



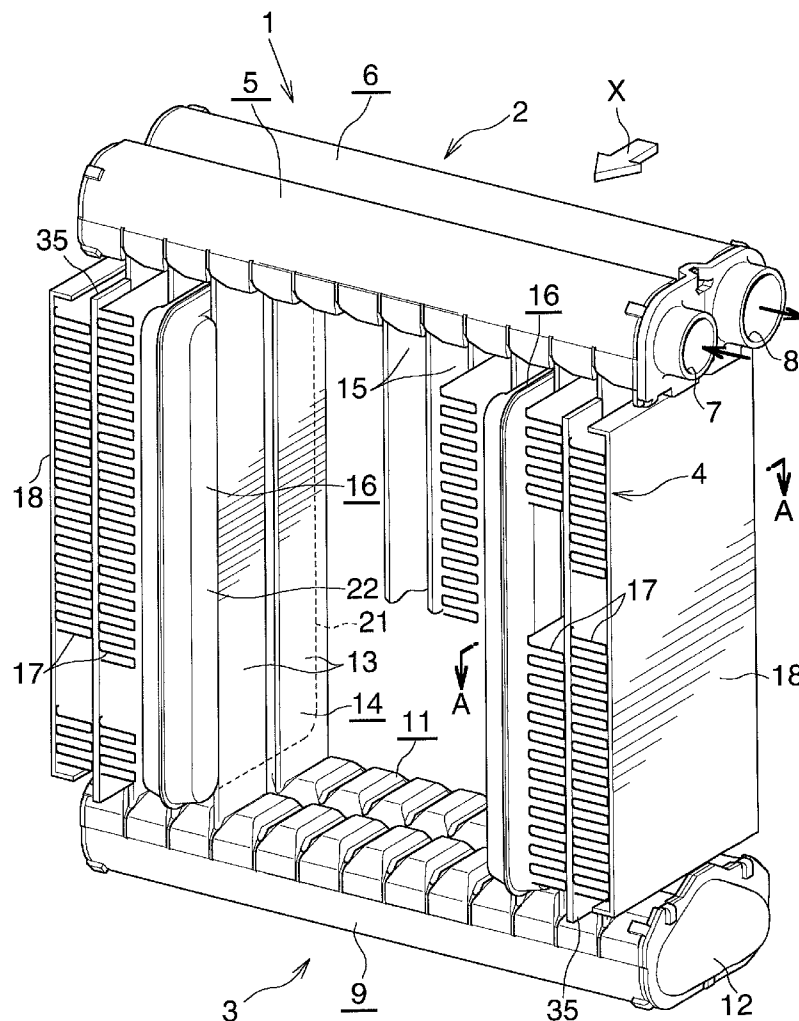
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(19) **United States**(12) **Patent Application Publication**
Kamoshida et al.(10) **Pub. No.: US 2012/0042687 A1**(43) **Pub. Date: Feb. 23, 2012**(54) **EVAPORATOR WITH COOL STORAGE
FUNCTION****Publication Classification**(51) **Int. Cl.**
F25B 39/02 (2006.01)(52) **U.S. Cl.** 62/524(57) **ABSTRACT**

An evaporator with a cool storage function includes a cool storage material container disposed at least one of air-passing clearances formed between adjacent refrigerant flow tubes, and fins disposed in air-passing clearances on opposite sides of the cool storage material container. The cool storage material container includes a container body portion joined to the corresponding refrigerant flow tubes, and an outward extending portion which extends from the front edge of the container body portion and projects frontward in relation to the refrigerant flow tubes. Each of the fins has a fin body portion joined to the corresponding refrigerant flow tubes, and an outward extending portion which extends from the front edge of the fin body portion and projects frontward in relation to the refrigerant flow tubes. The outward extending portions of the fins are brazed to opposite sides of the outward extending portion of the cool storage material container.

(75) Inventors: **Osamu Kamoshida**, Oyama-shi
(JP); **Naohisa Higashiyama**,
Oyama-shi (JP); **Takashi**
Hirayama, Oyama-shi (JP)(73) Assignee: **SHOWA DENKO K.K.**, Tokyo
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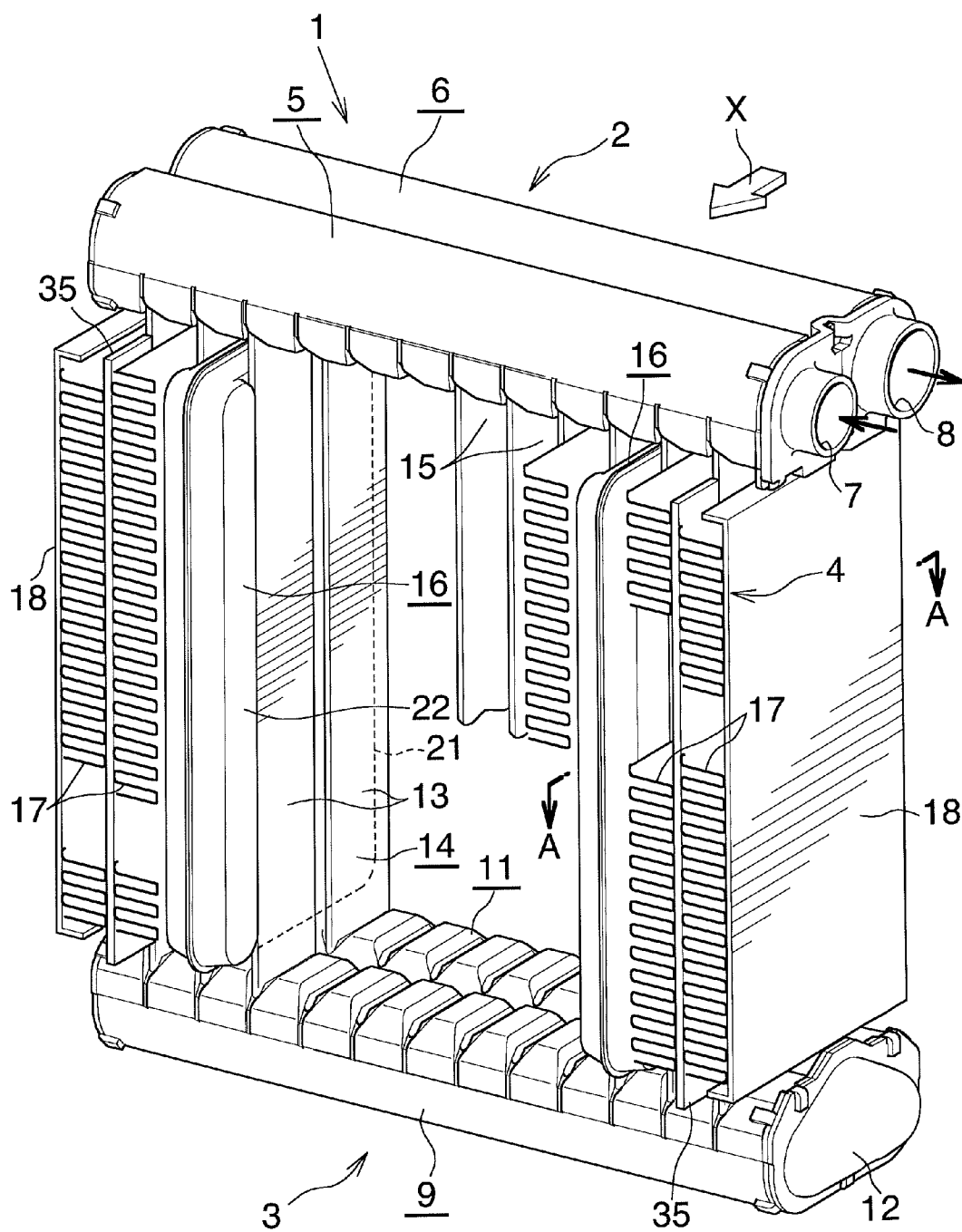


Fig.1

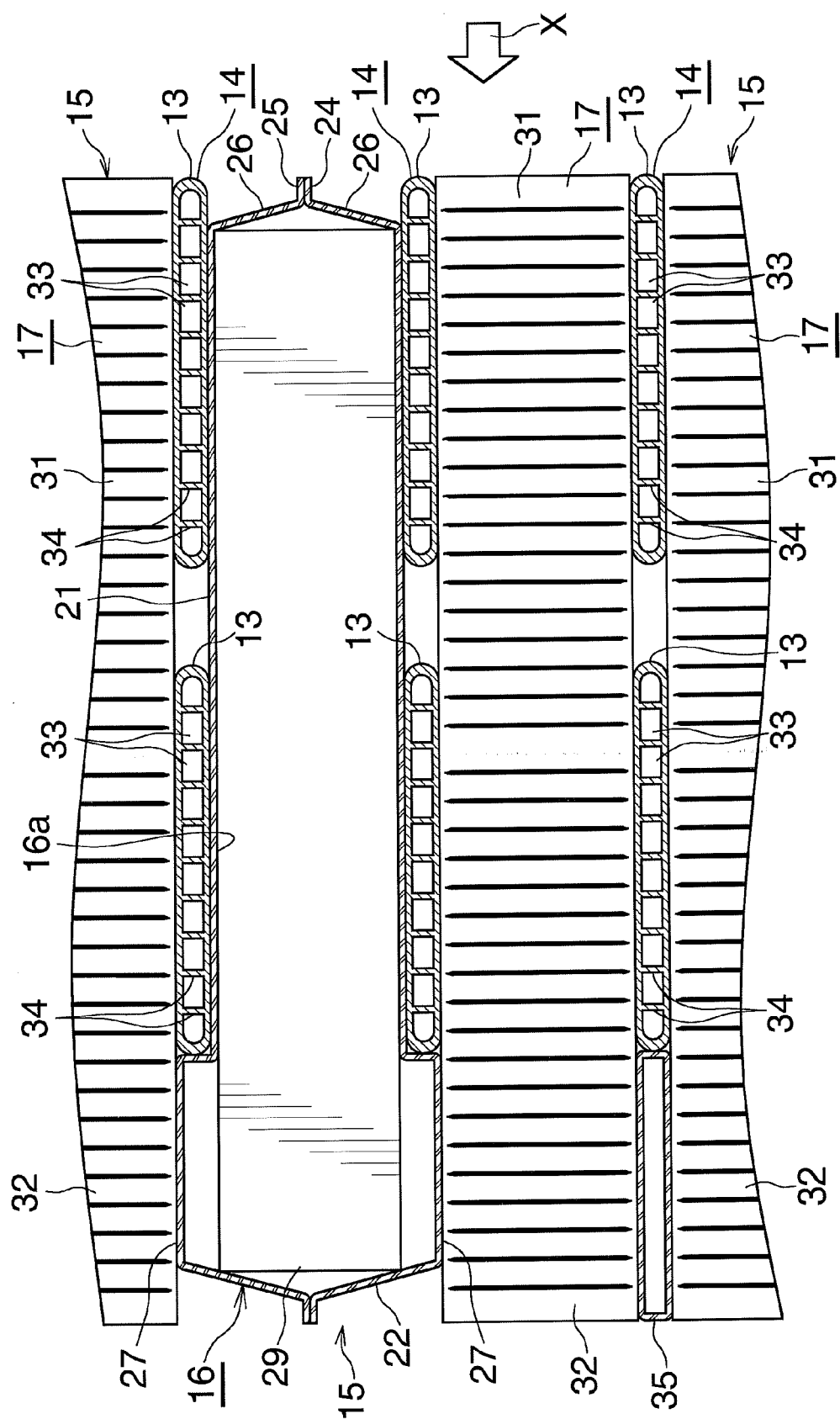


Fig.2

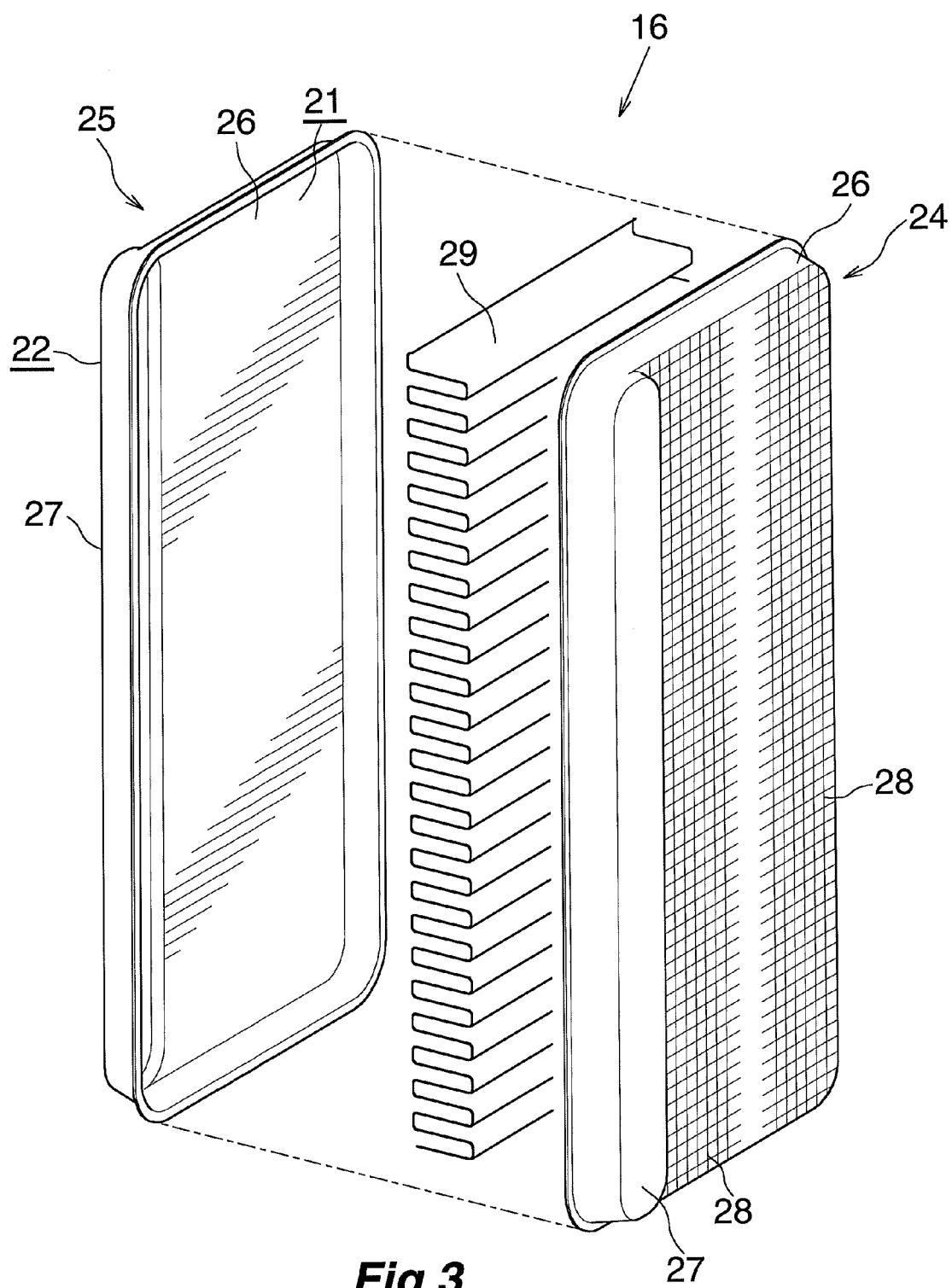


Fig.3

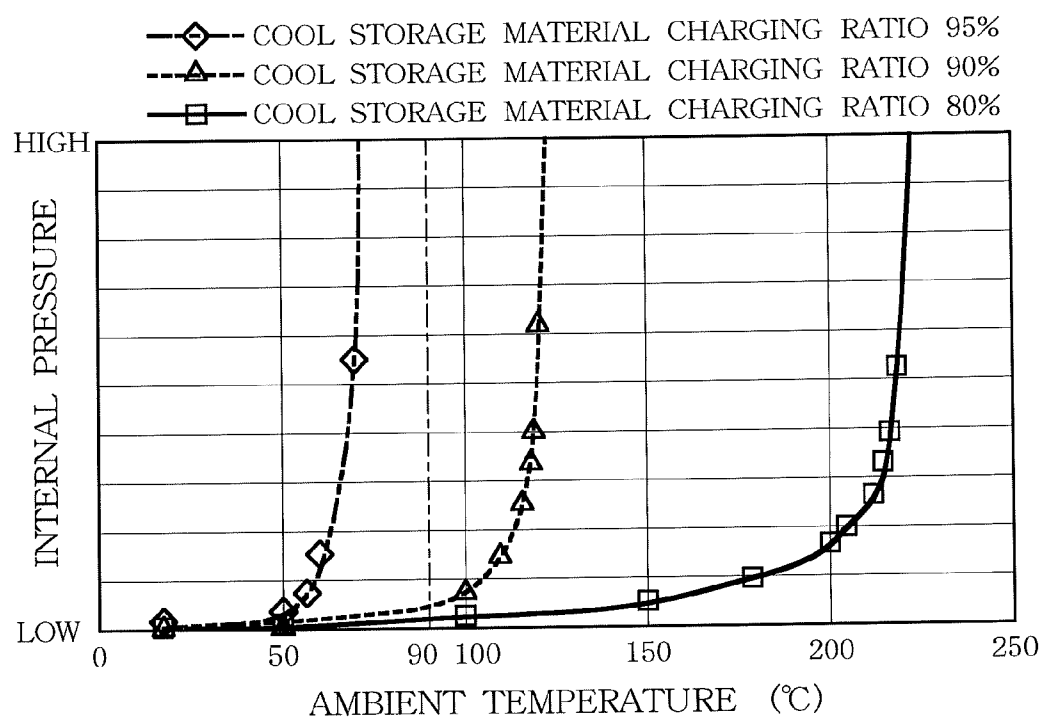


Fig.4

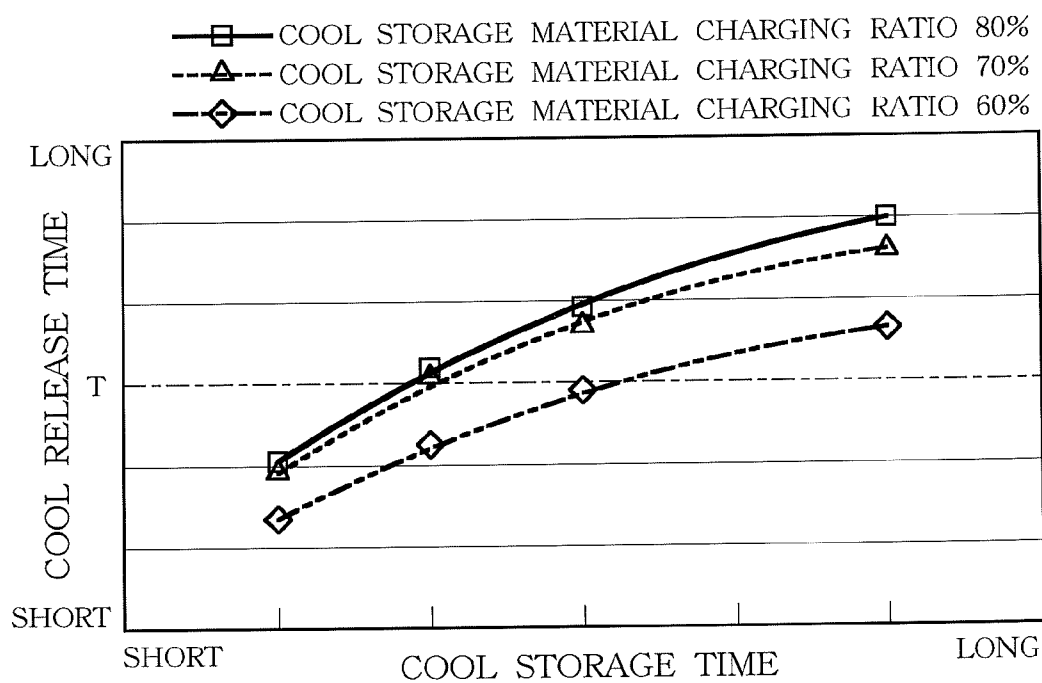


Fig.5

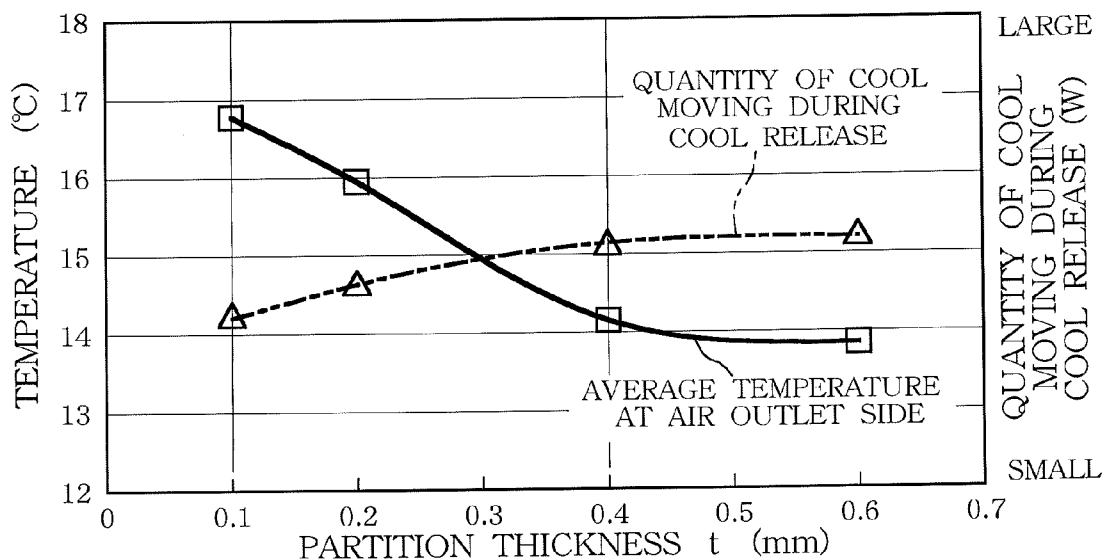


Fig. 6

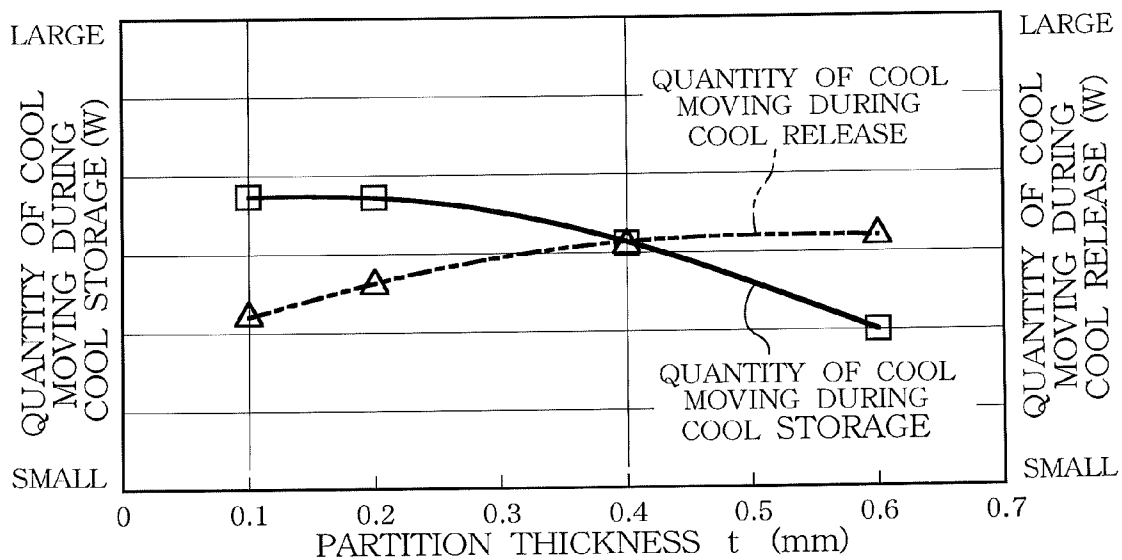


Fig. 7

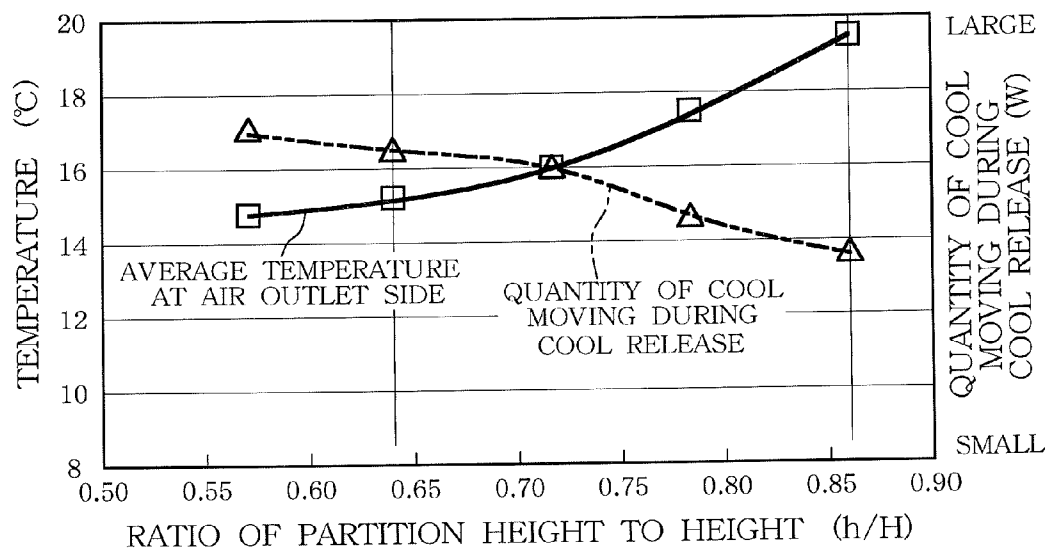


Fig. 8

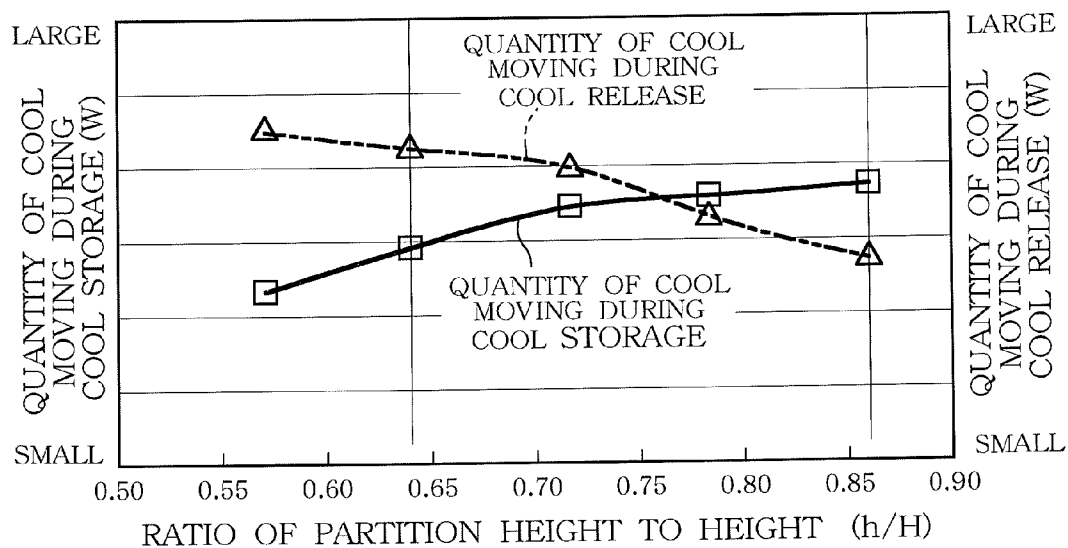


Fig. 9

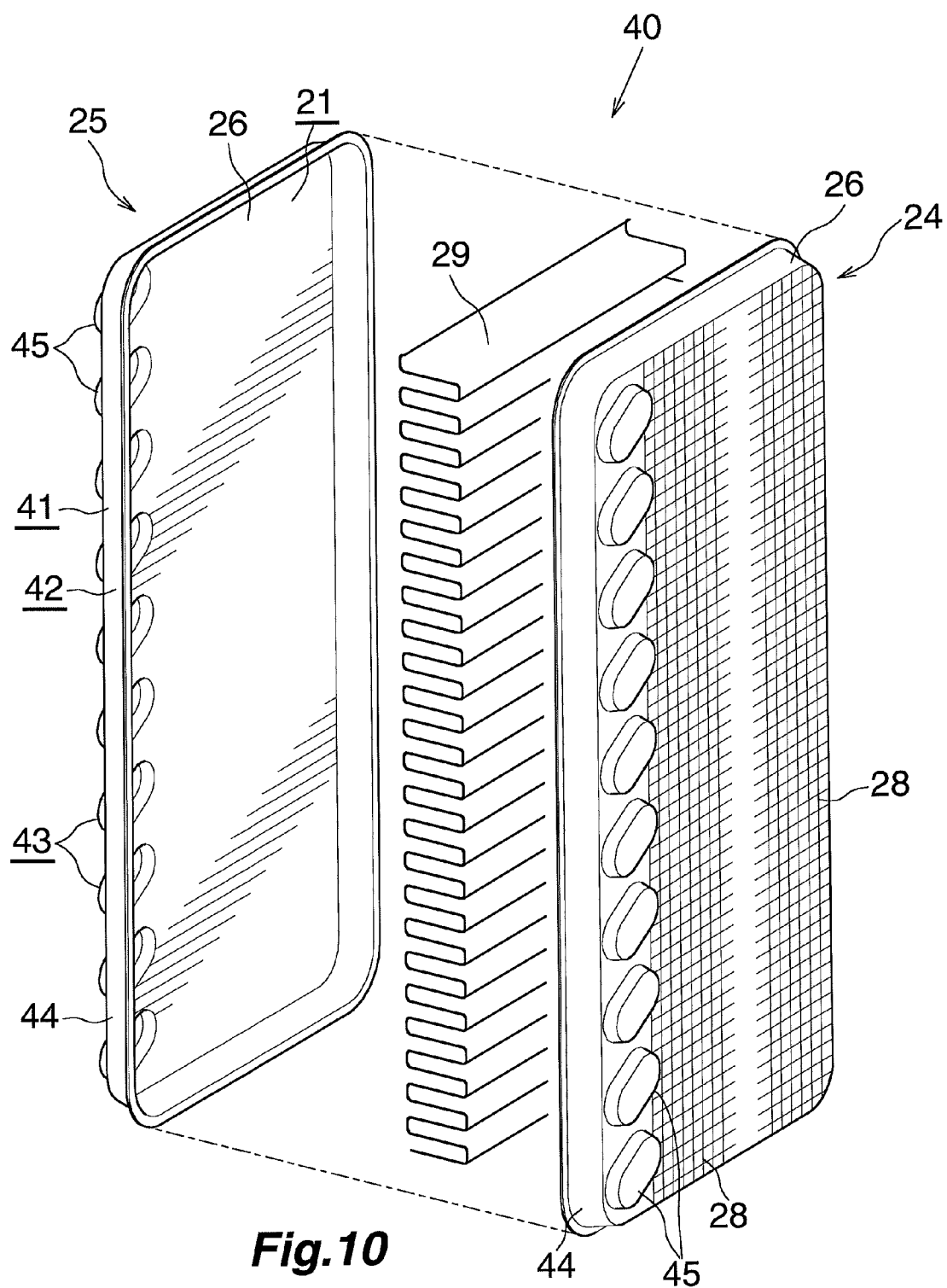


Fig.10

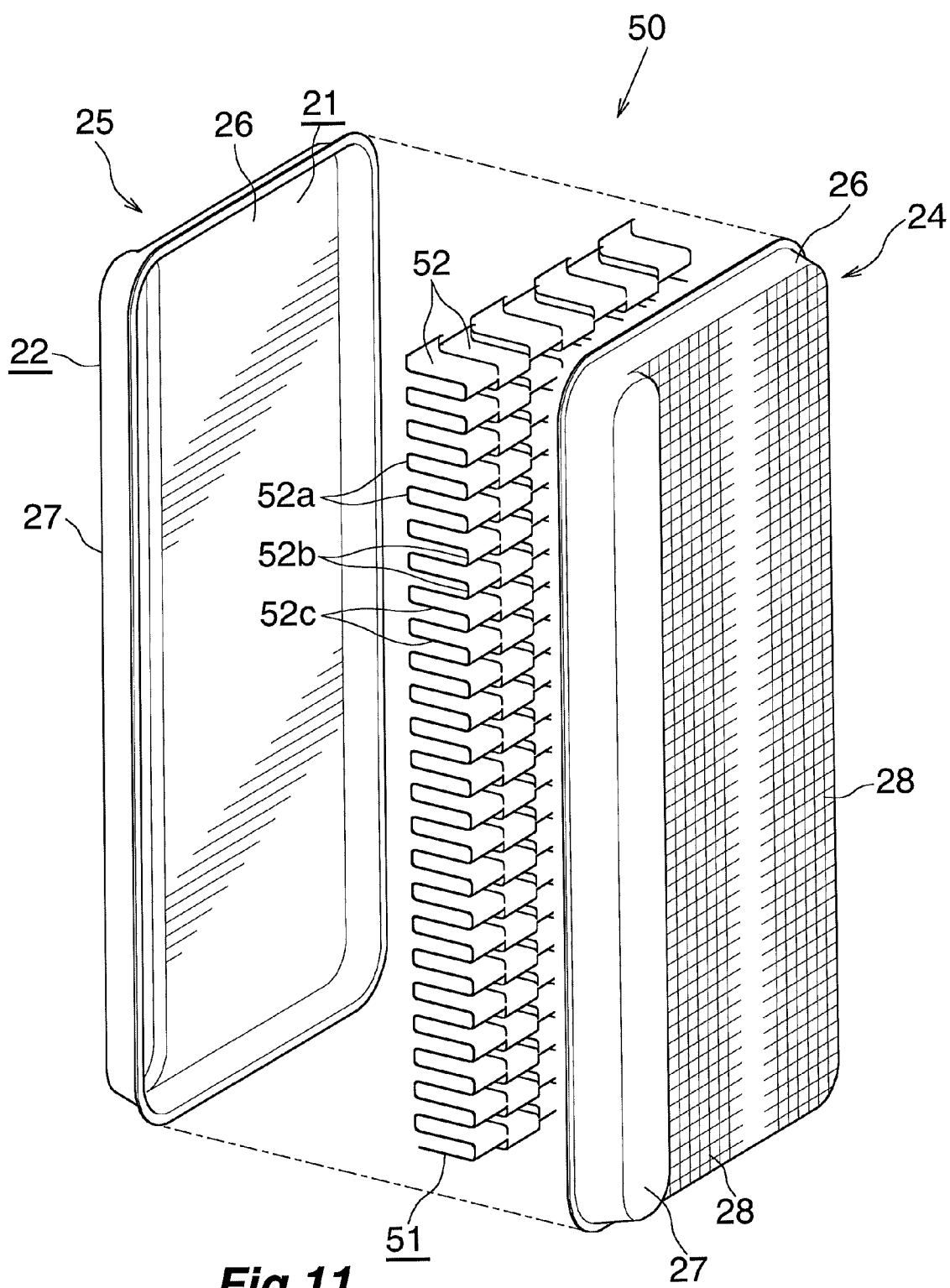
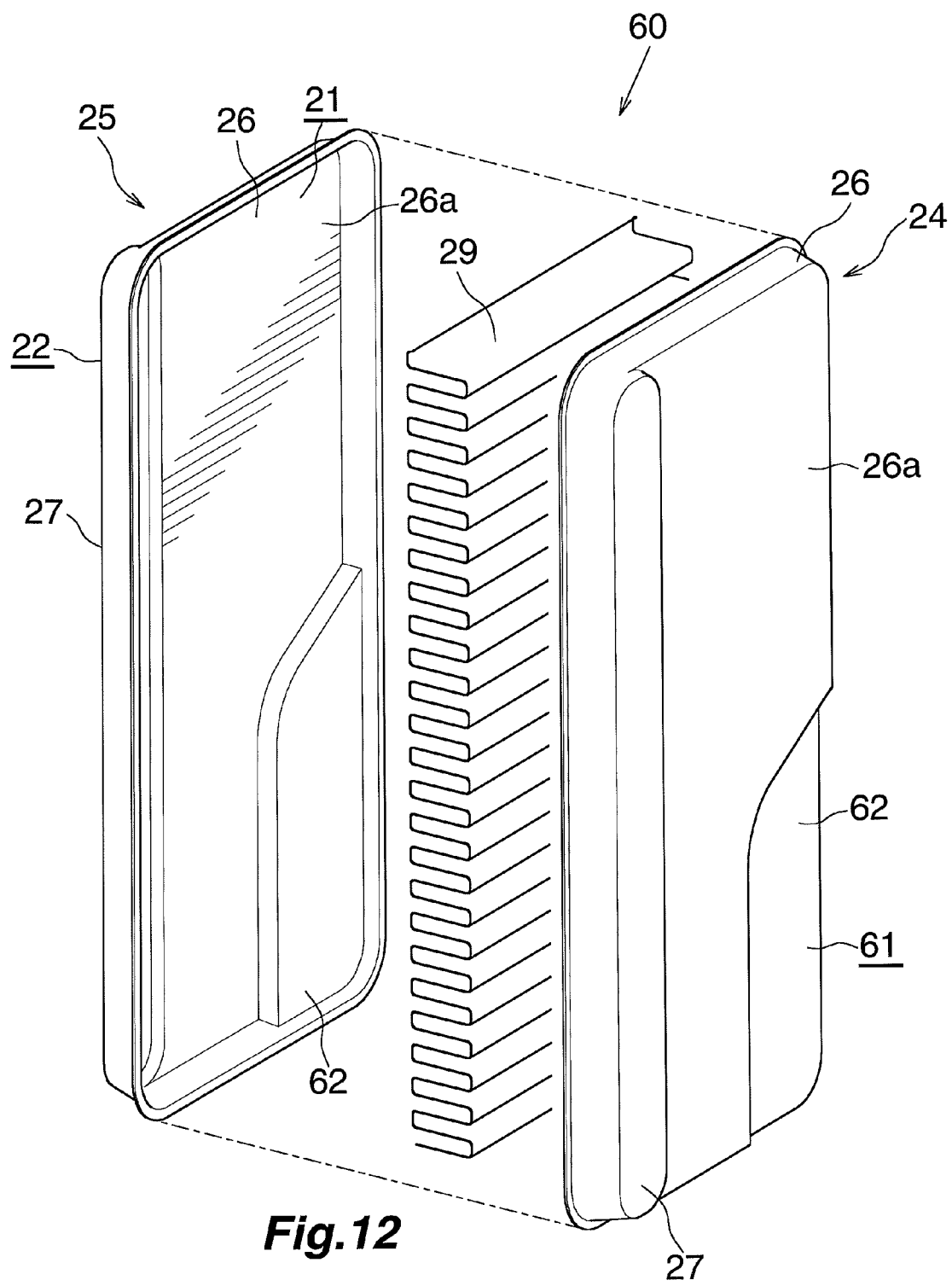


Fig. 11



EVAPORATOR WITH COOL STORAGE FUNCTION

BACKGROUND OF THE INVENTION

[0001] The present invention relates to an evaporator with a cool storage function for use in a car air conditioner for a vehicle in which an engine serving as a drive source for a compressor is temporarily stopped when the vehicle is stopped.

[0002] In the present specification and appended claims, the upper and lower sides of FIG. 1 will be referred to as “upper” and “lower,” respectively.

[0003] In recent years, in order to protect the environment and improve fuel consumption of automobiles, there has been proposed an automobile designed to automatically stop the engine when the automobile stops, for example, so as to wait for a traffic light to change.

[0004] Incidentally, an ordinary car air conditioner has a problem in that, when an engine of an automobile in which the air conditioner is mounted is stopped, a compressor driven by the engine is stopped, and supply of refrigerant to an evaporator stops, whereby the cooling capacity of the air conditioner sharply drops.

[0005] As one measure to solve such a problem, imparting a cool storage function to the evaporator has been considered, to thereby enable cooling of a vehicle compartment by making use of cool stored in the evaporator, when the compressor stops as a result of stoppage of the engine.

[0006] An evaporator with a cool storage function has been proposed (see, for example, Japanese Patent No. 4043776). The proposed evaporator includes a pair of refrigerant header sections disposed apart from each other, and a plurality of flat refrigerant flow tubes disposed between the two refrigerant header sections such that their width direction coincides with an air-passing direction, and they are spaced from one another in the longitudinal direction of the refrigerant header sections. Opposite ends of the refrigerant flow tubes are connected to the two refrigerant header sections, respectively. The evaporator further includes a plurality of hollow cool storage material containers disposed such that their width direction coincides with the air-passing direction. Each of the cool storage material containers is fixedly provided on one side of a corresponding refrigerant flow tube and contains a cool storage material therein. The dimension of each cool storage material container in the thickness direction thereof is made uniform over the entirety of the cool storage material container. A plurality of sets each composed of refrigerant flow tubes and a cool storage material container are disposed apart from one another, and a space between adjacent pairs each composed of refrigerant flow tubes and a cool storage material container serves as an air-passing clearance. A fin is disposed in the air-passing clearance, and is joined to the refrigerant flow tubes and the cool storage material container.

[0007] In the case of the evaporator with a cool storage function disclosed in the publication, when refrigerant of low temperature flows through the refrigerant flow tubes, cool is stored in the cool storage material within the cool storage material container.

[0008] However, the evaporator with a cool storage function disclosed in the publication has a problem in that, as compared with an ordinary evaporator which has the same effective core area and which does not have a cool storage material container, the number of refrigerant flow tubes decreases, whereby cooling performance deteriorates.

[0009] In order to solve the above-mentioned problem of the evaporator with a cool storage function disclosed in the publication, the present applicant has proposed an evaporator with a cool storage function in which a plurality of flat refrigerant flow tube portions which extend in the vertical direction and whose width direction coincides with an air-passing direction are disposed in parallel such that they are spaced apart from one another; air-passing clearances are formed between adjacent refrigerant flow tube portions; a cool storage material container filled with a cool storage material is disposed in each of some air-passing clearances selected from all the air-passing clearances, the selected air-passing clearances being not adjacent to one another; and fins are disposed in the remaining air-passing clearances (see Japanese Patent Application Laid-Open (kokai) No. 2010-149814).

[0010] However, the evaporator with a cool storage function disclosed in the publication has the following problem. Effective ways of increasing the quantity of a cool storage material charging into a cool storage material container, without changing the size of the heat exchange core section, to thereby improve cooling storage performance are increasing the number of cool storage material containers and increasing all the container heights of the entire cool storage material containers. However, in either case, the air passage area of the air-passing clearances decreases, and air-passing resistance increases.

SUMMARY OF THE INVENTION

[0011] An object of the present invention is to solve the above problems and to provide an evaporator with a cool storage function which can restrain an increase in air-passing resistance, as compared with the evaporator with a cool storage function disclosed in the publication, while restraining deterioration of cooling performance.

[0012] To fulfill the above object, the present invention comprises the following modes.

[0013] 1) An evaporator with a cool storage function in which a plurality of vertically extending flat refrigerant flow tubes are disposed in parallel such that their width direction coincides with an air-passing direction and they are spaced from one another, air-passing clearances are formed such that each air-passing clearance is provided between adjacent refrigerant flow tubes, a cool storage material container filled with a cool storage material is disposed in at least one of the air-passing clearances, and outer fins are disposed in the remaining air-passing clearances, wherein

[0014] the cool storage material container includes a container body portion joined to the corresponding refrigerant flow tubes, and an outward extending portion which extends from a downstream-side edge of the container body portion and projects downstream in relation to the refrigerant flow tubes;

[0015] an outer fin disposed in an air-passing clearance adjacent to the air-passing clearance in which the cool storage material container is disposed has a fin body portion joined to the corresponding refrigerant flow tubes, and an outward extending portion which extends from a downstream-side edge of the fin body portion and projects downstream in relation to the refrigerant flow tubes; and

[0016] the outward extending portion of the outer fin is in contact with a corresponding side surface of the outward extending portion of the cool storage material container.

[0017] 2) An evaporator with a cool storage function according to par. 1), wherein each of the outer fins disposed in

air-passing clearances located on opposite sides of the air-passing clearance in which the cool storage material container is disposed has the fin body portion and the outward extending portion; and the outward extending portions of the outer fins are in contact with the opposite side surfaces of the outward extending portion of the cool storage material container.

[0018] 3) An evaporator with a cool storage function according to par. 1), wherein the outward extending portion of the cool storage material container bulges over the entire length in the vertical direction, the outward extending portion bulging outward in relation to the container body portion with respect to a direction along which the refrigerant flow tubes are arrayed; and the outward extending portion has a dimension in a thickness direction thereof greater than a dimension of the container body portion in a thickness direction thereof.

[0019] 4) An evaporator with a cool storage function according to par. 1), wherein the outward extending portion of the cool storage material container has a base portion whose dimension in a thickness direction thereof is equal to a dimension of the container body portion in a thickness direction thereof, and a plurality of projecting portions which are provided on the base portion such that the projecting portions are spaced from one another in the vertical direction and which bulge outward from the base portion with respect to a direction along which the refrigerant flow tubes are arrayed.

[0020] 5) An evaporator with a cool storage function according to par. 1), wherein the outward extending portion of the corresponding outer fin is brazed to the outward extending portion of the cool storage material container.

[0021] 6) An evaporator with a cool storage function according to par. 1), wherein the cool storage material container is composed of two metal plates whose peripheral edge portions are joined together; and the container body portion and the outward extending portion of the cool storage material container are provided by means of outward bulging at least one of the two metal plates.

[0022] 7) An evaporator with a cool storage function according to par. 1), wherein an inner fin extending from the container body portion to the outward extending portion of the cool storage material container is disposed in the cool storage material container.

[0023] 8) An evaporator with a cool storage function according to par. 7), wherein the inner fin assumes a corrugated shape, and has crest portions extending in the air-passing direction, trough portions extending in the air-passing direction, and connection portions connecting the crest portions and the trough portions.

[0024] 9) An evaporator with a cool storage function according to par. 7), wherein the inner fin assumes a staggered shape, and is composed of a plurality of corrugated strips, each of which has crest portions extending in the air-passing direction, trough portions extending in the air-passing direction, and connection portions connecting the crest portion and the trough portion, the corrugated strips being arranged in the air-passing direction and integrally connected with one another such that the crest portions and the trough portions of one of two strips adjacent to each other in the air-passing direction are positionally shifted in the vertical direction from those of the other strip.

[0025] 10) An evaporator with a cool storage function according to par. 1), wherein the container body portion of the cool storage material container is brazed to the corresponding refrigerant flow tubes; and grooves are formed in portions of

outer surfaces of the container body portion of the cool storage material container, which portions are brazed to the corresponding refrigerant flow tubes.

[0026] 11) An evaporator with a cool storage function according to par. 10), wherein the grooves formed in each of the portions of the outer surfaces of the container body portion of the cool storage material container, which portions are brazed to the corresponding refrigerant flow tubes, form a grid.

[0027] 12) An evaporator with a cool storage function according to par. 1), comprising a plurality of refrigerant flow tube sets each including a plurality of flat refrigerant flow tubes disposed such that their width direction coincides with the air-passing direction and they are spaced from one another in the air-passing direction; and the container body portion of the cool storage material container is disposed to extend over all the refrigerant flow tubes of the corresponding set, and is joined to the refrigerant flow tubes.

[0028] 13) An evaporator with a cool storage function according to par. 1), wherein the container body portion of the cool storage material container has an internal-volume reducing portion which is formed through partial inward deformation of a wall of the cool storage material container and which reduces an internal volume of the cool storage material container.

[0029] 14) An evaporator with a cool storage function according to par. 13), wherein the internal-volume reducing portion of the container body portion of the cool storage material container is configured to bulge due to an increase in internal pressure when the internal-volume reducing portion is exposed to a high temperature exceeding a temperature range of use environment.

[0030] 15) An evaporator with a cool storage function according to par. 1), wherein a cool storage material charging ratio, which is the ratio of the volume of the charged cool storage material to the internal volume of the cool storage material container is 70 to 90%.

[0031] 16) An evaporator with a cool storage function according to par. 15), wherein the cool storage material charging ratio is 70 to 80%.

[0032] 17) An evaporator with a cool storage function according to par. 1), wherein each of the refrigerant flow tubes in thermal contact with the cool storage material container has a plurality of refrigerant flow channels which are arranged in the width direction of the refrigerant flow tube and are separated from one another by partitions; and

[0033] a relation $0.1 \leq t \leq 0.4$ and a relation $0.64 \leq h/H \leq 0.86$ are satisfied, where t represents a thickness (mm) of each partition, h represents a height (mm) of each partition, and H represents a tube height (mm), which is a dimension of each refrigerant flow tube in a thickness direction thereof.

[0034] 18) An evaporator with a cool storage function according to par. 17), wherein a relation $0.0 \leq (n \times t)/W \leq 0.31$ is satisfied, where n represents the number of the partitions of each refrigerant flow tube, and W represents a width (mm) of each refrigerant flow tube.

[0035] 19) An evaporator with a cool storage function according to par. 17), wherein the tube height H of each refrigerant flow tube is 12 to 25 mm, and the width W of each refrigerant flow tube is 1.3 to 3.0 mm.

[0036] According to the evaporator with a cool storage function of any one of pars. 1) to 19), the cool storage material container includes a container body portion joined to the corresponding refrigerant flow tubes, and an outward extend-

ing portion which extends from a downstream-side edge of the container body portion and projects downstream in relation to the refrigerant flow tubes. Therefore, the quantity of the cool storage material which can be charged into one cool storage material container can be increased by an amount corresponding to the internal volume of the outward extending portion, as compared with the cool storage material container of the evaporator with a cool storage function disclosed in the above-described publication. Accordingly, even when the quantity of the cool storage material charged into the cool storage material container is increased without changing the size of the heat change core section, it is unnecessary to increase the number of the cool storage material containers and all the container heights of the entire storage material containers. Therefore, as compared with the evaporator with a cool storage function disclosed in the above-described publication, a decrease in the air passing area of the air-passing clearances can be restrained, whereby an increase in air-passing resistance can be restrained.

[0037] In addition, a plurality of vertically extending flat refrigerant flow tubes are disposed in parallel such that their width direction coincides with an air-passing direction and they are spaced from one another, air-passing clearances are formed such that each air-passing clearance is provided between adjacent refrigerant flow tubes, a cool storage material container filled with a cool storage material is disposed in each of at least some of all the air-passing clearances which are not adjacent to one another, and outer fins are disposed in the remaining air-passing clearances. Therefore, even when the effective core area is made equal to that of the evaporator with a cool storage function disclosed in the above-described publication, the number of the refrigerant flow tubes does not decrease. Accordingly, deterioration of cooling performance can be restrained.

[0038] Moreover, an outer fin disposed in an air-passing clearance adjacent to the air-passing clearance in which the cool storage material container has a fin body portion joined to the corresponding refrigerant flow tubes, and an outward extending portion which extends from a downstream-side edge of the fin body portion body and projects downstream in relation to the refrigerant flow tubes; and the outward extending portion of the outer fin is in contact with a corresponding side surface of the outward extending portion of the cool storage material container. When cool is stored in the cool storage material within the cool storage material container upon operation of a compressor, the cool storage material is cooled by refrigerant flowing through the refrigerant flow tubes, and is also cooled by air which flows through the air-passing clearances and whose temperature is lowered. Therefore, the cool storage material can be cooled efficiently, whereby cool storage performance is enhanced. Meanwhile, when the compressor stops as a result of stoppage of an engine, the cool stored in the cool storage material within the container body portion of the cool storage material container is transferred to air passing through the adjacent air-passing clearances via the refrigerant flow tubes located on the opposite sides of the cool storage material container, and the cool stored in the cool storage material within the outward extending portion of the cool storage material container is transferred from the outward extending portion to the outer fin joined to one side surface of the outward extending portion, and then transferred to air passing through the air-passing clearance in which the outer fin is disposed. Therefore, cool release performance is enhanced.

[0039] According to the evaporator with a cool storage function of par. 2), both cool storage performance (performance of storing cool in the cool storage material within the cool storage material container when the compressor operates) and cool release performance (performance of releasing cool from the cool storage material within the cool storage material container when the compressor stops) are enhanced further.

[0040] According to the evaporator with a cool storage function of each of pars. 3) and 4), the quantity of the cool storage material within the cool storage container can be increased further.

[0041] According to the evaporator with a cool storage function of par. 4), the heat transfer area between the opposite side walls of the outward extending portion of the cool storage material container and the cool storage material within the outward extending portion increases.

[0042] According to the evaporator with a cool storage function of par. 6), the cool storage material container can be manufactured relatively easily.

[0043] According to the evaporator with a cool storage function of par. 7), an inner fin extending from the container body portion to the outward extending portion of the cool storage material container is disposed in the cool storage material container. Therefore, the cool storage material within the outward extending portion is also cooled quickly by refrigerant flowing through the refrigerant flow tubes. Accordingly, the cool storage material within the cool storage material container can be cooled efficiently.

[0044] According to the evaporator with a cool storage function of each of pars. 8) and 9), the cool storage material within the outward extending portion is cooled more effectively by refrigerant flowing through the refrigerant flow tubes.

[0045] According to the evaporator with a cool storage function of each of pars. 10) and 11), a melted flux or melted brazing filler material becomes more likely to flow through the grooves over the entire interface between the container body portion of the cool storage material container and the refrigerant flow tubes. Therefore, the container body portion of the cool storage material container and the refrigerant flow tubes can be brazed more reliably.

[0046] According to the evaporator with a cool storage function of each of pars. 13) and 14), the container body portion of the cool storage material container has an internal-volume reducing portion which is formed through partial inward deformation of a wall of the cool storage material container and which reduces the internal volume of the cool storage material container. Therefore, the internal volume of the cool storage material container decreases as compared with the case where the internal-volume reducing portion is not provided. As a result, even when the quantity of the cool storage material charged into the cool storage material container is determined to attain a cool storage material charging ratio suitable for the case where the internal-volume reducing portion is not provided (e.g., 70 to 90%), the cool storage material exists even in the vicinity of the upper end of the cool storage material container. Therefore, cool can be stored even in the vicinity of the upper end of the cool storage material container. Thus, when the compressor stops, an increase in the temperature of air flowing through portions of the air-passing clearances corresponding to the vicinity of the upper end of the cool storage material container can be restrained, whereby variation of discharge air temperature, which is the

temperature of air having passed through the evaporator with a cool storage function, can be restrained.

[0047] Even the evaporator with a cool storage function of par. 13) or 14) is designed such that within an ordinary temperature range of use environment (e.g., -40 to 90°C .), the cool storage material container does not break even when the internal pressure increases because of a change in the density of the cool storage material in the liquid phase, and thermal expansion of air remaining in the cool storage material container. When the cool storage material container is exposed to a temperature (e.g., 100°C .) higher than the ordinary temperature range of use environment, the change in the density of the liquid-phase cool storage material and the thermal expansion of air remaining in the cool storage material container become remarkable, whereby the internal pressure of the cool storage material container increases excessively. In such a case, the internal-volume reducing portion of the cool storage material container deforms through bulging, whereby breakage of the cool storage material container due to an increase in the internal pressure of the cool storage material container can be prevented. In addition, since the strength of the internal-volume reducing portion is lower than that of the remaining portion, when the cool storage material container is exposed to a higher temperature, the cool storage material container breaks at the internal-volume reducing portion, and the cool storage material leaks. However, since leakage of the cool storage material occurs at a previously determined location (the internal-volume reducing portion), the leaked cool storage material can be coped relatively easily.

[0048] According to the evaporator with a cool storage function of each of pars. 15) and 16), breakage of the cool storage material container due to the internal pressure thereof can be prevented even when the density of the liquid-phase cool storage material changes and air remaining in the cool storage material container expands within the temperature range of use environment (e.g., -40 to 90°C .).

[0049] According to the evaporator with a cool storage function of par. 16), breakage of the cool storage material container due to the internal pressure thereof within the temperature range of use environment can be prevented effectively.

[0050] According to the evaporator with a cool storage function of any one of pars. 17) to 19), when cool is stored, cool is efficiently transferred from refrigerant flowing through the flow channels of the refrigerant flow tubes to the opposite side surfaces of the cool storage material container, and, when cool is released, the cool stored in the cool storage material within the cool storage material container efficiently passes through the refrigerant flow tubes in the tube height direction, whereby both cool storage performance and cool release performance become excellent. In addition, cooling performance at the time of ordinary cooling when the compressor is operating is not sacrificed.

[0051] According to the evaporator with a cool storage function of par. 18), both cool storage performance and cool release performance become more excellent.

BRIEF DESCRIPTION OF THE DRAWINGS

[0052] FIG. 1 is a partially cut-away perspective view showing the overall structure of an evaporator with a cool storage function according to the present invention;

[0053] FIG. 2 is an enlarged sectional view taken along line A-A of FIG. 1;

[0054] FIG. 3 is an exploded perspective view showing a cool storage material container of the evaporator with a cool storage function of FIG. 1;

[0055] FIG. 4 is a graph showing results of computer simulation calculation performed for determining a cool storage material charging ratio, which is the ratio of the volume of a charged cool storage material to the internal volume of the cool storage material container;

[0056] FIG. 5 is a graph showing results of computer simulation calculation which is different from that shown in FIG. 4 and is performed for determining the cool storage material charging ratio, which is the ratio of the volume of the charged cool storage material to the internal volume of the cool storage material container;

[0057] FIG. 6 is a graph showing results of computer simulation calculation performed for determining the thickness of the partitions of each refrigerant flow tube;

[0058] FIG. 7 is a graph showing results of computer simulation calculation which is different from that shown in FIG. 6 and is performed for determining the thickness of the partitions of each refrigerant flow tube;

[0059] FIG. 8 is a graph showing results of computer simulation calculation performed for determining the ratio of the height of the partitions to a tube height, which is a dimension of each refrigerant flow tube in the thickness direction thereof;

[0060] FIG. 9 is a graph showing results of computer simulation calculation which is different from that shown in FIG. 8 and is performed for determining the ratio of the height of the partitions to the tube height, which is the dimension of each refrigerant flow tube in the thickness direction thereof;

[0061] FIG. 10 is an exploded perspective view showing a first modification of the cool storage material container;

[0062] FIG. 11 is an exploded perspective view showing a second modification of the cool storage material container; and

[0063] FIG. 12 is an exploded perspective view showing a third modification of the cool storage material container.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0064] An embodiment of the present invention will next be described with reference to the drawings. Notably, the same reference numerals are used throughout the drawings to refer to the same portions and members, and their repeated descriptions are omitted.

[0065] In the following description, the downstream side with respect to an air-passing direction (a direction represented by arrow X in FIGS. 1 and 2) will be referred to as the "front," and the opposite side as the "rear." Further, the left-hand and right-hand sides as viewed rearward from the front side; i.e., the left-hand and right-hand sides of FIG. 1, will be referred to as "left" and "right," respectively.

[0066] Furthermore, the term "aluminum" as used in the following description encompasses aluminum alloys in addition to pure aluminum.

[0067] FIG. 1 shows the overall configuration of an evaporator with a cool storage function according to the present invention, and FIGS. 2 and 3 show the configuration of an essential portion of the evaporator.

[0068] As shown in FIG. 1, an evaporator with a cool storage function 1 includes a first header tank 2 and a second header tank 3 formed of aluminum and disposed apart from each other in the vertical direction such that they extend in the

left-right direction; and a heat exchange core section 4 provided between the two header tanks 2 and 3.

[0069] The first header tank 2 includes a refrigerant inlet header section 5 located on the front side (downstream side with respect to the air-passing direction); and a refrigerant outlet header section 6 located on the rear side (upstream side with respect to the air-passing direction) and united with the refrigerant inlet header section 5. A refrigerant inlet 7 is provided at the right end of the refrigerant inlet header section 5, and a refrigerant outlet 8 is provided at right end of the refrigerant outlet header section 6. The second header tank 3 includes a first intermediate header section 9 located on the front side, and a second intermediate header section 11 located on the rear side and united with the first intermediate header section 9. The respective interiors of the first and second intermediate header sections 9 and 11 of the second header tank 3 are connected together via a communication member 12 which extends across and is joined to the right ends of the intermediate header sections 9 and 11 and which has a flow passage formed therein.

[0070] As shown in FIGS. 1 and 2, in the heat exchange core section 4, a plurality of flat refrigerant flow tubes 13 which extend in the vertical direction, whose width direction coincides with the air-passing direction (the front-rear direction), and which are formed of aluminum extrudate are disposed in parallel such that they are spaced from each other in the left-right direction. That is, a plurality of pairs 14 each composed of a plurality of (in the present embodiment, two) refrigerant flow tubes 13 spaced from one another in the front-rear direction are disposed at predetermined intervals in the left-right direction. An air-passing clearance 15 is formed between adjacent two of the pairs 14 each composed of the front and rear refrigerant flow tube 13. An upper end portion of each front refrigerant flow tube 13 is connected to the refrigerant inlet header section 5, and a lower end portion of each front refrigerant flow tube 13 is connected to the first intermediate header section 9. Similarly, an upper end portion of each rear refrigerant flow tube 13 is connected to the refrigerant outlet header section 6, and a lower end portion of each rear refrigerant flow tube 13 is connected to the second intermediate header section 11.

[0071] Each refrigerant flow tube 13 includes a plurality of refrigerant flow channels 33 which are arranged in the width direction of the refrigerant flow tube 13 (the front-rear direction), and are separated from one another by partitions 34. When the thickness of each partition 34 is represented by t (mm), the height of each partition 34 is represented by h (mm), and a tube height, which is the dimension of each refrigerant flow tube 13 in the thickness direction thereof, is represented by H (mm), preferably, a relation $0.1 \leq t \leq 0.4$ and a relation $0.64 \leq h/H \leq 0.86$ are satisfied. Furthermore, when the number of the partitions 34 of each refrigerant flow tube 13 is represented by n and the width of each refrigerant flow tube 13 is represented W (mm), preferably, a relation $0.07 \leq (n+1)/W \leq 0.31$ is satisfied. Notably, preferably, the tube height H of each refrigerant flow tube 13 is 12 to 25 mm, and the width W of each refrigerant flow tube 13 is 1.3 to 3.0 mm.

[0072] A cool storage material container 16 formed of aluminum filled with a cool storage material (not shown) is disposed in each of air-passing clearances 15 selected from all the air-passing clearances 15, the selected passing clearances 15 being not adjacent from one another, such that the cool storage material container 16 extends over the front and rear refrigerant flow tubes 13 of the corresponding pairs 14. Also,

a corrugated outer fin 17, which is formed from an aluminum brazing sheet having a brazing material layer on each of opposite surfaces thereof, is disposed in each of the remaining air-passing clearances 15 such that the corrugated outer fin 17 extends over the front and rear refrigerant flow tubes 13 of the corresponding pairs 14. The corrugated outer fin 17 disposed in each air-passing clearance 15 is brazed to the front and rear refrigerant flow tubes 13 of the left-side and right-side pairs 14 which define the air-passing clearance 15. That is, the outer fin 17 is disposed in each of the air-passing clearances 15 located on both sides of the air-passing clearance 15 in which the cool storage material container 16 is disposed. Also, the outer fin 17, which is formed from an aluminum brazing sheet having a brazing material layer on each of opposite surfaces thereof, is disposed on the outer side of the pair 14 of the refrigerant flow tubes 13 located at the left end, and is disposed on the outer side of the pair 14 of the refrigerant flow tubes 13 located at the right end. These outer fins 17 are brazed to the corresponding front and rear refrigerant flow tubes 13. Furthermore, a side plate 18 formed of aluminum is disposed on the outer side of each of the outer fins 17 located at the left and right ends, respectively, and is brazed to the corresponding outer fin 17.

[0073] As shown in FIGS. 2 and 3, each cool storage material container 16 includes a container main body portion 21 and an outward extending portion 22. The container main body portion 21 is located rearward of the front edges of the front refrigerant flow tubes 13, and is brazed to the front and rear refrigerant flow tubes 13 of the corresponding pairs 14. The outward extending portion 22 extends frontward from the front edge of the container body portion 21, and projects frontward (downstream) in relation to the front edges of the front rear refrigerant flow tubes 13. The container body portion 21 of the cool storage material container 16 has a constant dimension in the thickness direction (the left-right direction) over the entirety thereof. The outward extending portion 22 of the cool storage material container 16 has a dimension in the vertical direction equal to that of the container body portion 21, has a dimension in the left-right direction greater than that of the container body portion 21, and bulges in relation to the container body portion 21 to the outer side with respect to the left-right direction (the outer side with respect to the direction along which the refrigerant flow tubes 13 are arranged). The dimension of the outward extending portion 22 in the left-right direction is equal to a value obtained by adding the dimension of the container body portion 21 of the cool storage material container 16 in the left-right direction to a tube height, which is the dimension of each refrigerant flow tube 13 in the thickness direction (the left-right direction). For example, a paraffin-based latent heat storage material having an adjusted freezing point of about 5 to 10° C. is used as a cool storage material charged into the cool storage material container 16. Specifically, pentadecane, tetradecane, or the like is used. The quantity of the cool storage material charged into the cool storage material container 16 is desirably determined such that the cool storage material fills the interior of the cool storage material container 16 to a point near the upper end thereof. For example, a cool storage material charging ratio, which is the ratio of the volume of the charged cool storage material to the internal volume of the cool storage material container 16, is preferably 70 to 90%, more preferably, 70 to 80%. Notably, the cool storage material charging ratio is that at room temperature.

[0074] The reason why it is preferred that the cool storage material charging ratio, which is the ratio of the volume of the charged cool storage material to the internal volume of one sealed internal space 16a of the cool storage material container 16, is set to 70 to 90% is that results as shown in FIGS. 4 and 5 were obtained through computer simulation calculation.

[0075] Computer simulation calculation, the results of which are shown in FIG. 4, was performed for the case where pentadecane was used as a cool storage material, and the ambient temperature at the time of charging (at the beginning) was 20° C. The calculation was performed, while the charging ratio of the cool storage material charged into the cool storage material container 16 and the temperature of the atmosphere in which the cool storage material container was disposed were changed.

[0076] Computer simulation calculation, the results of which are shown in FIG. 5, was performed for the case where pentadecane was used as a cool storage material, under the conditions that the temperature of air flowing into the evaporator (1) with a cool storage function was 25° C., the relative humidity (RH) of the air was 50%, and the quantity of air as measured on the upstream side of the evaporator 1 with a cool storage function was 200 m³/h. The calculation was performed, while the charging ratio of the cool storage material charged into the cool storage material container 16 was changed.

[0077] The horizontal axis of the graph shown in FIG. 4 shows the temperature of the atmosphere in which the cool storage material container 16 was disposed (ambient temperature), and the vertical axis thereof represents the internal pressure of the cool storage material container 16. The horizontal axis of the graph shown in FIG. 5 shows a cool storage time required to store a required quantity of cool in the cool storage material within the cool storage material container 16, and the vertical axis thereof represents a cool release time over which a required quantity of cool is released from the cool storage material within the cool storage material container 16.

[0078] The graph shown in FIG. 4 reveals that, only in the case where the charging ratio of the cool storage material charged into the cool storage material container 16 is equal to or less than 90%, a sharp increase in the internal pressure can be prevented even at an ambient temperature higher than 90° C., which is the upper limit of an ordinary temperature range of for use of a car air conditioner including the evaporator 1 with a cool storage function. Also, the graph shown in FIG. 5 reveals that, only in the case where the charging ratio of the cool storage material charged into the cool storage material container 16 is equal to or greater than 70%, a required cool release time (T) can be attained by a relatively short cool storage time.

[0079] The cool storage material container 16 is composed of two generally rectangular aluminum plates 24 and 25, each of which is formed, through press work, from an aluminum brazing sheet having a brazing material layer on each of opposite sides thereof, and whose peripheral edge portions are brazed together. A first bulging portion 26 bulging rightward is provided over a portion of the right-hand-side aluminum plate 24, which constitutes the cool storage material container 16, the portion forming the container body portion 21; i.e., the greater portion of the right-hand-side aluminum plate 24 excluding a front portion thereof. Similarly, a second bulging portion 27 is provided over a portion of the right-

hand-side aluminum plate 24 forming the outward extending portion 22; i.e., the front portion of the right-hand-side aluminum plate 24, such that the second bulging portion 27 extends over the entire length in the vertical direction. The second bulging portion 27 extends frontward from the first bulging portion 26, bulges rightward, and has a bulging height greater than that of the first bulging portion 26. Furthermore, grooves 28 are formed, in a grid-like pattern, on an outer surface of the portion of the right-hand-side aluminum plate 24 forming the container body portion 21, in regions to which the refrigerant flow tubes 13 are brazed. The left-hand-side aluminum plate 25, which constitutes the cool storage material container 16, has a shape which is a mirror image of the shape of the right-hand-side aluminum plate 24, and the same portions are denoted by the same reference numerals.

[0080] The two aluminum plates 24 and 25 are assembled and brazed together such that openings of the first and second bulging portions 26 and 27 face each other, whereby the cool storage material container 16 is formed. The first bulging portions 26 of the two aluminum plates 24 and 25 form the container body portion 21, and the second bulging portions 27 of the two aluminum plates 24 and 25 form the outward extending portion 22.

[0081] An inner fin 29 made of aluminum and extending from the rear end of the container body portion 21 to the front end of the outward extending portion 22 is disposed in the cool storage material container 16 such that the inner fin 29 extends over substantially the entirety of the cool storage material container 16 in the vertical direction. The inner fin 29 assumes a corrugated shape, and has crest portions extending in the front-rear direction, trough portions extending in the front-rear direction, and connection portions connecting the crest portions and the trough portions. The inner fin 29 has a constant fin height over the entirety thereof, and is brazed to the inner surfaces of left and right walls of the container body portion 21 of the cool storage material container 16.

[0082] Each of the outer fins 17 assumes a corrugated shape, and has crest portions extending in the front-rear direction, trough portions extending in the front-rear direction, and connection portions connecting the crest portions and the trough portions. Each of the outer fins 17 has a fin body portion 31 and an outward extending portion 32. The fin body portion 31 is located rearward of the front edges of the front refrigerant flow tubes 13, and is brazed to the front and rear refrigerant flow tubes 13 of the corresponding pairs 14. The outward extending portion 32 extends from the front edge of the fin body portion 31, and projects frontward in relation to the front edges of the front refrigerant flow tubes 13 (outward in the air-passing direction). The outward extending portions 32 of the outer fins 17 disposed in two air-passing clearances 15 located adjacent to and on opposite sides of each air-passing clearance 15 in which the cool storage material container 16 is disposed are brazed to the left and right side surfaces of the outward extending portion 22 of the cool storage material container 16. Furthermore, a spacer 35 made of aluminum is disposed between the outward extending portions 32 of adjacent ones of the outer fins 17, and is brazed to the outward extending portions 32.

[0083] The above-described evaporator 1 with a cool storage function constitutes a refrigeration cycle in combination with a compressor driven by an engine of a vehicle, a condenser (refrigerant cooler) for cooling the refrigerant discharged from the compressor, and an expansion valve (pressure-reducing unit) for reducing the pressure of the

refrigerant having passed through the condenser. The refrigeration cycle is installed, as a car air conditioner, in a vehicle, such as an automobile, which temporarily stops the engine, which serves as a drive source of the compressor, when the vehicle is stopped. In the case of such a car air conditioner, when the compressor is operating, low pressure, two-phase refrigerant (a mixture of vapor refrigerant and liquid refrigerant) having been compressed by the compressor and having passed through the condenser and the expansion valve passes through the refrigerant inlet 7, and enters the inlet header section 5 of the evaporator 1. The refrigerant then passes through all the front refrigerant flow tubes 13, and enters the first intermediate header section 9. The refrigerant having entered the first intermediate header section 9 passes through the communication member 12, and enters the second intermediate header section 11. After that, the refrigerant passes through all the rear refrigerant flow tubes 13, enters the outlet header section 6, and flows out via the refrigerant outlet 8. When the refrigerant flows through the refrigerant flow tubes 13, the refrigerant performs heat exchange with air passing through the air-passing clearances 15, and flows out of the refrigerant flow tubes 13 in a vapor phase.

[0084] At that time, the cool storage material within the container body portion 21 of each cool storage material container 16 is cooled by the refrigerant flowing through the refrigerant flow tubes 13, and the cool stored in the cooled cool storage material within the container body portion 21 is transferred to the cool storage material within the outward extending portion 22 of the cool storage material container 16 via the inner fin 29. Furthermore, the cool storage material within the outward extending portion 22 of the cool storage material container 16 is cooled by air having been cooled by the refrigerant while passing through the air-passing clearances 15. As a result, cool is stored in the entire cool storage material within the cool storage material container 16.

[0085] When the compressor stops, the cool stored in the cool storage material within the container body portion 21 and outward extending portion 22 of each cool storage material container 16 is transferred to the left and right walls of the container body portion 21 and outward extending portion 22 via the inner fin 29. The cool transferred to the left and right walls of the container body portion 21 is transferred to air passing through the corresponding air-passing clearances 15 via the corresponding refrigerant flow tubes 13 and the fin body portions 31 of the outer fins 17 brazed to the refrigerant flow tubes 13. The cool transferred to the left and right walls of the outward extending portion 22 is transferred to air passing through the corresponding air-passing clearance 15 via the outward extending portions 32 of the outer fins 17 brazed to the left and right side surfaces of the outward extending portion 22. Accordingly, even when the temperature of air having passed through the evaporator 1 increases, the air is cooled, so that a sharp drop in the cooling capacity can be prevented.

[0086] As described above, when the thickness of the partitions 34 of the refrigerant flow tubes 13 is represented by t (mm), satisfaction of the relation $0.1 \leq t \leq 0.4$ is preferred, because the results as shown in FIGS. 6 and 7 were obtained through computer simulation calculation. This computer simulation calculation was performed, while the thickness t of the partitions 34 was changed under the conditions that the width W of the refrigerant flow tubes 13 was 16.95 mm, the tube height H thereof was 1.4 mm, and the number n of the partitions 34 was 13.

[0087] The left side vertical axis of the graph shown in FIG. 6 represents the average temperature of air having passed through the heat exchange core section 4 during a cool release period in which the compressor stops, and cool is released from the cool storage material within the cool storage material container 16. The left side vertical axis of the graph shown in FIG. 7 represents the quantity of moving cool which is transferred to each cool storage material container 16, via the corresponding refrigerant flow tubes 13, from the outer fins 17 disposed in the air-passing clearances 15 adjacent to the air-passing clearance 15 in which the cool storage material container 16 is disposed, during a cool storage period in which the compressor operates, and cool is stored in the cool storage material within the cool storage material container 16. The right side vertical axes of the graphs shown in FIGS. 6 and 7 each represent the quantity of moving cool transferred from each cool storage material container 16, via the corresponding refrigerant flow tubes 13, to the outer fins 17 disposed in the air-passing clearances 15 adjacent to the air-passing clearance 15 in which the cool storage material container 16 is disposed, during a cool release period in which the compressor stops, and cool is released from the cool storage material within the cool storage material container 16. The graph shown in FIG. 6 reveals that, when the thickness of the partitions 34 is 0.1 to 0.4 mm, the average temperature of air having passed through the heat change core section 4 at the time of cool release decreases efficiently. When the thickness of the partitions 34 exceeds 0.4 mm, the degree of drop of the average temperature decreases. Also, the graph shown in FIG. 7 reveals that, when the thickness of the partitions 34 is 0.1 to 0.4 mm, excellent cool storage performance and excellent cool release performance are attained. That is, during a cool storage period, a large quantity of cool is transferred to each cool storage material container 16, via the corresponding refrigerant flow tubes 13, from the outer fins 17 disposed in the air-passing clearances 15 adjacent to the air-passing clearance 15 in which the cool storage material container 16 is disposed, whereby excellent cool storage performance is attained; and during a cool release period, a large quantity of cool is transferred from each cool storage material container 16, via the corresponding refrigerant flow tubes 13, to the outer fins 17 disposed in the air-passing clearances 15 adjacent to the air-passing clearance 15 in which the cool storage material container 16 is disposed, whereby excellent cool release performance is attained. Notably, the reason why the lower limit of the thickness t of the partitions 34 is set to 0.1 mm is that, when the thickness of the partitions 34 is less than 0.1 mm, manufacture becomes difficult.

[0088] Also, when the tube height, which is the dimension of the refrigerant flow tubes 13 in the thickness direction, is represented by H (mm) and the height of the partitions is represented by h (mm), satisfaction of the relation $0.64 \leq h/H \leq 0.86$ is preferred, because the results as shown in FIGS. 8 and 9 were obtained through computer simulation calculation. This computer simulation calculation was performed, while the ratio of the height h of the partitions 34 to the tube height H was changed, under the conditions that the width W of the refrigerant flow tubes 13 was 16.95 mm, the tube height H thereof was 1.4 mm, the number n of the partitions 34 was 13, and the thickness t of the partitions 34 was 0.2 mm.

[0089] The left side vertical axis of the graph shown in FIG. 8 represents the average temperature of air having passed through the heat exchange core section 4 during a cool release period in which the compressor stops, and cool is released

from the cool storage material within the cool storage material container 16. The left side vertical axis of the graph shown in FIG. 9 represents the quantity of moving cool which is transferred to each cool storage material container 16, via the corresponding refrigerant flow tubes 13, from the outer fins 17 disposed in the air-passing clearances 15 adjacent to the air-passing clearance 15 in which the cool storage material container 16 is disposed, during a cool storage period in which the compressor operates, and cool is stored in the cool storage material within the cool storage material container 16. The right side vertical axes of the graphs shown in FIGS. 8 and 9 each represent the quantity of moving cool transferred from each cool storage material container 16, via the corresponding refrigerant flow tubes 13, to the outer fins 17 disposed in the air-passing clearances 15 adjacent to the air-passing clearance 15 in which the cool storage material container 16 is disposed, during a cool release period in which the compressor stops, and cool is released from the cool storage material within the cool storage material container 16. The graph shown in FIG. 8 reveals that, when the ratio h/H is 0.64 to 0.86, the average temperature of air having passed through the heat change core section 4 at the time of cool release decreases efficiently. When the ratio is less than 0.64, the degree of drop of the average temperature decreases. Also, the graph shown in FIG. 9 reveals that, when the ratio h/H is 0.64 to 0.86, excellent cool storage performance and excellent cool release performance are attained. That is, during a cool storage period, a large quantity of cool is transferred to each cool storage material container 16, via the corresponding refrigerant flow tubes 13, from the outer fins 17 disposed in the air-passing clearances 15 adjacent to the air-passing clearance 15 in which the cool storage material container 16 is disposed, whereby excellent cool storage performance is attained; and during a cool storage period, a large quantity of cool is transferred from each cool storage material container 16, via the corresponding refrigerant flow tubes 13, to the outer fins 17 disposed in the air-passing clearances 15 adjacent to the air-passing clearance 15 in which the cool storage material container 16 is disposed, whereby excellent cool release performance is attained. Notably, the reason why the upper limit of the ratio h/H is set to 0.86 is that, when the ratio h/H exceeds the limit, manufacture becomes difficult.

[0090] The above-described embodiment may be modified such that, as in the case of a so-called laminate-type evaporator, the refrigerant flow tubes of the evaporator with a cool storage function are provided in flat hollow bodies each formed of two aluminum plates which face each other and whose peripheral edge portions are brazed together. That is, each of the refrigerant flow tubes may be one formed between the two aluminum plates which constitute the flat hollow body and having a bulged shape.

[0091] The above-described evaporator 1 with a cool storage function may be disposed in an inclined posture such that the upper ends of the refrigerant flow tubes 13 and the cool storage material containers 16 of the heat exchange core section 4 are located on the upstream side or the downstream side (for example, upstream side) in relation to the lower ends thereof. In this case, preferably, the height of the liquid level of the cool storage material within the inclined cool storage material container 16 is equal to or higher than 90% the vertical height of a edge portion of the cool storage material container 16 located on the side toward the inclination direction, and desirably, the height of the liquid level of the cool storage material within the inclined cool storage material

container 16 is equal to the vertical height of the edge portion of the cool storage material container 16 located on the side toward the inclination direction.

[0092] FIGS. 10 to 12 show modifications of the cool storage material container.

[0093] In the case of a cool storage material container 40 shown in FIG. 10, an outward extending portion 41, which extends from the front edge of the container body portion 21 and projects frontward (downstream) in relation to the front edges of the front refrigerant flow tubes 13, is composed of a base portion 42 and a plurality of projection portions 43. The dimensions of the base portion 42 in the vertical and left-right directions are equal to those of the container body portion 21. The projection portions 43 are provided on the base portion 42 such that the projection portions 43 are spaced from one another in the vertical direction, and are bulged outward from the base portion 42 in the left-right direction. The projection portions 43 assume an oblong shape, and are inclined downward toward the front side, as viewed from the outer side with respect to the left-right direction. The dimension of the projection portions 43 of the outward extending portion 41 in the left-right direction is equal to a value obtained by adding the dimension of the container body portion 21 of the cool storage material container 40 in the left-right direction to the tube height, which is the dimension of each refrigerant flow tube 13 in the left-right direction.

[0094] The outward extending portion 32 of the corresponding outer fin 17 is brazed to projecting end surfaces of the projection portions 43 of the outward extending portion 41.

[0095] The first bulging portion 26 bulging rightward is provided over a portion of the right-hand-side aluminum plate 24, which constitutes the cool storage material container 40, the portion forming the container body portion 21; i.e., the greater portion of the right-hand-side aluminum plate 24 excluding a front portion thereof. Also, a second bulging portion 44 is provided over a portion of the right-hand-side aluminum plate 24 forming the outward extending portion 41; i.e., the front portion of the right-hand-side aluminum plate 24, such that the second bulging portion 44 extends over the entire length in the vertical direction. The second bulging portion 44 extends frontward from the first bulging portion 26, bulges rightward, and has a bulging height equal to that of the first bulging portion 26. Furthermore, by means of deforming the bulging top wall of the second bulging portion 44, a plurality of third bulging portions 45 bulging rightward in relation to the second bulging portion 44 are provided on the bulging top wall of the second bulging portion 44 such that they are spaced from one another in the vertical direction. The left-hand-side aluminum plate 25, which constitutes the cool storage material container 40, has a shape which is a mirror image of the shape of the right-hand-side aluminum plate 24, and the same portions are denoted by the same reference numerals.

[0096] The structure of the remaining portion is identical with that of the cool storage material container 16 of the above-described embodiment.

[0097] In the case of a cool storage material container 50 shown in FIG. 11, a staggered inner fin 51 made of aluminum and extending from the rear end of the container body portion 21 to the front end of the outward extending portion 22 is disposed in the cool storage material container 50 such that the inner fin 51 extends over substantially the entirety thereof in the vertical direction. The inner fin 51 is composed of a

plurality of corrugated strips **52**, each of which has crest portions **52a** extending in the front-rear direction (air-passing direction), trough portions **52b** extending in the front-rear direction, and connection portions **52c** connecting the crest portion **52a** and the trough portion **52b**. The corrugated strips **52** are arranged in the air-passing direction and integrally connected with one another such that the crest portions **52a** and the trough portions **52b** of one of two strips **52** adjacent to each other in the front-rear direction are positionally shifted in the vertical direction from those of the other strip **52**.

[0098] The structure of the remaining portion is identical with that of the cool storage material container **16** of the above-described embodiment.

[0099] In the case of a cool storage material container **60** shown in FIG. 12, through inward deformation of the left and right side walls of the cool storage material container **60**, an internal-volume reducing portion **61** for reducing the internal volume of the cool storage material container **60** is formed at a lower portion of the container body portion **21**, the lower portion being located upstream of the center of the clearance between the front and rear refrigerant flow tubes **13**. The dimension of the internal-volume reducing portion **61** in the left-right direction is smaller than the dimension of the container body portion **21** in the left-right direction. Thus, the internal volume of the cool storage material container **60** decreases, as compared with the case where the internal-volume reducing portion **61** is not provided. The amount by which the internal volume of the cool storage material container **60** is reduced by the internal-volume reducing portion **61** is determined such that the cool storage material exists in the vicinity of the upper end of the cool storage material container **60**, even when the cool storage material charging ratio (the ratio of the volume of the charged cool storage material to the internal volume of the sealed internal space of the cool storage material container **60**) for an assumed case where the internal-volume reducing portion **61** is not provided (that is, the thickness of the container body portion **21** in the left-right direction is constant over the entirety thereof) is 70 to 90%, preferably, 70 to 80%.

[0100] The internal-volume reducing portion **61** is provided by means of forming a recess portion **62**, which is formed through inward deformation of the bulging top wall **26a** of the first bulging portion **26** of each of the two aluminum plates **24** and **25** constituting the cool storage material container **60**.

[0101] Furthermore, at a location where the internal-volume reducing portion **61** is provided, the inner fin **29** deforms in a buckled shape, so that the strength of the cool storage material container **60** decreases at a location thereof where the internal-volume reducing portion **61** is provided. However, the cool storage material container **60** is designed to have a sufficient strength such that, within an ordinary temperature range (e.g., -40 to 90° C.) of use environment, the cool storage material container **60** does not break even when the internal pressure increases because of a change in the density of the cool storage material in the liquid phase and thermal expansion of air remaining in the cool storage material container **60**.

[0102] In the case of the cool storage material container **60**, a portion of the container body portion **21** located frontward of the internal-volume reducing portion **61** and being in contact with the front refrigerant flow tubes **13** are brazed to the refrigerant flow tubes **13** over the entire height.

What is claimed is:

1. An evaporator with a cool storage function in which a plurality of vertically extending flat refrigerant flow tubes are disposed in parallel such that their width direction coincides with an air-passing direction and they are spaced from one another, air-passing clearances are formed such that each air-passing clearance is provided between adjacent refrigerant flow tubes, a cool storage material container filled with a cool storage material is disposed in at least one of the air-passing clearances, and outer fins are disposed in the remaining air-passing clearances, wherein

the cool storage material container includes a container body portion joined to the corresponding refrigerant flow tubes, and an outward extending portion which extends from a downstream-side edge of the container body portion and projects downstream in relation to the refrigerant flow tubes;

an outer fin disposed in an air-passing clearance adjacent to the air-passing clearance in which the cool storage material container is disposed has a fin body portion joined to the corresponding refrigerant flow tubes, and an outward extending portion which extends from a downstream-side edge of the fin body portion and projects downstream in relation to the refrigerant flow tubes; and

the outward extending portion of the outer fin is in contact with a corresponding side surface of the outward extending portion of the cool storage material container.

2. An evaporator with a cool storage function according to claim 1, wherein each of the outer fins disposed in air-passing clearances located on opposite sides of the air-passing clearance in which the cool storage material container is disposed has the fin body portion and the outward extending portion; and the outward extending portions of the outer fins are in contact with the opposite side surfaces of the outward extending portion of the cool storage material container.

3. An evaporator with a cool storage function according to claim 1, wherein the outward extending portion of the cool storage material container bulges over the entire length in the vertical direction, the outward extending portion bulging outward in relation to the container body portion with respect to a direction along which the refrigerant flow tubes are arrayed; and the outward extending portion has a dimension in a thickness direction thereof greater than a dimension of the container body portion in a thickness direction thereof.

4. An evaporator with a cool storage function according to claim 1, wherein the outward extending portion of the cool storage material container has a base portion whose dimension in a thickness direction thereof is equal to a dimension of the container body portion in a thickness direction thereof, and a plurality of projecting portions which are provided on the base portion such that the projecting portions are spaced from one another in the vertical direction and which bulge outward from the base portion with respect to a direction along which the refrigerant flow tubes are arrayed.

5. An evaporator with a cool storage function according to claim 1, wherein the outward extending portion of the corresponding outer fin is brazed to the outward extending portion of the cool storage material container.

6. An evaporator with a cool storage function according to claim 1, wherein the cool storage material container is composed of two metal plates whose peripheral edge portions are joined together; and the container body portion and the out-

ward extending portion of the cool storage material container are provided by means of outward bulging at least one of the two metal plates.

7. An evaporator with a cool storage function according to claim 1, wherein an inner fin extending from the container body portion to the outward extending portion of the cool storage material container is disposed in the cool storage material container.

8. An evaporator with a cool storage function according to claim 7, wherein the inner fin assumes a corrugated shape, and has crest portions extending in the air-passing direction, trough portions extending in the air-passing direction, and connection portions connecting the crest portions and the trough portions.

9. An evaporator with a cool storage function according to claim 7, wherein the inner fin assumes a staggered shape, and is composed of a plurality of corrugated strips, each of which has crest portions extending in the air-passing direction, trough portions extending in the air-passing direction, and connection portions connecting the crest portion and the trough portion, the corrugated strips being arranged in the air-passing direction and integrally connected with one another such that the crest portions and the trough portions of one of two strips adjacent to each other in the air-passing direction are positionally shifted in the vertical direction from those of the other strip.

10. An evaporator with a cool storage function according to claim 1, wherein the container body portion of the cool storage material container is brazed to the corresponding refrigerant flow tubes; and grooves are formed in portions of outer surfaces of the container body portion of the cool storage material container, which portions are brazed to the corresponding refrigerant flow tubes.

11. An evaporator with a cool storage function according to claim 10, wherein the grooves formed in each of the portions of the outer surfaces of the container body portion of the cool storage material container, which portions are brazed to the corresponding refrigerant flow tubes, form a grid.

12. An evaporator with a cool storage function according to claim 1, comprising a plurality of refrigerant flow tube sets each including a plurality of flat refrigerant flow tubes disposed such that their width direction coincides with the air-passing direction and they are spaced from one another in the air-passing direction; and the container body portion of the cool storage material container is disposed to extend over all

the refrigerant flow tubes of the corresponding set, and is joined to the refrigerant flow tubes.

13. An evaporator with a cool storage function according to claim 1, wherein the container body portion of the cool storage material container has an internal-volume reducing portion which is formed through partial inward deformation of a wall of the cool storage material container and which reduces an internal volume of the cool storage material container.

14. An evaporator with a cool storage function according to claim 13, wherein the internal-volume reducing portion of the container body portion of the cool storage material container is configured to bulge due to an increase in internal pressure when the internal-volume reducing portion is exposed to a high temperature exceeding a temperature range of use environment.

15. An evaporator with a cool storage function according to claim 1, wherein a cool storage material charging ratio, which is the ratio of the volume of the charged cool storage material to the internal volume of the cool storage material container is 70 to 90%.

16. An evaporator with a cool storage function according to claim 15, wherein the cool storage material charging ratio is 70 to 80%.

17. An evaporator with a cool storage function according to claim 1, wherein

each of the refrigerant flow tubes in thermal contact with the cool storage material container has a plurality of refrigerant flow channels which are arranged in the width direction of the refrigerant flow tube and are separated from one another by partitions; and

a relation $0.1 \leq t \leq 0.4$ and a relation $0.64 \leq h/H \leq 0.86$ are satisfied, where t represents a thickness (mm) of each partition, h represents a height (mm) of each partition, and H represents a tube height (mm), which is a dimension of each refrigerant flow tube in a thickness direction thereof.

18. An evaporator with a cool storage function according to claim 17, wherein a relation $0.07 \leq (n \times t)/W \leq 0.31$ is satisfied, where n represents the number of the partitions of each refrigerant flow tube, and W represents a width (mm) of each refrigerant flow tube.

19. An evaporator with a cool storage function according to claim 17, wherein the tube height H of each refrigerant flow tube is 12 to 25 mm, and the width W of each refrigerant flow tube is 1.3 to 3.0 mm.

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