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London WC2A 1HN(GB)(54) **Warming and cooling system.**

(57) A warming and cooling system includes a cooling device (3, 4) for installation in an upper part (22) of a living space, a warming device (10, 11) for installation in a lower part (23) of the living space, a heat pump (7) having an evaporation portion (15) and a condensation portion (16) and serving as a heat transfer drive source for transferring heat recovered from the cooling device, a heat exchanger (8) to which the recovered heat is transferred, first heat pipe device (5, 6) having brine sealed therein and connecting the evaporation portion of the heat pump to the cooling device, second heat pipe device (17, 18) having brine sealed therein and connecting the condensation portion of the heat pump to the heat exchanger, and third heat pipe device (12, 13) having brine sealed therein and connecting the heat exchanger to the warming device to allow the warming device to emit radiant heat for warming the lower part of the living space.

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The present invention relates to a warming and cooling system which realizes with high efficiency a living space capable of accomplishing the principle of keeping the heads of dwellers cool and their feet and legs warm, which is most ideal from the standpoint of human engineering.

For controlling the interior temperature of a living space, it has been customary to use a cooling device such as, for example, a cooler during the summer and a warming device such as, for example, a stove during the winter or to use an air conditioner reversibly during the two seasons.

In the natural world, the temperature distribution in a given space is normally such that the temperature rises in proportion as the height from the floor increases and that the upper part of the space is warmer than the lower part thereof.

For this reason, the use of a cooling device during the summer results in cooling the lowermost part of the space surrounding dwellers' feet to an excessive extent and failing to sufficiently cool the lower middle part of the space surrounding their heads and, as a result, causing the foul room air to stagnate in the lower part of the space. When they stay in such a room, it frequently happens that they not only feel unpleasant but also complain of the so-called air-conditioningitis manifested in oversensitivity to cold and fatigue. When a warming device such as a stove or an air conditioner is used during the winter, the warm air wholly rises to the proximity of the ceiling of the room and the foul room air stagnates in the lower part below the intermediate height of the room space as naturally gathered from the temperature distribution in the natural world. Thus, the operation of the warming device has the disadvantage that it compels the dwellers in this room to suffer from unhealthy ventilation, feel unpleasant and keep their feet and legs surrounded by chill air.

When the air conditioning is considered from the standpoint of human engineering, it is held that the most desirable living room will keep dwellers' heads cool and their feet and legs warm. When the conventional air-conditioning system is evaluated in the light of this principle, it is found to be far parted from the ideal system of keeping the dwellers' heads cool and their feet and legs warm during not only the winter but also the summer.

The present invention has been accomplished to solve the problem of the prior art described above.

The main object of the present invention is to provide a warming and cooling system which produces a comfortable living space by heating the lower part of the living space to a suitable temperature with the heat recovered from a cooling device and forwarded through a heat exchanger, preeminently excels in economy because of the least

possible consumption of energy and allows the living space to maintain a stable environment of keeping dwellers' heads cool and their feet and legs warm throughout the entire year.

According to one aspect of the present invention, a warming and cooling system comprising a cooling device for installation in an upper part of a living space and a warming device for installation in a lower part of the living space, the system characterized in that a heat pump having an evaporation portion and a condensation portion is used as a heat transfer drive source for transferring heat recovered from the cooling device to a heat exchanger, that first heat pipe means has brine sealed therein and connects the evaporation portion of the heat pump to the cooling device, that second heat pipe means has brine sealed therein and connects the condensation portion of the heat pump to the heat exchanger, and that third heat pipe means has brine sealed therein and connects the heat exchanger to the warming device to allow the warming device to emit radiant heat for warming the lower part of the living space.

In the accompanying drawings:-

Figure 1 is a schematic view illustrating the construction of one embodiment of the warming and cooling system according to the present invention.

Figure 2 is an explanatory view illustrating the embodiment of Figure 1.

The present invention will now be described in detail with reference to the illustrated embodiment.

As shown in Figures 1 and 2, cooling devices 3 and 4 are disposed on the ceilings 22 of rooms 1 and 2 of a building or house and connected to a heat pump 7 serving as a heat transfer drive source via first heat pipe means having brine sealed therein and comprising a feed pipe 5 and a return pipe 6. The feed pipe 5 is provided midway the length thereof with an ice heat storage device 9. The return pipe 6 is provided midway the length thereof with a circulation pump 19. The heat pump 7 has an evaporation portion 15 and a condensation portion 16. The evaporation portion 15 of the heat pump 7 has a heat exchange portion 5a for the first heat pipe means. The ice heat storage device 9 has a tank which is provided therein with a plurality of heat storage pipes 9a each having water sealed therein and which permits the brine in the feed pipe 5 to pass through the inside thereof so that the water in the heat storage pipes 9a is iced.

The evaporation portion 15 and condensation portion 16 of the heat pump 7 are connected to each other via a compressor 21. The condensation portion 16 of the heat pump 7 is connected to a heat exchanger 8 via second heat pipe means having brine sealed therein and comprising a feed

pipe 17 and a return pipe 18 and is provided with a heat exchange portion 17a for the second heat pipe means. The feed pipe 17 of the second heat pipe means is provided midway the length thereof with a circulation pump 20.

The heat exchanger 8 is connected to warming devices 10 and 11 laid below the floors 23 of the rooms 1 and 2 via third heat pipe means having brine sealed therein and comprising a feed pipe 12 and a return pipe 13. The pipe in the heat exchanger 8 constitutes a heat exchange portion 8a. The feed pipe 12 of the third heat pipe means is arranged in a zigzagged manner below the floors 23 to form floor-warming portions 10a and 11a of the warming devices 10 and 11. The heat exchanger 8 is provided with a pipe 14 for feeding hot water to a bathtub, a kitchen sink, etc., a pipe 25 for hot water for further warming the hot water in a bathtub, and a boiler 24 which is used as an auxiliary heat source in the case where excessive heat has been consumed by the feeding of hot water.

As the warming device 10 or 11 of the present invention, the floor warming unit making use of the radiant heat from a hot water pipe as disclosed in Japanese Utility Model Publication No. 59-16730 is advantageously used.

The cooling devices 3 and 4 and the warming devices 10 and 11 have their operations adjusted by a control mechanism using various sensors, though omitted from illustration, so that the cooling will be strengthened and the warming weakened during the summer and so that the warming will be strengthened and the cooling weakened during the winter to balance the cooling power and the warming power of the system and maintain a comfortable environment throughout the entire year.

The brine cooled in the evaporation portion 15 of the heat pump 7 is supplied through the feed pipe 5 to the cooling devices 3 and 4 which effect the required cooling by exchange of heat between the air in the rooms 1 and 2 and the brine in the cooling devices 3 and 4. In this case, it is preferable to produce ice in the ice heat storage device 9 utilizing an inexpensive midnight electric power, whereby the cooling is economically effected by virtue of the latent heat of fusion of the ice.

The brine warmed with the heat extracted from the upper parts of the spaces of the rooms 1 and 2 is returned through the return pipe 6 to the evaporation portion 15 of the heat pump 7 to promote the evaporation of a flon gas present in the evaporation portion 15, and the flon gas is then compressed by the compressor 21 to generate heat having a temperature of about 60 degrees centigrade, for example, on the side of the condensation portion 16 of the heat pump 7. This heat is transmitted through the heat exchange portion 17a and

feed pipe 17 into the heat exchanger 8 where heat exchange is effected between the transmitted heat and the brine of the third heat pipe means. The heat-exchanged heat is then returned through the return pipe 18 of the second heat pipe means to the condensation portion 16. Thus, the radiation of heat is effected efficiently on the side of the condensation portion 16 of the heat pump 7. The heat-exchanged brine is supplied through the feed pipe 12 to the warming device 10 and 11 which effect the required warming by exchange of heat between the air in the rooms 1 and 2 and the brine in the warming devices 10 and 11. The brine heat-exchanged for the air in the rooms 1 and 2 is returned through the return pipe 13 to the heat exchanger 8.

During the summer, since the air temperature is high, the operation ratio of the heat pump 7 becomes high and the heat to be forwarded to the heat exchanger 8 has a fairly high calorific value. In the warming operation during the summer, the amount of the radiant heat is only required to give warmth for protecting the dwellers' bodies against excessive cooling. In this case, therefore, the heat obtained by the operation of the heat exchanger 8 cannot be wholly consumed. In the present embodiment, therefore, the heat exchanger 8 is provided with a hot water feeding pipe 14 adapted to supply hot water produced with the excessive heat from the heat exchanger 8 to a bathtub and/or a kitchen sink. The heat which still remains unused is released into the ambient air.

Owing to the construction described above, the cooling device 3 (4) cools the upper part of the living space to a suitable temperature and the warming device 10 (11) warms the floor radiantly with the heat recovered from the cooling device 3 (4) as the heat source so as to maintain an environment of keeping dwellers' heads cool and their feet and legs warm throughout the entire year by exchange of heat between the cooling device 3 (4) and the warming device 10 (11).

As regards the coefficient of performance of the floor warming in this case, since the heat acquired by cooling can be utilized effectively for warming the floor as coupled with the heat of the drive source for the transfer of the heat from the cooling, the system contributes to the economization of energy and preeminently excels in economy.

As has been described in the foregoing, the present invention effectively utilizes the heat recovered by the cooling device in warming the lower part of the living space. Thus, it requires virtually no energy for warming the living space. The cost of energy for the system as a whole is very low. The environment of keeping the dwellers' heads cool and their feet and legs warm is not only com-

fortable but also highly useful for the promotion of the dwellers' health. The construction which ensures maintenance of this luxurious environment of keeping the dwellers' heads cool and their feet and legs warm throughout the entire year at a very low energy cost promises the provision of a warming and cooling system of very high commodity value and follows faithfully the recent trend of general consumers toward commercial articles of high quality.

Claims

1. A warming and cooling system comprising a cooling device (3, 4) for installation in an upper part (22) of a living space and a warming device (10, 11) for installation in a lower part (23) of the living space, said system characterised in that a heat pump (7) having an evaporation portion (15) and a condensation portion (16) is used as a heat transfer drive source for transferring heat recovered from said cooling device to a heat exchanger (8), that first heat pipe means (5, 6) having brine sealed therein and connects the evaporation portion of said heat pump to said cooling device, that second heat pipe means (17, 18) having brine sealed therein and connects the condensation portion of said heat pump to said heat exchanger, and that third heat pipe means (12, 13) having brine sealed therein and connects said heat exchanger to said warming device to allow said warming device to emit radiant heat for warming the lower part of the living space.
2. A warming and cooling system according to claim 1, wherein said first heat pipe means (5, 6) is provided with an ice heat storage device (9) for producing ice therein and effecting cooling by virtue of latent heat of fusion of the produced ice.
3. A warming and cooling system according to any one of claims 1 and 2, wherein said heat exchanger (8) is provided with a boiler (24) used as an auxiliary heat source.
4. A warming and cooling system according to any one of claims 1 to 3, wherein said heat exchanger (8) is provided with a hot water feeding pipe (14) and a pipe (25) for hot water for further warming hot water in a bathtub.
5. A warming and cooling system according to any one of claims 1 to 4, wherein said first and second heat pipe means (5, 6, 17, 18) are each provided with a circulation pump (19, 20).

FIG. 1

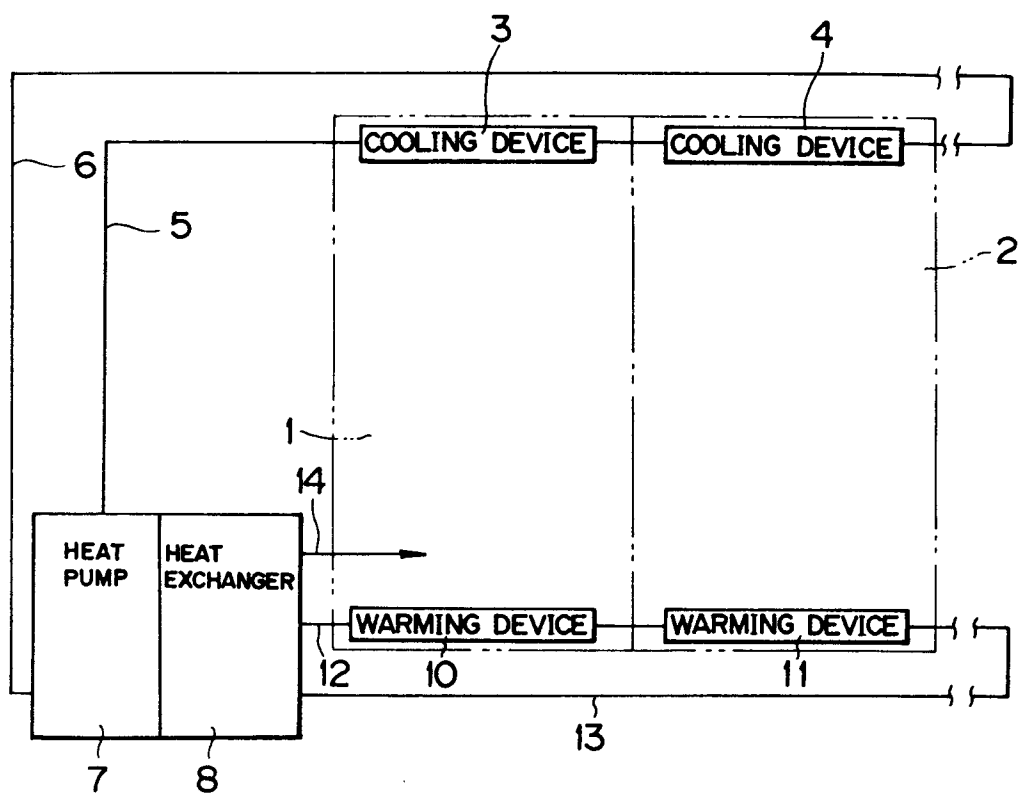


FIG. 2

