the refrigerant flows down to the liquid distribution mechanism on a lower tier. PTL 3 also discloses a related technique.

[Citation List]

[Patent Literature]

[0007]

[PTL 1] Japanese Unexamined Patent Application Publication No. H5-312361

[PTL 2] Japanese Unexamined Patent Application Publication No. H6-195130

[PTL 3] International Publication No. 2015/087530

[Summary of Invention]

[Technical Problem]

[0008]

However, PTL 1 and PTL 2 have problems as the following.

[0009]

In PTL 1, the branch conduit is provided on a side of the liquid distribution mechanism to allow the refrigerant to flow down to the liquid distribution mechanism below. In order to allow the refrigerant to flow down from the side, the branch conduit is formed with a bent portion. The bent portion increases the lateral width of the refrigerant supply device.

[0010]

Furthermore, with the configurations with a float and valve disclosed in PTL 1 and PTL 2, the float provided inside also increases the lateral width of the liquid distribution mechanism. These configurations also have a problem of making the mechanism of the refrigerant supply device more complicated.

[0011]

Embodiments of the present invention

provide a refrigerant supply device with a small lateral width and a capacity to supply refrigerant evenly among heat receivers disposed in multiple tiers.

[Solution to Problem]

[0012]

According to a first aspect of the present invention, there is provided a refrigerant supply device for distributing, by force of gravity, liquid phase refrigerant to heat receivers disposed in a plurality of tiers, the device including: a first conduit for supplying the refrigerant to the heat receivers; a second conduit provided in parallel with the first conduit; a first aperture provided in the first conduit for supplying the refrigerant to one of the heat receivers; a first blocking means provided below the first aperture for blocking the first conduit; a first communication opening provided above the first aperture and communicating the first conduit and the second conduit; a second communication opening provided below the first blocking means and communicating the first conduit and the second conduit; and a second blocking means provided below the second communication opening for blocking the second conduit.

According to a second aspect of the present invention, there is provided a refrigerant supply device comprising: a plurality of the above refrigerant supply devices.

According to a third aspect of the present invention, there is provided a cooling device comprising the above refrigerant supply devices, a heat receiver connected with the first aperture, and a gas phase tube connected with the heat receiver for exhausting the gas phase refrigerant from the heat receiver.

According to a fourth aspect of the present invention, there is provided a cooling system comprising: the above cooling device and a

radiator interposed between the gas phase tube and the refrigerant supply device for releasing heat of the refrigerant.

According to a fifth aspect of the present invention, there is provided a method of supplying refrigerant using the above a refrigerant supply device comprising: storing the refrigerant in the first conduit by the first blocking means; supplying the refrigerant through the first aperture to one of the heat receivers; allowing the refrigerant to overflow through the first communication opening to the second conduit; keeping the refrigerant in the second conduit by the second blocking means; and allowing the refrigerant to overflow through the second communication opening to the first conduit.

According to a sixth aspect of the present invention, there is provided a method comprising: conducting the above method of supplying refrigerant in a series to supply the refrigerant evenly among a plurality of the heat receivers.

According to a seventh aspect of the present invention, there is provided a method of controlling the above cooling system, comprising: supplying liquid phase refrigerant from the refrigerant supply device to the heat receivers; bringing the refrigerant to a boil by giving the heat receivers heat from an object to be cooled; returning the evaporated refrigerant through the gas phase tube to the radiator; liquefying the refrigerant by releasing heat of the refrigerant with the radiator; and returning the refrigerant to the refrigerant supply device.

According to an eight aspect of the present invention, there is provided a method of manufacturing a refrigerant supply device, the method comprising: forming apertures at predetermined positions on an outer wall(s) of a dual passage tube having two passageways; providing a communication opening(s) in a separation wall separating the two passageways for establishing communication between the two passageways,

by accessing the separation wall through part of the apertures; blocking the aperture(s) corresponding to the communication opening(s); and blocking the passageway(s) at part of the apertures.

[Advantageous Effects of Invention]

[0013]

Embodiments of the present invention provide a refrigerant supply device with a small lateral width and a capacity to supply refrigerant evenly among heat receivers disposed in multiple tiers.

[Brief Description of Drawings]

[0014]

[Fig. 1] Fig. 1 is a cross-sectional view illustrating a first example embodiment.

[Fig. 2] Fig. 2 is a cross-sectional view illustrating a second example

phase tube 30. The liquid phase refrigerant 20 is supplied evenly among the heat receivers 3 from the liquid phase tube 30 in a manner similar to the first exemplary embodiment. The flow of the liquid phase refrigerant 20 is indicated by the solid arrow. Fig. 4 illustrates an example with four heat receivers 3, but naturally the number of the heat receivers 3 is not limited thereto.

[0029]

The liquid phase refrigerant 20 boils in the heat receivers 3 and turns to the gas phase refrigerant 21. The heat receivers 3 are cooled by this phase change and absorb heat from the heat sources. This process is schematically illustrated by bubbles and dashed arrows in Fig. 5. The gas phase refrigerant 21 then flows to the gas phase tube 40, and returns through the gas phase conduit 42 to the radiator 50. The gas phase refrigerant then returns to a liquid phase by releasing heat and is supplied to the liquid phase conduit 31 again.

[0030]

As described above, the present example embodiment enables a cooling system in which refrigerant is supplied evenly among a plurality of heat receivers to be easily constructed.

[0031]

(Fifth example embodiment)

The present example embodiment relates to a manufacturing method of the refrigerant supply device. Figs. 5A and 5B are a plan view and a cross-sectional view of a dual passage tube used for production of the refrigerant supply device. Fig. 5A is a latitudinal plan view. As illustrated in the drawing, in the present example embodiment, a dual passage tube 60 having a passageway 61 and a passageway 62 is used. Fig. 5B is a longitudinal cross-sectional view. As illustrated in the drawing, this tube is a straight tube having two passageways. This type