

DESCRIPTION

TITLE OF INVENTION: SERVER SYSTEM

TECHNICAL FIELD

5 [0001]

The present disclosure relates to a server system.

Priority is claimed on Japanese Patent Application No. 2023-206792, filed December 7, 2023, the content of which is incorporated herein by reference.

BACKGROUND ART

10 [0002]

In a system provided with a heat-generating body, it is necessary to remove heat generated by the heat-generating body. For example, Patent Document 1 discloses a cooling device that receives heat from a heat-generating body to be cooled and that naturally circulates a refrigerant.

15 [0003]

In addition, for example, in a data center, a large number of racks for housing servers are installed in a server room. A chip such as a CPU or a GPU mounted on the server generates heat during operation. The server may malfunction when a temperature of the server exceeds a predetermined temperature range. Therefore, it is necessary to cool the inside of the server room. As a cooling method for the server room, for example, there is an air cooling method of cooling and circulating the air inside the server room using an air conditioner.

Citation List

Patent Document

25 [0004]

No. 2015-06414

SUMMARY OF INVENTION

Technical Problem

5 [0005]

However, when server racks are densely disposed in a limited space of the server room, the air cooling method requires a large amount of energy. Therefore, constructing a system capable of efficiently removing heat has been a challenge.

In addition, when a heat generation amount of the server is large, a cooling
10 capacity of the air cooling method may be insufficient.

[0006]

The present disclosure has been made to address the above-described challenge, and an object of the present disclosure is to provide a server system capable of efficiently dissipating heat.

15 The present disclosure has been made to address the above-described challenge, and an object of the present disclosure is to provide a server system capable of adjusting a cooling capacity according to a heat generation amount.

Solution to Problem

[0007]

20 In order to address the above-described challenge, a server system according to the present disclosure includes: a rack group in which a plurality of racks each housing a heat-generating body cooled by a refrigerant are arranged side by side in a first horizontal direction; a heat exchange section provided to correspond to each of the racks and configured to exchange heat between the refrigerant and air at a position above each of
25 the racks; and a duct positioned above a plurality of the heat exchange sections, the duct

extending in the first horizontal direction and forming a discharge flow path configured to discharge, in the first horizontal direction, the air that has undergone heat exchange in each of the heat exchange sections.

[0008]

- 5 A server system according to the present disclosure includes: a rack housing a heat-generating body cooled by a refrigerant; a heat exchange section provided to correspond to the rack and configured to exchange heat between the refrigerant and air at a position above the rack; a duct positioned above the heat exchange section, the duct forming a discharge flow path configured to discharge the air that has undergone heat
- 10 exchange in the heat exchange section; a cooling component attached to the heat-generating body and configured to allow the refrigerant to flow therethrough and cool the heat-generating body by exchanging heat with the refrigerant; an air-cooling fan configured to blow air to the heat exchange section to cool the heat exchange section; a refrigerant cooler configured to cool the refrigerant by exchanging heat with a second
- 15 refrigerant; a refrigerant circulation flow path including a natural circulation flow path provided with the heat exchange section and the cooling component and configured to naturally circulate the refrigerant by thermal convection, a forced circulation flow path that bypasses a portion of the natural circulation flow path and is configured to forcibly circulate the refrigerant without relying on thermal convection, and a refrigerant cooling
- 20 flow path that bypasses a portion of the natural circulation flow path and is provided with the refrigerant cooler; and a switching mechanism provided in the refrigerant circulation flow path and configured to switch a flow path of the refrigerant between a flow path where the refrigerant passes through the forced circulation flow path and a flow path where the refrigerant does not pass through the forced circulation flow path and switch
- 25 the flow path of the refrigerant between a flow path where the refrigerant passes through

the refrigerant cooling flow path and a flow path where the refrigerant does not pass through the refrigerant cooling flow path.

[0009]

A server system according to the present disclosure includes: a rack group in which a plurality of racks each housing a heat-generating body are arranged side by side in a first horizontal direction; a cooling fan provided in each of the racks and configured to supply air to the heat-generating body and discharge the air that has passed through the heat-generating body to an outside of the rack; and a duct positioned above the rack group, the duct extending in the first horizontal direction and forming a discharge flow path configured to discharge, toward the first horizontal direction, the air discharged from the rack by the cooling fan.

Advantageous Effects of Invention

[0010]

With the server system of the present disclosure, it is possible to efficiently dissipate heat. In addition, with the server system of the present disclosure, it is possible to adjust a cooling capacity according to a heat generation amount.

BRIEF DESCRIPTION OF DRAWINGS

[0011]

[FIG. 1] A view of a server system according to a first embodiment of the present disclosure as seen from a width direction.

[FIG. 2] A view of a server group and a duct according to the first embodiment of the present disclosure as seen from above.

[FIG. 3] A perspective view showing an outline of the server group and the duct according to the first embodiment of the present disclosure.

[FIG. 4] A view showing a rack, a heat exchange section, and a refrigerant circulation flow path according to the first embodiment of the present disclosure.

[FIG. 5] A view of the heat exchange section according to the first embodiment of the present disclosure as seen from a depth direction.

5 [FIG. 6] A view of a heat exchange section according to a second embodiment of the present disclosure as seen from the depth direction.

[FIG. 7] A view of the heat exchange section according to the second embodiment of the present disclosure as seen from the width direction.

[FIG. 8] A view of a heat exchange section according to a third embodiment of
10 the present disclosure as viewed from the depth direction.

[FIG. 9] A view of the heat exchange section according to the third embodiment of the present disclosure as seen from the width direction.

[FIG. 10] A view showing a rack, a heat exchange section, and a refrigerant circulation flow path according to a fourth embodiment of the present disclosure.

15 [FIG. 11] A view showing a rack, a heat exchange section, and a refrigerant circulation flow path according to a fifth embodiment of the present disclosure.

[FIG. 12] A view for describing switching of an operation of a server system according to the fifth embodiment of the present disclosure.

[FIG. 13] A view of a server system according to a sixth embodiment of the
20 present disclosure as seen from the width direction.

[FIG. 14] A view of a server system according to a seventh embodiment of the present disclosure as seen from the depth direction.

[FIG. 15] A view of a server system according to an eighth embodiment of the present disclosure as seen from the depth direction.

[FIG. 16] A view of a server system according to a ninth embodiment of the present disclosure as seen from the depth direction.

[FIG. 17] A view of a server system according to a tenth embodiment of the present disclosure as seen from the width direction.

5 [FIG. 18] A view of a server system according to an eleventh embodiment of the present disclosure as seen from above.

DESCRIPTION OF EMBODIMENTS

[0012]

<First Embodiment>

10 (Configuration of Server System)

Hereinafter, a server system 1 according to a first embodiment of the present disclosure will be described with reference to FIGS. 1 to 5.

As shown in FIG. 1, the server system 1 includes a server center 2, a rack group 10, a heat exchange section 20, a filter 3, a duct 30, a support member 4 (see FIG. 5), a cooling component 5 (see FIG. 4), and a refrigerant circulation flow path 40 (see FIG. 4).

15 [0013]

(Server Center)

A server room 2a is provided on each floor of the server center 2. Each server room 2a houses various devices and equipment that constitute the server system 1, such as the rack group 10, the heat exchange section 20, the filter 3, the duct 30, the support member 4, the cooling component 5, and the refrigerant circulation flow path 40.

20 [0014]

(Rack Group)

As shown in FIGS. 1 to 3, the rack group 10 is configured with a plurality of racks 11. The rack 11 is formed in a rectangular parallelepiped shape and extends in a vertical direction Dv.

[0015]

5 Hereinafter, a depth direction Dd of the rack 11 will be simply referred to as a depth direction Dd, and a width direction Dw of the rack 11 will be simply referred to as a width direction Dw. The depth direction Dd and the width direction Dw are both horizontal directions and are orthogonal to each other.

10 In addition, hereinafter, the depth direction Dd will be referred to as a first horizontal direction D1, and the width direction Dw will be referred to as a second horizontal direction D2. That is, the first horizontal direction D1 and the second horizontal direction D2 are orthogonal to each other.

[0016]

15 The rack group 10 is configured with the plurality of racks 11 arranged side by side in the first horizontal direction D1 (depth direction Dd).

A plurality of the rack groups 10 are provided side by side in the second horizontal direction D2 (width direction Dw).

[0017]

20 As shown in FIG. 4, the rack 11 houses a plurality of servers 12. The plurality of servers 12 are disposed within the rack 11 at intervals in the vertical direction Dv. The server 12 has a board 13 and a heat-generating body 14 inside.

25 The heat-generating body 14 is a chip such as a CPU or a GPU mounted on the board 13. Although only one heat-generating body 14 is shown on each board 13, a plurality of the heat-generating bodies 14 may be provided. For example, the plurality of heat-generating bodies 14 may be provided side by side in the second horizontal

direction D2 (width direction Dw) on each board 13. The heat-generating body 14 generates heat during operation. The heat-generating body 14 is cooled by a refrigerant R circulating through a refrigerant circulation flow path 40 described below.

The refrigerant R of the present embodiment is, for example, water. The type of the refrigerant R can be changed as appropriate. The refrigerant R may be, for example, hydrofluoroolefin (HFO) (for example, R1233zd) with a low global warming potential (GWP) and a low ozone depletion potential (ODP). In addition, the refrigerant R may be, for example, a type of refrigerant that does not correspond to perfluoroalkyl substances and polyfluoroalkyl substances (PFAS).

[0018]

(Heat Exchange Section)

As shown in FIGS. 4 and 5, the heat exchange section 20 is provided to correspond to each rack 11. In the present embodiment, the heat exchange section 20 is disposed directly above the rack 11. That is, the heat exchange section 20 is provided at a position above the rack 11 and overlapping the rack 11 in the vertical direction Dv.

The heat exchange section 20 is provided in the refrigerant circulation flow path 40 described below, and is supplied with the refrigerant R after cooling the heat-generating body 14. The heat exchange section 20 is a so-called radiator. The heat exchange section 20 exchanges heat between the refrigerant R and air A at a position above each rack 11, and dissipates heat of the refrigerant R.

[0019]

The heat exchange section 20 is formed in a linear shape that is positioned lower as it goes from one side in the second horizontal direction D2 toward the other side in the second horizontal direction D2, as viewed from the first horizontal direction D1. The heat exchange section 20 includes a supply header 21 to which the refrigerant R is

supplied, a discharge header 22 that discharges the refrigerant R, and a heat dissipation section 23 that connects the supply header 21 and the discharge header 22.

[0020]

5 The supply header 21 is a tubular member extending in the first horizontal direction D1.

The discharge header 22 is provided at a position spaced apart from the supply header 21 to the other side in the second horizontal direction D2 and below the supply header 21. The discharge header 22 is a tubular member extending in the first horizontal direction D1. The discharge header 22 is formed to have a smaller diameter
10 than the supply header 21.

[0021]

The heat dissipation section 23 is formed in a tubular shape extending in the second horizontal direction D2 from the supply header 21 toward the discharge header 22. The heat dissipation section 23 allows the supply header 21 and the discharge
15 header 22 to communicate with each other. The heat dissipation section 23 is formed to gradually decrease in diameter toward the discharge header 22. The shape of the heat dissipation section 23 can be changed as appropriate. The heat dissipation section 23 may be formed in a cylindrical shape or a prismatic shape with a uniform thickness.

The heat dissipation section 23 releases the heat of the refrigerant R to the
20 outside air. A plurality of the heat dissipation sections 23 are arranged side by side in the first horizontal direction D1. In addition, the heat dissipation section 23 includes fins 24 formed to protrude from an outer peripheral surface in a flange shape. A plurality of the fins 24 are provided side by side in an axial direction (second horizontal direction D2) of the heat dissipation section 23.

25 [0022]

(Filter)

As shown in FIGS. 1 to 3, the server room 2a is provided with an air inlet 2b for introducing outside air for cooling into the server room 2a. The air inlet 2b is provided on one side of the server 12 group in the first horizontal direction D1. The air inlet 2b extends in the second horizontal direction D2 and is formed over the entire area of the plurality of server 12 groups. The filter 3 is mounted inside the air inlet 2b. The filter 3 is disposed upstream of the rack group 10 in a flow direction of the air A generated by an introduction fan 70. The air A can flow through the filter 3. The filter 3 is provided to be detachable by being divided into a plurality of parts in the second horizontal direction D2. The filter 3 collects dust and the like contained in the air A.

[0023]

(Duct)

The duct 30 is provided above the plurality of heat exchange sections 20 corresponding to one rack group 10. The duct 30 extends in the first horizontal direction D1 and forms a discharge flow path S for discharging, toward the first horizontal direction D1, the air A that has undergone heat exchange in each heat exchange section 20. A plurality of the ducts 30 are provided side by side in the second horizontal direction D2. In the present embodiment, the ducts 30 are provided in the same number as the rack groups 10.

[0024]

The duct 30 includes an internal duct 31 disposed in the server center 2 (an example of a building) and an external duct 32 that communicates with the internal duct 31, at least a portion of the external duct 32 being disposed outside the server center 2 (an example of a building).

[0025]

The internal duct 31 is supported by a support member (not shown) on the ceiling of the server room 2a. The internal duct 31 includes a horizontal duct 33 extending in the first horizontal direction D1. The horizontal duct 33 forms a horizontal discharge flow path SH extending in the first horizontal direction D1 in the discharge flow path S. The horizontal duct 33 is open downward. The air A that has undergone heat exchange with the refrigerant R in the heat exchange section 20 is introduced into the duct 30 through the downward opening of the horizontal duct 33. The horizontal duct 33 includes an upper plate 34, side plates 35, an end plate 36, and a partition plate 37.

10 [0026]

The upper plate 34 extends along a horizontal plane and extends in the first horizontal direction D1. The side plates 35 are provided at both ends of the upper plate 34 in the second horizontal direction D2 and extend downward from the upper plate 34. The side plates 35 extend in the first horizontal direction D1. The ducts 30 adjacent to each other share the side plate 35. The side plate 35 does not necessarily have to be shared between the ducts 30 adjacent to each other. The side plate 35 may be individually provided for each duct 30.

[0027]

The end plate 36 is provided at an end portion of the upper plate 34 on one side in the first horizontal direction D1. The end plate 36 extends downward from the upper plate 34. The end plate 36 connects the side plates 35 facing each other in the width direction Dw. A plurality of the partition plates 37 are provided within the horizontal duct 33 at intervals in the first horizontal direction D1. The partition plate 37 is disposed at an interval downward from the upper plate 34 and partitions the horizontal discharge flow path SH in the first horizontal direction D1. One heat exchange section

20 is disposed in each of a plurality of spaces partitioned by the plurality of partition plates 37.

In the present embodiment, the entirety of each heat exchange section 20 is disposed in the horizontal duct 33.

5 [0028]

The external duct 32 extends upward from an end portion of the horizontal duct 33 on the other side in the first horizontal direction D1. The external duct 32 is formed in a tubular shape extending upward along a wall surface of the server center 2. The external duct 32 forms a vertical discharge flow path SV extending in the vertical
10 direction Dv in the discharge flow path S. The external duct 32 is attached to the wall surface of the server center 2. An upper end of the external duct 32 is curved and is open downward.

[0029]

(Support Member)

15 The support member 4 is provided in the duct 30 and connects the heat exchange section 20 and the duct 30. The support member 4 supports the duct 30 from below. The support member 4 is provided in each of the supply header 21 and the discharge header 22. Hereinafter, the support member 4 provided in the supply header 21 is referred to as a supply-side support member 4a, and the support member 4 provided in
20 the discharge header 22 is referred to as a discharge-side support member 4b. The supply-side support member 4a extends from the supply header 21 to one side in the second horizontal direction D2 and is connected to the side plate 35. The discharge-side support member 4b extends from the discharge header 22 to the other side in the second horizontal direction D2 and is connected to the side plate 35.

25 [0030]

(Cooling Component)

The cooling component 5 is attached to the heat-generating body 14 and allows the refrigerant R to flow therethrough. The refrigerant R cools the heat-generating body 14 by exchanging heat with the refrigerant R. The cooling component 5 is, for example, a cold plate, and is supplied with the refrigerant R from a refrigerant circulation flow path 40 described below. In the cooling component 5, the refrigerant R boils by receiving the heat of the heat-generating body 14.

[0031]

(Refrigerant Circulation Flow Path)

10 The refrigerant circulation flow path 40 includes a natural circulation flow path 41 that is provided with the heat exchange section 20 and the cooling component 5 described above and that naturally circulates the refrigerant R by thermal convection.

The natural circulation flow path 41 includes a discharge pipe 42, a first header 43, a supply-side connection pipe 44, a discharge-side connection pipe 45, a second header 46, and a supply pipe 47.

The discharge pipe 42 is provided for each cooling component 5. The discharge pipe 42 extends from an upper surface of the cooling component 5. The refrigerant R that has undergone heat exchange with the heat-generating body 14 from the cooling component 5 is discharged through the discharge pipe 42. A plurality of the discharge pipes 42 are connected to the first header 43.

[0032]

The first header 43 combines the refrigerant R flowing through each of the discharge pipes 42. The first header 43 extends upward. The first header 43 is connected to the supply-side connection pipe 44. The first header 43 has a flange 43a that protrudes radially outward at its upper end.

[0033]

The supply-side connection pipe 44 extends upward and is connected to the supply header 21 of the heat exchange section 20. The supply-side connection pipe 44 has a flange 44a that protrudes radially outward at its lower end. The flange 44a of the supply-side connection pipe 44 is fixed while overlapping the flange 43a of the first header 43. The refrigerant R flowing through the first header 43 is supplied to the supply header 21 of the heat exchange section 20 via the supply-side connection pipe 44. Thereafter, the refrigerant R dissipates heat in the heat dissipation section 23 and is sent to the discharge header 22. The discharge header 22 is provided with the discharge-side connection pipe 45.

[0034]

The discharge-side connection pipe 45 extends downward from the discharge header 22. The discharge-side connection pipe 45 has a flange 45a that protrudes radially outward at its lower end. The second header 46 is connected to the discharge-side connection pipe 45.

[0035]

The second header 46 extends downward from the discharge-side connection pipe 45. The second header 46 has a flange 46a that protrudes radially outward at its upper end. The flange 45a of the discharge-side connection pipe 45 is fixed while overlapping the flange 46a of the second header 46. The refrigerant R discharged from the discharge header 22 is sent to the second header 46 via the discharge-side connection pipe 45. The second header 46 is provided with the same number of supply pipes 47 as the cooling components 5.

[0036]

The supply pipe 47 extends from the second header 46 and connects the corresponding cooling component 5 and the second header 46. The supply pipe 47 is connected to the cooling component 5 below the discharge pipe 42. The plurality of supply pipes 47 distribute and supply the refrigerant R flowing through the second header 46 to each cooling component 5.

[0037]

(Cooling Mechanism of Heat-Generating Body)

Subsequently, a cooling mechanism of the heat-generating body 14 in the server system 1 will be described.

When the server 12 is operated and the heat-generating body 14 generates heat, the refrigerant R in the cooling component 5 is heated. The heated refrigerant R has a lower density than the refrigerant R before being heated and rises. In this way, the refrigerant R naturally circulates in the refrigerant circulation flow path 40 due to thermal convection generated by the heat of the heat-generating body 14. In the present embodiment, the refrigerant R boils and vaporizes in the cooling component 5. The vaporized refrigerant R flows into the first header 43 through the discharge pipe 42. Thereafter, the refrigerant R is supplied to the heat exchange section 20. In the heat exchange section 20, heat exchange is performed between the refrigerant R and the surrounding air A. As a result, the refrigerant R is cooled and liquefied.

[0038]

On the other hand, the air A around the heat exchange section 20 is heated. The air A around the heat exchange section 20 is heated, so that an upward flow is generated around the heat exchange section 20. The upward flow generated around the heat exchange section 20 causes the air A, which has absorbed heat from the refrigerant R in the heat exchange section 20, to be introduced into the duct 30 above. The air A is

discharged outside the server center 2 (outside the server room 2a) through the discharge flow path S. In this way, the heat of the heat-generating body 14 is dissipated outside the server center 2 (outside the server room 2a).

[0039]

5 When the refrigerant R is cooled in the heat exchange section 20, the refrigerant R is supplied to the cooling component 5 in a liquid state through the second header 46 and the supply pipe 47. In the cooling component 5, heat exchange is performed again between the refrigerant R supplied from the supply pipe 47 and the heat-generating body 14.

10 In this way, the refrigerant R flows through the refrigerant circulation flow path 40 to cool each heat-generating body 14, and the heat of the heat-generating body 14 can be dissipated to outside the server center 2 (outside the server room 2a) through the duct 30.

[0040]

15 (Action and Effect)

The server system 1 of the present embodiment can exhibit the following actions and effects.

In the present embodiment, the server system 1 includes the rack group 10, the heat exchange section 20, and the duct 30. The rack group 10 is configured such that a
20 plurality of racks 11 each housing the heat-generating body 14 cooled by the refrigerant R are arranged side by side in the first horizontal direction D1. The heat exchange section 20 is provided to correspond to each rack 11, and performs heat exchange between the refrigerant R and the air A at a position above each rack 11. The duct 30 is positioned above a plurality of the heat exchange sections 20, extends in the first
25 horizontal direction D1, and forms the discharge flow path S for discharging, toward the

first horizontal direction D1, the air A that has undergone heat exchange in each heat exchange section 20.

[0041]

The heat of the heat-generating body 14 is absorbed by the refrigerant R. The
5 refrigerant R that has absorbed the heat of the heat-generating body 14 is sent to the heat
exchange section 20. The heat exchange section 20 performs heat exchange between
the refrigerant R and the air A around the heat exchange section 20. In this way, in the
heat exchange section 20, the heat of the heat-generating body 14 transmitted via the
refrigerant R is discharged to the outside air. The duct 30 can collectively discharge the
10 air A that has absorbed waste heat from the plurality of heat exchange sections 20
belonging to the corresponding rack group 10. Therefore, with the above configuration,
the heat can be dissipated efficiently.

[0042]

<Second Embodiment>

15 (Configuration of Server System)

Hereinafter, a server system 201 according to a second embodiment of the
present disclosure will be described with reference to FIGS. 6 and 7. The same
configurations as those of the above-described embodiment are denoted by the same
names and the same reference signs, and a description thereof will be omitted as
20 appropriate.

As shown in FIGS. 6 and 7, the server system 201 includes a support member 4,
similarly to the server system 1 of the first embodiment.

[0043]

(Support Member)

Among the support members 4, a plurality of supply-side support members 4a are provided along the supply header 21, and a plurality of discharge-side support members 4b are provided along the discharge header 22.

In addition, in the present embodiment, the entire heat exchange section 20 is
5 disposed in the duct 30.

[0044]

The side plate 35 has an insertion hole 38 into which the support member 4 is inserted. Among the insertion holes 38, an insertion hole 38 into which the supply-side support member 4a is inserted is referred to as a supply-side insertion hole 38a, and an
10 insertion hole 38 into which the discharge-side support member 4b is inserted is referred to as a discharge-side insertion hole 38b. The supply-side insertion hole 38a is provided at a higher position than the discharge-side insertion hole 38b.

[0045]

(Action and Effect)

15 The server system 201 of the present embodiment can exhibit the following actions and effects.

In the present embodiment, the server system 201 further includes the support member 4 that connects the heat exchange section 20 and the duct 30. The entire heat exchange section 20 is disposed in the duct 30. The duct 30 has the insertion hole 38
20 into which the support member 4 is inserted.

[0046]

By simply inserting the support member 4 into the insertion hole 38, at least a portion of the heat exchange section 20 can be easily disposed in the duct 30. As a result, the air A that has absorbed waste heat from the heat exchange section 20 is likely

to be guided into the duct 30. Therefore, with the above configuration, heat dissipation can be performed more efficiently.

[0047]

In the present embodiment, the entire heat exchange section 20 is disposed in the duct 30, but the present disclosure is not limited to this. A portion of the heat exchange section 20 may be disposed in the duct 30.

[0048]

<Third Embodiment>

(Configuration of Server System)

Hereinafter, a server system 301 according to a third embodiment of the present disclosure will be described with reference to FIGS. 8 and 9. The same configurations as those of the above-described embodiment are denoted by the same names and the same reference signs, and a description thereof will be omitted as appropriate.

As shown in FIGS. 8 and 9, the server system 301 further includes an elastic member 6. The elastic member 6 is disposed in the duct 30. The elastic member 6 is designed to be elastically deformable. Examples of the elastic member 6 include a rubber material.

In addition, in the present embodiment, the entire heat exchange section 20 is disposed in the duct 30.

[0049]

(Elastic Member)

The elastic member 6 is provided to fill a gap between the heat exchange section 20 and the duct 30.

The elastic member 6 is provided in each of the supply header 21 and the discharge header 22. Among the elastic member 6, the elastic member 6 provided in the

supply header 21 is referred to as a supply-side elastic member 6a, and the elastic member 6 provided in the discharge header 22 is referred to as a discharge-side elastic member 6b.

[0050]

5 The supply-side elastic member 6a extends in the first horizontal direction D1 along the supply header 21. Both end portions of the supply-side elastic member 6a are in close contact with the partition plate 37. The supply-side elastic member 6a is compressed between the outer peripheral surface of the supply header 21 and the side plate 35 of the duct 30, and is in close contact with the side plate 35 of the duct 30 and
10 the outer peripheral surface of the supply header 21.

 The discharge-side elastic member 6b extends in the first horizontal direction D1 along the discharge header 22. Both end portions of the discharge-side elastic member 6b are in close contact with the partition plate 37. The discharge-side elastic member 6b is compressed between the outer peripheral surface of the discharge header 22 and the
15 side plate 35 of the duct 30, and is in close contact with the side plate 35 of the duct 30 and the outer peripheral surface of the discharge header 22.

[0051]

(Action and Effect)

 The server system 301 of the present embodiment can exhibit the following
20 actions and effects.

[0052]

 In the present embodiment, the server system 301 further includes the elastic member 6 that is disposed in the duct 30 and that is elastically deformable. The entire heat exchange section 20 is disposed in the duct 30. The elastic member 6 is provided
25 to fill a gap between the heat exchange section 20 and the duct 30.

[0053]

By disposing the elastic member 6 in close contact with the heat exchange section 20 and the duct 30, it is possible to suppress the leakage of the air A that has absorbed waste heat from the heat exchange section 20 to the outside of the duct 30.

5 Therefore, with the above configuration, heat dissipation can be performed more efficiently.

[0054]

In the present embodiment, the entire heat exchange section 20 is disposed in the duct 30, but the present disclosure is not limited to this. A portion of the heat exchange
10 section 20 may be disposed in the duct 30.

[0055]

In the present embodiment, a case where the elastic member 6 is provided at both end portions of the heat exchange section 20 in the second horizontal direction D2 (width direction Dw) has been described, but the present disclosure is not limited to this.

15 The elastic member 6 may be provided to cover the heat exchange section 20 from the entire circumference in the horizontal direction.

[0056]

<Fourth Embodiment>

(Configuration of Server System)

20 Hereinafter, a server system 401 according to a fourth embodiment of the present disclosure will be described with reference to FIG. 10. The same configurations as those of the above-described embodiment are denoted by the same names and the same reference signs, and a description thereof will be omitted as appropriate. In FIG.
10, only one duct 30 of a plurality of ducts 30 constituting one group of ducts 30 is
25 shown as a representative. In addition, only one rack group 10 of the plurality of rack

groups 10 is shown as a representative, and only one rack 11 of the plurality of racks 11 constituting one rack group 10 is shown as a representative. Only one heat-generating body 14 is shown on each board 13, but a plurality of heat-generating bodies 14 are provided on each board 13 at the same height in the second horizontal direction D2

5 (width direction Dw). A plurality of cooling components 5 are attached to the respective heat-generating bodies 14 and are provided at the same height in the second horizontal direction D2 (width direction Dw). The number of the heat-generating bodies 14 and the number of the cooling components 5 can be changed as appropriate. For example, only one heat-generating body 14 and one cooling component 5 may be
10 provided on each board 13.

As shown in FIG. 10, the duct 30 includes a horizontal duct 33 and a second duct 39.

[0057]

The second duct 39 is provided to be connectable to the horizontal duct 33 from
15 below. The second duct 39 communicates with the horizontal duct 33. The second duct 39 is formed in a quadrangular tubular shape extending in the vertical direction Dv.

[0058]

The heat exchange section 20 is surrounded by the second duct 39. In addition, the heat exchange section 20 is provided integrally with the second duct 39. The heat
20 exchange section 20 and the second duct 39 are connected to each other by, for example, the support member 4. The support member 4 is provided to fill a gap between the heat exchange section 20 and the second duct 39. In addition, the gap between the heat exchange section 20 and the second duct 39 may be filled with, for example, the elastic member 6 described above. Hereinafter, an integrated body of the heat exchange
25 section 20 and the second duct 39 is referred to as a heat exchange unit U. In the

present embodiment, the supply-side connection pipe 44 and the discharge-side connection pipe 45 are included in the heat exchange unit U.

[0059]

The integrated body (heat exchange unit U) of the heat exchange section 20 and the second duct 39 is provided directly above the rack 11. That is, the integrated body (heat exchange unit U) of the heat exchange section 20 and the second duct 39 is provided at a position above the rack 11 and overlapping the rack 11 in the vertical direction Dv.

[0060]

In the present embodiment, the first header 43 and the second header 46 are housed in the rack 11. The first header 43 extends in the vertical direction Dv. An upper end portion of the first header 43 protrudes above the rack 11. An upper end portion of the second header 46 protrudes above the rack 11. Both the first header 43 and the second header 46 are supported by a support member (not shown) on the rack 11.

[0061]

The heat exchange unit U is mounted on the upper end portions of the first header 43 and the second header 46. The flange 44a of the supply-side connection pipe 44 is fixed to the flange 43a of the first header 43, and the flange 45a of the discharge-side connection pipe 45 is fixed to the flange 46a of the second header 46. In this way, the heat exchange unit U is fixed to the first header 43 and the second header 46.

[0062]

In addition, in the present embodiment, the server system 401 further includes a refrigerant pump 7 and a switching mechanism 60.

The refrigerant circulation flow path 40 includes a branch portion 48 and a forced circulation flow path 49 in addition to the natural circulation flow path 41 described above.

The branch portion 48 is provided at an upstream end portion of the natural circulation flow path 41.

[0063]

(Forced Circulation Flow Path)

The forced circulation flow path 49 is provided to branch off from the branch portion 48 and to bypass a portion of the natural circulation flow path 41. An upstream end of the forced circulation flow path 49 is connected to the branch portion 48, and a downstream end of the forced circulation flow path 49 is connected to a downstream end portion of the second header 46. The refrigerant pump 7 is provided in the forced circulation flow path 49. The refrigerant pump 7 pumps the refrigerant R under pressure. The forced circulation flow path 49 forcibly circulates the refrigerant R by the pumping force of the refrigerant pump 7 without relying on thermal convection. The power for the forced circulation flow path 49 to forcibly circulate the refrigerant R without relying on thermal convection may be supplied from a power source other than the refrigerant pump 7.

[0064]

(Switching Mechanism)

The switching mechanism 60 is provided in the refrigerant circulation flow path 40. The switching mechanism 60 can switch a flow path of the refrigerant R between a flow path where the refrigerant R passes through the forced circulation flow path 49 and a flow path where the refrigerant R does not pass through the forced circulation flow path 49.

[0065]

The switching mechanism 60 of the present embodiment includes a first valve 61 and a second valve 62.

The first valve 61 is provided in the second header 46, downstream of the branch
5 portion 48 and upstream of all the supply pipes 47.

The second valve 62 is provided downstream of the branch portion 48 in the forced circulation flow path 49.

[0066]

By opening the first valve 61 and closing the second valve 62, the flow path of
10 the refrigerant R can be set to a flow path where the refrigerant R does not pass through the forced circulation flow path 49 (natural circulation).

On the other hand, by closing the first valve 61 and opening the second valve 62, the flow path of the refrigerant R can be set to a flow path where the refrigerant R passes through the forced circulation flow path 49 (forced circulation). In this state, the
15 refrigerant R can be forcibly circulated by driving the refrigerant pump 7.

[0067]

(Action and Effect)

The server system 401 of the present embodiment can exhibit the following actions and effects.

20 In the present embodiment, the duct 30 includes the horizontal duct 33 and the second duct 39. The horizontal duct 33 extends in the first horizontal direction D1. The second duct 39 is provided to be connectable to the horizontal duct 33 from below and communicates with the horizontal duct 33. The heat exchange section 20 is surrounded by the second duct 39 and is provided integrally with the second duct 39.
25 The integrated body (heat exchange unit U) of the heat exchange section 20 and the

second duct 39 is provided at a position above the rack 11 and overlapping the rack 11 in the vertical direction Dv.

[0068]

The load of the heat exchange section 20 can be directly received on the rack 11 side. Therefore, the stability can be improved. Further, since the heat exchange section 20, the second duct 39, and the rack 11 can be assembled as a set, the installation thereof is facilitated.

[0069]

In the present embodiment, the server system 401 includes the cooling component 5, the refrigerant pump 7, the refrigerant circulation flow path 40, and the switching mechanism 60. The cooling component 5 is attached to the heat-generating body 14 and allows the refrigerant R to flow therethrough, and cools the heat-generating body 14 by exchanging heat with the refrigerant R. The refrigerant pump 7 pumps the refrigerant R under pressure. The refrigerant circulation flow path 40 includes the natural circulation flow path 41 and the forced circulation flow path 49. The natural circulation flow path 41 is provided with the heat exchange section 20 and the cooling component 5, and naturally circulates the refrigerant R by thermal convection. The forced circulation flow path 49 bypasses a portion of the natural circulation flow path 41. The refrigerant pump 7 is provided in the forced circulation flow path 49. The forced circulation flow path 49 forcibly circulates the refrigerant R by the pumping force of the refrigerant pump 7 without relying on thermal convection. The switching mechanism 60 is provided in the refrigerant circulation flow path 40. The switching mechanism 60 can switch a flow path of the refrigerant R between a flow path where the refrigerant R passes through the forced circulation flow path 49 and a flow path where the refrigerant R does not pass through the forced circulation flow path 49.

[0070]

In a case where the heat generation amount is small, the flow path of the refrigerant R is switched to the flow path where the refrigerant R does not pass through the forced circulation flow path 49, so that the refrigerant R can be naturally circulated only by thermal convection caused by the heat of the heat-generating body 14.

In a case where the heat generation amount is large, the flow path of the refrigerant R is switched to the flow path where the refrigerant R passes through the forced circulation flow path 49, so that the refrigerant R can be forcibly circulated without relying on thermal convection. As a result, the refrigerant R smoothly circulates, and the cooling capacity can be improved.

[0071]

In this way, depending on the heat generation amount, the circulation of the refrigerant R can be switched between the natural circulation based only on the thermal convection and the forced circulation by the refrigerant pump 7, which does not rely on the thermal convection. Therefore, it is possible to efficiently cool the heat-generating body 14.

[0072]

<Fifth Embodiment>

(Configuration of Server System)

Hereinafter, a server system 501 according to a fifth embodiment of the present disclosure will be described with reference to FIGS. 11 and 12. The same configurations as those of the above-described embodiment are denoted by the same names and the same reference signs, and a description thereof will be omitted as appropriate. In FIG. 11, only one duct 30 of a plurality of ducts 30 constituting one group of ducts 30 is shown as a representative. In addition, only one rack group 10 of

the plurality of rack groups 10 is shown as a representative, and only one rack 11 of the plurality of racks 11 constituting one rack group 10 is shown as a representative. Only one heat-generating body 14 is shown on each board 13, but a plurality of heat-generating bodies 14 are provided on each board 13 at the same height in the second horizontal direction D2 (width direction Dw). A plurality of cooling components 5 are attached to the respective heat-generating bodies 14 and are provided at the same height in the second horizontal direction D2 (width direction Dw). The number of the heat-generating bodies 14 and the number of the cooling components 5 can be changed as appropriate. For example, only one heat-generating body 14 and one cooling component 5 may be provided on each board 13. In the present embodiment as well, the heat exchange section 20 and the second duct 39 are connected to each other by, for example, the support member 4. The support member 4 is provided to fill a gap between the heat exchange section 20 and the second duct 39. In addition, the gap between the heat exchange section 20 and the second duct 39 may be filled with, for example, the elastic member 6 described above.

As shown in FIGS. 11 and 12, the refrigerant circulation flow path 40 includes the above-described natural circulation flow path 41, the forced circulation flow path 49, and a refrigerant cooling flow path 50.

[0073]

(Refrigerant Cooling Flow Path)

The refrigerant cooling flow path 50 is provided to further branch off from the forced circulation flow path 49 and to bypass a portion of the natural circulation flow path 41. An upstream end of the refrigerant cooling flow path 50 is connected between the second valve 62 and the refrigerant pump 7 in the forced circulation flow path 49, and a downstream end of the refrigerant cooling flow path 50 is connected to a downstream

end portion of the first header 43. The refrigerant cooling flow path 50 is provided with a refrigerant cooler 9 described below.

In addition, the server system 501 further includes an air-cooling fan 8, a refrigerant cooler 9, and a second refrigerant pump 56.

5 [0074]

(Air-Cooling Fan)

The air-cooling fan 8 blows air to the heat exchange section 20 to cool the heat exchange section 20. The air-cooling fan 8 is disposed above the heat exchange section 20 in the second duct 39. It is desirable that the air-cooling fan 8 be provided at a position close to the heat dissipation section 23 of the heat exchange section 20. The air-cooling fan 8 sucks the air A below and blows the air A toward the horizontal duct 33 above.

[0075]

(Refrigerant Cooler)

15 The refrigerant cooler 9 is provided in the refrigerant cooling flow path 50. The refrigerant cooler 9 is disposed below the refrigerant pump 7. The refrigerant cooler 9 is supplied with the refrigerant R circulating through the refrigerant circulation flow path 40, as well as a second refrigerant R2 supplied from a second refrigerant flow path 55 different from the refrigerant circulation flow path 40. The refrigerant cooler 9 20 cools the refrigerant R by exchanging heat with the second refrigerant R2. The second refrigerant R2 is, for example, water. The second refrigerant R2 is not limited to water and can be selected as appropriate.

In addition, the second refrigerant flow path 55 is provided with a second refrigerant pump 56 that pumps the second refrigerant R2 under pressure.

25 [0076]

(Switching Mechanism)

The switching mechanism 60 can switch a flow path of the refrigerant R between a flow path where the refrigerant R passes through the forced circulation flow path 49 and a flow path where the refrigerant R does not pass through the forced circulation flow path 49. Further, the switching mechanism 60 can switch the flow path of the refrigerant R between a flow path where the refrigerant R passes through the refrigerant cooling flow path 50 and a flow path where the refrigerant R does not pass through the refrigerant cooling flow path 50.

[0077]

10 The switching mechanism 60 of the present embodiment includes a first valve 61, a second valve 62, a third valve 63, and a fourth valve 64.

The third valve 63 is provided upstream of the refrigerant cooling flow path 50.

The fourth valve 64 is provided downstream of the first header 43 in the natural circulation flow path 41. The fourth valve 64 is provided downstream of all the
15 discharge pipes 42 in the first header 43.

In the present embodiment, the flow path of the refrigerant R can be selectively switched according to the heat generation amount by switching the first valve 61, the second valve 62, the third valve 63, and the fourth valve 64.

[0078]

20 Hereinafter, an example of switching the circulation of the refrigerant R will be described with reference to FIG. 12.

In a case where the heat generation amount per heat-generating body 14 (hereinafter, heat generation amount of heat-generating body) is 0 W or more and 500 W (first heat-generating body threshold) or less and the total heat generation amount per
25 rack 11 (hereinafter, total heat generation amount) is 0 kW or more and 15 kW (first rack

threshold) or less (first condition C1), the first valve 61 and the fourth valve 64 are opened, and the second valve 62 and the third valve 63 are closed. In this case, the refrigerant R can be naturally circulated only by the thermal convection generated by the heat of the heat-generating body 14.

5 [0079]

In a case where the heat generation amount of the heat-generating body is 500 W (first heat-generating body threshold) or more and 1500 W (second heat-generating body threshold) or less and the total heat generation amount is 0 kW or more and 15 kW (first rack threshold) or less (second condition C2), the second valve 62 and the fourth valve 10 64 are opened, and the first valve 61 and the third valve 63 are closed. In this state, the refrigerant pump 7 is driven. This allows the refrigerant R to be pumped under pressure by the refrigerant pump 7 and forcibly circulated.

[0080]

In a case where the heat generation amount of the heat-generating body is 0 W 15 or more and 500 W (first heat-generating body threshold) or less and the total heat generation amount is 15 kW (first rack threshold) or more and 50 kW (second rack threshold) or less (third condition C3), the first valve 61 and the fourth valve 64 are opened, and the second valve 62 and the third valve 63 are closed. Further, the air-cooling fan 8 is driven. As a result, the refrigerant R can be cooled by the air-cooling 20 fan 8 while the refrigerant R is naturally circulated only by the thermal convection generated by the heat of the heat-generating body 14.

[0081]

In a case where the heat generation amount of the heat-generating body is 500 W (first heat-generating body threshold) or more and 1500 W (second heat-generating body 25 threshold) or less and the total heat generation amount is 15 kW (first rack threshold) or

more and 50 kW (second rack threshold) or less (fourth condition C4), the second valve 62 and the fourth valve 64 are opened, and the first valve 61 and the third valve 63 are closed. In this state, the refrigerant pump 7 is driven. Further, the air-cooling fan 8 is driven. This allows the refrigerant R to be pumped under pressure by the refrigerant pump 7, circulated forcibly, and cooled by the air-cooling fan 8.

[0082]

In a case where the heat generation amount of the heat-generating body is 0 W or more and 1500 W (second heat-generating body threshold) or less and the total heat generation amount per rack 11 is 50 kW (second rack threshold) or more and 100 kW (third rack threshold) or less (fifth condition C5), the first valve 61, the second valve 62, and the fourth valve 64 are closed, and the third valve 63 is opened. In this state, the refrigerant pump 7 and the second refrigerant pump 56 are driven. This allows the refrigerant R to be pumped under pressure by the refrigerant pump 7, circulated forcibly, and cooled by the second refrigerant R2.

[0083]

While specific values are shown as examples for the first and second heat-generating body thresholds and the first to third rack thresholds, the present disclosure is not limited to these. The first and second heat-generating body thresholds and the first to third rack thresholds can be changed as appropriate. For example, the first rack threshold may be 12 kW, and the second rack threshold may be 25 kW.

[0084]

(Action and Effect)

The server system 501 of the present embodiment can exhibit the following actions and effects.

In the present embodiment, the server system 501 further includes the cooling component 5, the air-cooling fan 8, the refrigerant pump 7, the refrigerant cooler 9, the refrigerant circulation flow path 40, and the switching mechanism 60.

The cooling component 5 is attached to the heat-generating body 14 and allows
5 the refrigerant R to flow therethrough, and cools the heat-generating body 14 by exchanging heat between the heat-generating body 14 and the refrigerant R. The refrigerant pump 7 pumps the refrigerant R under pressure. The air-cooling fan 8 blows air to the heat exchange section 20 to cool the heat exchange section 20. The refrigerant cooler 9 cools the refrigerant R by exchanging heat with the second refrigerant R2. The
10 refrigerant circulation flow path 40 includes the natural circulation flow path 41, the forced circulation flow path 49, and the refrigerant cooling flow path 50. The natural circulation flow path 41 is provided with the heat exchange section 20 and the cooling component 5, and the natural circulation flow path 41 naturally circulates the refrigerant R by thermal convection. The forced circulation flow path 49 bypasses a portion of the
15 natural circulation flow path 41, and the refrigerant pump 7 is provided in the forced circulation flow path 49. The forced circulation flow path 49 forcibly circulates the refrigerant R by the pumping force of the refrigerant pump 7 without relying on thermal convection. The refrigerant cooling flow path 50 bypasses a portion of the natural circulation flow path 41, and the refrigerant cooler 9 is provided in the refrigerant cooling
20 flow path 50. The switching mechanism 60 can switch the flow path of the refrigerant R between a flow path including the forced circulation flow path 49 and a flow path not including the forced circulation flow path 49. Further, the switching mechanism 60 can switch the flow path of the refrigerant R between a flow path where the refrigerant R passes through the refrigerant cooling flow path 50 and a flow path where the refrigerant
25 R does not pass through the refrigerant cooling flow path 50.

[0085]

In a case where the heat generation amount is small, the flow path of the refrigerant R is switched to the flow path where the refrigerant R does not pass through the forced circulation flow path 49 and the refrigerant cooler 9, so that the refrigerant R
5 can be naturally circulated only by thermal convection caused by the heat of the heat-generating body 14.

In a case where the heat generation amount is large, the flow path of the refrigerant R is switched to the flow path where the refrigerant R passes through the forced circulation flow path 49, and the refrigerant pump 7 is driven, so that the
10 refrigerant R can be forcibly circulated without relying on thermal convection. As a result, the refrigerant R smoothly circulates, and the cooling capacity can be improved. In addition, the air-cooling fan 8 is driven to air-cool the heat exchange section 20, thereby improving the cooling capacity. In addition, the flow path of the refrigerant R is switched to the flow path where the refrigerant R passes through the refrigerant cooling
15 flow path 50, and the refrigerant cooler 9 is driven, so that the refrigerant R can be cooled and the cooling capacity can be improved. The power for the forced circulation flow path 49 to forcibly circulate the refrigerant R without relying on thermal convection may be supplied from a power source other than the refrigerant pump 7.

The system can appropriately switch between an operation by the natural
20 circulation of the refrigerant R, an operation of forcibly circulating the refrigerant R without relying on thermal convection, and an operation for improving the cooling capacity by driving the air-cooling fan 8 and the refrigerant cooler 9. In addition, the operation of forcibly circulating the refrigerant R without relying on thermal convection and the driving of the air-cooling fan 8 and the refrigerant cooler 9 can be combined as

appropriate. Therefore, according to the present embodiment, the cooling capacity can be adjusted according to the heat generation amount.

[0086]

Sixth Embodiment>

5 (Configuration of Server System)

Hereinafter, a server system 601 according to a sixth embodiment of the present disclosure will be described with reference to FIG. 13. The same configurations as those of the above-described embodiment are denoted by the same names and the same reference signs, and a description thereof will be omitted as appropriate.

10 As shown in FIG. 13, the server system 601 includes an introduction fan 70 and a filter 3.

The introduction fan 70 generates a flow of the air A in the first horizontal direction D1 and introduces the air A into the rack group 10. The introduction fan 70 is provided for each rack group 10 and is provided on one side of each rack group 10 in the
15 first horizontal direction D1.

The filter 3 is disposed upstream of the rack group 10 in a flow direction of the air A generated by the introduction fan 70. The air A can flow through the filter 3. The filter 3 collects dust and the like contained in the air A.

[0087]

20 (Action and Effect)

The server system 601 of the present embodiment can exhibit the following actions and effects.

In the present embodiment, the server system 601 further includes the introduction fan 70 and the filter 3.

The introduction fan 70 generates a flow of the air A in the first horizontal direction D1 and introduces the air A into the rack group 10. The filter 3 is disposed upstream of the rack group 10 in the flow direction of the air A generated by the introduction fan 70.

5 [0088]

The filter 3 can remove the dust and the like from the air A supplied to the rack 11. Further, the introduction fan 70 can compensate for the pressure loss of the air A passing through the filter 3. Therefore, it is possible to satisfactorily introduce the air A into the rack group 10. Therefore, with the above configuration, heat dissipation can be performed more efficiently.

[0089]

<Seventh Embodiment>

(Configuration of Server System)

Hereinafter, a server system 701 according to a seventh embodiment of the present disclosure will be described with reference to FIG. 14. The same configurations as those of the above-described embodiment are denoted by the same names and the same reference signs, and a description thereof will be omitted as appropriate. In FIG. 14, only one duct 30 of a plurality of ducts 30 constituting one group of ducts 30 is shown as a representative. In addition, only some of the plurality of rack groups 10 are shown as representatives, and only one rack 11 of the plurality of racks 11 constituting one rack group 10 is shown as a representative. Only one heat-generating body 14 is shown on each board 13, but a plurality of heat-generating bodies 14 are provided on each board 13 at the same height in the first horizontal direction D1 (depth direction Dd). A plurality of cooling components 5 are attached to each heat-generating body 14 and are provided at the same height in the first horizontal direction D1 (depth direction Dd).

The number of the heat-generating bodies 14 and the number of the cooling components 5 can be changed as appropriate. For example, only one heat-generating body 14 and one cooling component 5 may be provided on each board 13.

As shown in FIG. 14, two heat exchange sections 20 are provided as a pair for each corresponding rack 11. The two heat exchange sections 20 constituting the pair are disposed in a V-shape as viewed from the first horizontal direction D1 such that the discharge header 22 is positioned below the supply header 21.

In the present embodiment, the pair of two heat exchange sections 20 disposed in the V-shape is provided directly above the rack 11.

10 [0090]

The supply-side connection pipe 44 extends downward from each of two supply headers 21 and combines with the first header 43. In addition, the discharge-side connection pipe 45 extends downward from each of two discharge headers 22 and combines with the second header 46.

15 [0091]

(Action and Effect)

The server system 701 of the present embodiment can exhibit the following actions and effects.

In the present embodiment, two heat exchange sections 20 are provided as a pair for each corresponding rack 11. The two heat exchange sections 20 constituting the pair are disposed in a V-shape as viewed from the first horizontal direction D1 such that the discharge header 22 is positioned below the supply header 21.

[0092]

As a result, the heat exchange efficiency per rack 11 can be improved. Therefore, with the above configuration, heat dissipation can be performed more efficiently.

[0093]

5 In the above embodiment, the two heat exchange sections 20 each include the discharge header 22, but the present disclosure is not limited to this. The two heat exchange sections 20 may share one discharge header 22.

[0094]

<Eighth Embodiment>

10 (Configuration of Server System)

Hereinafter, a server system 801 according to an eighth embodiment of the present disclosure will be described with reference to FIG. 15. The same configurations as those of the above-described embodiment are denoted by the same names and the same reference signs, and a description thereof will be omitted as appropriate. In FIG. 15, only one duct 30 of a plurality of ducts 30 constituting one group of ducts 30 is shown as a representative. In addition, only some of the plurality of rack groups 10 are shown as representatives, and only one rack 11 of the plurality of racks 11 constituting one rack group 10 is shown as a representative. Only one heat-generating body 14 is shown on each board 13, but a plurality of heat-generating bodies 14 are provided on each board 13 at the same height in the first horizontal direction D1 (depth direction Dd). A plurality of cooling components 5 are attached to each heat-generating body 14 and are provided at the same height in the first horizontal direction D1 (depth direction Dd). The number of the heat-generating bodies 14 and the number of the cooling components 5 can be changed as appropriate. For example, only one heat-generating body 14 and one cooling component 5 may be provided on each board 13.

As shown in FIG. 15, the two heat exchange sections 20 disposed in the V-shape extend in the second horizontal direction D2 from the vicinity of one end in the second horizontal direction D2 of the corresponding rack 11 to the vicinity of one end in the second horizontal direction D2 of a rack 11 adjacent to the corresponding rack 11 on the other side in the second horizontal direction D2.

[0095]

In the present embodiment, of the two heat exchange sections 20 disposed in the V-shape, the heat exchange section 20 on one side in the second horizontal direction D2 is disposed directly above the rack 11, and the heat exchange section 20 on the other side in the second horizontal direction D2 is disposed directly above a passage between the racks 11.

[0096]

In the present embodiment as well, as in the seventh embodiment, the supply-side connection pipe 44 extends downward from each of the two supply headers 21 and combines with the first header 43. In addition, the discharge-side connection pipe 45 extends downward from each of two discharge headers 22 and combines with the second header 46.

[0097]

(Action and Effect)

The server system 801 of the present embodiment can exhibit the following actions and effects.

In the present embodiment, the two heat exchange sections 20 disposed in the V-shape extend in the second horizontal direction D2 from the vicinity of one end in the second horizontal direction D2 of the corresponding rack 11 to the vicinity of one end in

the second horizontal direction D2 of a rack 11 adjacent to the corresponding rack 11 on the other side in the second horizontal direction D2.

[0098]

As a result, the heat exchange section 20 can be made longer in the second horizontal direction D2, thereby further improving the heat exchange efficiency per rack 11. Therefore, with the above configuration, heat dissipation can be performed more efficiently.

[0099]

<Ninth Embodiment>

(Configuration of Server System)

Hereinafter, a server system 901 according to a ninth embodiment of the present disclosure will be described with reference to FIG. 16. The same configurations as those of the above-described embodiment are denoted by the same names and the same reference signs, and a description thereof will be omitted as appropriate. In FIG. 16, only one duct 30 of a plurality of ducts 30 constituting one group of ducts 30 is shown as a representative. In addition, only some of the plurality of rack groups 10 are shown as representatives, and only one rack 11 of the plurality of racks 11 constituting one rack group 10 is shown as a representative. Only one heat-generating body 14 is shown on each board 13, but a plurality of heat-generating bodies 14 are provided on each board 13 at the same height in the first horizontal direction D1 (depth direction Dd). A plurality of cooling components 5 are attached to each heat-generating body 14 and are provided at the same height in the first horizontal direction D1 (depth direction Dd). The number of the heat-generating bodies 14 and the number of the cooling components 5 can be changed as appropriate. For example, only one heat-generating body 14 and one cooling component 5 may be provided on each board 13.

As shown in FIG. 16, a space between the rack groups 10 adjacent to each other in the second horizontal direction D2 is designated as a hot line HL or a cool line CL.

The hot line HL and the cool line CL are provided alternately. The hot line HL and the cool line CL extend in the first horizontal direction D1 along the rack groups 10. The duct 30 is provided above each hot line HL.

[0100]

In the present embodiment, two heat exchange sections 20 are provided as a pair above each hot line HL and below each duct 30. The two heat exchange sections 20 constituting the pair are disposed in a V-shape as viewed from the first horizontal direction D1 such that the discharge header 22 is positioned below the supply header 21.

[0101]

In addition, the supply-side connection pipe 44 extends downward from each of the two supply headers 21. In addition, the discharge-side connection pipe 45 extends downward from each of the two discharge headers 22.

[0102]

The supply-side connection pipe 44 belonging to the heat exchange section 20 on one side in the second horizontal direction D2 combines with the first header 43 belonging to the rack 11 on one side in the second horizontal direction D2. The supply-side connection pipe 44 belonging to the heat exchange section 20 on the other side in the second horizontal direction D2 combines with the first header 43 belonging to the rack 11 on the other side in the second horizontal direction D2.

In addition, the discharge-side connection pipe 45 belonging to the heat exchange section 20 on one side in the second horizontal direction D2 combines with the second header 46 belonging to the rack 11 on one side in the second horizontal direction D2. The discharge-side connection pipe 45 belonging to the heat exchange section 20

on the other side in the second horizontal direction D2 combines with the second header 46 belonging to the rack 11 on the other side in the second horizontal direction D2.

[0103]

(Cooling Fan)

5 The server system 901 further includes a cooling fan 75. The cooling fan 75 is provided in each rack 11, supplies the air A to the heat-generating body 14, and discharges the air A that has passed through the heat-generating body 14 to the outside of the rack 11. The cooling fan 75 is a fan pre-mounted in the server 12 for cooling the heat-generating body 14 such as a CPU and a GPU. The cooling fans 75 are provided,
10 for example, to sandwich the heat-generating body 14 in the second horizontal direction D2. The cooling fan 75 blows the air A to be sent from the cool line CL to the hot line HL. The air A is blown from both sides in the second horizontal direction D2 to the hot line HL, and the air A is guided to the duct 30 above. The duct 30 discharges the air A discharged from the rack 11 toward the first horizontal direction D1 through the
15 discharge flow path S.

[0104]

(Action and Effect)

The server system 901 of the present embodiment can exhibit the following actions and effects.

20 In the present embodiment, the server system 901 further includes the cooling fan 75 that is provided in each rack 11, supplies the air A to the heat-generating body 14, and discharges the air A that has passed through the heat-generating body 14 to the outside of the rack 11. The duct 30 discharges the air A discharged from the rack 11 toward the first horizontal direction D1 through the discharge flow path S.

25 [0105]

As a result, the air A can be supplied to the heat exchange section 20 by using the cooling fan 75 provided to directly cool the heat-generating body 14.

[0106]

<Tenth Embodiment>

5 (Configuration of Server System)

Hereinafter, a server system 1001 according to a tenth embodiment of the present disclosure will be described with reference to FIG. 17. The same configurations as those of the above-described embodiment are denoted by the same names and the same reference signs, and a description thereof will be omitted as appropriate.

10 As shown in FIG. 17, a plurality of (for example, two in the shown example) server centers 2 (an example of a building) are provided. The external duct 32 belonging to one server center 2 is disposed to face the external duct 32 belonging to the other server center 2 in the first horizontal direction D1. The number of the server centers 2 can be changed as appropriate.

15 [0107]

(Action and Effect)

The server system 1001 of the present embodiment can exhibit the following actions and effects.

20 In the present embodiment, the external duct 32 belonging to one server center 2 is disposed to face the external duct 32 belonging to the other server center 2.

[0108]

As a result, a portion of the external duct 32 is shielded by the server center 2. Therefore, it is possible to suppress the collision of an object heading toward the server center 2 with the external duct 32.

25 [0109]

<Eleventh Embodiment>

(Configuration of Server System)

Hereinafter, a server system 1101 according to an eleventh embodiment of the present disclosure will be described with reference to FIG. 18. The same configurations
5 as those of the above-described embodiment are denoted by the same names and the same reference signs, and a description thereof will be omitted as appropriate.

As shown in FIG. 18, a plurality of server centers 2 (an example of a building) are provided. In the shown example, four server centers 2 are provided in a ring shape. The number of the server centers 2 can be changed as appropriate.

10 [0110]

The external duct 32 belonging to each server center 2 is provided in a gap between the server centers 2 adjacent to each other. Specifically, the external duct 32 belonging to one server center 2 (referred to as a first server center 2) is exposed to the outside of the first server center 2 from an end portion of the first server center 2 on the
15 other side in the first horizontal direction D1. Further, the external duct 32 belonging to the first server center 2 faces an end portion on one side in the first horizontal direction D1 of another server center 2 (referred to as a second server center 2) which is located on the other side in the first horizontal direction D1 with respect to the first server center 2. The plurality of server centers 2 are disposed in a ring shape such that the arrangement of
20 the first server center 2 and the second server center 2 is repeated.

[0111]

(Action and Effect)

The server system 1101 of the present embodiment can exhibit the following actions and effects.

In the present embodiment, the external duct 32 belonging to each server center 2 is provided in a gap between the server centers 2 adjacent to each other.

[0112]

As a result, a portion of the external duct 32 is shielded by the building.

5 Therefore, it is possible to suppress the collision of an object heading toward the building with the external duct 32.

[0113]

(Other Embodiments)

The embodiments of the present disclosure have been described in detail with
10 reference to the accompanying drawings, but the specific configuration is not limited to the embodiments, and design changes and the like are also included within the scope that does not deviate from the gist of the present disclosure.

In the above-described embodiments, the rack 11 is formed in a rectangular
parallelepiped shape, but the present disclosure is not limited to this. The shape of the
15 rack 11 can be changed as appropriate.

[0114]

In the above-described embodiments, the first horizontal direction D1 and the
second horizontal direction D2 are orthogonal to each other, but the present disclosure is
not limited to this. The angle formed by the first horizontal direction D1 and the second
20 horizontal direction D2 may be more or less than 90 degrees.

[0115]

In the above-described embodiments, the depth direction Dd of the rack 11 is the
first horizontal direction D1, the width direction Dw of the rack 11 is the second
horizontal direction D2, and the duct 30 extends in the depth direction Dd of the rack 11,
25 but the present disclosure is not limited to this. The depth direction Dd of the rack 11

may be the second horizontal direction D2, the width direction Dw of the rack 11 may be the first horizontal direction D1, and the duct 30 may extend in the width direction Dw of the rack 11.

[0116]

5 In the above-described embodiments, a case where the heat exchange section 20 includes the supply header 21, the discharge header 22, and the heat dissipation section 23 has been described, but the present disclosure is not limited to this. The form of the heat exchange section 20 can be changed as appropriate.

[0117]

10 For example, in the above-described embodiments such as the first embodiment, the number of the ducts 30 is the same as the number of the rack groups 10, but the present disclosure is not limited to this. The number of the ducts 30 to be installed can be changed as appropriate. For example, one duct 30 that extends in the second horizontal direction D2 may cover the plurality of rack groups 10 (for example, all the
15 rack groups 10).

[0118]

 In the above-described embodiments, the air A is introduced into the duct 30 from the downward opening of the horizontal duct 33, but the present disclosure is not limited to this. The position of the opening for introducing the air A into the horizontal
20 duct 33 can be changed as appropriate. For example, the end plate 36 or the side plate 35 of the horizontal duct 33 may have an opening.

[0119]

 In the above-described embodiments, a case where the refrigerant R boils and vaporizes in the cooling component 5 has been described, but the present disclosure is

not limited to this. The refrigerant R may circulate in the refrigerant circulation flow path 40 in a liquid state without boiling in the cooling component 5.

[0120]

In the above-described embodiments, the embodiment has been described by taking the server center 2 as an example of the building, but the present disclosure is not limited to this. The building may be the server room 2a in the server center 2.

[0121]

<Additional Notes>

The server system 1, 201, 301, 401, 501, 601, 701, 801, 901, 1001, 1101 described in each embodiment is understood as follows, for example.

[0122]

(1) A server system 1, 201, 301, 401, 501, 601, 701, 801, 901, 1001, 1101 according to a first aspect includes: a rack group 10 in which a plurality of racks 11 each housing a heat-generating body 14 cooled by a refrigerant R are arranged side by side in a first horizontal direction D1; a heat exchange section 20 provided to correspond to each of the racks 11 and configured to exchange heat between the refrigerant R and air A at a position above each of the racks 11; and a duct 30 positioned above a plurality of the heat exchange sections 20, the duct 30 extending in the first horizontal direction D1 and forming a discharge flow path S configured to discharge, in the first horizontal direction D1, the air A that has undergone heat exchange in each of the heat exchange sections 20.

[0123]

The heat of the heat-generating body 14 is absorbed by the refrigerant R. The refrigerant R that has absorbed the heat of the heat-generating body 14 is sent to the heat exchange section 20. The heat exchange section 20 performs heat exchange between the refrigerant R and the air A around the heat exchange section 20. In this way, in the

heat exchange section 20, the heat of the heat-generating body 14 transmitted via the refrigerant R is discharged to the outside air. The duct 30 can collectively discharge the air A that has absorbed waste heat from the plurality of heat exchange sections 20 belonging to the corresponding rack group 10.

5 [0124]

(2) A server system 201 according to a second aspect is the server system 201 according to (1) further including: a support member 4 configured to connect the heat exchange section 20 and the duct 30, in which at least a portion of the heat exchange section 20 may be disposed within the duct 30, and the duct 30 may have an insertion
10 hole 38 into which the support member 4 is inserted.

[0125]

By simply inserting the support member 4 into the insertion hole 38, at least a portion of the heat exchange section 20 can be easily disposed in the duct 30. As a result, the air A that has absorbed waste heat from the heat exchange section 20 is likely
15 to be guided into the duct 30.

[0126]

(3) A server system 301 according to a third aspect is the server system 301 according to (1) or (2) further including: an elastic member 6 that is disposed within the duct 30 and is elastically deformable, in which at least a portion of the heat exchange
20 section 20 may be disposed within the duct 30, and the elastic member 6 may be provided to fill a gap between the heat exchange section 20 and the duct 30.

Examples of the elastic member 6 include a rubber material.

[0127]

By disposing the elastic member 6 in close contact with the heat exchange section 20 and the duct 30, it is possible to suppress the leakage of the air A that has absorbed waste heat from the heat exchange section 20 to the outside of the duct 30.

[0128]

5 (4) A server system 401 according to a fourth aspect is the server system 401 according to any one of (1) to (3), in which the duct 30 may include a horizontal duct 33 extending in the first horizontal direction D1, and a second duct 39 that is provided to be connectable to the horizontal duct 33 from below and communicates with the horizontal duct 33, the heat exchange section 20 may be surrounded by the second duct 39 and may
10 be provided integrally with the second duct 39, and an integrated body of the heat exchange section 20 and the second duct 39 may be provided at a position above the rack 11 and overlapping the rack 11 in a vertical direction Dv.

[0129]

The load of the heat exchange section 20 can be directly received on the rack 11
15 side.

[0130]

(5) A server system 401 according to a fifth aspect is the server system 401 according to any one of (1) to (4) further including: a cooling component 5 attached to the heat-generating body 14 and configured to allow the refrigerant R to flow
20 therethrough and cool the heat-generating body 14 by exchanging heat with the refrigerant R; a refrigerant circulation flow path 40 including a natural circulation flow path 41 provided with the heat exchange section 20 and the cooling component 5 and configured to naturally circulate the refrigerant R by thermal convection, and a forced circulation flow path 49 that bypasses a portion of the natural circulation flow path 41
25 and is configured to forcibly circulate the refrigerant R without relying on thermal

convection; and a switching mechanism 60 provided in the refrigerant circulation flow path 40 and configured to switch a flow path of the refrigerant R between a flow path where the refrigerant R passes through the forced circulation flow path 49 and a flow path where the refrigerant R does not pass through the forced circulation flow path 49.

5 [0131]

In a case where the heat generation amount is small, the flow path of the refrigerant R is switched to the flow path where the refrigerant R does not pass through the forced circulation flow path 49, so that the refrigerant R can be naturally circulated only by thermal convection caused by the heat of the heat-generating body 14.

10 In a case where the heat generation amount is large, the flow path of the refrigerant R is switched to the flow path where the refrigerant R passes through the forced circulation flow path 49, so that the refrigerant R can be forcibly circulated without relying on thermal convection. As a result, the refrigerant R smoothly circulates, and the cooling capacity can be improved.

15 [0132]

(6) A server system 501 according to a sixth aspect is the server system 501 according to any one of (1) to (4) further including: a cooling component 5 attached to the heat-generating body 14 and configured to allow the refrigerant R to flow therethrough and cool the heat-generating body 14 by exchanging heat with the refrigerant R; an air-cooling fan 8 configured to blow air to the heat exchange section 20 to cool the heat exchange section 20; a refrigerant cooler 9 configured to cool the refrigerant R by exchanging heat with a second refrigerant R2; a refrigerant circulation flow path 40 including a natural circulation flow path 41 provided with the heat exchange section 20 and the cooling component 5 and configured to naturally circulate the refrigerant R by thermal convection, a forced circulation flow path 49 that bypasses a

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portion of the natural circulation flow path 41 and is configured to forcibly circulate the refrigerant R without relying on thermal convection, and a refrigerant cooling flow path 50 that bypasses a portion of the natural circulation flow path 41 and is provided with the refrigerant cooler 9; and a switching mechanism 60 provided in the refrigerant circulation

5 flow path 40 and configured to switch a flow path of the refrigerant R between a flow path where the refrigerant R passes through the forced circulation flow path 49 and a flow path where the refrigerant R does not pass through the forced circulation flow path 49 and switch the flow path of the refrigerant R between a path where the refrigerant R passes through the refrigerant cooling flow path 50 and a path where the refrigerant R

10 does not pass through the refrigerant cooling flow path 50.

[0133]

In a case where the heat generation amount is small, the flow path of the refrigerant R is switched to the flow path where the refrigerant R does not pass through the forced circulation flow path 49 and the refrigerant cooler 9, so that the refrigerant R

15 can be naturally circulated only by thermal convection caused by the heat of the heat-generating body 14.

In a case where the heat generation amount is large, the flow path of the refrigerant R is switched to the flow path where the refrigerant R passes through the forced circulation flow path 49, so that the refrigerant R can be forcibly circulated

20 without relying on thermal convection. As a result, the refrigerant R smoothly circulates, and the cooling capacity can be improved. In addition, the air-cooling fan 8 is driven to air-cool the heat exchange section 20, thereby improving the cooling capacity. In addition, the flow path of the refrigerant R is switched to the flow path where the refrigerant R passes through the refrigerant cooling flow path 50, and the

refrigerant cooler 9 is driven, so that the refrigerant R can be cooled and the cooling capacity can be improved.

The system can appropriately switch between an operation by the natural circulation of the refrigerant R, an operation of forcibly circulating the refrigerant R without relying on thermal convection, and an operation for improving the cooling capacity by driving the air-cooling fan 8 and the refrigerant cooler 9. In addition, the operation of forcibly circulating the refrigerant R without relying on thermal convection and the driving of the air-cooling fan 8 and the refrigerant cooler 9 can be combined as appropriate.

10 [0134]

(7) A server system 601 according to a seventh aspect is the server system 601 according to any one of (1) to (6) further including: an introduction fan 70 configured to generate a flow of air A in the first horizontal direction D1 and introduce the air A into the rack group 10; and a filter 3 disposed upstream of the rack group 10 in a flow direction of the air A generated by the introduction fan 70 and configured to allow the air A to flow therethrough.

[0135]

The filter 3 can remove the dust and the like from the air A supplied to the rack 11. Further, the introduction fan 70 can compensate for the pressure loss of the air A passing through the filter 3. Therefore, it is possible to satisfactorily introduce the air A into the rack group 10.

[0136]

(8) A server system 701 according to an eighth aspect is the server system 701 according to any one of (1) to (7), in which two heat exchange sections 20 may be provided as a pair for each corresponding rack 11, the heat exchange section 20 may

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include a supply header 21 to which the refrigerant R is supplied, a discharge header 22 configured to discharge the refrigerant R, and a heat dissipation section 23 configured to connect the supply header 21 and the discharge header 22 and release heat of the refrigerant R to outside air, and the two heat exchange sections 20 constituting the pair
5 may be disposed in a V-shape as viewed from the first horizontal direction D1 such that the discharge header 22 is positioned below the supply header 21.

[0137]

As a result, the heat exchange efficiency per rack 11 can be improved.

[0138]

10 (9) A server system 801 according to a ninth aspect is the server system 801 according to (8), in which a plurality of the rack groups 10 may be provided side by side in a second horizontal direction D2 that intersects the first horizontal direction D1, and the two heat exchange sections 20 disposed in the V-shape may extend in the second horizontal direction D2 from the vicinity of one end in the second horizontal direction D2
15 of the corresponding rack 11 to the vicinity of one end in the second horizontal direction D2 of a rack 11 adjacent to the corresponding rack 11 on the other side in the second horizontal direction D2.

[0139]

As a result, the heat exchange section 20 can be made longer in the second
20 horizontal direction D2, thereby further improving the heat exchange efficiency per rack 11.

[0140]

(10) A server system 901 according to a tenth aspect is the server system 901 according to any one of (1) to (9) further including: a cooling fan 75 provided in each of
25 the racks 11 and configured to supply air A to the heat-generating body 14 and discharge

the air A that has passed through the heat-generating body 14 to an outside of the rack 11, in which the discharge flow path S of the duct 30 may discharge, toward the first horizontal direction D1, the air A discharged from the rack 11 by the cooling fan 75.

[0141]

5 As a result, the air A can be supplied to the heat exchange section 20 by using the cooling fan 75 provided to directly cool the heat-generating body 14.

[0142]

(11) A server system 501 according to an eleventh aspect includes: a rack 11 housing a heat-generating body 14 cooled by a refrigerant R; a heat exchange section 20 provided to correspond to the rack 11 and configured to exchange heat between the refrigerant R and air A at a position above the rack 11; a duct 30 positioned above the heat exchange section 20, the duct 30 forming a discharge flow path S configured to discharge the air A that has undergone heat exchange in the heat exchange section 20; a cooling component 5 attached to the heat-generating body 14 and configured to allow the refrigerant R to flow therethrough and cool the heat-generating body 14 by exchanging heat with the refrigerant R; an air-cooling fan 8 configured to blow air to the heat exchange section 20 to cool the heat exchange section 20; a refrigerant cooler 9 configured to cool the refrigerant R by exchanging heat with a second refrigerant R2; a refrigerant circulation flow path 40 including a natural circulation flow path 41 provided with the heat exchange section 20 and the cooling component 5 and configured to naturally circulate the refrigerant R by thermal convection, a forced circulation flow path 49 that bypasses a portion of the natural circulation flow path 41 and is configured to forcibly circulate the refrigerant R without relying on thermal convection, and a refrigerant cooling flow path 50 that bypasses a portion of the natural circulation flow path 41 and is provided with the refrigerant cooler 9; and a switching mechanism 60

provided in the refrigerant circulation flow path 40 and configured to switch a flow path of the refrigerant R between a flow path where the refrigerant R passes through the forced circulation flow path 49 and a flow path where the refrigerant R does not pass through the forced circulation flow path 49 and switch the flow path of the refrigerant R between a flow path where the refrigerant R passes through the refrigerant cooling flow path 50 and a flow path where the refrigerant R does not pass through the refrigerant cooling flow path 50.

[0143]

(12) A server system 901 according to a twelfth aspect includes: a rack group 10 in which a plurality of racks 11 each housing a heat-generating body 14 are arranged side by side in a first horizontal direction D1; a cooling fan 75 provided in each of the racks 11 and configured to supply air A to the heat-generating body 14 and discharge the air A that has passed through the heat-generating body 14 to an outside of the rack 11; and a duct 30 positioned above the rack group 10, the duct 30 extending in the first horizontal direction D1 and forming a discharge flow path S configured to discharge, toward the first horizontal direction D1, the air A discharged from the rack 11 by the cooling fan 75.

[0144]

(13) A server system 1001 according to a thirteenth aspect is the server system 1001 according to any one of (1) to (12) further including: a building in which the duct 30 is housed, in which the duct 30 may include an internal duct 31 disposed in the building, and an external duct 32 that communicates with the internal duct 31, at least a portion of the external duct 32 being disposed outside the building, a plurality of the buildings may be provided, and the external duct 32 belonging to one of the buildings may be disposed to face the external duct 32 belonging to another of the buildings.

Examples of the building include the server center 2 or the server room 2a.

[0145]

As a result, a portion of the external duct 32 is shielded by the building.

Therefore, it is possible to suppress the collision of an object heading toward the building with the external duct 32.

5 [0146]

(14) A server system 1101 according to a fourteenth aspect is the server system 1101 according to any one of (1) to (12) further including: a building in which the duct 30 is housed, in which the duct 30 may include an internal duct 31 disposed in the building, and an external duct 32 that communicates with the internal duct 31, at least a
10 portion of the external duct 32 being disposed outside the building, a plurality of the buildings may be provided, and the external duct 32 belonging to each of the buildings may be disposed in a gap between the buildings adjacent to each other.

Examples of the building include the server center 2 or the server room 2a.

[0147]

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As a result, a portion of the external duct 32 is shielded by the building.

Therefore, it is possible to suppress the collision of an object heading toward the building with the external duct 32.

INDUSTRIAL APPLICABILITY

[0148]

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With the server system of the present disclosure, it is possible to efficiently dissipate heat. In addition, with the server system of the present disclosure, it is possible to adjust a cooling capacity according to a heat generation amount.

REFERENCE SIGNS LIST

[0149]

25

1 Server system

	2 Server center (building)
	2a Server room
	2b Air inlet
	3 Filter
5	4 Support member
	4a Supply-side support member
	4b Discharge-side support member
	5 Cooling component
	6 Elastic member
10	6a Supply-side elastic member
	6b Discharge-side elastic member
	7 Refrigerant pump
	8 Air-cooling fan
	9 Refrigerant cooler
15	10 Rack group
	11 Rack
	12 Server
	13 Board
	14 Heat-generating body
20	20 Heat exchange section
	21 Supply header
	22 Discharge header
	23 Heat dissipation section
	24 Fin
25	30 Duct

	31 Internal duct
	32 External duct
	33 Horizontal duct
	34 Upper plate
5	35 Side plate
	36 End plate
	36 Partition plate
	38 Insertion hole
	38a Supply-side insertion hole
10	38b Discharge-side insertion hole
	39 Second duct
	40 Refrigerant circulation flow path
	41 Natural circulation flow path
	42 Discharge pipe
15	43 First header
	43a Flange
	44 Supply-side connection pipe
	44a Flange
	45 Discharge-side connection pipe
20	45a Flange
	46 Second header
	46a Flange
	47 Supply pipe
	48 Branch portion
25	49 Forced circulation flow path

	50 Refrigerant cooling flow path
	55 Second refrigerant flow path
	56 Second refrigerant pump
	60 Switching mechanism
5	61 First valve
	62 Second valve
	63 Third valve
	64 Fourth valve
	70 Introduction fan
10	75 Cooling fan
	201 Server system
	301 Server system
	401 Server system
	501 Server system
15	601 Server system
	701 Server system
	801 Server system
	901 Server system
	1001 Server system
20	1101 Server system
	A: Air
	Dv Vertical direction
	Dd Depth direction
	Dw Width direction
25	D1 First horizontal direction

D2 Second horizontal direction

HL Hot line

CL Cool line

R Refrigerant

5 R2 Second refrigerant

S Discharge flow path

SH Horizontal discharge flow path

SV Vertical discharge flow path

U Heat exchange unit

CLAIMS

[Claim 1] A server system comprising:

a rack group in which a plurality of racks each housing a heat-generating body cooled by a refrigerant are arranged side by side in a first horizontal direction;

5 a heat exchange section provided to correspond to each of the racks and configured to exchange heat between the refrigerant and air at a position above each of the racks; and

a duct positioned above a plurality of the heat exchange sections, the duct extending in the first horizontal direction and forming a discharge flow path configured to discharge, in the first horizontal direction, the air that has undergone heat exchange in each of the heat exchange sections.

[Claim 2] The server system according to Claim 1, further comprising:

a support member configured to connect the heat exchange section and the duct, wherein at least a portion of the heat exchange section is disposed within the duct, and

the duct has an insertion hole into which the support member is inserted.

[Claim 3] The server system according to Claim 1 or 2, further comprising:

an elastic member that is disposed within the duct and is elastically deformable, wherein at least a portion of the heat exchange section is disposed within the duct, and

the elastic member is provided to fill a gap between the heat exchange section and the duct.

[Claim 4] The server system according to Claim 1 or 2,

wherein the duct includes a horizontal duct extending in the first horizontal direction, and

a second duct that is provided to be connectable to the horizontal duct from below and communicates with the horizontal duct,

the heat exchange section is surrounded by the second duct and is provided integrally with the second duct, and

5 an integrated body of the heat exchange section and the second duct is provided at a position above the rack and overlapping the rack in a vertical direction.

[Claim 5] The server system according to Claim 1 or 2, further comprising:

a cooling component attached to the heat-generating body and configured to allow the refrigerant to flow therethrough and cool the heat-generating body by

10 exchanging heat with the refrigerant;

a refrigerant circulation flow path including a natural circulation flow path provided with the heat exchange section and the cooling component and configured to naturally circulate the refrigerant by thermal convection, and a forced circulation flow path that bypasses a portion of the natural circulation flow path and is configured to

15 forcibly circulate the refrigerant without relying on thermal convection; and

a switching mechanism provided in the refrigerant circulation flow path and configured to switch a flow path of the refrigerant between a flow path where the refrigerant passes through the forced circulation flow path and a flow path where the refrigerant does not pass through the forced circulation flow path.

20 [Claim 6] The server system according to Claim 1 or 2, further comprising:

a cooling component attached to the heat-generating body and configured to allow the refrigerant to flow therethrough and cool the heat-generating body by exchanging heat with the refrigerant;

25 an air-cooling fan configured to blow air to the heat exchange section to cool the heat exchange section;

a refrigerant cooler configured to cool the refrigerant by exchanging heat with a second refrigerant;

a refrigerant circulation flow path including a natural circulation flow path provided with the heat exchange section and the cooling component and configured to naturally circulate the refrigerant by thermal convection, a forced circulation flow path that bypasses a portion of the natural circulation flow path and is configured to forcibly circulate the refrigerant without relying on thermal convection, and a refrigerant cooling flow path that bypasses a portion of the natural circulation flow path and is provided with the refrigerant cooler; and

a switching mechanism provided in the refrigerant circulation flow path and configured to switch a flow path of the refrigerant between a flow path where the refrigerant passes through the forced circulation flow path and a flow path where the refrigerant does not pass through the forced circulation flow path and switch the flow path of the refrigerant between a flow path where the refrigerant passes through the refrigerant cooling flow path and a flow path where the refrigerant does not pass through the refrigerant cooling flow path.

[Claim 7] The server system according to Claim 1 or 2, further comprising:

an introduction fan configured to generate a flow of air in the first horizontal direction and introduce the air into the rack group; and

a filter disposed upstream of the rack group in a flow direction of the air generated by the introduction fan and configured to allow the air to flow therethrough.

[Claim 8] The server system according to Claim 1 or 2,

wherein two heat exchange sections are provided as a pair for each corresponding rack,

the heat exchange section includes

a supply header to which the refrigerant is supplied,
 a discharge header configured to discharge the refrigerant, and
 a heat dissipation section configured to connect the supply header and the
 discharge header and release heat of the refrigerant to outside air, and

5 the two heat exchange sections constituting the pair are disposed in a V-shape as
 viewed from the first horizontal direction such that the discharge header is positioned
 below the supply header.

[Claim 9] The server system according to Claim 8,

wherein a plurality of the rack groups are provided side by side in a second
 10 horizontal direction that intersects the first horizontal direction, and
 the two heat exchange sections disposed in the V-shape extend in the second
 horizontal direction from the vicinity of one end in the second horizontal direction of the
 corresponding rack to the vicinity of one end in the second horizontal direction of a rack
 adjacent to the corresponding rack on the other side in the second horizontal direction.

15 [Claim 10] The server system according to Claim 1 or 2, further comprising:

a cooling fan provided in each of the racks and configured to supply air to the
 heat-generating body and discharge the air that has passed through the heat-generating
 body to an outside of the rack,

wherein the discharge flow path of the duct discharges, toward the first
 20 horizontal direction, the air discharged from the rack by the cooling fan.

[Claim 11] A server system comprising:

a rack housing a heat-generating body cooled by a refrigerant;
 a heat exchange section provided to correspond to the rack and configured to
 exchange heat between the refrigerant and air at a position above the rack;

a duct positioned above the heat exchange section, the duct forming a discharge flow path configured to discharge the air that has undergone heat exchange in the heat exchange section;

a cooling component attached to the heat-generating body and configured to
 5 allow the refrigerant to flow therethrough and cool the heat-generating body by exchanging heat with the refrigerant;

an air-cooling fan configured to blow air to the heat exchange section to cool the heat exchange section;

a refrigerant cooler configured to cool the refrigerant by exchanging heat with a
 10 second refrigerant;

a refrigerant circulation flow path including a natural circulation flow path provided with the heat exchange section and the cooling component and configured to naturally circulate the refrigerant by thermal convection, a forced circulation flow path that bypasses a portion of the natural circulation flow path and is configured to forcibly
 15 circulate the refrigerant without relying on thermal convection, and a refrigerant cooling flow path that bypasses a portion of the natural circulation flow path and is provided with the refrigerant cooler; and

a switching mechanism provided in the refrigerant circulation flow path and configured to switch a flow path of the refrigerant between a flow path where the
 20 refrigerant passes through the forced circulation flow path and a flow path where the refrigerant does not pass through the forced circulation flow path and switch the flow path of the refrigerant between a flow path where the refrigerant passes through the refrigerant cooling flow path and a flow path where the refrigerant does not pass through the refrigerant cooling flow path.

25 [Claim 12] A server system comprising:

a rack group in which a plurality of racks each housing a heat-generating body are arranged side by side in a first horizontal direction;

a cooling fan provided in each of the racks and configured to supply air to the heat-generating body and discharge the air that has passed through the heat-generating

5 body to an outside of the rack; and

a duct positioned above the rack group, the duct extending in the first horizontal direction and forming a discharge flow path configured to discharge, toward the first horizontal direction, the air discharged from the rack by the cooling fan.

[Claim 13] The server system according to any one of Claims 1, 11, and 12, further
10 comprising:

a building in which the duct is housed,

wherein the duct includes

an internal duct disposed in the building, and

an external duct that communicates with the internal duct, at least a portion of

15 the external duct being disposed outside the building,

a plurality of the buildings are provided, and

the external duct belonging to one of the buildings is disposed to face the external duct belonging to another of the buildings.

[Claim 14] The server system according to any one of Claims 1, 11, and 12, further
20 comprising:

a building in which the duct is housed,

wherein the duct includes

an internal duct disposed in the building, and

an external duct that communicates with the internal duct, at least a portion of

25 the external duct being disposed outside the building,

a plurality of the buildings are provided, and
the external duct belonging to each of the buildings is disposed in a gap between
the buildings adjacent to each other.