The movement of each floating heat conduction block 233 causes parts of the thermal pad 234 corresponding to each floating heat conduction block 233 to deform. As another implementation, the liquid cooling plate includes multiple thermal pads 234. For example, each thermal pad 234 corresponds to each floating heat conduction block 233, and one thermal pad 234 is arranged between each floating heat conduction block 233 and the cold plate body 232.

In some embodiments, both the cold plate body 232 and the floating heat conduction block 233 are metal parts, to ensure heat conduction performance of the cold plate body 232 and the multiple floating heat conduction blocks 233, meet overall structural strength requirement of the liquid cooling plate, and ensure reliability of the liquid cooling plate. By way of example, the cold plate body 232 is made of metal materials such as aluminum, aluminum alloy, titanium, titanium alloy, or alloy steel. The multiple floating heat conduction blocks 233 are made of metal materials such as copper and aluminum. For example, the multiple floating heat conduction blocks 233 are copper plates, which improve the heat conduction performance of the multiple floating heat conduction blocks 233.

The at least one liquid cooling tube 231 is also be made of metal materials to improve heat conduction efficiency between the cold plate body 232 and the at least one liquid cooling tube 231. Moreover, the at least one liquid cooling tube 231 has high structural strength and good reliability. By way of example, the at least one liquid cooling tube 231 is a metal tube such as a copper tube or an aluminum tube.

Since the thermal pad 234 needs to be elastic and compressible, the thermal pad 234 is a flexible pad, and the thermal pad 234 is made of flexible material. For example, the material for manufacturing the thermal pad 234 is polyamide (PA) or polypropylene (PP).

Still referring to FIG. 10, based on that the thermal pad 234 is arranged between the

multiple floating heat conduction blocks 233 and the cold plate body 232, the liquid cooling plate further includes elastic members 235. The elastic members 235 are connected between each floating heat conduction block 233 and the cold plate body 232. The elastic members 235 are extendable and contractible along the second direction to drive the floating heat conduction block 233 to float along the second direction. The elastic members 235 have a large elastic force and strong elastic deformation capacity. Serving as a main driving structure, the elastic members 235 reliably drive the multiple floating heat conduction blocks 233 to float. In addition, the elastic force of the elastic members 235 acts on the optical modules through the multiple floating heat conduction blocks 233, which increases pressure between the multiple floating heat conduction blocks 233 and the optical modules, ensures tight contact between the multiple floating heat conduction blocks 233 and the optical modules, reduces the contact thermal resistance between the multiple floating heat conduction blocks 233 and the optical modules, and improves the heat dissipation efficiency and heat dissipation effect of the at least one liquid cooling assembly 230.

In some examples, two elastic members 235 are connected between the multiple floating heat conduction blocks 233 and the cold plate body 232, and the two elastic members 235 are respectively located at two ends of the each floating heat conduction block 233. In this way, the two elastic members 235 apply a large elastic force to the multiple floating heat conduction blocks 233, thereby the pressure between the multiple floating heat conduction blocks 233 and the optical modules is increased, and tight contact between the multiple floating heat conduction blocks 233 and the optical modules is ensured. In addition, the two elastic members 235 apply pressure to two ends of the each floating heat conduction block 233 respectively, so as to ensure balance of the multiple floating heat conduction blocks 233 and ensure good contact between the multiple floating heat conduction blocks 233 and the optical modules.

In this case, the thermal pad 234 is arranged between the two elastic members 235. A large space is formed between the two elastic members 235 at two ends of each floating heat conduction block 233, which reserves sufficient space for the thermal pad 234 and ensures that the thermal pad 234 has a sufficient surface area. In addition, the thermal pad 234 is attached to a body area of the multiple floating heat conduction blocks 233. In this way, the thermal pad 234 quickly and completely conducts heat on the multiple floating heat conduction blocks 233 to the cold plate body 232.

Still referring to FIG. 10, in some implementations, the cold plate body 232 includes a main support plate 2321 and a stop assembly 2322. The main support plate 2321 is a body structure of the cold plate body 232, and the main support plate 2321 extends along the first direction. The multiple floating heat conduction blocks 233 are located on a first side of the main support plate 2321, and the at least one liquid cooling tube 231 is located on a second side of the main support plate 2321. The stop assembly 2322 is connected with an outer side of the main support plate 2321, and the stop assembly 2322 and the main support plate 2321 jointly form floating grooves 2323. The floating grooves 2323 are located on two sides of the main support plate 2321, and groove openings of the floating grooves 2323 on the two sides face each other. Two ends of each floating heat conduction block 233 are inserted into the floating grooves 2323 on the two sides, to limit the movement travel of the multiple floating heat conduction blocks 233.

The cold plate body 232 is composed of the stop assembly 2322 and the main support plate 2321. The floating grooves 2323 defined therebetween form a mounting base for the multiple floating heat conduction blocks 233, so that the multiple floating heat conduction blocks 233 are fixed on the cold plate body 232 and the movement travel of the multiple floating heat conduction blocks 233 is limited. In this way, the main support plate 2321 is substantially plate-shaped, which facilitates production and processing of the main support plate 2321. In addition, this facilitates assembly of the cold plate body, and reduces costs of machining, assembly, and other procedures of the cold plate body.

The stop assembly 2322 includes stop members 2322a connected with two opposite sides of the main support plate 2321. The stop assembly 2322 does not cover the second side of the main support plate 2321, and the second side of the main support plate 2321 is exposed. In this way, the stop members 2322a on the two sides and the main support plate 2321 jointly form the floating grooves 2323 on the two sides, so that two ends of each floating heat conduction block 233 are inserted into the floating grooves 2323 on the two sides. In addition, this facilitates mounting of the at least one liquid cooling tube 231 on the second side of the main support plate 2321. The overall heat conduction path of the at least one liquid cooling assembly 230 is short, and the heat conduction efficiency is higher.

By way of example, with regard to the stop members 2322a on a single side of the main support plate 2321, multiple stop members 2322a are arranged at intervals along the first direction of extension of the main support plate 2321 (see FIG. 8), and each stop member

2322a corresponds to at least one floating heat conduction block 233. Multiple stop members 2322a are arranged along the first direction of extension of the main support plate 2321 to support and fix all floating heat conduction blocks 233, and one stop member 2322a only corresponds to a part of the multiple floating heat conduction blocks 233. This facilitates assembly of the multiple floating heat conduction blocks 233 and the stop members 2322a onto the main support plate 2321, and also facilitates disassembly and replacement of each floating heat conduction block 233.

Referring to FIG. 10, each stop member 2322a includes a body portion 23221 and a stop portion 23222 which are connected with each other. The body portion 23221 is a body structure of each stop member 2322a, and each stop member 2322a is connected with the main support plate 2321 by means of the body portion 23221. The stop portion 23222 is located at an end of the body portion 23221, and a gap is reserved between the stop portion 23222 and the main support plate 2321. The stop portion 23222, the body portion 23221, and the main support plate 2321 jointly form the floating grooves 2323, and the stop portion 23222 abuts against an end of the at least one floating heat conduction block 233.

For the outer liquid cooling assembly 230b, since the liquid cooling plate of the outer liquid cooling assembly 230b has a large area, specifically, the liquid cooling plate has a large width, a side of the main support plate 2321 facing the at least one board card 210 extends out of the floating heat conduction block 233. In this case, each stop member 2322a located on a side of the main support plate 2321 facing away from the at least one board card 210 is connected with a side wall of the main support plate 2321. The body portion 23221 of each stop member 2322a extends along the side wall of the main support plate 2321, and the stop portion 23222 of each stop member 2322a is perpendicular to the body portion 23221. Each stop member 2322a located on a side of the main support plate 2321 facing the at least one board card 210 is connected with a plate surface of the main support plate 2321. The body portion 23221 of each stop member 2322a extends along the plate surface of the main support plate 2321, and the stop portion 23222 of each stop member 2322a is parallel to the body portion 23221.

FIG. 11 is a schematic structural diagram of an inner liquid cooling assembly according to embodiments of the present disclosure from one perspective. FIG. 12 is a schematic structural diagram of the inner liquid cooling assembly in FIG. 11 from another perspective. FIG. 13 is a partial sectional structural view of the inner liquid cooling assembly in FIG. 11.

Referring to FIG. 11 and FIG. 12, similar to the outer liquid cooling assembly 230b, the inner liquid cooling assembly 230a also includes a liquid cooling plate and at least one liquid cooling tube 231. A side surface of the liquid cooling plate faces the inner connector group 220a corresponding to the side surface of the liquid cooling plate, and the side surface of the liquid cooling plate is configured to be in contact with the optical modules inserted into the multiple connectors 221 in the inner connector group 220a. The at least one liquid cooling tube 231 is arranged on the other side surface of the liquid cooling plate, and the at least one liquid cooling tube 231 is configured to provide flow space for cooling liquid.

Referring to FIG. 13, similar to the liquid cooling plate of the outer liquid cooling assembly 230b, a liquid cooling plate of the inner liquid cooling assembly 230a also includes a cold plate body 232, multiple floating heat conduction blocks 233, and a thermal pad 234. The multiple floating heat conduction blocks 233 are all arranged on the first side of the cold plate body 232, and the multiple floating heat conduction blocks 233 are arranged at intervals along the first direction. Each floating heat conduction block 233 corresponds to each connector 221 in the at least one connector group 220. Each floating heat conduction block 233 is configured to pass through the contact window 2211 on each connector 221 and come into contact with the optical modules inserted into each connector 221. The thermal pad 234 is arranged between the cold plate body 232 and the multiple floating heat conduction blocks 233, and two side surfaces of the thermal pad 234 are in contact with the cold plate body 232 and the multiple floating heat conduction blocks 233 respectively. The at least one liquid cooling tube 231 is arranged on the second side of the cold plate body 232.

The multiple floating heat conduction blocks 233 are capable of floating along the second direction. The thermal pad 234 arranged between the multiple floating heat conduction blocks 233 and the cold plate body 232 has elasticity. The thermal pad 234 deforms along with the movement of the multiple floating heat conduction blocks 233, so that two sides of the thermal pad 234 are always attached to the cold plate body 232 and the multiple floating heat conduction blocks 233.

In addition, the liquid cooling plate of the inner liquid cooling assembly 230a also includes elastic members 235, which are connected between each floating heat conduction block 233 and the cold plate body 232. By way of example, two elastic members 235 are connected between each floating heat conduction block 233 and the cold plate body 232, the two elastic members 235 are respectively located at two ends of each floating heat conduction

block 233, and the thermal pad 234 is arranged between the two elastic members 235. Details are not described herein again.

Furthermore, still referring to FIG. 13, similar to the cold plate body 232 of the outer liquid cooling assembly 230b, the cold plate body 232 of the inner liquid cooling assembly 230a also includes a main support plate 2321 and a stop assembly 2322. The stop assembly 2322 is connected with an outer side of the main support plate 2321, and the stop assembly 2322 and the main support plate 2321 jointly form floating grooves 2323. The stop assembly 2322 includes stop members 2322a connected with two opposite sides of the main support plate 2321. The second side of the main support plate 2321 is exposed. With regard to the stop members 2322a on a single side of the main support plate 2321, multiple stop members 2322a are arranged at intervals along the first direction of extension of the main support plate 2321 (see FIG. 11), and each stop member 2322a corresponds to at least one floating heat conduction block 233. Each stop member 2322a includes a body portion 23221 and a stop portion 23222 connected with each other. The stop portion 23222, the body portion 23221, and the main support plate 2321 jointly form the floating grooves 2323, and the stop portion 23222 abuts against an end of the at least one floating heat conduction block 233.

Different from the outer liquid cooling assembly 230b, since the liquid cooling plate of the inner liquid cooling assembly 230a has a smaller area, specifically, the liquid cooling plate has a smaller width, a width of the main support plate 2321 and a width of the floating heat conduction block 233 are substantially equal. In this case, the stop members 2322a located on two sides of the main support plate 2321 are both connected with a side wall of the main support plate 2321. The body portions 23221 of the stop members 2322a on two sides both extend along the side walls of the main support plate 2321 corresponding to the body portions 23221 of the stop members 2322a, and the stop portions 23222 of the stop members 2322a on two sides are both perpendicular to the body portion 23221.

In the description of the embodiments of the present disclosure, it should be noted that unless otherwise clearly specified and limited, the terms “mount”, “connected”, and “connection” shall be construed in a broad sense. For example, the “connection” is a fixed connection, an indirect connection via an intermediate medium, an internal communication between two components, or an interaction relationship between the two components. The person of ordinary skill in the art understands specific meanings of the terms in embodiments of the present disclosure based on specific situations.

The terms “first”, “second”, “third”,, “fourth”, and the like (if any) used in the specification, claims, and drawings of the embodiments of the present disclosure are intended to distinguish similar objects, and are not used for describing a specific sequence or order. In addition, terms “include”, “have”, and any other variants mean to cover non-exclusive inclusion. For example, a process, method, system, product, or device that includes a series of operations or units is not necessarily limited to the listed operations or units, but includes other operations or units not expressly listed or inherent to the process, method, product, or device.

Finally, it should be noted that the embodiments are only used for illustrating the technical solutions of the embodiments of the present disclosure, and are not intended to limit the present disclosure. Although the embodiments of the present disclosure have been described in detail with reference to the embodiments, the person of ordinary skill in the art shall understand that modifications are made to the technical solutions recorded in the embodiments, or equivalent replacements are made to part or all of the technical features thereof. Such modifications or replacements shall not cause the essence of the corresponding technical solutions to depart from the scope of the technical solutions of the embodiments of the present disclosure.

CLAIMS

1. A cold plate liquid cooling assembly for optical modules, comprising:

a cold plate body, extending along a first direction and comprising a first side and a second side opposite to each other;

a plurality of floating heat conduction blocks, connected with the first side of the cold plate body and capable of floating along a second direction perpendicular to the first direction, wherein the plurality of floating heat conduction blocks are arranged at intervals along the first direction, and the plurality of floating heat conduction blocks are configured to be in contact with optical modules sequentially arranged along the first direction;

a thermal pad, arranged between the cold plate body and the plurality of floating heat conduction blocks, and in contact with the cold plate body and the plurality of floating heat conduction blocks; and

at least one liquid cooling tube, arranged on the second side of the cold plate body.

2. The cold plate liquid cooling assembly for optical modules as claimed in claim 1, further comprising:

elastic members, connected between each floating heat conduction block and the cold plate body, and extendable and contractible along the second direction.

3. The cold plate liquid cooling assembly for optical modules as claimed in claim 2, wherein two elastic members are connected between each floating heat conduction block and the cold plate body, the two elastic members are respectively located at two ends of each floating heat conduction block, and the thermal pad is located between the two elastic members.

4. The cold plate liquid cooling assembly for optical modules as claimed in any one of claims 1 to 3, wherein the cold plate body comprises:

a main support plate, extending along the first direction, wherein the plurality of floating heat conduction blocks are located on a first side of the main support plate, and the at least one liquid cooling tube is located on a second side of the main support plate; and

a stop assembly, connected with an outer side of the main support plate and jointly defining floating grooves with the main support plate, wherein the floating grooves are

located on two sides of the main support plate, groove openings of the floating grooves on the two sides face each other, and two ends of each floating heat conduction block are inserted into the floating grooves on the two sides.

5. The cold plate liquid cooling assembly for optical modules as claimed in claim 4, wherein the stop assembly comprises stop members connected with two opposite sides of the main support plate, and the second side of the main support plate is exposed.

6. The cold plate liquid cooling assembly for optical modules as claimed in claim 5, wherein each stop member comprises a body portion and a stop portion connected with each other, the body portion is connected with the main support plate, and the stop portion abuts against an end of at least one floating heat conduction block.

7. The cold plate liquid cooling assembly for optical modules as claimed in claim 5, wherein a plurality of stop members are arranged at intervals along the first direction, and each stop member stops the at least one floating heat conduction block.

8. The cold plate liquid cooling assembly for optical modules as claimed in any one of claims 1 to 3, wherein one liquid cooling tube is provided, and the one liquid cooling tube penetrates two ends of the cold plate body along the first direction.

9. The cold plate liquid cooling assembly for optical modules as claimed in claim 8, wherein the one liquid cooling tube extends in a wavy line from one end of the cold plate body to the other end of the cold plate body.

10. A network switching device, comprising:

at least one board card;

at least one connector group, wherein each connector group comprises a plurality of connectors sequentially arranged along a first direction, each connector is electrically connected with the at least one board card, each connector in the at least one connector group is provided with a contact window, and the contact window is located on a mounting side of the at least one connector group; and

at least one cold plate liquid cooling assembly for optical modules as claimed in any one of claims 1 to 9, wherein the at least one cold plate liquid cooling assembly for optical modules is arranged on the mounting side of the at least one connector group, and each floating heat conduction block of the at least one cold plate liquid cooling assembly for

optical modules is configured to pass through the contact window and come into contact with optical modules inserted into each connector.

11. The network switching device as claimed in claim 10, wherein at least two connector groups are arranged at intervals along a second direction perpendicular to the first direction, the plurality of connectors in each connector group are respectively provided with the contact window, and one cold plate liquid cooling assembly for optical modules is arranged for each connector group.

12. The network switching device as claimed in claim 11, wherein one board card is provided, the at least two connector groups comprise two inner connector groups and two outer connector groups, the two inner connector groups are respectively connected with two side surfaces of the one board card, the two outer connector groups are respectively located on sides of the two inner connector groups facing away from the one board card, and the two outer connector groups are both electrically connected with the one board card; and

four cold plate liquid cooling assemblies for optical modules are provided, which are respectively arranged on the mounting side of each connector group.

13. The network switching device as claimed in claim 12, wherein the mounting side of each connector group is a side of each connector group facing away from the one board card, and the cold plate liquid cooling assemblies for optical modules comprise two inner liquid cooling assemblies and two outer liquid cooling assemblies; and

the two inner liquid cooling assemblies are respectively located between an inner connector group and an outer connector group on each side, and the two inner liquid cooling assemblies are configured to be in contact with optical modules inserted into the inner connector group; the two outer liquid cooling assemblies are respectively located on each side of the outer connector group facing away from the one board card, and the two outer liquid cooling assemblies are configured to be in contact with optical modules inserted into the outer connector group.

14. The network switching device as claimed in claim 13, wherein each connector in the two outer connector groups is provided with a bracket, the bracket extends toward the one board card and is connected with the one board card, and the two outer liquid cooling assemblies cover at least part of the bracket.

15. The cold plate liquid cooling assembly for optical modules as claimed in claim 1,

wherein the thermal pad deforms following movement of the plurality of floating heat conduction blocks, and remains to be tightly attached to the plurality of floating heat conduction blocks and the cold plate body all the time.