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(54) SEMICONDUCTOR COOLING REFRIGERATOR

HALBLEITERKÜHLANLAGE

RÉFRIGÉRATEUR DE REFROIDISSEMENT À SEMI-CONDUCTEUR

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(56) References cited:
EP-A2- 0 592 044
CN-A- 101 941 072
CN-A- 102 510 990
CN-A- 104 729 182
CN-U- 204 612 291
CN-Y- 201 281 563
JP-A- H11 257 882
US-B1- 6 865 906

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Description

TECHNICAL FIELD

[0001] The present invention is related to a refrigerator, and more particularly to a semiconductor refrigerator.

BACKGROUND

[0002] A semiconductor refrigerator, also called a thermoelectric refrigerator, achieves refrigeration by using automatic voltage-and-current changing techniques and semiconductor cooling plates which radiate and transfer heat through highly efficient two-layered loop heat pipes. A semiconductor refrigerator does not require refrigerating working media and mechanically movable members, and solves the application problems of a traditional mechanical refrigerator such as contamination by working media and mechanical vibrations.

[0003] When refrigerating by the cold end of a semiconductor cooling plate, plenty of heat will be generated at the hot end thereof. To ensure reliable and continuous working of the semiconductor cooling plate, heat radiation is required for the hot end thereof. However, in the prior arts, usually heat exchange with an ambient environment is performed through heat pipes and heat radiating plates when radiating the heat at the hot end of the semiconductor cooling plate.

[0004] An existing sintered heat pipe extends from its one end to the other along an exclusive path. When one end of the sintered heat pipe is heated, the liquid in the capillary core is evaporated and vaporized. The vapors flow to the other end due to a slight pressure difference, emits heat and condenses into liquid again. Then, the liquid flows to the evaporating segment again under the capillary force along porous materials. This process cycles endlessly, transferring the heat from one end to the other end of the sintered heat pipe. However, existing sintered heat pipes may not achieve desired effects when radiating heat for heat sources of a high heat flow density such as semiconductor cooling plates.

[0005] EP0592044A2 discloses a refrigerator according to the preamble of claim 1.

SUMMARY

[0006] One object of the present invention is to overcome at least one defect of an existing semiconductor refrigerator by providing a semiconductor refrigerator with high heat radiation efficiency.

[0007] To achieve the above object, the present invention provides a semiconductor refrigerator comprising a semiconductor cooling plate and a hot end heat radiating device, wherein the hot end heat radiating device comprises multiple sintered heat pipes, each having a main pipe with both ends closed, wherein the main pipe comprises a first pipe segment thermally connected with a hot end of the semiconductor cooling plate, and a second pipe segment, which is located above the first pipe segment, and from whose one or more portions extend one or more manifolds to radiate heat from the hot end of the semiconductor cooling plate to an ambient environment.

[0008] Optionally, the first pipe segment of the main pipe is formed by extending from a lower end of the main pipe vertically upwards by a predetermined length, and the first pipe segments of multiple main pipes are located in the same plane in parallel and with gaps therebetween, the plane being parallel with a rear wall of an inner tank of the semiconductor refrigerator.

[0009] Optionally, the hot end heat radiating device further comprises: a fixed bottom plate whose front surface is thermally connected with the hot end of the semiconductor cooling plate and whose rear surface is provided with one or more grooves; and a fixed cover plate whose front surface is provided with one or more grooves and which is configured to cooperate with the fixed bottom plate to clamp the first pipe segment of the main pipe between the grooves of the fixed cover plate and of the fixed bottom plate.

[0010] Optionally, the second pipe segment of the main pipe is formed by extending from an upper end of the main pipe vertically downwards by a predetermined length, and the second pipe segments of multiple main pipes are located in the same plane in parallel and with gaps therebetween, the plane being parallel with the rear wall of the inner tank of the semiconductor refrigerator; or the second pipe segment of the main pipe is formed by extending from the upper end of the main pipe longitudinally forwards by a predetermined length and then vertically downwards by a predetermined length, the vertical portions of the second pipe segments of the multiple main pipes are located in the same plane in parallel and with gaps therebetween, the plane being parallel with the rear wall of the inner tank of the semiconductor refrigerator, and a starting end of the manifold of the sintered heat pipe is located at the vertical portion of a corresponding second pipe segment.

[0011] Optionally, the manifold of the sintered heat pipe is perpendicular to the rear wall of the inner tank.

[0012] Optionally, the manifolds of each sintered heat pipe are located at the same side of the corresponding main pipe, or the manifolds of each sintered heat pipe are located at the opposite sides of the corresponding main pipe respectively.

[0013] Optionally, the hot end heat radiating device further comprises: one or two fin groups, each fin group comprising multiple corresponding plate fins which are arranged in parallel and with gaps therebetween, and each fin group being installed at a manifold on a corresponding side of the main pipe via pipe holes of the respective plate fins.

[0014] Optionally, the hot end heat radiating device further comprises: a blower arranged at a transverse side of or above the multiple manifolds and configured such that an air inlet area of the blower sucks air flow and the air flow is blown to a gap between each two adjacent

plate fins, or the air flow is sucked from the gap between each two adjacent plate fins and is then blown to the air inlet area.

[0015] Optionally, the middle portion of each plate fin is provided with a receiving through hole so that each fin group defines a receiving space extending along the axes of the receiving through holes; the hot end heat radiating device further comprises one or two blowers respectively provided in the receiving spaces of the corresponding fin groups and configured such that air flow is sucked from an air inlet area of each blower and is blown to a gap between each two adjacent plate fins of the corresponding fin group.

[0016] Optionally, the hot end heat radiating device further comprises: multiple spiral fins each spirally installed on a corresponding manifold, and a blower arranged at a transverse side of or above the multiple manifolds such that the manifolds of each sintered heat pipe are located at an air inlet area or an air sucking area of the blower.

[0017] In the semiconductor refrigerator of the present invention, as multiple manifolds for radiating heat or transferring cold extend from the second pipe segment of the main pipe of each sintered heat pipe, the heat radiating or cold transferring efficiency of the semiconductor refrigerator is considerably improved, enabling the sintered heat pipe to adapt to heat sources of a high heat flow density, such as semiconductor cooling plates, for radiating heat, and enabling the semiconductor refrigerator of the present invention to have higher energy efficiency.

[0018] The above and other objects, advantages and features of the present invention will be understood by those skilled in the art more clearly with reference to the detailed description of the embodiments of the present below with reference to the accompanied drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The followings will describe some embodiments of the present in detail in an exemplary rather than restrictive manner with reference to the accompanying drawings. The same reference signs in the drawings represent the same or similar parts. Those skilled in the art shall understand that these drawings are only schematic ones of this invention, and may not be necessarily drawn according to the scales. In the drawings:

Fig. 1 is a schematic right view of a semiconductor refrigerator according to an embodiment of the present invention;

Fig. 2 is a schematic view of a sintered heat pipe of a semiconductor refrigerator according to an embodiment of the present invention;

Fig. 3 is a schematic rear view of a semiconductor refrigerator according to an embodiment of the present invention;

Fig. 4 is a schematic right view of a semiconductor refrigerator according to another embodiment of the present invention;

Fig. 5 is a schematic right view of a semiconductor refrigerator according to yet another embodiment of the present invention; and

Fig. 6 is a schematic left view of a semiconductor refrigerator according to an embodiment of the present invention.

DETAILED DESCRIPTION

[0020] Fig. 1 is a schematic right view of a semiconductor refrigerator according to an embodiment of the present invention. As shown in Figs. 1-3, an embodiment of the present invention provides a semiconductor refrigerator. The semiconductor refrigerator typically comprises an inner tank 100, a semiconductor cooling plate 150, a cold end cold transferring device 180, a hot end heat radiating device and a housing. The semiconductor cooling plate 150 may be installed between the rear walls of the inner tank 100 and of the housing.

[0021] The cold end cold transferring device 180 is configured to transfer the cold from the cold end of the semiconductor cooling plate 150 to a storage compartment in the inner tank 100. For example, the cold end cold transferring device 180 may comprise a cold transferring block, cold transferring fins and a cold transferring blower. The rear surface of the cold transferring block is thermally connected to the cold end of the semiconductor cooling plate 150. The front surface of the cold transferring block is mounted with multiple cold transferring fins. The cold transferring fins and the cold transferring blower are mounted in an air passage inside the semiconductor refrigerator to transfer cold to the storage compartment.

[0022] The hot end heat radiating device is configured to radiate the heat from the hot end of the semiconductor cooling plate 150 to ambient air. The hot end heat radiating device may comprise multiple sintered heat pipes 200, each having a main pipe 210 with both ends closed. The main pipe 210 may comprise a first pipe segment 211 and a second pipe segment 212 located above the first pipe segment 211. The first pipe segment 211 is thermally connected with a hot end of the semiconductor cooling plate 150. Specifically, one or more manifolds 220 extend from one or more portions of the second pipe segment 212 to radiate the heat from the hot end of the semiconductor cooling plate 150 to an ambient environment, which considerably improves the heat radiating efficiency of the semiconductor refrigerator.

[0023] The working chamber of the manifold 220 may communicate with the working chamber of the corresponding main pipe 210 to facilitate steam flow in the sintered heat pipe 200. The liquid absorbing core in the manifold 220 may be connected with the liquid absorbing core in the main pipe 210. The liquid absorbing cores in

the manifold 220 and in the main pipe 210 closely contact the inner wall of the corresponding pipes respectively to facilitate flow of the working liquid. Further, the diameter of the manifold 220 may equal that of the main pipe 210. In some alternative embodiments of the present invention, the diameter of the manifold 220 may be smaller than that of the main pipe 210.

[0024] In some embodiments of the present invention, the first pipe segment 211 of the main pipe 210 is formed by extending from a lower end of the main pipe 210 vertically upwards by a predetermined length; and the first pipe segments 211 of multiple main pipes 210 are located in the same plane in parallel and with gaps therebetween, the plane being parallel with the rear wall of an inner tank 100 of the semiconductor refrigerator.

[0025] To facilitate heat connection between the sintered heat pipe 200 and the semiconductor cooling plate 150 and the fixing of the sintered heat pipe 200, the hot end heat radiating device of the semiconductor cooling plate 150 further comprises a fixed bottom plate 310 and a fixed cover plate 320. The rear surface of the fixed bottom plate 310 is provided with one or more grooves. The front surface of the fixed bottom plate 310 may be attached to the hot end of the semiconductor cooling plate 150 so as to be thermally connected therewith, or may be thermally connected the hot end of the semiconductor cooling plate 150 through a heat transferring block. The front surface of the fixed cover plate 320 is also provided with one or more grooves, and the fixed cover plate 320 is configured to cooperate with the fixed bottom plate 310 to clamp the first pipe segment 211 of the main pipe 210 between the grooves of the fixed cover plate 320 and of the fixed bottom plate 310. After clamping the sintered heat pipe 200 between the fixed cover plate 320 and the fixed bottom plate 310, the three members are firmly fixed together by welding or mechanical squeezing. To effectively transfer heat, usually heat conducting silicone grease is coated on the contact surfaces between the sintered heat pipe 200 and the fixed bottom plate 310/the fixed cover plate 320.

[0026] As shown in Fig. 2, the second pipe segment 212 of the main pipe 210 is formed by extending from an upper end of the main pipe 210 longitudinally forwards by a predetermined length and then vertically downwards by a predetermined length, and the vertical portions 2121 of the second pipe segments 212 of multiple main pipes 210 are located in the same plane in parallel and with gaps therebetween, the plane being parallel with the rear wall of the inner tank 100 of the semiconductor refrigerator. That is, the second pipe segment 212 of multiple main pipe 210 may comprise the vertical portion 2121 whose lower end communicates with the corresponding first pipe segment 211 and a horizontal portion 2122 which extends from the upper end of the vertical portion 2121 perpendicularly to the vertical portion 2121 and whose tail end is closed. A starting end of the manifold 220 of the sintered heat pipe 200 is located at the vertical portion 2121 of a corresponding second pipe segment 212. Preferably, the projection of the manifold 220 of each sintered heat pipe 200 in a plane perpendicular to the corresponding vertical portion 2121 overlaps with the projection of the corresponding horizontal portion 2122 in the plane. Or the manifolds 220 of each sintered heat pipe 200 are located at the same side of the corresponding main pipe 210.

[0027] As shown in Fig. 3, the main pipe 210 may further include a connecting pipe segment 213 connected between the first and second pipe segments 211, 212 and arranged at an angle of 100°-170° relative to the first pipe segment 211 and to the vertical portion 2121 of the second pipe segment 212 respectively. The hot end heat radiating device of the embodiments of the present invention may comprise four sintered heat pipes 200. The main pipes 210 of the four sintered heat pipes 200 are arranged in the same plane in symmetry with respect to a geometrical symmetry plane. The length of the connecting pipe segment 213 of one sintered heat pipe 200 at one side of the geometrical symmetry plane is smaller than that of the connecting pipe segment 213 of the other sintered heat pipe 200 at the same side of the geometrical symmetry plane, so that the four sintered heat pipes 200 are reasonably arranged. There may be one manifold 220 for each sintered heat pipes 200.

[0028] In the embodiments of the present invention, the manifold 220 of the sintered heat pipe 200 is perpendicular to the rear wall of the inner tank 100. Further, the hot end heat radiating device further comprises one fin group 400 comprising multiple corresponding plate fins which are arranged in parallel and with gaps therebetween, and the fin group 400 being installed at a manifold 220 on a corresponding side of the main pipe 210 via pipe holes of the respective plate fins. The fin group 400 may be installed at the horizontal portion 2122 of the second pipe segment 212 of the main pipe 210 via the pipe holes of the respective plate fins. Preferably, the middle portion of each plate fin is provided with a receiving through hole so that each fin group 400 defines a receiving space extending along the axes of the receiving through holes. The hot end heat radiating device further comprises a blower 500 provided in the receiving space of the corresponding fin group 400 and configured such that air flow is sucked from an air inlet area of the blower and is blown to a gap between each two adjacent plate fins of the fin group 400. The blower 500 may be a centrifugal blower. The rotary axis of the blades overlaps with the axis of the receiving through hole, so that air flow is sucked from an axial direction of the centrifugal blower and is blown to the gap between each two adjacent plate fins using a centrifugal force. The plate fin may be rectangular.

[0029] Fig. 4 is a schematic right view of a semiconductor refrigerator according to another embodiment of the present invention. In the embodiments of the present invention, the second pipe segment 212 of the main pipe 210 is formed by extending from an upper end of the main pipe 210 vertically downwards by a predetermined

length, and the second pipe segments 212 of multiple main pipes 210 are located in the same plane in parallel and with gaps therebetween, the plane being parallel with the rear wall of the inner tank 100 of the semiconductor refrigerator. The manifolds 220 of each sintered heat pipe 200 are located at the opposite sides of the corresponding main pipe 210 respectively. The hot end heat radiating device further comprises two fin groups 400 and a blower 500. Each fin group 400 comprises multiple corresponding plate fins which are arranged in parallel and with gaps therebetween, and is installed at a manifold 220 on a corresponding side of the main pipe 210 via pipe holes of the respective plate fins. The blower 500 may be arranged at a transverse side of or above the multiple manifolds 220 and configured such that an air inlet area of the blower sucks air flow and the air flow is blown to a gap between each two adjacent plate fins, or the air flow is sucked from the gap between each two adjacent plate fins and is then blown to the air inlet area. For example, the blower 500 is an axial flow blower fixed on top of the two fin groups 400.

[0030] Fig. 5 is a schematic right view of a semiconductor refrigerator according to yet another embodiment of the present invention. As shown in Figs. 5-6, the manifold 220 of the sintered heat pipe 200 is perpendicular to the rear wall of the inner tank 100. The manifolds 220 of each sintered heat pipe 200 are located at the same side of the corresponding main pipe 210, or are located at the opposite sides of the corresponding main pipe 210 respectively. The hot end heat radiating device further comprises: multiple spiral fins 450 and a blower 500. Each of the multiple spiral fins 450 is spirally installed on a corresponding manifold 220, and the blower 500 is arranged at a transverse side of or above the multiple manifolds 220 such that the manifolds 220 of each sintered heat pipe 200 are located at an air inlet area or an air sucking area of the blower 500. For example, the blower 500 may be an axial flow blower and may be located at one side transverse to the multiple manifolds 220.

[0031] In the embodiments of the present invention, as the manifolds 220 of a sintered heat pipe 200 are independent from those of the other sintered heat pipe 200, to avoid deformation of the sintered heat pipes 200 and the spiral fins 450, or specifically to avoid unnecessary deformation of the sintered heat pipes 200 and the spiral fins 450 due to transportation or installation so as to affect the performance of the hot end heat radiating device, the hot end heat radiating device further comprises one and/or two fastening members 600. The fastening member 600 may be fixed at an end of the second pipe segment 212 of a corresponding main pipe 210 away from the corresponding first pipe segment 211 along the length direction of the fastening member 600 at different parts of the fastening member respectively. The other fastening member 600 may be fixed at an end of the second pipe segment 212 of a corresponding main pipe 210 close to the corresponding first pipe segment 211 along the length direction of the fastening member 600 at different parts of the fastening member respectively. For example, the fastening member 600 may be a fastening steel bar, a fastening steel wire, a fastening tube or the like.

[0032] Although multiple embodiments of this invention have been illustrated and described in detail, those skilled in the art may make various modifications and variations to the present invention based on the content disclosed by the present invention or the content derived therefrom without departing from the scope of the present invention as claimed.

Claims

1. A semiconductor refrigerator, comprising a semiconductor cooling plate (150) and a hot end heat radiating device,
   wherein the hot end heat radiating device comprises multiple sintered heat pipes (200), each having a main pipe (210) with both ends closed,
   wherein the main pipe (210) comprises a first pipe segment (211) thermally connected with a hot end of the semiconductor cooling plate, and a second pipe segment (212), which is located above the first pipe segment (211), and from whose one or more portions extend one or more manifolds (220) to radiate heat from the hot end of the semiconductor cooling plate (150) to an ambient environment.

2. The semiconductor refrigerator of claim 1, wherein the first pipe segment (211) of the main pipe (210) is formed by extending from a lower end of the main pipe vertically upwards by a predetermined length, and
   the first pipe segments (211) of multiple main pipes are located in the same plane in parallel and with gaps therebetween, the plane being parallel with a rear wall of an inner tank (100) of the semiconductor refrigerator.

3. The semiconductor refrigerator of claim 1, wherein the hot end heat radiating device further comprises:

   a fixed bottom plate (310) whose front surface is thermally connected with the hot end of the semiconductor cooling plate (150) and whose rear surface is provided with one or more grooves;
   and
   a fixed cover plate (320) whose front surface is provided with one or more grooves and which is configured to cooperate with the fixed bottom plate (310) to clamp the first pipe segment (211) of the main pipe (210) between the grooves of the fixed cover plate and of the fixed bottom plate.

4. The semiconductor refrigerator of claim 1, wherein

the second pipe segment (212) of the main pipe is formed by extending from an upper end of the main pipe vertically downwards by a predetermined length, and the second pipe segments (212) of multiple main pipes are located in the same plane in parallel and with gaps therebetween, the plane being parallel with the rear wall of the inner tank (100) of the semiconductor refrigerator; or
the second pipe segment (212) of the main pipe is formed by extending from the upper end of the main pipe longitudinally forwards by a predetermined length and then vertically downwards by a predetermined length, the vertical portions of the second pipe segments (212) of the multiple main pipes are located in the same plane in parallel and with gaps therebetween, the plane being parallel with the rear wall of the inner tank (100) of the semiconductor refrigerator, and a starting end of the manifold (220) of the sintered heat pipe (200) is located at the vertical portion of a corresponding second pipe segment (212).

5. The semiconductor refrigerator of claim 1, wherein the manifold (220) of the sintered heat pipe (200) is perpendicular to the rear wall of the inner tank (100).

6. The semiconductor refrigerator of claim 1, wherein the manifolds of each sintered heat pipe are located at the same side of the corresponding main pipe (210), or are located at the opposite sides of the corresponding main pipe (210) respectively.

7. The semiconductor refrigerator of claim 6, wherein the hot end heat radiating device further comprises: one or two fin groups (400), each fin group comprising multiple corresponding plate fins which are arranged in parallel and with gaps therebetween, and each fin group being installed at a manifold (220) on a corresponding side of the main pipe via pipe holes of the respective plate fins.

8. The semiconductor refrigerator of claim 7, wherein the hot end heat radiating device further comprises: a blower (500) arranged at a transverse side of or above the multiple manifolds (220) and configured such that an air inlet area of the blower sucks air flow and the air flow is blown to a gap between each two adjacent plate fins, or the air flow is sucked from the gap between each two adjacent plate fins and is then blown to the air inlet area.

9. The semiconductor refrigerator of claim 7, wherein the middle portion of each plate fin is provided with a receiving through hole so that each fin group defines a receiving space extending along the axes of the receiving through holes; and
the hot end heat radiating device further comprises one or two blowers (500) respectively provided in the receiving spaces of the corresponding fin groups (400) and configured such that air flow is sucked from an air inlet area of each blower (500) and is blown to a gap between each two adjacent plate fins of the corresponding fin group (400).

10. The semiconductor refrigerator of claim 5, wherein the hot end heat radiating device further comprises: multiple spiral fins (450) each spirally installed on a corresponding manifold (220), and a blower (500) arranged at a transverse side of or above the multiple manifolds such that the manifolds of each sintered heat pipe (200) are located at an air inlet area or an air sucking area of the blower (500).

Patentansprüche

1. Halbleiterkühlschrank mit einer Halbleiterkühlplatte (150) und einer Heißes-Ende-Wärmestrahlungsvorrichtung,
wobei die Heißes-Ende-Wärmestrahlungsvorrichtung mehrere gesinterte Wärmeleitungen (200) aufweist, wobei jede eine Hauptleitung (210) aufweist, bei der beide Enden geschlossen sind,
wobei die Hauptleitung (210) ein erstes Leitungssegment (211) aufweist, das mit einem heißen Ende der Halbleiterkühlplatte thermisch verbunden ist, und eine zweites Leitungssegment (212), das sich oberhalb des ersten Leitungssegments (211) befindet und von dessen einem oder mehreren Abschnitten sich ein oder mehrere Verteiler (220) erstrecken, um Wärme von dem heißen Ende der Halbleiterkühlplatte (150) in eine Umgebung abzugeben.

2. Halbleiterkühlschrank nach Anspruch 1, wobei das erste Leitungssegment (211) der Hauptleitung (210) ausgebildet ist, indem es sich von einem unteren Ende der Hauptleitung vertikal nach oben um eine vorbestimmte Länge erstreckt, und
wobei sich die ersten Leitungssegmente (211) mehrere Hauptleitungen in der gleichen Ebene parallel zueinander befinden und sich zwischen ihnen Lücken befinden, wobei die Ebene parallel zu einer Rückwand eines Innentanks (100) des Halbleiterkühlschranks ist.

3. Halbleiterkühlschrank nach Anspruch 1, wobei die Heißes-Ende-Wärmestrahlungsvorrichtung aufweist:

eine fixierte Bodenplatte (310), deren vordere Fläche mit dem heißen Ende der Halbleiterkühlplatte (150) thermisch verbunden ist und deren hinter Fläche mit einer oder mehreren Nuten versehen ist; und
eine fixierte Abdeckplatte (320), deren vordere Fläche mit einer oder mehreren Nuten versehen

ist, und die derart ausgebildet ist, dass sie mit der fixierten Bodenplatte (310) zusammenwirkt, um das erste Leitungssegment (211) der Hauptleitung (210) zwischen den Nuten der fixierten Abdeckplatte und der fixierten Bodenplatte zu klemmen.

4. Halbleiterkühlschrank nach Anspruch 1, wobei das zweite Leitungssegment (212) der Hauptleitung ausgebildet ist, indem es sich von einem oberen Ende der Hauptleitung vertikal nach unten um eine vorbestimmte Länge erstreckt, und wobei sich die zweiten Leitungssegmente (212) der mehreren Hauptleitungen in der gleichen Ebene parallel zueinander befinden und sich Lücken zwischen ihnen befinden, wobei die Ebene parallel zu der Rückwand des Innentanks (100) des Halbleiterkühlschranks ist; oder wobei das zweite Leitungssegment (212) der Hauptleitung ausgebildet ist, indem es sich von dem oberen Ende der Hauptleitung längs nach vorne um eine vorbestimmte Länge erstreckt und anschließend vertikal nach unten um eine vorbestimmte Länge erstreckt, wobei sich die vertikalen Abschnitte der zweiten Leitungssegmente (212) der mehreren Hauptleitungen in der gleichen Ebene parallel zueinander befinden und sich Lücken zwischen ihnen befinden, wobei die Ebene parallel zu der Rückwand des Innentanks (100) des Halbleiterkühlschranks ist, und wobei sich ein Startende des Verteilers (220) der gesinterten Wärmeleitung (200) an dem vertikalen Abschnitt eines entsprechenden zweiten Leitungssegments (212) befindet.

5. Halbleiterkühlschrank nach Anspruch 1, wobei der Verteiler (220) der gesinterten Wärmeleitung (200) senkrecht zur Rückwand des Innentanks (100) ist.

6. Halbleiterkühlschrank nach Anspruch 1, wobei sich die Verteiler jeder gesinterten Wärmeleitung an der gleichen Seite der entsprechenden Hauptleitung (210) befinden bzw. sich an den entgegengesetzten Seiten der entsprechenden Hauptleitung (210) befinden.

7. Halbleiterkühlschrank nach Anspruch 6, wobei die Heißes-Ende-Wärmestrahlungsvorrichtung aufweist:
eine oder zwei Rippengruppen (400), wobei jede Rippengruppe mehrere entsprechende Plattenrippen aufweist, die parallel und mit Lücken dazwischen angeordnet sind, und wobei jede Rippengruppe an einem Verteiler (220) auf einer entsprechenden Seite der Hauptleitung installiert ist über Leitungslöcher der jeweiligen Plattenrippen.

8. Halbleiterkühlschrank nach Anspruch 7, wobei die Heißes-Ende-Wärmestrahlungsvorrichtung aufweist:
ein Gebläse (500), das an einer Querseite der oder oberhalb der mehreren Verteiler (220) angeordnet ist und derart ausgebildet ist, dass ein Lufteinlassbereich des Gebläses einen Luftstrom ansaugt und der Luftstrom zu einer Lücke zwischen den jeweils zwei benachbarten Plattenrippen geblasen wird, oder der Luftstrom von der Lücke zwischen den jeweils zwei benachbarten Plattenrippen angesaugt wird und dann in den Lufteinlassbereich geblasen wird.

9. Halbleiterkühlschrank nach Anspruch 7, wobei der Mittelabschnitt jeder Plattenrippe eine Aufnahmedurchgangsbohrung aufweist, so dass jede Rippengruppe einen Aufnahmeraum definiert, der sich entlang der Achsen der Aufnahmedurchgangsbohrung erstreckt; und
wobei die Heißes-Ende-Wärmestrahlungsvorrichtung ferner ein oder zwei Gebläse (500) aufweist, die jeweils in den Aufnahmeräumen der entsprechenden Rippengruppen (400) vorgesehen sind und derart ausgebildet sind, dass der Luftstrom von einem Lufteinlassbereich jedes Gebläses (500) angesaugt wird und zu einer Lücke zwischen jeweils zwei benachbarten Plattenrippen der entsprechenden Rippengruppe (400) geblasen wird.

10. Halbleiterkühlanlage nach Anspruch 5, wobei die Heißes-Ende-Wärmestrahlungsvorrichtung ferner aufweist:

mehrere Spiralrippen (450), die jeweils spiralförmig auf einem entsprechenden Verteiler (220) installiert sind, und
ein Gebläse (500), das an einer Querseite der oder oberhalb der mehreren Verteiler angeordnet ist, so dass sich die Verteiler jeder gesinterten Wärmeleitung (200) an einem Lufteinlassbereich oder einem Luftansaugbereich des Gebläses (500) befinden.

Revendications

1. Réfrigérateur à semi-conducteur, comprenant une plaque de refroidissement à semi-conducteur (150) et un dispositif de rayonnement de chaleur d'extrémité chaude, dans lequel le dispositif de rayonnement de chaleur d'extrémité chaude comprend de multiples caloducs frittés (200), ayant chacun un tuyau principal (210) avec les deux extrémités fermées,
dans lequel le tuyau principal (210) comprend un premier segment de tuyau (211) raccordé thermiquement à une extrémité chaude de la plaque de refroidissement à semi-conducteur, et un second segment de tuyau (212), qui est situé au-dessus du premier segment de tuyau (211), et depuis une ou

plusieurs portions de celui-ci s'étendent un ou plusieurs collecteurs (220) pour rayonner de la chaleur depuis l'extrémité chaude de la plaque de refroidissement à semi-conducteur (150) vers un environnement ambiant.

2. Réfrigérateur à semi-conducteur selon la revendication 1, dans lequel le premier segment de tuyau (211) du tuyau principal (210) est formé en s'étendant depuis une extrémité inférieure du tuyau principal à la verticale vers le haut d'une longueur prédéterminée, et
les premiers segments de tuyau (211) de multiples tuyaux principaux sont situés dans le même plan en parallèle et avec des écartements entre eux, le plan étant parallèle à une paroi arrière d'une cuve intérieure (100) du réfrigérateur à semi-conducteur.

3. Réfrigérateur à semi-conducteur selon la revendication 1, dans lequel le dispositif de rayonnement de chaleur d'extrémité chaude comprend en outre :

une plaque de dessous fixe (310) dont la surface avant est raccordée thermiquement à l'extrémité chaude de la plaque de refroidissement à semi-conducteur (150) et dont la surface arrière est pourvue d'une ou de plusieurs rainures ; et une plaque couvrante fixe (320) dont la surface avant est pourvue d'une ou de plusieurs rainures et qui est configurée pour coopérer avec la plaque de dessous fixe (310) pour serrer le premier segment de tuyau (211) du tuyau principal (210) entre les rainures de la plaque couvrante fixe et de la plaque de dessous fixe.

4. Réfrigérateur à semi-conducteur selon la revendication 1, dans lequel le second segment de tuyau (212) du tuyau principal est formé en s'étendant depuis une extrémité supérieure du tuyau principal à la verticale vers le bas d'une longueur prédéterminée, et les seconds segments de tuyau (212) de multiples tuyaux principaux sont situés dans le même plan en parallèle et avec des écartements entre eux, le plan étant parallèle à la paroi arrière de la cuve intérieure (100) du réfrigérateur à semi-conducteur ; ou
le second segment de tuyau (212) du tuyau principal est formé en s'étendant depuis l'extrémité supérieure du tuyau principal longitudinalement vers l'avant d'une longueur prédéterminée puis à la verticale vers le bas d'une longueur prédéterminée, les portions verticales des seconds segments de tuyau (212) des multiples tuyaux principaux sont situées dans le même plan en parallèle et avec des écartements entre elles, le plan étant parallèle à la paroi arrière de la cuve intérieure (100) du réfrigérateur à semi-conducteur, et une extrémité de départ du collecteur (220) du caloduc fritté (200) est située au niveau de la portion verticale d'un second segment de tuyau (212) correspondant.

5. Réfrigérateur à semi-conducteur selon la revendication 1, dans lequel le collecteur (220) du caloduc fritté (200) est perpendiculaire à la paroi arrière de la cuve intérieure (100).

6. Réfrigérateur à semi-conducteur selon la revendication 1, dans lequel les collecteurs de chaque caloduc fritté sont situés du même côté du tuyau principal (210) correspondant, ou sont situés des côtés opposés du tuyau principal (210) correspondant respectivement.

7. Réfrigérateur à semi-conducteur selon la revendication 6, dans lequel le dispositif de rayonnement de chaleur d'extrémité chaude comprend en outre : un ou deux groupes d'ailettes (400), chaque groupe d'ailettes comprenant de multiples plaques-ailettes correspondantes qui sont agencées en parallèle et avec des écartements entre elles, et chaque groupe d'ailettes est installé au niveau d'un collecteur (220) sur un côté correspondant du tuyau principal via des orifices de tuyau des plaques-ailettes respectives.

8. Réfrigérateur à semi-conducteur selon la revendication 7, dans lequel le dispositif de rayonnement de chaleur d'extrémité chaude comprend en outre : une soufflante (500) agencée d'un côté transversal des multiples collecteurs (220) ou au-dessus de ceux-ci et configurée de sorte qu'une zone d'entrée d'air de la soufflante aspire un flux d'air et le flux d'air est soufflé sur un écartement entre deux plaques-ailettes adjacentes, ou le flux d'air est aspiré depuis l'écartement entre deux plaques-ailettes adjacentes et est ensuite soufflé sur la zone d'entrée d'air.

9. Réfrigérateur à semi-conducteur selon la revendication 7, dans lequel la portion milieu de chaque plaque-ailette est pourvue d'un trou traversant de réception de sorte que chaque groupe d'ailettes définisse un espace de réception s'étendant selon les axes des trous traversants de réception ; et
le dispositif de rayonnement de chaleur d'extrémité chaude comprend en outre une ou deux soufflantes (500) prévues respectivement dans les espaces de réception des groupes d'ailettes (400) correspondants et configurées de sorte qu'un flux d'air soit aspiré depuis une zone d'entrée d'air de chaque soufflante (500) et soit soufflé sur un écartement entre deux plaques-ailettes adjacentes du groupe d'ailettes (400) correspondant.

10. Réfrigérateur à semi-conducteur selon la revendication 5, dans lequel le dispositif de rayonnement de chaleur d'extrémité chaude comprend en outre : de multiples ailettes spiralées (450) installées chacune en spirale sur un collecteur (220) correspondant, et

une soufflante (500) agencée d'un côté transversal des multiples collecteurs ou au-dessus de ceux-ci de sorte que les collecteurs de chaque caloduc fritté (200) soient situés au niveau d'une zone d'entrée d'air ou d'une zone d'aspiration d'air de la soufflante (500).

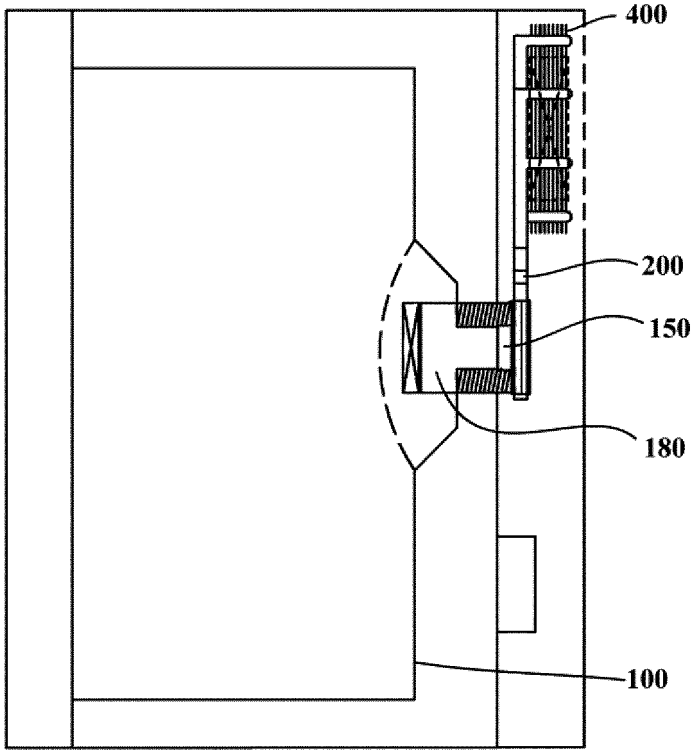

Fig. 1

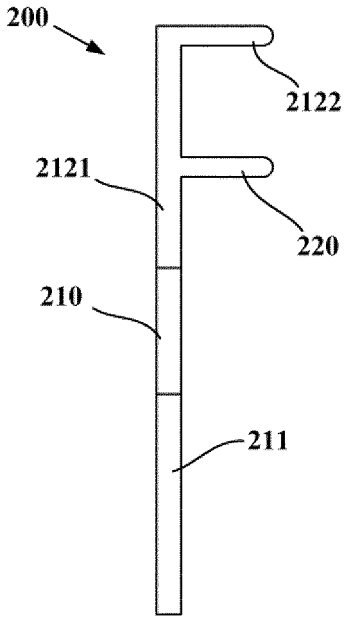

Fig. 2

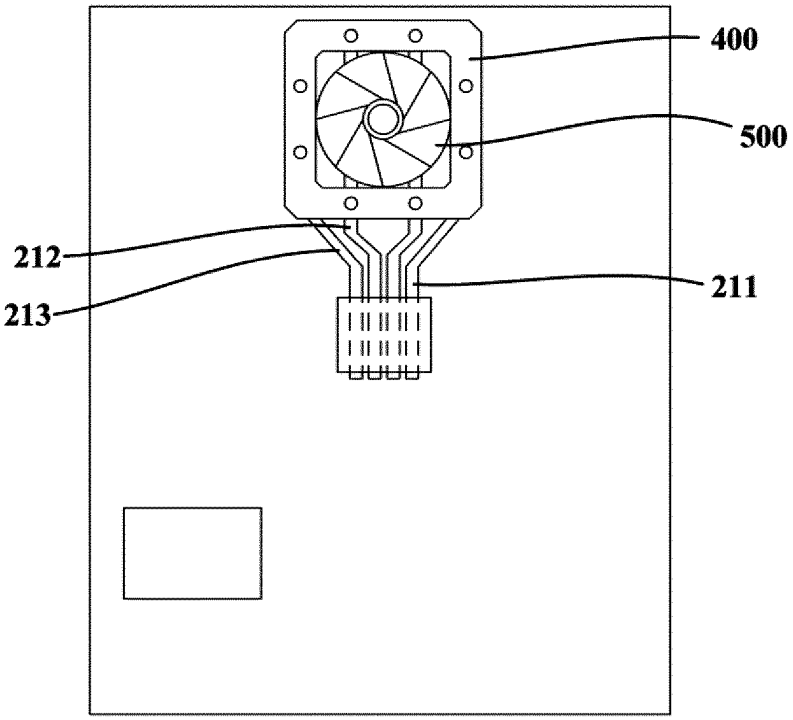

Fig. 3

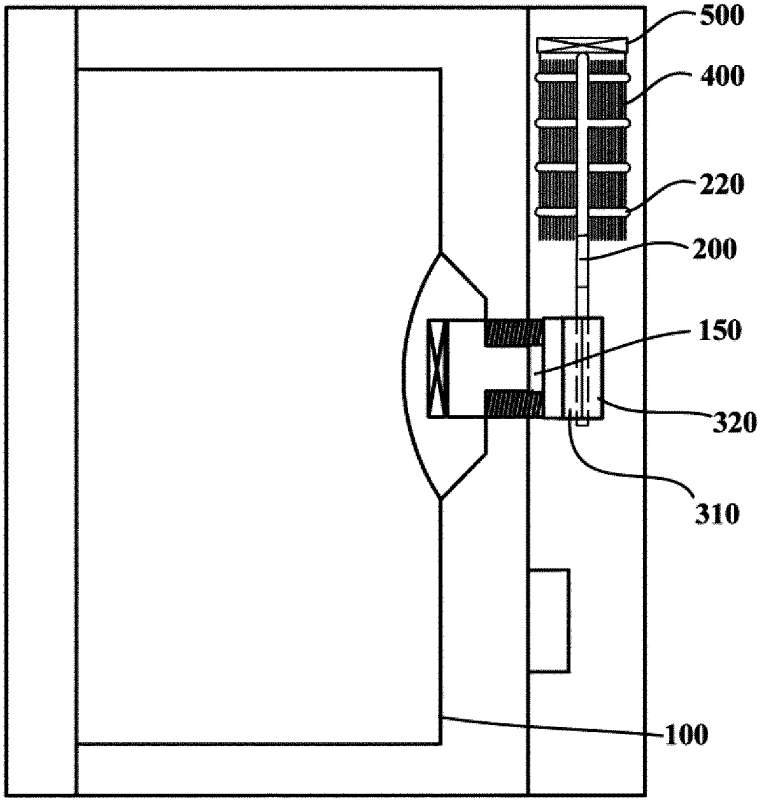

Fig. 4

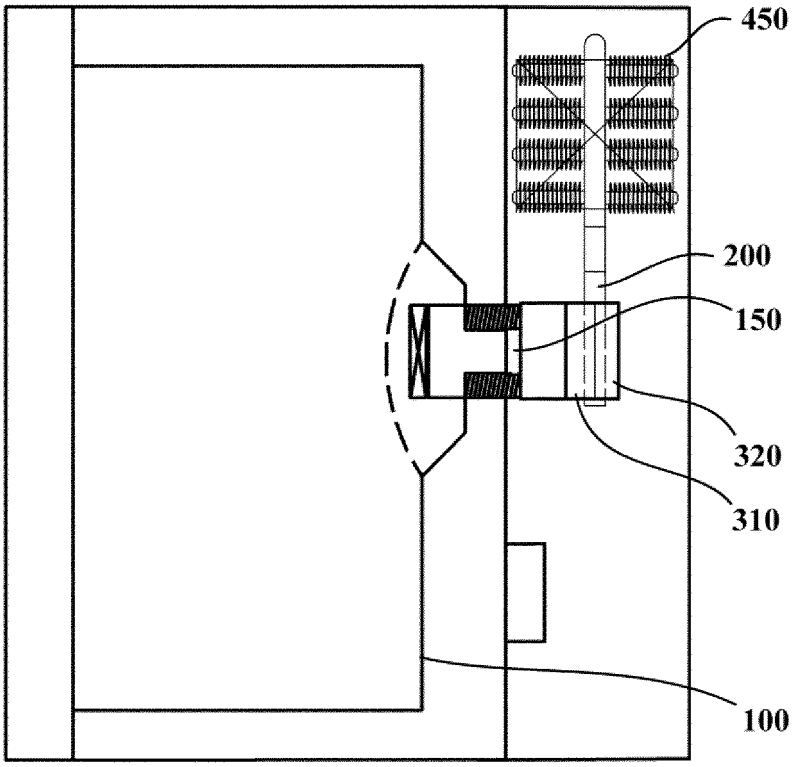

Fig. 5

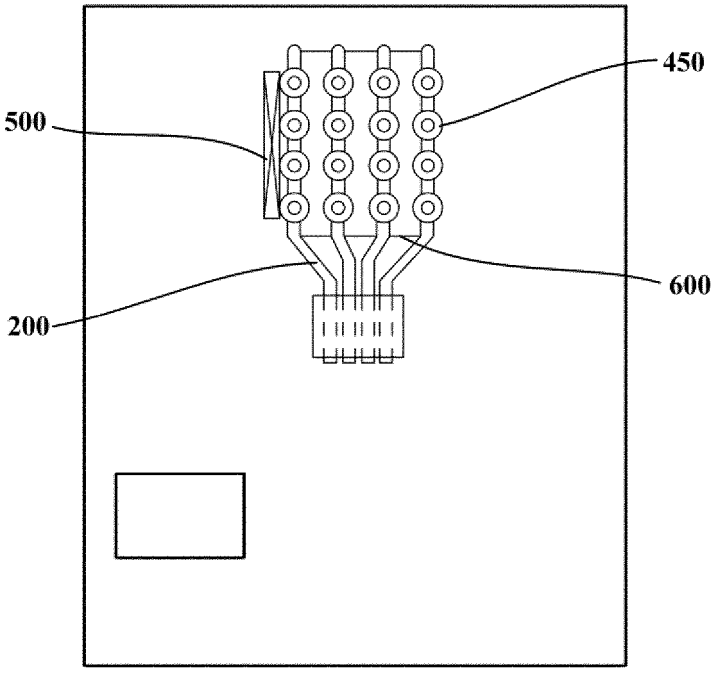

Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 0592044 A2 **[0005]**