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METHOD AND DEVICE FOR AIR CONDITIONING AND/OR
HEATING DWELLINGS, NOTABLY BLOCKS OF FLATS

The invention concerns a method and a device for air conditioning and/or heating dwellings, notably blocks of flats.

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Devices suitable for air conditioning and heating dwellings are of four types differentiated by the external energy source, air or water, used, and by the fluid, air or water, used to restore this energy in the dwellings.

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The first type of device consists of air/water systems consisting generally of a centralised installation composed of an outdoor unit installed on a terrace, and fan convactor units disposed in the rooms to be heated and cooled and supplied from the outdoor unit by means of insulated hydraulic pipes.

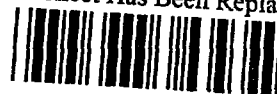
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In addition to their high cost, such installations have several drawbacks. In the first place, they make it necessary to pre-equip the entire building without judging beforehand whether or not the occupants require the air conditioning option. In addition, they require the fitting of an energy metering system meeting specific standards, the cost price of which is relatively high. In addition, such installations present a flexibility problem when, in mid-season, certain rooms which are well exposed require to be cooled whilst other rooms require to be heated. It should be noted that this last problem can be resolved by installing two outdoor units, one per facade, south and north. However, this solution leads to a not insignificant increase in investment cost. Lastly, any failure in the outdoor unit results in depriving all the dwellings of heating or air conditioning.

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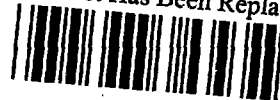
The second type of device consists of water/air systems consisting of heat pumps disposed in the dwellings and supplied by means of a constant-temperature water loop, maintained at the desired temperature by a loop heater and a cooling tower using the evaporation of 15% of the water in the circuit in order to cool it.

This system makes it possible to mitigate some of the drawbacks of the air/water systems described above. This is because it is possible to heat or air condition different dwellings in the building at the same time. In addition, except for a failure of one of the components of the cooling tower, any operating defect concerns only one dwelling rather than the entire building. On the other hand, this system also presents drawbacks. In the first place, the noise level in the dwellings is high since the compressors are disposed inside the heat pumps installed in these dwellings. In addition, although pre-equipping is less expensive than in the case of an air/water system (the cooling tower is less expensive than the outdoor unit of this air/water system, and the pipes are not insulated) the total cost of the installation is greater than that of air/water systems.

The third type of device consists of water/water systems consisting of fan convactor units disposed in the dwellings, and fed by means of a water loop provided with a cooling tower. Such a system can be compared to the air/water systems with however the drawback of not allowing change over of the cycle.

Finally, the fourth type of device consists of air/air systems produced by means of split systems, that is to say appliances including the condenser part and evaporator part and consisting of an outdoor unit and an indoor unit connected by a "Freon" pipe, the outdoor unit comprising a

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fan, a compressor and an exchanger, and the indoor unit comprising a fan and an exchanger.

Such split systems can be designed to treat an entire dwelling. The indoor unit is then connected to a network of ducts enabling the air to be distributed in the various rooms in this dwelling. Such a system has the advantage of being of lower cost compared with the aforementioned three systems. In addition, the different dwellings are treated in a totally independent manner. On the other hand, the cost price of the installation still remains relatively high. In addition, the noise level at the air intake of the indoor unit is high. Finally, the regulation of the temperature in the different rooms is very uncertain.

These split systems can also be used individually, by installing one appliance per room. This solution offers great flexibility in use but its cost is high.

The present invention aims to mitigate the above-mentioned drawbacks of the various devices for air conditioning and heating dwellings, and its main objective is to provide an air conditioning and/or heating device consisting of an air/air system with low cost price and noise level and enabling the dwellings to be treated individually.

To this end, the invention relates to a method of air conditioning and/or heating dwellings, notably in a block of flats, of the type consisting of:

- using an outdoor unit and an indoor unit linked by fluid and electrical connections, the outdoor unit comprising a compressor, ventilation means and an exchanger, the indoor unit comprising ventilation means and an exchanger,

- producing a circulation of air inside the dwelling using the ventilation means of the indoor unit, and

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- controlling the operation of the compressor of the outdoor unit by means of a device monitoring the temperature inside the dwelling and determining a set temperature.

5 According to the invention, this method is characterised in that it consists of:

- using a low-pressure indoor unit able to deliver air at a pressure of at most 8 mm, and

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- delivering this air in bulk in a false ceiling forming a sealed plenum chamber able to serve as an expansion chamber, the said plenum chamber having blower grilles opening out into each of the rooms to be treated.

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According to this method, the air conditioning of a dwelling with several rooms is provided by means of an assembly consisting of an indoor unit and an outdoor unit originally designed to treat a single room (wide-vent blowing because
20 of the low pressure of the indoor appliance).

Consequently it is notably possible according to the method of the invention to air condition an apartment with a relatively small area but having several rooms, by using an
25 assembly originally designed to air condition a single room.

This air conditioning is also provided by means of an installation which has no blowing duct and whose sound level is lower on the one hand because of the low pressure of the
30 indoor unit and on the other hand because of the expansion chamber phenomenon given by the plenum chamber.

The originality of the technique used according to the invention lies therefore in its extreme simplicity, which
35 makes it possible to effect the air conditioning of a dwelling by means of an installation whose cost is very much less than that of current installations.

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Preferentially, the aim of this method is to allow the air conditioning and heating of dwellings and use is made, for this purpose, of an outdoor unit provided with cycle change-over means and an indoor unit equipped with a supplementary electrical battery controlled by an external thermostat.

In addition, according to one preferential embodiment:

- 10 - use is made, for one of the rooms in the dwelling, referred to as the master room, of a blowing grille having ventilation characteristics suitable for allowing fluctuations in the output of the said grille with respect to its nominal output, and for the other rooms in the dwelling, referred to as the ancillary rooms, blowing
15 grilles provided with adjustment dampers enabling the output of the said grilles to be varied with respect to their nominal output, in a range such that the blowing grille of the master room can absorb these variations in output, and
- 20 - the temperature in the various ancillary rooms in the dwelling is regulated by modifying, by means of the adjustment dampers, the flow of air delivered into the said ancillary rooms.
- 25 According to this preferred embodiment, the regulation of the temperature in an ancillary room can be refined very simply by modifying, by means of the adjustment damper, the flow of air blown into the said room.
- 30 This is because the variation in flow brought about by the closure or opening of one of the blowing grilles in one or more of the ancillary rooms has repercussions in the master room through the blowing grille therein, which on the one hand does not have an adjustment damper and on the other
35 hand is designed so as to be able to absorb these fluctuations in flow.

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It should be noted that the use of such dampers is possible because of the fact that low-pressure air is being used, which prevents any overpressure at the outlets and any noise nuisance, even when the output of the said outlets is
5 minimal.

In addition, the operation of the compressor is advantageously controlled by means of a temperature monitoring device disposed so as to read the temperature of
10 the air taken in by the indoor unit ventilation means.

The temperature monitoring device is thus disposed so as to read the temperature of all the air taken in, which corresponds to the mean temperature in the dwelling, and
15 this then reacts to the fluctuations in output of the different blowing grilles so as to readjust the temperatures in the dwelling.

In addition, the dampers for regulating the blowing grilles
20 in the ancillary rooms are preferably controlled by means of thermostatic control devices.

According to another characteristic of the invention, the top face of the false ceiling is covered with a layer of
25 sound and heat insulating material.

The essential function of such a material is to prevent any condensation resulting from a temperature difference between the inside of the plenum chamber and the ambient air. It
30 also has the function of attenuating the noise level, firstly of the indoor unit and secondly between the rooms.

In addition, the indoor unit is advantageously integrated in the false ceiling, and the said false ceiling is separated,
35 by means of a cheek, into two parts forming an intake plenum chamber, provided with an intake grille able to serve as an inspection hatch, and the blowing plenum chamber.

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of non-limitative example, a preferred embodiment thereof. In these drawings, which form an integral part of the present invention:

- 5 - Figure 1 is a plan view of a dwelling with a balcony, equipped with a device according to the invention,
- Figure 2 is a diagrammatic view in elevation through a vertical plane in this apartment.

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The installation according to the invention includes an indoor unit 1 and an outdoor unit 2 with direct expansion connected together by refrigerant pipes and electrical lines such as 3 protected by an ICT and embedded in the floor screed. The characteristics of these units given below by way of example correspond to an apartment with a floor area of around 50 m².

The outdoor unit 2 consists of a direct-expansion heat pump with a refrigerating capacity of 3600 W and a heat output of 3800 W.

It includes, in a conventional manner, a hermetic refrigeration compressor equipped with a casing resistance, a direct-expansion exchanger made of copper with aluminium fins, a refrigerating circuit and a low-speed axial fan. The refrigerating circuit also includes, essentially, a pressure reducer, a four-way cycle change-over valve, an impact-resistant liquid bottle and a de-humidifier.

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This outdoor unit 2 also includes a defrosting system able to monitor the temperature at the exchanger and periodically demand cycle change-over when this temperature is below a predetermined threshold.

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As for the indoor unit 1, this consists of a fan convector unit without a casing, with a nominal output of 650 m³/hr at

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a pressure below 6 mm and around 5 mm. It includes a three-speed ventilation unit, a copper/aluminium direct expansion exchanger and a 2 kW electrical battery. This electrical battery is controlled by an external thermostat, which allows it to be triggered below a predetermined set point.

This indoor unit 1 is connected to a prewired control box including a thermostat, disposed in the apartment so that the said thermostat reads the temperature of the air taken in by the said unit. This control box 4 also has a stop/start button, a ventilation speed selector and a winter/summer cycle change-over switch.

The refrigeration connections linking the two units, indoor 1 and outdoor 2, include a gas tube and a liquid tube sheathed in a sleeve made from insulating material.

The electrical connections connecting these two units 1, 2 for their part include electrical cables bringing the power delivered to the circuit breaker as far as the outdoor unit 2, and enabling the thermostat control signal to be delivered to this outdoor unit 2.

In the example, the outdoor unit 2 is installed on the balcony of the apartment close to the guardrail on this balcony, and has an external grille 5 integrated in this guardrail. It should be noted that, because of the small depth (around 25 cm) of this outdoor unit 2, it is easy to design an architectural solution enabling it to be integrated directly into the guardrail.

As for the indoor unit 1, this is disposed above a false ceiling 6 consisting of a sheet of BA 13 gypsum plasterboard, extending in the apartment passageways, and adapted to form a blowing plenum chamber 7 for distributing air in all the rooms to be heated or cooled. In order to discharge the condensates, this indoor unit 1 is connected

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to a discharge pipe 8 connected by a syphon 9 to a waste-water pipe.

- 4 The volume delimited by the false ceiling 6 is also
5 separated in two by a vertical cheek 10 disposed in line
with the indoor unit 1, so as to form two separate volumes
constituting the blowing plenum chamber 7 extending at the
front of the indoor unit 1, and an intake plenum 11
extending to the rear of this indoor unit 1.

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- In order to provide the air intake, this false ceiling 6 is
provided with a grille 12 disposed in line with the indoor
unit 1 so as to communicate with the intake plenum chamber
11. This grille 12, for example fixed by means of screws,
15 advantageously has dimensions (for example 600 mm x 600 mm)
which, by virtue of its positioning in line with the indoor
unit 1, enable this indoor unit to be maintained or
repaired.

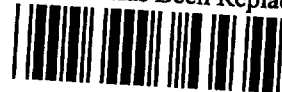
- 20 In addition, in order to allow circulation of air between
the rooms to be heated and cooled, and circulation, the
access doors to these rooms are relieved so as to form a
slot 13 underneath the said doors.

- 25 It should be noted, finally, concerning this air intake,
that the control box 4 incorporating the thermostat is
disposed in the circulation and therefore reads the
temperature of the air taken in by the indoor unit 1.

- 30 With regard to the distribution of air, and in the first
place, the false ceiling 6 is covered, in its part
delimiting the blowing plenum chamber 7, with a layer 14 of
sound and heat insulating material, such as rockwool.

- 35 This blowing plenum chamber 7 is also equipped with blowing
grilles for distributing air in the various rooms:

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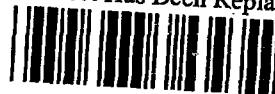
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- the blowing grille 15 supplying the main room, generally the living room, being adapted to have ventilation characteristics suitable for allowing fluctuations in the output of the said grille of plus or minus 40% with respect to its nominal output,

- the blowing grilles 16, 17 supplying the other rooms being provided with adjustment dampers suitable for making it possible to vary the output of the said grilles by plus or minus 30% with respect to their nominal output.

In addition, the adjustment dampers of the blowing grilles 16, 17 are controlled by a thermostatic control device (not shown) enabling the temperature of these rooms to be regulated independently.

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CLAIMS

1. Method of air conditioning and/or heating dwellings,
notably in a block of flats, of the type consisting of:
- using an outdoor unit (2) and an indoor unit (1) linked by fluid and electrical connections (3), the outdoor unit (2) comprising a compressor, ventilation means and an exchanger,
the indoor unit (1) comprising ventilation means and an exchanger,
 - producing a circulation of air inside the dwelling using the ventilation means of the indoor unit (1), and
 - controlling the operation of the compressor of the outdoor unit (2) by means of a device (4) monitoring the temperature inside the dwelling and determining a set temperature,
- the said method being characterised in that it consists of:
- using a low-pressure indoor unit (1) able to deliver air at a pressure of at most 8 mm, and
 - delivering this air in bulk in a false ceiling (6) forming a sealed plenum chamber (7) able to serve as an expansion chamber, the said plenum chamber having blower grilles (15-17) opening out into each of the rooms to be treated.
2. Method according to Claim 1 for air conditioning and heating dwellings, in which use is made of an outdoor unit (2) provided with cycle change-over means, and an indoor unit (1) equipped with an auxiliary electrical battery controlled by an external thermostat.

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3. Method according to one of Claims 1 or 2, in which an indoor unit (1) and a direct-expansion outdoor unit (2) are used.
- 5 4. Method according to one of Claims 1 to 3, characterised in that:
 - use is made, for one of the rooms in the dwelling, referred to as the master room, of a blowing grille (15) having ventilation characteristics suitable for allowing fluctuations in the output of the said grille with respect to its nominal output, and for the other rooms in the dwelling, referred to as the ancillary rooms, blowing grilles (16, 17) provided with adjustment dampers enabling the output of the said grilles to be varied with respect to their nominal output, in a range such that the blowing grille (15) of the master room can absorb these variations in output, and
 - 20 - the temperature in the various ancillary rooms in the dwelling is regulated by modifying, by means of the adjustment dampers, the flow of air delivered into the said ancillary rooms.
- 25 5. Method according to Claim 4, characterised in that the adjustment dampers of the blowing grilles (16, 17) in the ancillary rooms are controlled by means of thermostatic control devices.
- 30 6. Method according to one of Claims 4 or 5, characterised in that the operation of the compressor is controlled by means of a temperature monitoring device (4) disposed so as to read the temperature of the air taken in by the indoor unit ventilation means (1).
- 35 7. Method according to one of the preceding claims, characterised in that the top face of the false ceiling (6)

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is covered with a layer (14) of sound and heat insulating material.

8. Method according to one of the preceding claims,
5 characterised in that the indoor unit (1) is integrated in the false ceiling (6), and in that the said false ceiling is separated by a cheek (10) into two parts forming an intake plenum chamber (11) provided with an intake grille (12) able to serve as an inspection hatch, and the blowing plenum
10 chamber (7).

9. Device for air conditioning and/or heating dwellings, notably blocks of flats, of the type comprising:

15 - an indoor unit (1) and an outdoor unit (2) connected by fluid and electrical connections (3), the outdoor unit (2) comprising ventilation means and an exchanger, and the indoor unit (1) comprising ventilation means and an exchanger,

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- means of blowing out and taking in air connected to the indoor unit (1),

- a device (4) for monitoring the temperature inside the
25 dwelling able to control the operation of the compressor in the outdoor unit (2),

the said device being characterised in that:

30 - the indoor unit (1) is a low-pressure unit able to deliver air at a pressure of at most 8 mm,

- the blowing means comprise a false ceiling (6) forming a sealed plenum chamber (7) able to serve as an expansion
35 chamber, the said plenum chamber having blowing grilles (15-17) for each of the rooms in the house.

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10. Air conditioning and heating device according to Claim 9, in which the outdoor unit (2) is provided with cycle change-over means, and the indoor unit (1) is equipped with an electrical battery controlled by an external thermostat.
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11. Device according to one of Claims 9 or 10, in which the indoor unit (1) and the outdoor unit (2) are of the direct-expansion type.
- 10 12. Device according to one of Claims 9 to 11, characterised in that:
 - one of the blowing grilles (15) is adapted to have ventilation characteristics suitable for allowing
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- fluctuations in the output of the said grille with respect to its nominal output,
- the other blowing grilles (16, 17) are provided with adjustment dampers suitable for making it possible to vary
- 20
- the output of the said grilles with respect to their nominal output, in a range such that the blowing grille (15) can absorb the variations in output.
13. Device according to Claim 12, characterised in that it
- 25
- comprises, for each blowing grille (16, 17) provided with an adjustment damper, a thermostatic control device for controlling the said damper.
14. Device according to one of Claims 9 to 13,
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- characterised in that the false ceiling (6) is covered with a layer (14) of sound and heat insulating material.

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