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(54) A system for air-conditioning the interior of buildings

(57) The invention concerns a system for air conditioning the interior of buildings in which a first plurality of zones (A,B) with high probability of people staying therein and a second plurality of zones (Z) with low probability of people staying therein are defined, comprising first air/water heat exchangers (7a, 7b) located in said first plurality of high probability zones (A,B) and second air/water heat exchangers (8, 9, 10) located in said second plurality of low probability zones (Z) so as to create a temperature difference between the zones (A,B) of said first plurality and the zones (Z) of said second plurality.

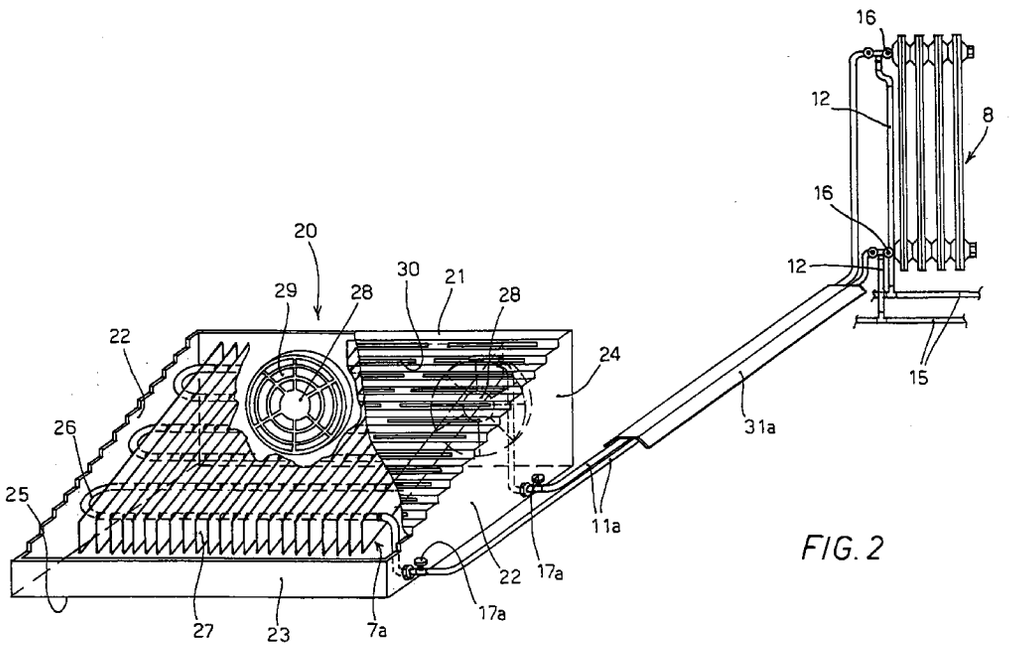

FIG. 2

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Description

The present invent ion refers to a system for air conditioning the interior of buildings.

More precisely, the invention concerns a hot or cold water conditioning, for heating or cooling building rooms, respectively.

In the following, for sake of simplicity, reference will be made to a heating system since the cooling is a consequence only of the temperature change in the circulating water.

The system according to the invention proved to be particularly suitable for heating or cooling any residential or industrial room in which a first plurality di zones of high probability of occupancy and a second plurality of zones of low probability of occupancy are defined.

Typical examples of the above mentioned environments are the rooms of administration offices where the employees occupy working positions that are substantially fixed during the working time, the industrial rooms in which the workers are assigned to the machinary control, schoolrooms, and residential rooms used as bedrooms.

For heating residential and industrial rooms there are used heating systems based on a hot water circuit provided with heat exchangers located in the rooms to be heated and a central or local boiler for heating the circulating water.

In order to reduce the surfaces and volumes occupied by the heat exchangers in the rooms to be heated, so that the available space can be better used for furnitures or working apparatuses, such heat exchangers are usually disposed adjacent the walls, under windowsills or near the doors.

However this arrangement does not efficiently distribute the temperature inside the rooms to be heated with respect to the positions occupied by the people in the room.

Because of the peripheral locations of the heat exchangers, the temperature of the central zones of the rooms - where it is generally more likely that people stay - is lower than that of the peripheral zones near the walls where the probability of people staying is low.

In order to obtain an adequate temperature in those zones of the rooms that are usually occupied, mainly when the rooms have large size, it is often necessary to increase the amount of heat supplied to the heat exchangers by oversizing the heating system or rising the water temperature.

However this solution proved to be ineffective, besides considerably increasing the running costs. In fact the temperature of the zones with high probability of being occupied are often insufficient whereas the temperature of the zones with a low probability of being occupied, such as those near the walls or the passage zones, are excessive.

According to a known solution to the problem of optimizing the heat distribution inside a room to be heated heat exchangers are located on the foors of the rooms and uniformely distributed over the whole floor surface. This way a substantially uniform temperature is achieved in the room.

In addition to the drawback of being unsuitable for large rooms because of the high cost, this solution has the further drawback of preventing a differentiated adjustment or control of the temperature inside the room to be heated.

For example when the heated room is used as an office where the personnel occupy substantially fixed positions in the working time, all the working posts will be at the same temperature and the single persons would not be allowed to adjust the temperature in accordance with their preferences

A first object of the present invention is therefore to solve the problem of obtaining different temperatures at different points of the rooms to be heated, so as to achieve temperatures that are adequate in every zone of the room, while accomplishing a saving in the running expenses.

This object of the present invention is accomplished through a conditioning system as claimed in claim 1.

A futher drawback of the known heating systems comes from the fact that the heat exchangers are to be connected to a hydraulic circuit that is embedded in the building wall structure. Therefore the locations of the heat exchangers inside the rooms to be heated are to be to selected when designing the building, i.e. when the use of the rooms has not yet been defined.

Moreover, the locations of the heat exchangers cannot be easily and inexpensively changed at a later time should a different use be assigned to one or more rooms.

A futher object of the present invention is therefore to solve the problem of rendering easier a different arrangement of the heat exchangers inside the rooms to meet changed situations of use.

This futher object of the invention is accomplished through a conditioning system recited in claim 13. Other objects of the present invention are accomplished through a conditioning system as claimed in the dependent claims.

Further characteristics and advantages of the invention will become evident from the following description of a preferred but not exclusive embodiment of the conditioning system, illustrated in the attached drawings without limiting purposes. In the drawings:

Fig. 1 is a diagram of a conditioning system according to the invention;

Fig. 2 shows a detail of the conditioning system of Fig. 1.

With reference to Fig. 1 there is schematically shown a system according to the invention for air conditioning a room 1, for example used as an office, in which there are defined first zones A and B, enclosed by dots

and dashes lines in Fig. 1, wherein the probability of people staying is high, and a second zone Z where the probability of people staying is low. Room 1 further comprises an entrance 2 and two windows 3, 4.

In the embodiment illustrated in Fig. 1, said first zones A and B substantially correspond to the working posts of as many clerks, each post including a desk 5a, 5b and a chair 6a, 6b.

In said zones A and B having a high probability of permanence there are located first air/water heat exchangers 7a and 7b, while second air/water heat exchangers 8, 9 and 10 are located in said zones Z having low probabilities of permanence and being adjacent one of the walls in room 1.

Each of said first heat exchangers 7a and 7b is further connected through pairs of pipes 11a and 11b to a corresponding heat exchanger 8 and 10, respectively, of said second heat exchangers 8, 9 and 10.

Pipes 11a and 11b are disposed under the floor of the room 1 to be heated and are protected by ducts 31a and 31b, respectively.

Through corresponding pairs of pipes 12, 13 and 14 said second heat exchangers 8, 9 and 10 are connected to the pipeworks 15 of a central heating system comprising a boiler (not shown) for heating the water to be circulated in the heat exchangers.

In correspondence of the second heat exchangers 8, 9 and 10 and of the first heat exchangers 7a and 7b there are provided respective adjusting valves 16, 17a and 17b for separately adjusting the flow of hot water sent into said first and second heat exchangers, thus making it possible to obtain a temperature difference between said first zones A and B and said second zone Z.

Fig. 2 illustrates a preferred embodiment in which one (7a) of said first heat exchangers 7a and 7b is housed within a conditioning unit 20 on which people can step, equipped with an inclined stepped footboard 21, a pair of sidewalls 22, a front wall 23, a rear wall 24 and a base 25.

Inside said conditioning unit 20, adjacent to said footboard 21, there is located a heat exchanger 7a of the type comprising a radiator provided with a coil 26 in which water circulates, and with a plurality di metal fins 27 welded to said coil 26 for increasing the heat spreading.

A pair di electric fans 28 is further provided inside the conditioning unit 20, adjacent to said rear wall 24 for creating a forced flow of warm air.

First slits 29 for the outlet of the forced air are formed in the rear wall 24 in correspondence of the fans 28, and second slits 30 for the inlet of the drawn air are provided in correspondence of the steps in the footboard 21.

A temperature sensor (not shown) is further provided for actuating said fans 28 when the temperature inside the footboard 21 reaches a predetermined value (threshold).

This way, when the temperature in the footboard 21 is below said predetermined level or threshold, the heat from the heat exchanger 7a rises through convection inside the unity 20 thus heating the footboard 21. Moreover the heat from the heat exchanger 7a reaches the outside of unit 20 through the slits 30 thus heating the outer space surrounding the high probability zones.

When the temperature of the footboard 21 rises above said predetermined value, fans 28 are started and the flow of the circulating air is reversed. Thus the flow of forced air drawn through the slits 30 of the footboard 21 subtracts heat from the inner space of the footboard 21 and heats the air coming out through the rear slits 29 that in turn heats the surrounding space in the high probability zone.

The provision of the fans 28 is thus particularly effective in maintaining a minimum adequate temperature in a room 1 containing the unit 20.

When the fans 28 are not operating, the hot water flowing in the heat exchanger 7a continues to heat the footboard 21 together with the zones in which unit 20 is disposed.

Unit 20 can further be provided with one or more conventional electric resistances for heating air when hot water is lacking in the system because this latter has not yet been actuated, or in the event of a failure.

Even when said electric resistances are used, since the units 20 are located in the high probability zones, and since people can step or walk over such units, the system of the invention allows for a large energy saving with respect to the use of conventional electric heaters located in the rooms to be heated.

Fig. 2 further illustrates the pipes 11a covered by a protection duct 31a on which people can step, such pipes connecting the coil 26 of the heat exchanger 7a to the central heating system in correspondence of the heat exchanger 8.

Pipes 11a are positioned adjacent the floor of the room to be heated and can therefore be easily moved and laid in different locations similarly to what happens for the conventional electric cables.

Alternatively said pipes 11a could be housed below the floor when suitable ducts have been provided or when the floor is a so-called "floating" floor.

From the above description it is evident that a considerable saving of the running costs can be achieved through the conditioning system according to the invention, thus providing an adequate heating to the high probability zones inside a room and maintaning a lower temperature in the remaining portions of the room where the presence of people is less frequent.

Namely it is known that the first feeling of cold when the temperature is too low is usually sensed in the feet and the hands.

In the traditional heating systems in order to maintain an adequate temperature, e.g. 20°C, in the lowest air layers near the floor, it is necessary to have a much higher temperature, e.g. 26°C, in correspondence of the

highest air layers near the ceiling.

By rendering the heat source local, as provided by the present invention, particularly in the high probability zones and more particularly under the feet of the people in the room, it is possibile to concentrate the heat distribution where it is more required with a consequent reduction of the heating costs.

The conditioning system according to the invention further allows to easily locate the conditioning units anywhere in the room to be heated.

Although the conditioning system according to the invention has been described with reference to the heating of a room, the system can advantageously be used for cooling a room when the temperature of the circulating water is kept low enough by means of a centralized device instead of a boiler.

Claims

1. A system for air conditioning the interior of buildings in which a first plurality of zones (A,B) having a high probability of people staying therein and a second plurality of zones (Z) having a low probability of people staying therein are defined, comprising first air/water heat exchangers (7a, 7b) located in said first plurality of high probability zones (A,B) and second air/water heat exchangers (8, 9, 10) located in said second plurality of low probability zones (Z) so as to create a temperature difference between the zones (A, B) of said first plurality and the zones (Z) of said second plurality.

2. A system according to claim 1, in which said first heat exchangers (7a, 7b) and said second heat exchangers (8, 9, 10) are connected to the same central heating system in which hot water flows.

3. A system according to claim 1, in which said first heat exchangers (7a, 7b) and said second heat exchangers (8, 9, 10) are connected to a central heating system in which cold water flows.

4. A system according to claim 2 or 3, in which said first heat exchangers (7a, 7b) are housed inside respective conditioning units (20) on which people can step.

5. A system according to claim 2 or 3 or 4, in which said first heat exchangers (7a, 7b) comprises means for generating a flow of forced air.

6. A system according to claim 5, in which said means for generating a flow of forced air comprises a pair of fans (28).

7. A system according to claim 4, in which said conditioning unit (20) on which people can step comprises a footboard (21), said footboard (21) being located adjacent said heat exchanger (8, 9, 10).

8. A system according to claim 6, in which said footboard (21) is inclined with respect to the floor of the room.

9. A system according to claim 6 and 7, in which said conditioning unit (20) comprises first slits (29) provided in correspondence of said pair of fans (28) and second slits (30) provided in said footboard (21), said first slits and said second slits being provided for the air inlet and outlet, respectively, when said pair of fans (28) are not operating and for the air outlet and inlet, respectively, when said pair of fans (28) are operating.

10. A system according to claim 9, in which means are provided for actuating said fans (28) when the temperature of said footboard (21) exceeds a predetermined value.

11. A system according to any of claims 2 to 10, in which said conditioning system comprises adjusting valves (16, 17a, 17b) for separately controlling the flow rate of the water sent to said first (7a, 7b) and second (8, 9, 10) heat exchangers.

12. A system according to any of the preceding claims, in which said first heat exchangers (7a, 7b) are connected to one of said second (8, 9, 10) heat exchangers through pairs of pipes (11a, 11b) for circulating the water.

13. A system according to any of the preceding claims, in which said pairs of pipes (11a, 11b) are disposed in contact with the floor of the room to be heated and are protected by a protection duct (31) on which people can be walk.

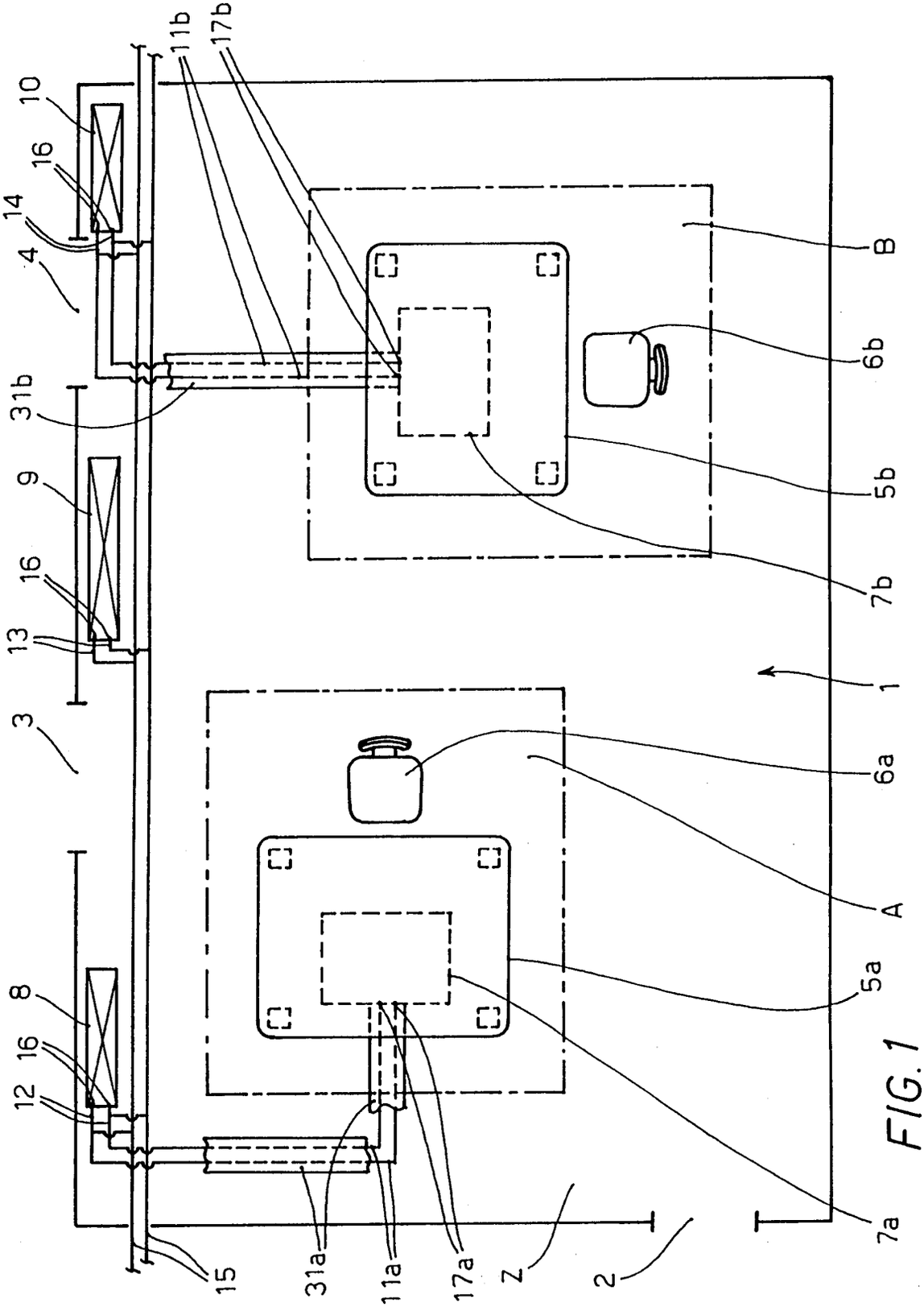
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FIG. 1

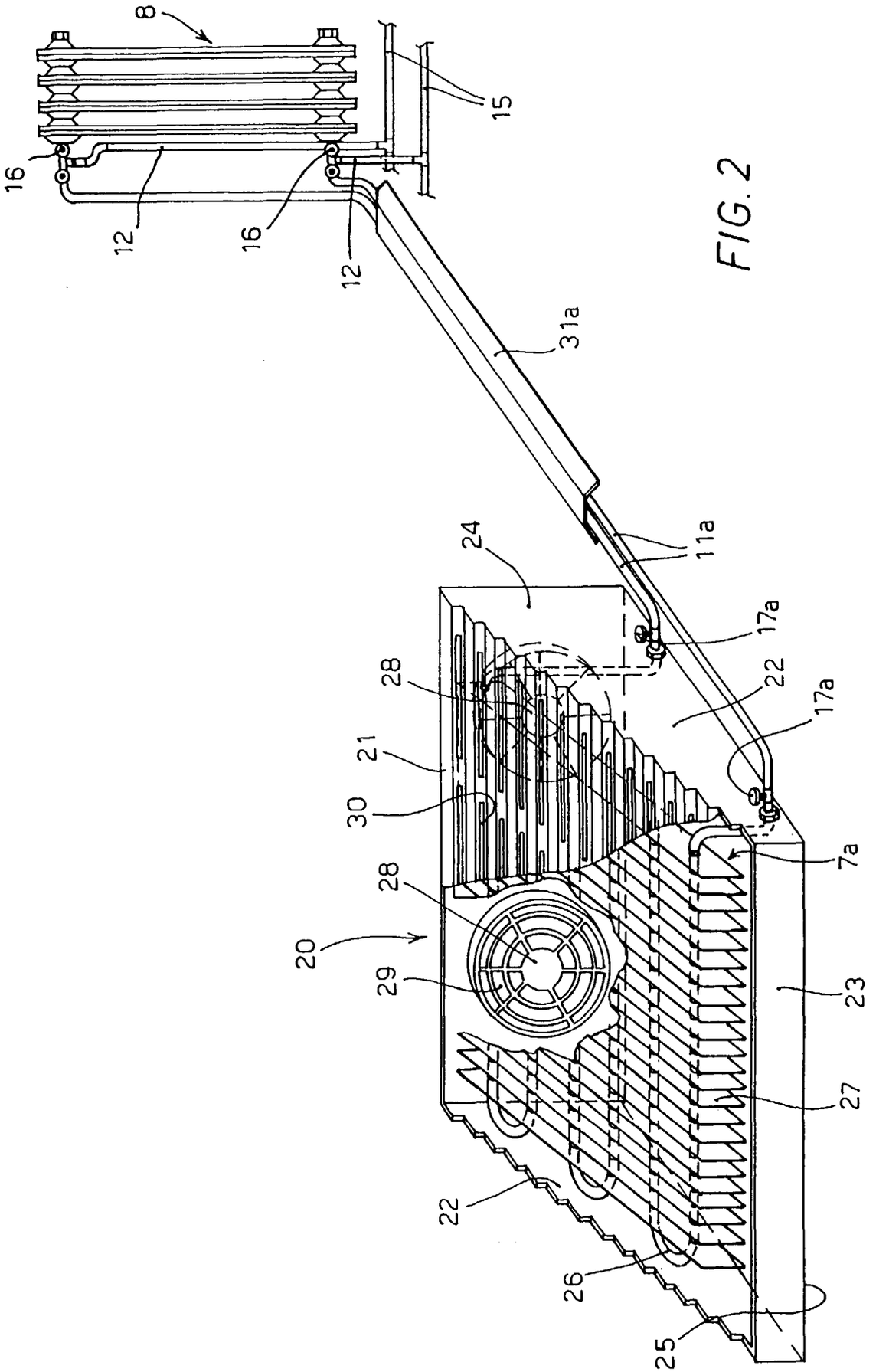
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FIG. 2