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DEVICE FOR SUPPLYING COOLED AIR

This invention is concerned with a device for supplying cooled air, wherein air to be blown is cooled by a heat exchanger.

In general, a heat pump type cooling device has been well known
5 as a device for cooling air. This heat pump type cooling device consists of an inner unit and an outer unit, the former being provided therein with a heat-exchanger, a blower, etc., and installed in the wall or on the floor of a room, while the latter being provided with a compressor and a radiator. Both these inner and
10 outer units are mutually connected through a tube for circulating a cooling medium. On account of such construction as mentioned in the preceding, the device as a whole becomes disadvantageously large in size and expensive in price. Further, once installed, the device can no longer be moved readily to other rooms owing to its use of the
15 cooling medium circulating pipe, which is another shortcoming.

As another type of the conventional cooling device, there was such one that evaporates water fed by a pump from the upper part of a ventilation flue, by means of the blower, and cools air sent from the blower by heat of evaporation to be generated at the time of the
20 water evaporation.

However, this type of the conventional device requires to have a pump for supplying water to the ventilation flue and a water storage tank for storing water dropped from the ventilation flue with the result that the device disadvantageously increases its size and becomes expensive. Moreover, since humidity in the room becomes so high, it not only causes the human body to feel uncomfortable, but also, gives mal-effects to the furnitures and fittings as well as clothing in the room.

With a view, therefore, to solving the abovementioned disadvantages with these conventional devices, there has been proposed one as disclosed in Japanese Utility Model Registration No. 1,392,306.

The cooling device in this prior art is of such a construction that a heat-exchanger with a regenerative cooling agent being sealed in it is installed in an adiabatic container having an inlet port for external air and an outlet port for cooled air in a manner to be able to be removed readily. The heat-exchanger is cooled in advance in a refrigerator, etc. so as to freeze the regenerative cooling agent, after which the heat-exchanger is placed in the adiabatic container, and then the external air which has been forced to introduce into the adiabatic container through the external air inlet port is impinged on the heat-exchanger to thereby cool the same as introduced thereinto through the inlet port to obtain the cooled air.

The heat exchanger as proposed in this Utility Model Registration No. 1,392,306, however, was in a thick planar form, owing to which it had a small contact area with air and its heat-exchanging efficiency was low. On account of this, the device was not able to produce cooled air at a sufficiently low temperature.

It is therefore a primary object of the present invention to provide a cooled air supplying device which is simple in construction, capable of cooling air with good efficiency, and easy to carry.

In an attempt to realize the cooled air supplying device of the abovementioned advantages, the present invention constructs such cooled air supplying device by first providing a ventilation flue in the interior of a casing having an inlet port for external air and an outlet port for cooled air in such a manner that the ventilation flue may be communicating between the inlet port and the outlet port, and then by providing in the interior of this ventilation flue an air blowing means for introducing external air through the inlet port and a heat-exchanger to cool the external air as introduced into it, the heat-exchanger being constructed with a regenerative cooling body with a regenerative cooling agent being sealed in its interior and a heat-exchanging plate formed separately from the regenerative cooling agent and installed in the abovementioned ventilation flue in its state of being in close contact with the regenerative cooling body.

The foregoing object, other objects as well as specific construction, function and resulting effect of the cooled air supplying device according to the present invention will become more apparent and understandable from the following detailed description thereof, when read in conjunction with the accompanying drawing illustrating a few preferred embodiments thereof.

In the drawing:

Figures 1 to 4 illustrate the first embodiment of the present invention, wherein Figure 1 is a perspective view of the cooled air supply device as a whole, in a state of a heat-exchanger being taken out of the casing; Figure 2 is a cross-sectional view at the center

part of the device in a state of its being in use; Figure 3 is an enlarged view of the main part of the device in Figure 2; and Figure 4 is an end view of the main part of the heat-exchanging plate;

Figures 5 to 9 show the second embodiment of the present invention, in which Figure 5 is a cross-sectional view at the center part of the entire device; Figure 6 is a cross-sectional view taken along a line VI-VI in Figure 5; Figure 7 is a perspective view of the heat-exchanging plate in the course of its manufacture; Figure 8 is a perspective view of the heat-exchanging plate in its completed form; and Figure 9 is a perspective view for explaining a manner, in which the regenerative cooling body shown in Figure 5 is to be taken out of the casing; and

Figure 10 is a cross-sectional view showing the third embodiment of the device according to the present invention.

In the following, the present invention will be explained in detail with reference to preferred embodiments thereof shown in the accompanying drawing.

Figures 1 to 4 illustrate the first embodiment of the cooled air supplying device according to the present invention, wherein a reference numeral 1 designates a box-shaped casing having a discharge (outlet) opening 1a formed in its front face and an inlet opening 1b for introducing external air at the corner part of the casing, where the bottom wall surface and the rear wall surface thereof meet; a numeral 2 refers to a ventilation flue formed in the interior of this casing 1 extending from the air inlet opening 1b to the air outlet opening 1a; a reference numeral 3 denotes an opening formed in the upper wall surface of the casing 1 and on the way of the ventilation flue 2, which is normally closed with a lid 5 which is

pivotally held at its one side edge to the casing 1 with a hinge 4 in a freely openable and closable manner; and a numeral 6 refers to an air blower provided within the ventilation flue 2 at a position in the vicinity of the air inlet port 1b, and having rotary vane 7 to be

5 rotationally driven by an electric motor (not shown). Incidentally, in this particular embodiment, the rotary vane 7 is of a centrifugal type, so that it has a multitude of blades 8 provided in parallel each other. This rotary vane may also be of an axial type, i.e., it may have the propeller blades. Referring again to the drawing, a reference

10 numeral 9 indicates a power line for the blower 6; a numeral 10 refers to a heat-exchanger which is inserted and fitted into the ventilation flue 2 through the abovementioned top opening 3. The heat-exchanger is constructed with a regenerative cooling body 12 fabricated by sealing a regenerative cooling agent 11 in gel form made of a material

15 such as fatty acid, and so forth into an air-tight container made of a material of good heat conductivity, and heat-exchanging plates 13, 14, each of which is disposed in both upper and lower parts of this regenerative cooling body and in close contact with the regenerative cooling body 12. The heat-exchanging plate 13 (14) is formed by

20 bending a sheet material of good heat conductivity, e.g., aluminum plate, in a corrugated shape, as shown in Figures 1 and 4, so as to increase the heat-exchanging area with the external air passing through the ventilation flue 2, and is disposed in such a manner that ridge portions 15 of the corrugation may take the same direction as

25 the blowing direction of the external air. A reference numeral 16 designates a plurality of grills provided in the outlet opening 1a of the casing 1, and a numeral 17 refers to a packing made of a material such as sponge or rubber, which is interposed between the lid 5

and the heat-exchanger 10 in a compressed state so as to urge the heat-exchanger 10 with pressure from the lid 5 to prevent it from displacing. The lid 5 has a locking mechanism at the opposite side of the hinge 4, which is of a construction, as shown in Figure 3, comprising an engaging piece 19 to be engaged with a recess 18 formed at a corresponding position in the casing 1, and a spring 20 to constantly energize the engaging piece in a projecting direction toward the recess 18. A reference numeral 21 refers to operating buttons for switches (not shown) to control operations of the blower 6.

In the above-described construction of the cooled air supplying device according to the present invention, the regenerative cooling body 12 is sufficiently cooled in a refrigerator prior to actual operation of the device, after which this refrigerated regenerative cooling body 12 is placed in the ventilation flue 2 through the top opening 3 by lifting up the lid 5 so that the heat-exchanging plates 13 and 14 may be positioned on both upper and lower surfaces of the heat-exchanger as shown in Figures 1 and 2, followed by closure of the lid 5 and operation of the blower 6. Upon operation of the blower 6, external air is sucked and introduced into the ventilation flue 2 through the inlet port 1b, and, during its passage by and around the regenerative cooling body of the heat-exchanger 10, is cooled by the regenerative cooling body 12 and/or the heat-exchanging plates 13 and 14 to become cooled air, and is blown out of the discharge opening 1a in the front face of the casing 1.

When the temperature of the regenerative cooling body 12 goes up after long hours' use, it may be replaced with a separate regenerative

cooling body which has been kept cooled in the refrigerator. By the way, when gelled liquid containing therein fatty acid, etc. is used as the regenerative cooling agent 11, the external air introduced into the ventilation flue 2, during its use, can be cooled down effectively over a long period of time, since the regenerative cooling agent is a substance of large heat capacity, which is in a frozen and solidified state or in a semi-frozen and semi-solidified state below a certain predetermined temperature, and is turned into a liquid state above such predetermined temperature.

Furthermore, in the above-described embodiment, it is possible to obtain cooled air at a temperature which is lower by 2 to 3 degrees Centigrade than the external air as introduced. However, when the cooled air of much lower temperature is to be obtained by increasing the cooling capacity, a plurality of regenerative cooling bodies 12, for example, are used simultaneously, in which case these regenerative cooling bodies and the heat-exchanging plates 13, 14 are stacked alternately. Moreover, where the heat-exchanging plates 13, 14 are all formed in the same dimension and of the same material, the cost of manufacture of the device becomes cheap and fabrication of the device becomes more convenient.

In the following, the second embodiment of the cooled air supplying device according to the present invention will be explained.

In Figures 5 to 9 showing the second embodiment of the cooled air supplying device of the present invention from various views, exchange of the regenerative cooling body can be done more easily than in the first embodiment as described in the foregoing.

That is to say, the characteristic point in this embodiment is that the heat-exchanging plates 13, 14 are so provided that they may enclose the substantially whole circumference of the regenerative cooling body 12, and that one of the heat-exchanging plates (13 or 14) is mounted on the lid 5, whereby this heat-exchanging plate 13 is made separable from the regenerative cooling body 12 simultaneously with opening of the lid 5.

The detailed construction of the second embodiment will be described in the following.

Reference numerals 13 and 14 designate the semi-circular heat-exchanging plates in their complete structure, as shown in Figure 8. Such heat-exchanging plate 13 is formed by sequentially bending a thin metal strip at the right angle with a certain definite space interval to thereby obtain a continuous rectangular corrugation in its cross-sectional shape, the ridge and valley portions of which are perpendicular to the direction of air flow as shown in Figure 7, and then whole of the continuous rectangular corrugation is curved in a semi-cylindrical form so that both end parts 13a and 14a may be mutually opposed on one and the same plane as shown in Figure 8. Then, on the one hand, the heat-exchanging plate 13 is mounted on the lower surface of the lid 5 with screws 22 in a freely attachable and detachable manner through screw holes 13b at both end parts 13a, and, on the other hand, the heat-exchanging plate 14 is placed in the casing 1 through its top opening 3 (this being not shown in Figure 9) and fitted therein with screws 23 through the screw holes 14b at both end parts 14a and the corresponding screw holes 29 in the casing 1. And, the regenerative cooling body 12 made entirely

of a metal material is formed in a cylindrical shape as shown in Figure 9 so that it may be snugly fitted in a cylindrical space formed by the two semi-circular heat-exchanging plates 13 and 14 in their mounted condition. The regenerative cooling body 12 comprises a cylindrical part 24 and caps 25, 26 securely fitted at both open end parts of the cylindrical member 24, as shown in Figure 5. By the way, a reference numeral 27 denotes recessed portions formed in the upper surface of the cover 5, which are for easiness of lifting up the lid 5 by the user of the device.

10 Furthermore, according to this embodiment, the blower 6 has the electric motor 28 and the propeller-shaped rotary blades 7, as shown in Figure 5. The rest of the construction is the same as the abovementioned first embodiment.

With such construction, when the regenerative cooling body 12 is to be replaced, the lid 5 may be lifted upward as shown in Figure 9, and the regenerative cooling body 12 remaining in the casing 1 in the state of the upper part being exposed outside is removed, and a separate regenerative cooling body 12 which has been freezed in the refrigerator is, instead, placed thereinto, and the lid 5 is put back to its original position. Therefore, the replacement of the regenerative cooling body 12 can be done in a very simple operation. Incidentally, as is apparent from Figure 7, the heat-exchanging plates 13, 14 according to this embodiment need not be manufactured in two different structures, but two pieces of it in the same size and shape may be fabricated, whereby it becomes possible to use them for both sides of the casing 1 and the lid 5 by only changing the fitting direction thereof, hence reduction in the manufacturing cost

can be realized advantageously.

In the following, the third embodiment of the device according to the present invention will be explained.

The characteristic point of this third embodiment resides in that
5 a single heat-exchanging plate is provided as shown in Figure 10.
That is to say, the heat-exchanging plate 13 is formed by curving a
rectilinearly corrugated thin flat metal plate into a circular shape and
joining both end faces to thereby obtain a hollow cylindrical member,
as shown in the drawing.

10 This heat-exchanging plate 13 is fitted onto the lid 5 with
screws 32 by means of metal fittings 31 in a freely attachable and
detachable manner, the cylindrical regenerative cooling body 12 being
fitted in a cavity at the center part of this heat-exchanging plate 13
in a freely insertable and withdrawable manner. The rest of the
15 construction of the device in this embodiment is the same as that of
the abovementioned second embodiment.

Therefore, according to this embodiment, as the regenerative
cooling body 12 can also be taken out of the casing 1 simultaneously
with lifting of the lid 5, and subsequently the regenerative cooling
20 body 12 may be taken out of the heat-exchanging plate 13, replace-
ment of the regenerative cooling body 12 can be done much simpler.

Although not used in each of the afore-described embodiments,
for the regenerative cooling agent to be sealed in the regenerative
cooling body, there may be used ice blocks which have been sufficiently
25 frozen in a refrigerator, and readily available at a cheap price.

As stated in the foregoing, according to the present invention,
since the regenerative cooling body, in which the regenerative cooling

agent is sealed, is provided in the ventilation flue in a freely attachable and detachable manner, the air in the room to be supplied from the blower through the heat-exchanging plate which is in close contact with the regenerative cooling body can be cooled down efficiently, and there is no apprehension of increase in the relative humidity of air in the room, hence the cooled air supply device which is small in size, light in weight, and easy in its handling can be obtained at a cheap cost.

Furthermore, since the regenerative cooling body and the heat-exchanging plate can be separately handled, the required freezing space can be kept to the minimum, even in case of cooling the regenerative cooling body in the refrigerator, and a number of regenerative cooling bodies can be cooled even in a refrigerator of a small freezing space with the consequence that cooled air can be obtained continuously over a long period of time.

Although, in the foregoing, the present invention has been described with specific details in reference to preferred embodiments, the invention is not limited to these embodiments alone, which are merely illustrative of the invention, but any changes and modifications may be made by those persons skilled in the art within the spirit and scope of the present invention as recited in the appended claims.



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CLAIMS:

1. A cooled air supply device which comprises, in combination:

- a) a casing having an inlet port for external air and an outlet port for cooled air;
- 5 b) a ventilation flue formed in the interior of said casing, and extending from the inlet port to the outlet port thereof;
- c) blowing means disposed in the interior of said ventilation flue for introducing the
- 10 external air into said ventilation flue and forwarding the same toward said outlet port;
- d) a regenerative cooling body, disposed in the interior of said ventilation flue, including therein a regenerative cooling substance; and
- 15 e) heat exchange plate means in contact with and separable from said regenerative cooling body, which heat exchanging plate means being of heat conducting material and having elements
- 20 extending outwardly with respect to the body to provide additional surface area for heat exchange with the air circulating in the ventilation flue;

wherein at least the regenerative cooling body is disposed in the ventilation flue in a freely

25 insertable and removable manner.

2. The cooled air supply device according to claim 1, wherein said heat-exchanging plate means are arranged on both side surfaces of said regenerative cooling body so as to hold the same therebetween.

30 3. The cooled air supply device according to claim 2, wherein said heat-exchanging plate means on both side surfaces of said regenerative cooling body is of the same size and material.

35 4. The cooled air supply device according to any preceding claim, wherein said heat-exchanging plate means are in a corrugated form in their cross-section.



5. The cooled air supply device according to claim 1 or 4 as dependent on claim 1, wherein said heat-exchanging plate means are arranged in a manner to surround the outer periphery of said regenerative cooling body.

6. The cooled air supply device according to claim 5, wherein the heat-exchanging plate means comprise heat-exchanging plates curved in conformity to the shape of the outer peripheral surface of the regenerative cooling body so as to encompass its surrounding.

7. The cooled air supply device according to claim 5, wherein said heat-exchanging plate means to be arranged to enclose the outer periphery of said regenerative cooling body is formed in a hollow cylindrical shape, and said regenerative cooling body is snugly fitted into the hollow central portion of the cylindrically formed heat-exchanging plate means.

8. The cooled air supply device according to claim 7, wherein said cylindrical heat-exchanging plate means encompassing said regenerative cooling body is formed by connecting a plurality of heat-exchanging plates.

9. The cooled air supply device according to claim 1, wherein said heat-exchanging plate is formed of a thin planar material.

10. A cooled air supply device as claimed in any preceding claim comprising an opening formed in one part of said casing for communicating the half way of said ventilation flue to outside, and at least said regenerative cooling body being disposed in said ventilation flue through the opening in said casing in a freely insertable and removable manner.

11. The cooled air supply device according to claim 10, further comprising a lid member provided at said opening in said casing to freely open and close the same.



- 5 12. The cooled air supply device according to claim 11, wherein at least part of said heat-exchanging plate means is attached to said lid member so that said part of said heat-exchanging plate means may be removed from said ventilation flue with lifting of said lid member.
- 10 13. The cooled air supply device according to claim 11, wherein said regenerative cooling body is attached to said lid member so that said regenerative cooling body may be removed from said ventilation flue with lifting of said lid member.
- 15 14. The cooled air supply device according to claim 11, wherein said heat-exchanging plate means and said regenerative cooling body are attached to said lid member so that said regenerative cooling body may be removed from said lid member without necessity for removal of said heat-exchanging plate.
- 20 15. A cooled air supply device substantially as hereinbefore described with reference to and as shown in figures 1 to 4, or in figures 5 to 9 or in figure 10 of the accompanying drawings.
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