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(54) **EVAPORATOR WITH COOL STORAGE FUNCTION**

(75) Inventors: **Hironaka Sasaki**, Oyama-shi (JP); **Naohisa Higashiyama**, Oyama-shi (JP); **Osamu Kamoshida**, Oyama-shi (JP); **Motoyuki Takagi**, Oyama-shi (JP)

(73) Assignee: **Showa Denko K.K.**, Tokyo (JP)

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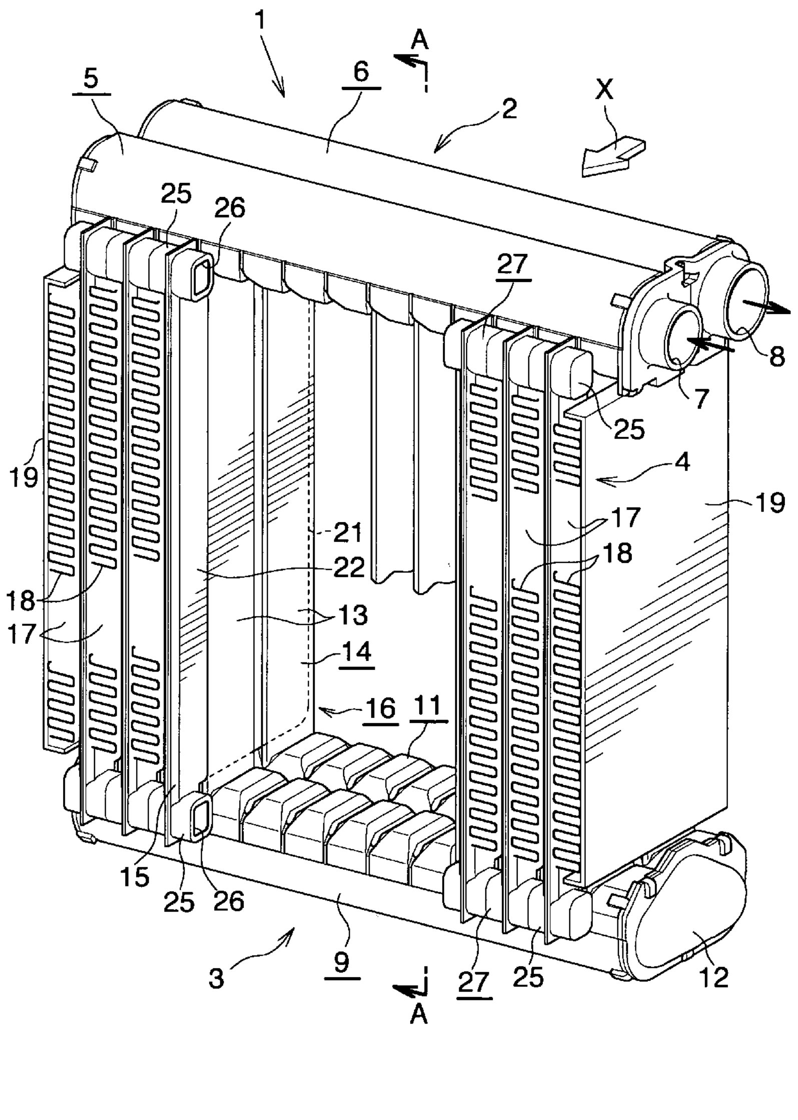
(57) **ABSTRACT**

An evaporator with a cool storage function includes a plurality of flat refrigerant flow tubes spaced apart from one another, and a plurality of flat cool storage material containers each of which contains a cool storage material and is disposed on one side of the corresponding refrigerant flow tube, and is brazed to the corresponding refrigerant flow tube. The cool storage material container includes a container body brazed to the corresponding refrigerant flow tube, and an internal-volume-increasing portion which extends downstream from the container body, which projects downstream from the refrigerant flow tube, and which is greater in dimension in a thickness direction than the container body. An inner fin extending from the container body to the internal-volume-increasing portion is disposed in the cool storage material container. This evaporator is suitable for a refrigeration cycle which constitutes a car air conditioner.



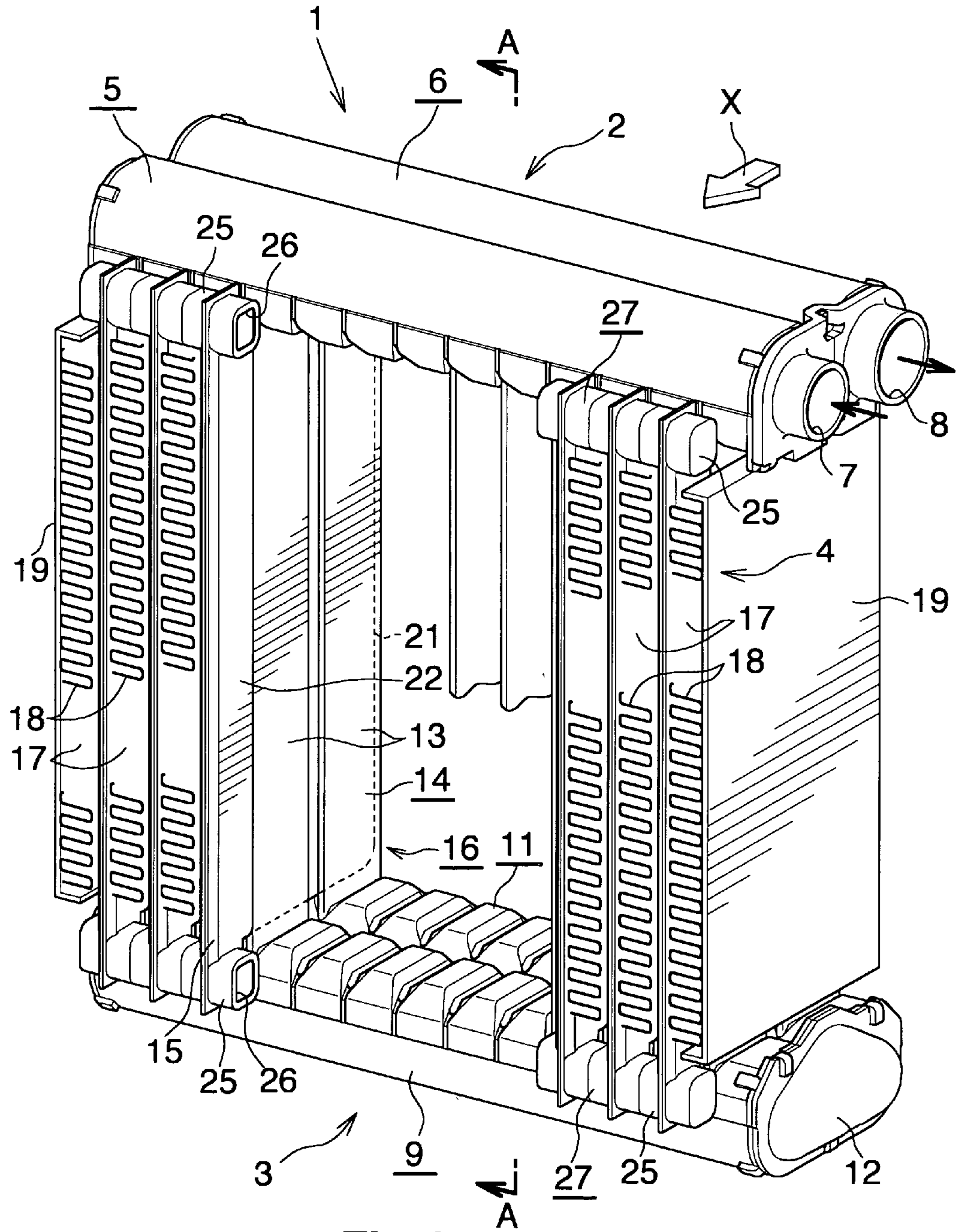

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Fig.1

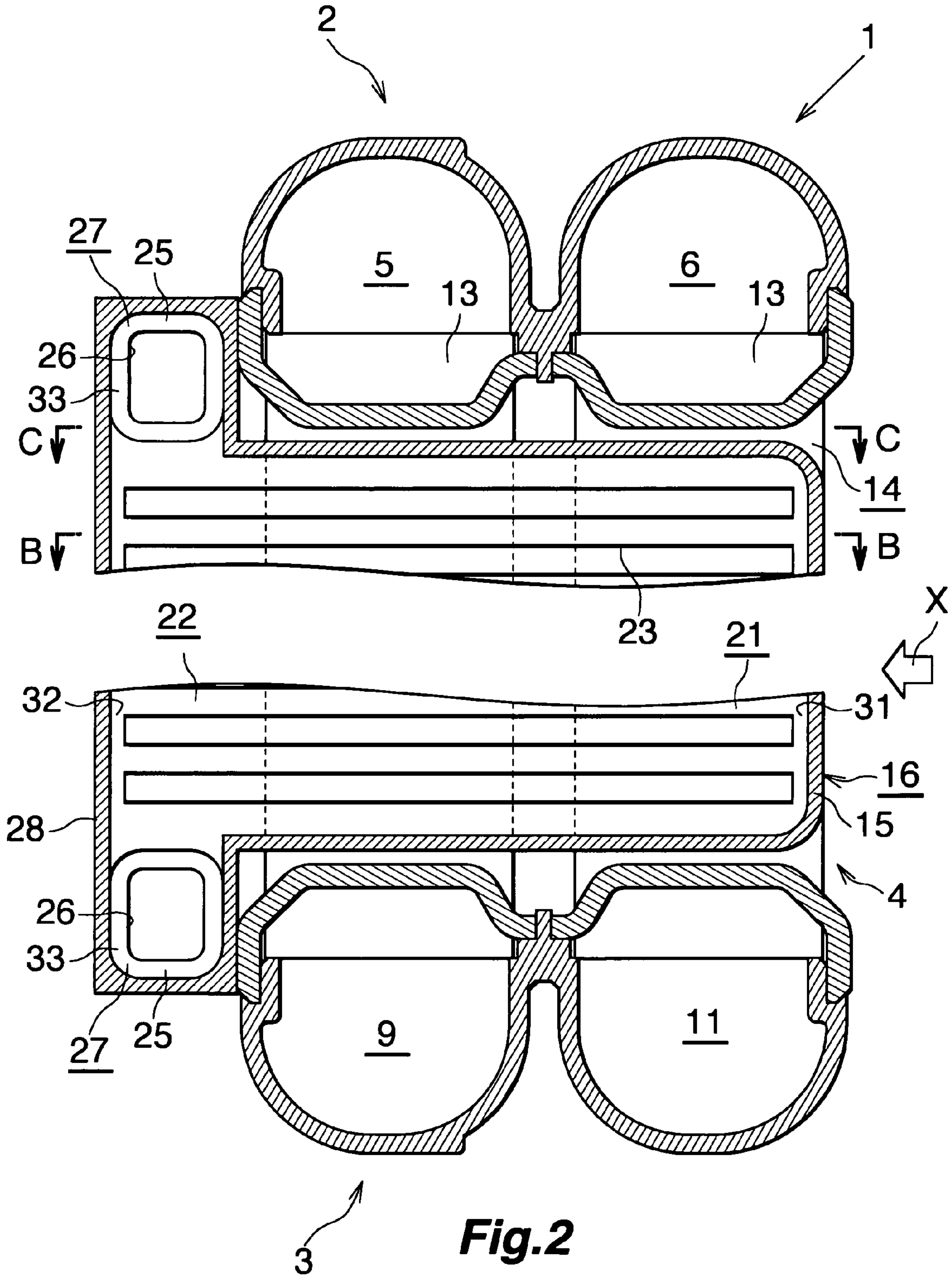
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Fig.2

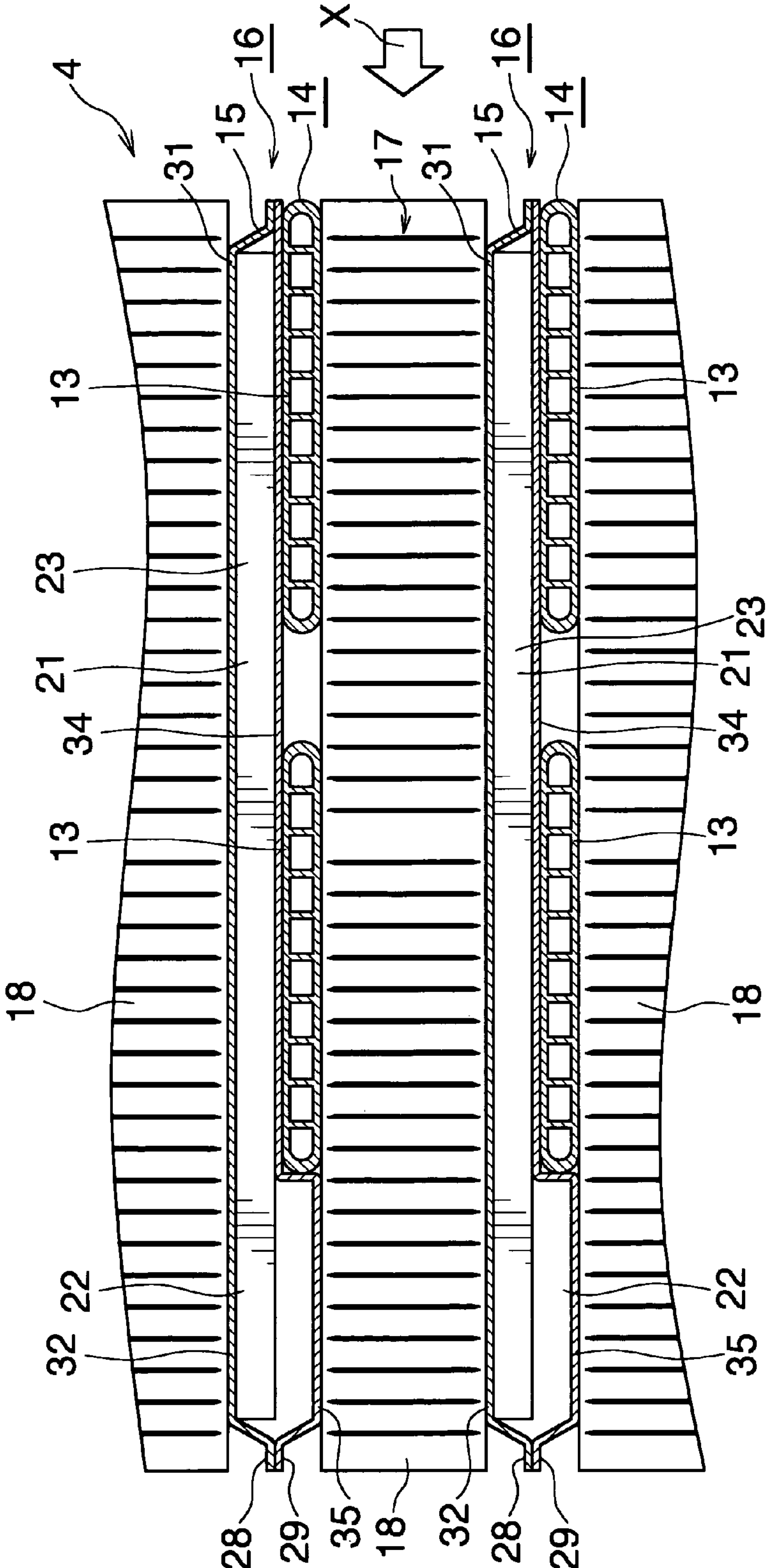

Fig.3

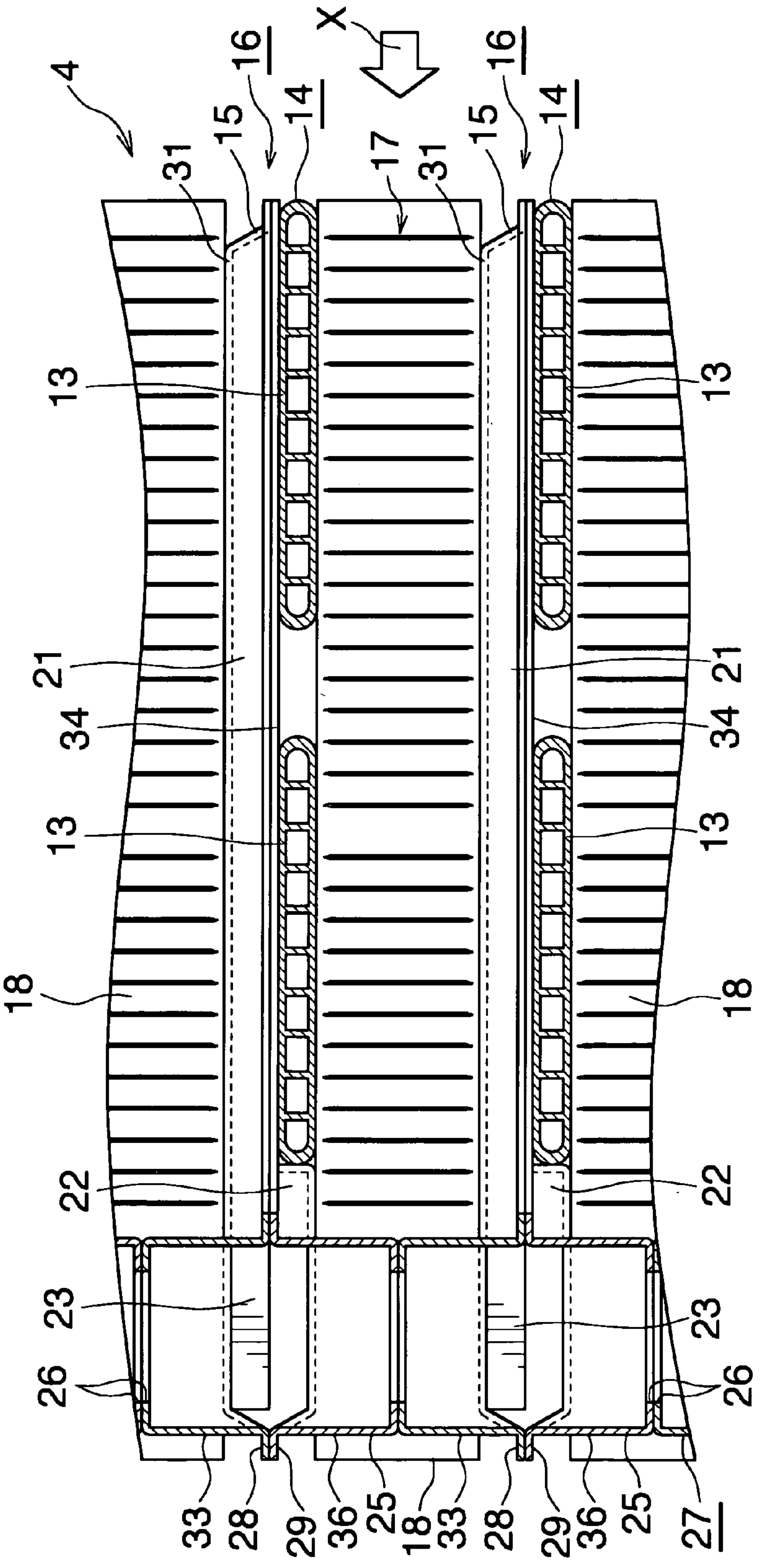

Fig.4

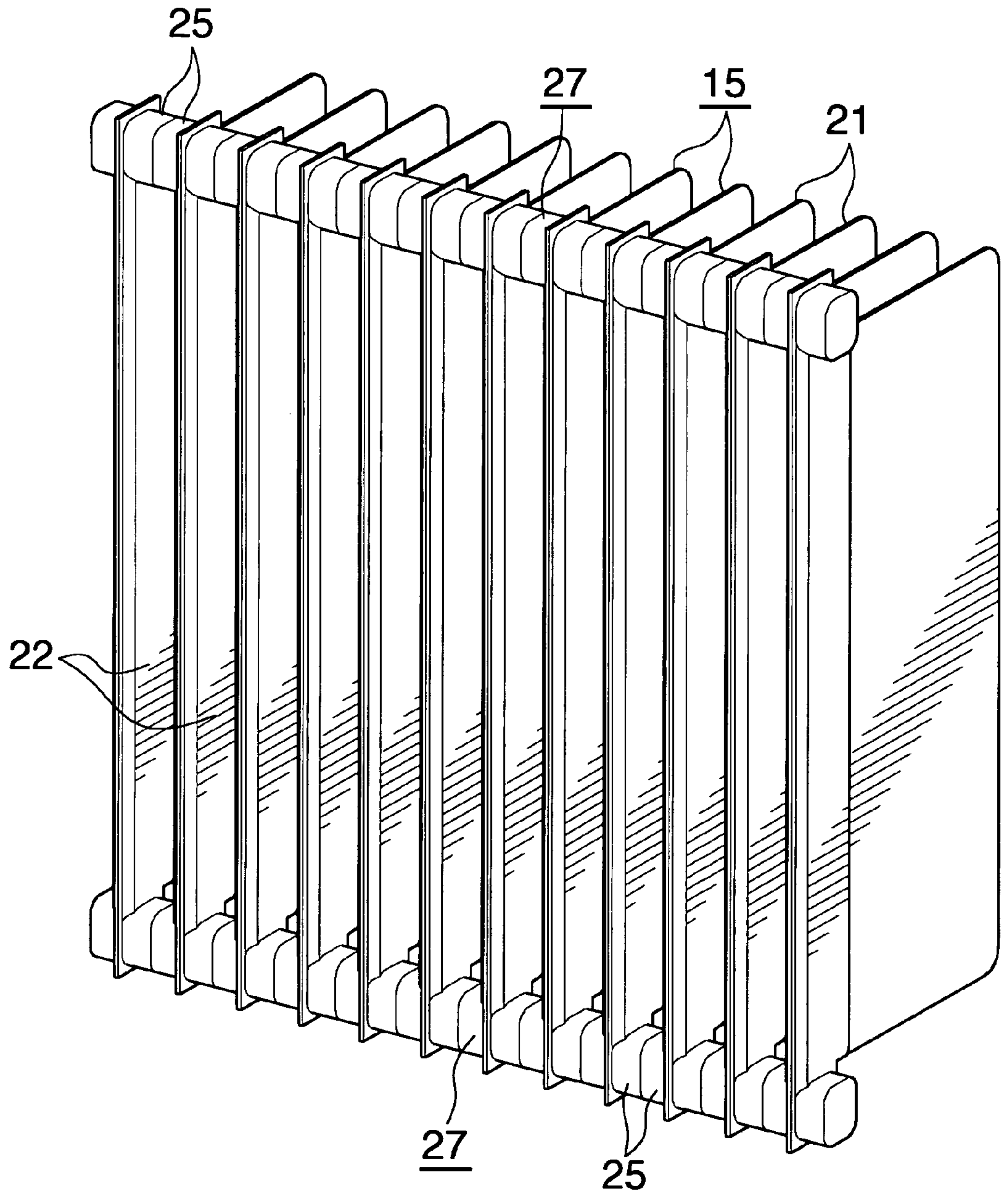

Fig.5

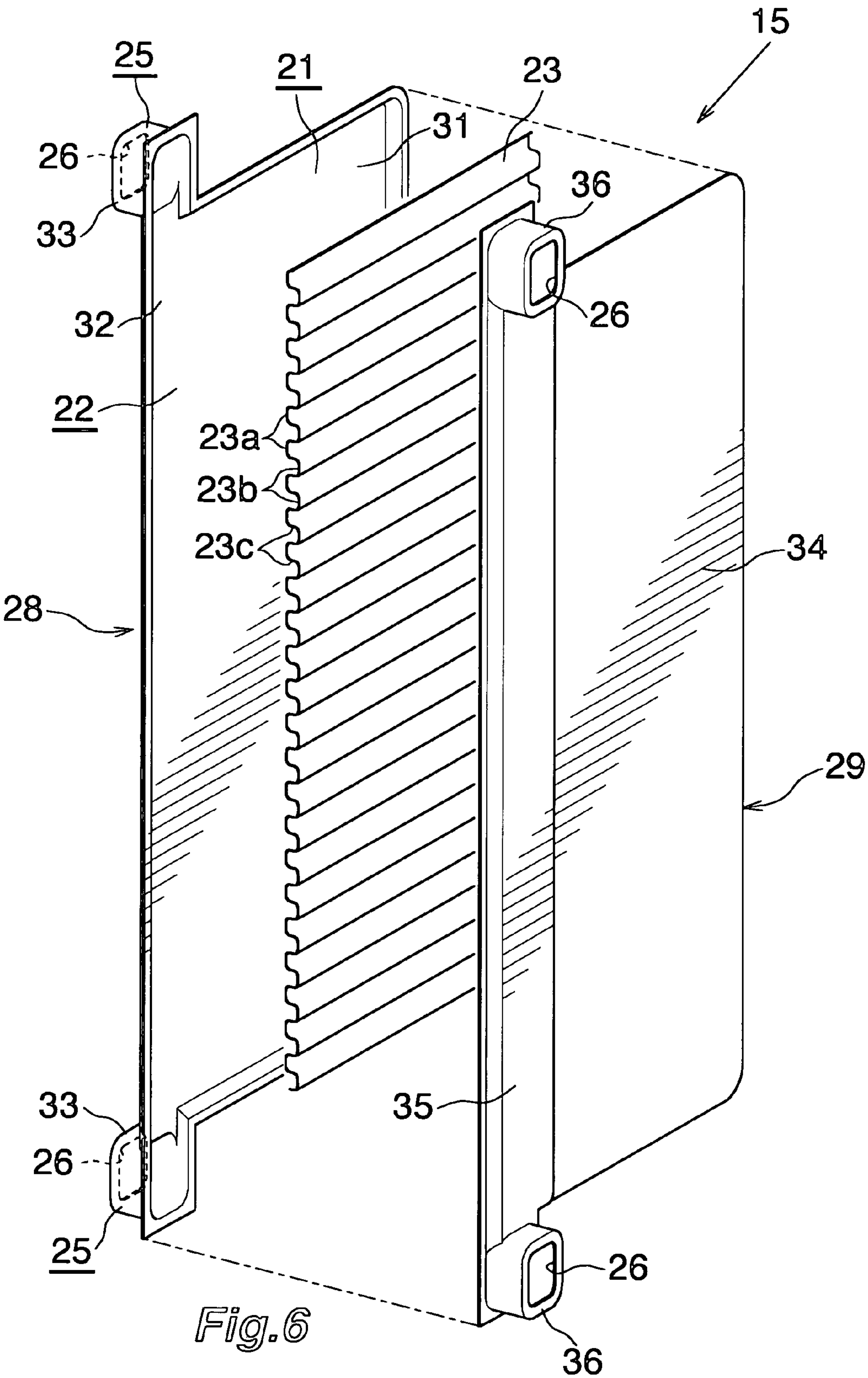

Fig.6

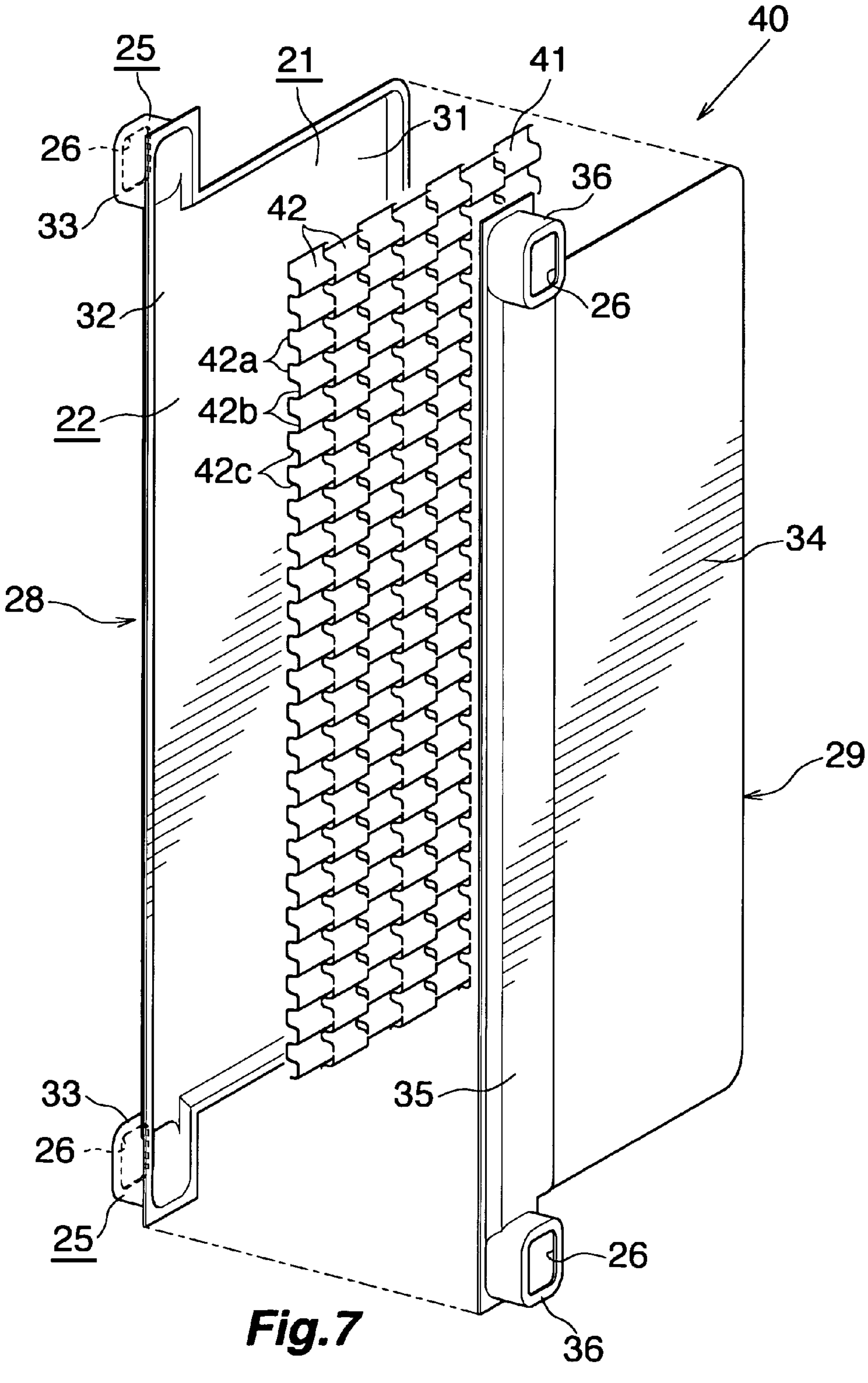
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Fig.7

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] Herein and in the appended claims, the upper side and lower side of FIGS. **1** and **2** 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 having a cool storage function has been proposed (see Japanese Patent No. 4043776). The proposed evaporator includes a plurality of sets each including two flat refrigerant flow tubes whose width direction coincides with an air flow direction and which are spaced apart from one another in the air flow direction, the plurality of sets being disposed at intervals in a direction perpendicular to the width direction of the refrigerant flow tubes. A flat cool storage material container whose width direction coincides with the air flow direction and which is filled with a cool storage material is disposed on one side of each set including two refrigerant flow tubes such that the cool storage material container extends over the refrigerant flow tubes adjacent to each other in the air flow direction, and is brazed to the refrigerant flow tubes. The cool storage material container has a constant dimension in the thickness direction over the entire cool storage material container. Assemblies each composed of a set of refrigerant flow tubes arranged in the air flow direction and a cool storage material container brazed to the set of refrigerant flow tubes are disposed at intervals in the direction perpendicular to the width direction of the refrigerant flow tubes. A space between adjacent assemblies serves as an air-passing clearance, and an outer fin is disposed in the air-passing clearance and is brazed to the corresponding refrigerant flow tubes and the corresponding cool storage material container.

[0007] In the case of the evaporator having 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, in the case of the evaporator having a cool storage function disclosed in the publication, when an increase in the amount of the cool storage material in the cool storage material container is desired in order to improve the cool storage performance, the lengths of the cool storage material containers and the refrigerant flow tubes must be increased, and the container height (dimension with respect to the thickness direction) of the cool storage material containers must be increased over the entirety thereof. However, when the lengths of the cool storage material containers and the refrigerant flow tubes are increased, the size of the heat exchange core section of the evaporator increases, with a resultant increase in weight and deterioration in space saving performance. Moreover, when the container height of the cool storage material container is increased over the entirety thereof, a longer time is needed so as to cool the cool storage material. Therefore, cooling performance at the time of start of cooling operation drops. Further, when the container height of the cool storage material containers is increased over the entirety thereof without changing the dimension of the heat exchange core section of the evaporator with a cool storage function, the air passage area of each air-passing clearance decreases, and air passage resistance increases, whereby the cooling performance of the evaporator drops.

SUMMARY OF THE INVENTION

[0009] An object of the present invention is to solve the above problems and to provide an evaporator with a cool storage function whose size and weight can be reduced as compared with the evaporator with a cool storage function described in Japanese Patent No. 4043776, which can efficiently cool a cool storage material, and which can suppress an increase in air passage resistance.

[0010] To fulfill the above object, the present invention comprises the following modes.

[0011] 1) An evaporator with a cool storage function comprising a plurality of flat refrigerant flow tubes disposed in parallel such that the refrigerant flow tubes extend vertically, the width direction of the refrigerant flow tubes coincides with an air flow direction, and the refrigerant flow tubes are spaced apart from one another, and a plurality of flat cool storage material containers each of which contains a cool storage material and is disposed on one side of the corresponding refrigerant flow tube such that the cool storage material container extends vertically, the width direction of the cool storage material container coincides with the air flow direction, and the cool storage material container is in thermal contact with the corresponding refrigerant flow tubes, wherein

[0012] each of the cool storage material containers includes a container body in thermal contact with the corresponding refrigerant flow tube, and an internal-volume-increasing portion which extends from the container body toward the upstream side or downstream side with respect to the air flow direction, which projects outward, with respect to the air flow direction, from the refrigerant flow tube, and which is greater in dimension in a thickness direction than the container body; and

[0013] each of the cool storage material containers includes an inner fin disposed therein and extending from the container body to the internal-volume-increasing portion.

[0014] 2) An evaporator with a cool storage function according to par. 1), wherein the interiors of the cool storage material containers are connected with one another at the internal-volume-increasing portions thereof.

[0015] 3) An evaporator with a cool storage function according to par. 2), wherein the interiors of all the cool storage material containers are connected with one another.

[0016] 4) An evaporator with a cool storage function according to par. 1), wherein the inner fin is a corrugated fin having crest portions extending in the air flow direction, trough portions extending in the air flow direction, and connection portions connecting the crest portions and the trough portions.

[0017] 5) An evaporator with a cool storage function according to par. 1), wherein the inner fin is a staggered fin composed of a plurality of wavy strips which are arranged in the air flow direction and are unitarily connected to one anther, each of the strips having crest portions extending in the air flow direction, trough portions extending in the air flow direction, and connection portions connecting the crest portions and the trough portions, wherein the crest portions and trough portions of one of two strips adjacent to each other in the air flow direction are vertically shifted in position from those of the other of the two strips.

[0018] 6) An evaporator with a cool storage function according to par. 4) or 5), wherein the inner fin has a constant fin height over the entirety of the inner fin, the fin height being equal to the height of the interior of the container body of the cool storage material container and less than the height of the interior of the internal-volume-increasing portion.

[0019] 7) An evaporator with a cool storage function according to par. 1), wherein the refrigerant flow tubes and the cool storage material containers are formed separately; a plurality of assemblies each composed of a refrigerant flow tube and a cool storage material container whose container body is brazed to the refrigerant flow tube are disposed at intervals in a direction perpendicular to the width direction of the refrigerant flow tubes; spaces each formed between adjacent assemblies serve as air-passing clearances; outer fins are disposed in the air-passing clearances; portions of the outer fins on the side toward the internal-volume-increasing portions of the cool storage material containers project outward, with respect to the air flow direction, from the refrigerant flow tubes; and the outer fins are brazed to opposite surfaces of the internal-volume-increasing portions of the cool storage material containers.

[0020] 8) An evaporator with a cool storage function according to par. 7), wherein the refrigerant flow tube of each of the assembly comprises a plurality of refrigerant flow tubes disposed such that the refrigerant flow tubes are spaced apart from each other in the air flow direction; and the container body of the cool storage material container of each assembly is disposed to extend over and is brazed to all the refrigerant flow tubes of the assembly.

[0021] 9) An evaporator with a cool storage function according to par. 1), wherein a portion of each cool storage material container on the downstream side with respect to the air flow direction projects outward, with respect to the air flow direction, from the refrigerant flow tubes; and the internal-volume-increasing portion is provided on the portion of the cool storage material container that projects from the refrigerant flow tubes.

[0022] According to the evaporator with a cool storage function of par. 1) to 9), each of the cool storage material containers includes a container body in thermal contact with the refrigerant flow tubes, and an internal-volume-increasing portion which extends from the container body toward the upstream side or downstream side with respect to the air flow direction, which projects outward, with respect to the air flow direction, from the refrigerant flow tube, and which is greater in dimension in a thickness direction than the container body. Therefore, the amount of the cool storage material charged into the cool storage material containers can be increased without increasing the lengths of the refrigerant flow tubes and the cool storage material containers, or increasing the container height (the dimension in the thickness direction) of the cool storage material containers over the entirety thereof, as in the evaporator with a cool storage function described in Japanese Patent No. 4043776. Accordingly, the size and weight of the evaporator can be reduced, as compared with the evaporator with a cool storage function described in Japanese Patent No. 4043776 in which the container height of the cool storage material containers is constant over the entirety thereof. Moreover, the time required to cool the cool storage material can be shortened as compared with the case where the container height is increased in the evaporator with a cool storage function described in Japanese Patent No. 4043776 in which the container height of the cool storage material containers is constant over the entirety thereof. Therefore, a drop in the cooling performance at the start of cooling operation is suppressed. In addition, since an inner fin extending from the container body to the internal-volume-increasing portion is disposed in each cool storage material container, the cool storage material within the internal-volume-increasing portion is cooled quickly. Accordingly, the cool storage material within the cool storage material containers can be cooled efficiently.

[0023] Furthermore, the internal-volume-increasing portion extends from the container body toward the upstream side or downstream side with respect to the air flow direction and projects outward, with respect to the air flow direction, from the refrigerant flow tube. Therefore, even in the case where a plurality of assemblies each composed of a refrigerant flow tube and a cool storage material container whose container body is in thermal contact with the refrigerant flow tube are disposed at intervals in a direction perpendicular to the width direction of the refrigerant flow tubes, and spaces each formed between adjacent assemblies serve as air-passing clearances, the amount of the cool storage material charged into the cool storage material containers can be increased without changing the dimensions of the heat exchange core section. Accordingly, a decrease in the areas of the air-passing clearance can be suppressed as compared with the evaporator with a cool storage function described in Japanese Patent No. 4043776, whereby an increase in air passage resistance can be suppressed, and, as a result, a drop in cooling performance can be prevented.

[0024] According to the evaporator with a cool storage function of par. 2), the interiors of the cool storage material containers communicate with one another at the internal-volume-increasing portions thereof. Therefore, through formation of a cool-storage-material charging opening in the internal-volume-increasing portion of one cool storage material container and an air bleeding opening in the internal-volume-increasing portion of another cool storage material container, an operation of charging the cool storage material into the mutually connected cool storage material containers becomes easier.

[0025] According to the evaporator with a cool storage function of par. 4) to 6), when the cool storage material is charged from the internal-volume-increasing portion into the cool storage material container, the cool storage material having entered the internal-volume-increasing portion of the cool storage material container reaches the container body via spaces between adjacent connection portions of the inner fin. Therefore, the operation of charging the cool storage material can be readily performed.

[0026] According to the evaporator with a cool storage function of par. 7), a plurality of assemblies each composed of a refrigerant flow tube and a cool storage material container whose container body is brazed to the refrigerant flow tube are disposed at intervals in a direction perpendicular to the width direction of the refrigerant flow tubes; spaces each formed between adjacent assemblies serve as air-passing clearances; outer fins are disposed in the air-passing clearances; portions of the outer fins on the side toward the internal-volume-increasing portions of the cool storage material containers project outward, with respect to the air flow direction, from the refrigerant flow tubes; and the outer fins are brazed to opposite surfaces of the internal-volume-increasing portions of the cool storage material containers. Therefore, when a compressor stops as a result of stoppage of an engine, the cool stored in the cool storage material within the internal-volume-increasing portion of each cool storage material container is transferred from the opposite side surfaces of the internal-volume-increasing portion to air passing through the air-passing clearance via the fins brazed to the opposite side surfaces of the internal-volume-increasing portions. Accordingly, cool radiation performance is improved.

[0027] According to the evaporator with a cool storage function of par. 9), the internal-volume-increasing portion is provided on the downstream side of the container body. Therefore, the internal-volume-increasing portion into which a large amount of the cool storage material is charged is present at a position at which air passing through the air-passing clearances has a lowered temperature. Accordingly, the cool storage material within the cool storage material containers can be cooled efficiently, whereby cool storage performance is improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] 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;

[0029] FIG. **2** is a partially omitted enlarged sectional view taken along line A-A of FIG. **1**;

[0030] FIG. **3** is an enlarged sectional view taken along line B-B of FIG. **2**;

[0031] FIG. **4** is an enlarged sectional view taken along line C-C of FIG. **2**;

[0032] FIG. **5** is a perspective view showing a plurality of cool storage material containers united together;

[0033] FIG. **6** is an exploded perspective view showing a single cool storage material container; and

[0034] FIG. **7** is an exploded perspective view corresponding to FIG. **6** and showing a modification of the cool storage material container.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0035] An embodiment of the present invention will next be described with reference to the drawings.

[0036] In the following description, the downstream side with respect to the air flow direction (a direction represented by arrow X in FIGS. **1** to **4**) 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.

[0037] In the following description, the term "aluminum" encompasses aluminum alloys in addition to pure aluminum.

[0038] FIG. **1** shows the overall configuration of an evaporator with a cool storage function according to the present invention, and FIGS. **2** to **6** show the configurations of essential portions of the evaporator.

[0039] As shown in FIGS. **1** and **2**, 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**.

[0040] The first header tank **2** includes a refrigerant inlet header section **5** located on the front side (downstream side with respect to the air flow direction); and a refrigerant outlet header section **6** located on the rear side (upstream side with respect to the air flow 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 brazed to the right ends of the intermediate header sections **9** and **11** and which has a flow passage formed therein.

[0041] As shown in FIGS. **1** to **4**, the heat exchange core section **4** includes a plurality of sets **14** each composed of a plurality of (two in the present embodiment) flat refrigerant flow tubes **13** formed of aluminum extrudate. The refrigerant flow tubes **13** extend in the vertical direction, and are disposed such that their width direction coincides with the front-rear direction and they are spaced apart from each other in the front-rear direction. The plurality of sets **14** are disposed at predetermined intervals in the left-right direction (the direction perpendicular to the width direction of the refrigerant flow tubes **13**). A flat cool storage material container **15** formed of aluminum and filled with a cool storage material (not illustrated) is disposed on one side (the left side surface in the present embodiment) of each set **14** composed of two refrigerant flow tubes **13**. The cool storage material container **15** extends in the vertical direction, and is disposed such that its width direction coincides with the front-rear direction. The cool storage material container **15** extends over the two refrigerant flow tubes **13** of each set **14**.

[0042] Upper end portions of the front refrigerant flow tubes **13** are connected to the refrigerant inlet header section **5**, and lower end portions of the front refrigerant flow tubes **13** are connected to the first intermediate header section **9**. Further, upper end portions of the rear refrigerant flow tubes **13** are connected to the refrigerant outlet header section **6**, and lower end portions of the rear refrigerant flow tubes **13** are connected to the second intermediate header section **11**. Thus, there are formed a plurality of assemblies **16** each composed of one set **14** including the two refrigerant flow tubes **13** arranged in the front-rear direction, and the cool storage material container **15** disposed to extend over the two refrigerant flow tubes **13** of each set **14**. The plurality of assemblies **16** are disposed at predetermined intervals in the left-right direction. Spaces each formed between adjacent assemblies **16** serve air-passing clearances **17**. Outer fins **18** formed of aluminum are disposed in the air-passing clearances **17**, and are brazed to the corresponding refrigerant flow tubes **13** and the corresponding cool storage material containers **15**. Further, the outer fin **18** formed of aluminum is disposed on the outer sides of the assemblies **16** (each composed of the refrigerant flow tubes **13** of each set **14** and the corresponding cool storage material container **15**) located at the left and right ends, respectively. The right end outer fin **18** is brazed to the front and rear refrigerant flow tubes **13** located at the right end, and the left end outer fin **18** is brazed to the cool storage material container **15** located at the left end. Notably, each of the outer fins **18** is a corrugated fin having 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. A side plate **19** formed of aluminum is disposed on the outer side of each of the outer fins **18** located at the left and right ends, respectively, and is brazed to the corresponding outer fin **18**. Thus, the air-passing clearance **17** is also formed between the side plate **19** at the left end and the assembly **16** at the left end and between the side plate **19** at the right end and the assembly **16** at the right end.

[0043] As shown in FIGS. **2** to **5**, each cool storage material container **15** includes a container body **21** and an internal-volume-increasing portion **22**. The container body **21** is located rearward of the front edges of the refrigerant inlet header section **5** and the first intermediate header section **9**, and is brazed to the front and rear refrigerant flow tubes **13** of the corresponding set **14**. The internal-volume-increasing portion **22** extends from the front edge of the container body **21** such that the volume-increasing portion **22** projects frontward from the front edges of the refrigerant inlet header section **5** and the first intermediate header section **9**. The dimension of the internal-volume-increasing portion **22** as measured in the thickness direction (left-right direction) is greater than that of the container body **21**. The dimension of the container body **21** as measured in the left-right direction is constant over the entirety thereof. The dimension of the internal-volume-increasing portion **22** as measured in the left-right direction is equal to the sum of a tube height, which is the dimension of the refrigerant flow tubes **13** as measured in the thickness direction (left-right direction) and the dimension of the container body **21** of each cool storage material container **15** as measured in the thickness direction. The internal-volume-increasing portion **22** is swelled rightward only in relation to the container body **21**, and the left side surface of the internal-volume-increasing portion **22** is flush with the left side surface of the container body **21**.

[0044] An inner fin **23** which is formed of aluminum and which extends from the rear edge of the container body **21** to the front end of the internal-volume-increasing portion **22** is disposed in each cool storage material container **15** such that the inner fin **23** extends over substantially the entire vertical length of the container body **21**. The inner fin **23** is a corrugated fin having crest portions **23*a*** extending in the front-rear direction, trough portions **23*b*** extending in the front-rear direction, and connection portions **23*c*** connecting the crest portions **23*a*** and the trough portions **23*b*** (see FIG. **6**). The fin height of the inner fin **23** is constant over the entire inner fin **23**. The inner fin **23** is brazed to the inner surfaces of the left-side walls of the container body **21** and the internal-volume-increasing portion **22** of the cool storage material container **15**, and is brazed to the inner surface of the right-side wall of the container body **21**.

[0045] Upper and lower end portions of the internal-volume-increasing portion **22** of each cool storage material container **15** project upward and downward, respectively, from the upper and lower ends of the container body **21**. Each of the projecting portions of the internal-volume-increasing portion **22** has left and right tank-forming portion **25** swelled outward with respect to the left-right direction. The tank-forming portion **25** of the internal-volume-increasing portions **22** of adjacent cool storage material containers **15** are brazed to each other, whereby all the cool storage material containers **15** are united. Further, a communication hole **26** formed in a swelled end wall portion of each of the tank-forming portion **25** establishes communication between the interiors of the tank-forming portion **25** of the internal-volume-increasing portions **22** of adjacent cool storage material containers **15**. The upper tank-forming portion **25** of the internal-volume-increasing portions **22** of all the cool storage material containers **15** form an upper communication tank **27**, and the lower tank-forming portion **25** of the internal-volume-increasing portions **22** of all the cool storage material containers **15** form a lower communication tank **27**. Thus, the interiors of all the cool storage material containers **15** are connected together via the upper and lower communication tanks **27**. Although not illustrated, preferably, a cool-storage-material charging opening is formed in one of the upper and lower communication tanks **27**, and an air-bleeding opening is formed in the other of the upper and lower communication tanks **27**. A cool storage material is charged into all the cool storage material containers **15** via the cool-storage-material charging opening. In this case, the cool storage material first enters the internal-volume-increasing portion **22** of each cool storage material container **15**, and then enters the container body **21** thereof through spaces between the adjacent connection portions **23*c*** of the corresponding inner fin **23**. After the cool storage material is charged into the cool storage material containers **15**, the cool-storage-material charging opening and the air-bleeding opening are closed by appropriately means. Examples of the cool storage material to be charged into the cool storage material containers **15** include a water-based cool storage material and a paraffin-based cool storage material having an adjusted freezing point of about 3 to 10° C. Further, preferably, the amount of the cool storage material charged into the cool storage material containers **15** is determined so that the cool storage material fills all the cool storage material containers **15** up to their upper ends.

[0046] As shown in FIG. **6**, each cool storage material container **15** is composed of two generally rectangular, vertically elongated aluminum plates **28** and **29** brazed together along their peripheral edge portions. Both the aluminum plates **28** and **29** are formed from an aluminum brazing sheet having a brazing material layer on each of opposite sides thereof, and have the same external shape when they are viewed from the left and right sides, respectively. The left-hand aluminum plate **28**, which partially constitutes the cool storage material container **15**, includes a first swelled portion **31** for forming the container body **21**, a second swelled portion **32** for forming the internal-volume-increasing portion **22**, and third swelled portions **33** for forming the tank-forming portions **25**. The first swelled portion **31** accounts for the greater part of the aluminum plate **28**, excluding a front portion thereof, and is swelled leftward. The second swelled portion **32**, which extends frontward from the first swelled portion **31**, is swelled leftward, and has the same swelling height as the first swelled portion **31**. The third swelled portions **33** are provided at the upper and lower ends of the second swelled portion **32**, are swelled leftward, and have a swelling height greater than that of the second swelled portion **32**. The above-mentioned communication holes **26** are formed on the swelled end walls of the third swelled portions **33** of the left-hand aluminum plate **28** of each cool storage material container **15**, excluding the cool storage material container **15** at the left end.

[0047] The right-hand aluminum plate **29**, which partially constitutes the cool storage material container **15**, includes a flat portion **34** for forming the container body **21**, a first swelled portion **35** for forming the internal-volume-increasing portion **22**, and second swelled portions **36** for forming the tank-forming portions **25**. The flat portion **34** accounts for the greater part of the aluminum plate **29**, excluding a front portion thereof. The first swelled portion **35**, which extends frontward from the flat portion **34**, is swelled rightward. The second swelled portions **36** are provided at the upper and lower ends of the first swelled portion **35**, are swelled rightward, and have a swelling height greater than that of the first swelled portion **35**. The above-mentioned communication holes **26** are formed on the swelled end walls of the second swelled portions **36** of the right-hand aluminum plate **29** of each cool storage material container **15**, excluding the cool storage material container **15** at the right end.

[0048] The two aluminum plates **28** and **29** are assembled and brazed together so that the openings of the swelled portions **32** and **35** face each other, the openings of the swelled portions **33** and **36** face each other, and the opening of the first swelled portion **31** is closed by the flat portion **34**. Thus, the cool storage material container **15** is formed. The tank formation portions **25** of two adjacent cool storage material containers **15** are brazed to each other such that the communication holes **26** of the third swelled portions **33** communicate with the communication holes **26** of the second swelled portions **36**.

[0049] A front portion of each outer fin **18** projects frontward from the front refrigerant flow tubes **13**. A portion of the outer fin **18**, which portion projects frontward from the front refrigerant flow tubes **13**, is brazed to the left side surface of the internal-volume-increasing portion **22** of the cool storage material container **15** located on the right side of the outer fin **18**, and is brazed to the right side surface of the internal-volume-increasing portion **22** of the cool storage material container **15** located on the left side of the outer fin **18**.

[0050] 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 an 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 **17**, and flows out of the refrigerant flow tubes **13** in a vapor phase.

[0051] At that time, the cool storage material within the container body **21** of each cool storage material container **15** is cooled by the refrigerant flowing through the refrigerant flow tubes **13**, and cool of the cooled cool storage material within the container body **21** is transferred to the cool storage material within the internal-volume-increasing portion **22** of the cool storage material container **15** via the inner fin **23**. In addition, the cool storage material within the internal-volume-increasing portion **22** of each cool storage material container **15** is cooled by air having been cooled by the refrigerant while passing through the air-passing clearances **17**. As a result, cool is stored in the entire cool storage material within the cool storage material container **15**.

[0052] When the compressor stops, the cool stored in the cool storage material within the container body **21** and the internal-volume-increasing portion **22** of each cool storage material container **15** is transferred to the left side walls of the container body **21** and the internal-volume-increasing portion **22** via the corresponding inner fin **23**, and then transferred to air passing through the corresponding air-passing clearance **17** via the outer fin **18** brazed to the left side surface of the cool storage material container **15**. Furthermore, the cool stored in the cool storage material within the container body **21** of each cool storage material container **15** is transferred to the right side wall of the container body **21** via the corresponding inner fin **23**, and then transferred from the right side surface of the container body **21** to air passing through the corresponding air-passing clearance **17** via the corresponding refrigerant flow tubes **13** and the outer fin **18** brazed to the refrigerant flow tubes **13**. Moreover, the cool stored in the cool storage material within the internal-volume-increasing portion **22** of each cool storage material container **15** is transmitted from the right side surface of the internal-volume-increasing portion **22** to the air passing through the corresponding air-passing clearances **17** via the outer fin **18** brazed to the right side surface of the internal-volume-increasing portion **22**. Accordingly, even when the temperature of wind having passed through the evaporator **1** increases, the wind is cooled, so that a sharp drop in the cooling capacity can be prevented.

[0053] In the above-described embodiment, each of the refrigerant flow tubes of the evaporator with a cool storage function may be provided in a flat hollow body formed by two aluminum plates brazed together along their peripheral edge portions, as in the case of a so-called laminate-type evaporator. That is, each of the refrigerant flow tubes may be formed between the two aluminum plates which were swelled so as to constitute a flat hollow body.

[0054] FIG. **7** shows a modification of the cool storage material container.

[0055] In the case of a cool storage material container **40** shown in FIG. **7**, a staggered inner fin **41** formed of aluminum is disposed in the cool storage material container **40** such that the inner fin **41** extends from the rear end of the container body **21** to the front end of the internal-volume-increasing portion **22**, and extends over substantially the entire vertical length of the container body **21**. The inner fin **41** is formed by means of unitarily connecting a plurality of wavy strips **42** which are arranged in the air flow direction and each of which has crest portions **42***a* extending in the front-rear direction (the air flow direction), trough portions **42***b* extending in the front-rear direction, and connection portions **42***c* connecting the crest portions **42***a* and the trough portions **42***b*. The crest portions **42***a* and trough portions **42***b* of one of two strips **42** adjacent to each other in the front-rear direction are vertically shifted in position from those of the other of the two strips **42**.

[0056] Other structures are the same as the cool storage material container **15** of the above-described embodiment.

1. An evaporator with a cool storage function comprising a plurality of flat refrigerant flow tubes disposed in parallel such that the refrigerant flow tubes extend vertically, the width direction of the refrigerant flow tubes coincides with an air flow direction, and the refrigerant flow tubes are spaced apart from one another; and a plurality of flat cool storage material containers each of which contains a cool storage material and is disposed on one side of the corresponding refrigerant flow tube such that the cool storage material container extends vertically, the width direction of the cool storage material container coincides with the air flow direction, and the cool storage material container is in thermal contact with the corresponding refrigerant flow tube, wherein

each of the cool storage material containers includes a container body in thermal contact with the corresponding refrigerant flow tube, and an internal-volume-increasing portion which extends from the container body toward the upstream side or downstream side with respect to the air flow direction, which projects outward, with respect to the air flow direction, from the refrigerant flow tube, and which is greater in dimension in a thickness direction than the container body; and

each of the cool storage material containers includes an inner fin disposed therein and extending from the container body to the internal-volume-increasing portion.

2. An evaporator with a cool storage function according to claim **1**, wherein the interiors of the cool storage material containers are connected with one another at the internal-volume-increasing portions thereof.

3. An evaporator with a cool storage function according to claim **2**, wherein the interiors of all the cool storage material containers are connected with one another.

4. An evaporator with a cool storage function according to claim **1**, wherein the inner fin is a corrugated fin having crest portions extending in the air flow direction, trough portions extending in the air flow direction, and connection portions connecting the crest portions and the trough portions.

5. An evaporator with a cool storage function according to claim **1**, wherein the inner fin is a staggered fin composed of a plurality of wavy strips which are arranged in the air flow direction and are unitarily connected to one anther, each of the strips having crest portions extending in the air flow direction, trough portions extending in the air flow direction, and connection portions connecting the crest portions and the trough portions, wherein the crest portions and trough portions of one of two strips adjacent to each other in the air flow direction are vertically shifted in position from those of the other of the two strips.

6. An evaporator with a cool storage function according to claim **4**, wherein the inner fin has a constant fin height over the entirety of the inner fin, the fin height being equal to the height of the interior of the container body of the cool storage material container and less than the height of the interior of the internal-volume-increasing portion.

7. An evaporator with a cool storage function according to claim **1**, wherein the refrigerant flow tubes and the cool storage material containers are formed separately; a plurality of assemblies each composed of a refrigerant flow tube and a cool storage material container whose container body is brazed to the refrigerant flow tube are disposed at intervals in a direction perpendicular to the width direction of the refrigerant flow tubes; spaces each formed between adjacent assemblies serve as air-passing clearances; outer fins are disposed in the air-passing clearances; portions of the outer fins on the side toward the internal-volume-increasing portions of the cool storage material containers project outward, with respect to the air flow direction, from the refrigerant flow tubes; and the outer fins are brazed to opposite surfaces of the internal-volume-increasing portions of the cool storage material containers.

8. An evaporator with a cool storage function according to claim **7**, wherein the refrigerant flow tube of each of the assembly comprises a plurality of refrigerant flow tubes disposed such that the refrigerant flow tubes are spaced apart from each other in the air flow direction; and the container body of the cool storage material container of each assembly is disposed to extend over and is brazed to all the refrigerant flow tubes of the assembly.

9. An evaporator with a cool storage function according to claim **1**, wherein a portion of each cool storage material container on the downstream side with respect to the air flow direction projects outward, with respect to the air flow direction, from the refrigerant flow tubes; and the internal-volume-increasing portion is provided on the portion of the cool storage material container that projects from the refrigerant flow tubes.

10. An evaporator with a cool storage function according to claim **5**, wherein the inner fin has a constant fin height over the entirety of the inner fin, the fin height being equal to the height of the interior of the container body of the cool storage material container and less than the height of the interior of the internal-volume-increasing portion.

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