

The present invention relates to an air-processing module for use in an installation designed for the ventilation and air-conditioning of a plurality of rooms.

Conventionally, when it is desired to ventilate and
5 air-condition a plurality of rooms, there is a choice between two types of installation.

A first type of installation, disclosed e.g. in US-A-2 286 115, has a single centralised air-processing plant which is housed in a plant room and provides
10 supply, in parallel, to air blowing openings in the different rooms through a system of branching ducts; the single centralised air-processing plant, which is supplied with fresh air, also recovers air from each room through another system of branching ducts ending in air
15 suction openings in the various rooms.

The disadvantage of a known installation of this type is that it is very difficult and even impossible to adapt the ventilation and air-conditioning to the specific needs of each room; for example, it is
20 practically impossible to find a setting of the air-conditioning plant which will give the ventilation and air-conditioning needed for a sick room, an office and a computer room which may nevertheless be neighbouring rooms.

Furthermore, a known installation of this type implies mixing of the stale air from the various rooms and re-introduction of this mixed air (mixed, it is true, with fresh air) into the various rooms; in other words, the air taken from one room is then distributed among the
25 other rooms, and if this air is charged with fumes, microbes or viruses, these fumes, microbes or viruses are distributed in the other rooms to the detriment of the comfort and health of their occupants.

Finally, a known installation of this type has the
35 disadvantage of requiring the installation of a complex

system of branching ducts implying the presence of numerous connections and variations in diameter as well as difficulties related to crossing over with other systems such as systems for water, gas and electrical supply, and the disadvantage that any breakdown or maintenance operation in the air-processing plant may interrupt ventilation and air-conditioning in all the rooms concerned.

An installation of the second type remedies these drawbacks inasmuch as each room has its own fan-assisted convector which takes air only from this room (apart from a supply of fresh air) and blows air only into this room, as disclosed in e.g. US-A-3 384 155, although this particular prior art installation appears to operate without addition of fresh air, or in US-A-3 722 580 which is the basis for subdivision of claim 1 into a preamble and a characterising part; this approach is a hygienic one and can be adjusted with great flexibility to the specific ventilation and air-conditioning needs of the room considered; furthermore, it eliminates the need for air ducts.

However, this installation also has disadvantages; the fan-assisted convector placed in each room takes up a non-negligible amount of space and the supply of the fan-assisted convector with fresh air necessarily means that it must be placed on the outside wall of the building, which limits the possibilities of room layout, rules out its use in rooms that do not adjoin an outside wall and as each room requires a fresh air tap, spoils the general aesthetics of buildings fitted with it and limits the choice as regards aesthetics; furthermore, individual supply of each fan-assisted convector with fresh air through a fresh air tap on the outside wall prevents effective control over the flowrate of fresh air given by the fan-assisted convectors since this flowrate is

closely related to atmospheric and, more precisely, to wind conditions; to cope with these disadvantages, this individual supply of fresh air to each fan-assisted convector is sometimes replaced by a supply of fresh air to the various rooms from an air-processing plant connected to the various rooms by a system of ducts, with the facility to control the flowrate and temperature of this fresh air, but in this case several disadvantages indicated earlier for an installation of the first type ensue.

Furthermore, when setting the desired temperature of the air travelling through each fan-assisted convector of an installation of the second type implies heat exchange with a heat-exchanging fluid, as is usual with fan-assisted convectors used for cooling air and as is frequent with fan-assisted convectors used for heating air, it is necessary to make provision for a system for the supply of heat-exchanging fluid, which is complicated and expensive to install and difficult to maintain; moreover, a condensate discharging system is needed for reasons of hygiene, and has the same disadvantages.

Finally, the second type of installation requires maintenance personnel to work in each room under conditions that are often uncomfortable, whether the fan-assisted convector is placed beneath a window or in a false ceiling; sometimes, maintenance work can even make the room unusable for a time, as is the case for certain hospital rooms; this is also true for leakages of heat-exchanging fluid or condensates, which may furthermore cause damage to equipment in the rooms in which they occur.

To remedy all these drawbacks there is proposed an air-processing installation, designed for the ventilation and air-conditioning of a plurality of rooms, and comprising, to this end, air-processing means housed in a

plant room, at least one air blowing opening and at least one air suction opening in each room and ducts to connect said air blowing and air suction openings to the air-processing means, wherein said air processing means
5 comprise a plurality of air processing modules grouped together in said plant room, each associated with a respective room, and each including, independently of the other air-processing modules:

10 - an air suction connector connected to the air suction opening of the respectively associated room by a respective duct,

- an air blowing connector connected to the air blowing opening of the respectively associated room by a respective duct,

15 - an internal air circuit connecting said air suction and air blowing connectors to each other,

- ventilation and air-conditioning means interposed in said internal air circuit,

20 - means for connecting the ventilation and air-conditioning means to energy supply means,

- adjustable means to regulate the ventilation and air-conditioning means at least as regards air temperature,

25 and in which there are provided respective means for the remote control of the adjustable means for the regulation of the ventilation and air-conditioning means of each air-processing module from the respectively associated room.

30 It will easily be seen that the air taken from each room can be re-injected only into this room, at a temperature and a flowrate set directly and individually by the occupant of this room, possibly within limits laid down by centralised technical management means, so that the system meets the most stringent hygienic conditions
35 and provides the best possibility of continuous

adaptation to the specific ventilation and air-conditioning needs of each room. The user comfort of the installation is further increased if, as in a preferred embodiment, each air blowing opening has a thermostatically controlled flap to direct the blown air according to the blowing temperature (this is known per se).

Furthermore, breakdown of or maintenance work on an air-processing module does not cause any interruption in ventilation and air-conditioning except in the respectively associated room, and this interruption may be considerably shortened since it is possible to design the air-processing modules and place them in the plant room in such a way that maintenance is made easier, and this totally separately from aesthetic considerations and imperatives concerning location in an inhabited room; nevertheless, each module designed to ventilate and air-condition a single room may occupy a space which is small enough for it to be easily and swiftly changed in the event of a fault.

The condensates being formed only in the plant room, their removal does not call for any network through the different rooms, and can be effected very simply through a collecting duct common to all the fan-assisted convectors and restricted to the plant room, or even more simply through gravity flow to a siphon built into the floor of the plant room; any leakages and stagnation of these condensates are limited to the plant room and do not affect the hygiene of the rooms, a factor that is especially important in certain instances, for example in hospital rooms.

Furthermore, most maintenance or repair work requires action only in the plant room. This makes periodic maintenance operations such as the changing of filters much faster and furthermore makes it possible to

perform these operations without affecting the possibility of using the rooms; similarly, when the ventilation and air-conditioning means imply heat exchange between air and a heat-exchanging fluid, any leakages of this liquid are limited to the plant room, i.e. they have no effect on the use of the rooms and do not represent any risk of damage to equipment in these rooms, and their repair implies action only in the plant room.

Finally, an installation of this type makes it possible totally to eliminate branching connections or changes in the diameter of the ducts, i.e. it simplifies their construction and installation; all the ducts can have the same constant diameter from one end to the other; this diameter, which is adapted to the flowrate corresponding to a single room, may be relatively small so that, despite the number of ducts, crossing over with pipes and electrical cables raises no difficulty, even in small spaces, e.g. in low false ceilings; the possibility of using ducts of constant diameter and of any desired length also results in an appreciable saving.

The air processing modules are preferably identical and only their settings are individualised; they can therefore be easily and quickly interchanged in the event of a fault.

For the implementation of an installation of this kind the present invention proposes an air processing module including, in a manner that is known in itself from US-A-3 722 580:

- an air suction inlet,
- an air blowing outlet,
- an internal air circuit connecting said air suction inlet and said air blowing outlet,
- ventilation and air conditioning means in said internal air circuit,

- means for connecting the ventilation and air conditioning means to energy supply means,
- means to regulate the ventilation and air conditioning means at least in terms of air temperature,

5 said module being delimited externally by two mutually parallel plain lateral faces and by outside faces, respectively mutually opposed front faces, a top face and a bottom face, which outside faces join said lateral faces together and include support means for said
10 module, said air suction inlet, said air blowing outlet, said connecting means to energy supply means and access means to said ventilation and air conditioning means.

US-A-3 722 580 describes modules of this kind coupled in pairs in a head-to-tail arrangement to process
15 directly the air from a respective one of two neighbouring rooms and delimiting between their mutually facing lateral faces a space accommodating common vertical pipes supplying hot or cold fluid and a common vertical condensate extraction pipe, to which they are
20 connected by a pipe passing through the respective lateral side. This is a bulky arrangement and requires difficult intervention between the modules in some maintenance or repair operations or to demount a module. However, the module of the invention is characterised in
25 that:

- the air suction inlet comprises an air suction connector adapted to receive an air suction duct,
- the air blowing outlet comprises an air blowing connector adapted to receive an air blowing duct,
30 - the regulation means comprise adjustable and remote control means for regulating the ventilation and air conditioning means at least in terms of air temperature,
- said lateral faces do not include any members on which action may be required for purposes of adjustment,
35 maintenance, basic repair or demounting of the module,

which members are grouped together on outside faces that are freely accessible even when modules are juxtaposed at said lateral faces.

5 Using this arrangement, the air-processing modules can be grouped in one compact battery inside the plant room with optimum access for maintenance and repairs; it is especially easy to replace a faulty module by another one if the supporting means of the various modules are independent of each other and capable of enabling each
10 module to be separated from the others by a movement parallel to said flat lateral faces.

 These flat, lateral faces are preferably vertical and the modules are preferably juxtaposed horizontally, for easier connection of the ventilation and air-
15 conditioning means to the power supply means, which are run horizontally, parallel to the battery of juxtaposed modules.

 Furthermore, in this case, the supporting means of each module may advantageously comprise means for
20 suspending the module, each module being suspended from the plant room ceiling; thus the battery of juxtaposed modules occupies no space on the floor and the modules can be placed at shoulder height, i.e. in a position that makes them especially accessible for maintenance
25 operations; according to a preferred embodiment, the suspension means for each module are located in an upper peripheral zone of the module, vertically above its centre of gravity, and have vibration damping means by which the transmission of vibrations to the ceiling of
30 the plant room can be minimised; furthermore, through a suitable choice of suspension means, the localised suspension system makes it easier to replace one module by another.

 When the modules are suspended in this way, an
35 optimum layout is obtained inside the plant room by

seeing to it that the ducts are on the ceiling, that the air suction and blowing connectors of each module face upwards and that the internal air circuit of each module is U-shaped between said air suction connections and air blowing connections of this module.

This arrangement is easily compatible with the passage of ducts in the false ceilings towards the air-blowing and air-suction openings of the various rooms; furthermore, the overall size of each module is minimised, assisted by the advantageous positioning of the ventilation and air-conditioning means on the U-shaped circuit defined in each module; preferably:

- the ventilation and air-conditioning means for each module have a respective vertical or horizontal filter and said internal circuit has an inlet plenum chamber between said filter and the respective air suction connector; the ability to interchange the filter, which is a frequent maintenance operation, is especially easy if, in a preferred embodiment, each module has detachable means to receive the respectively associated filter, a lower hatch for mounting and demounting the filter on a lower outside face of said module and a removable lower lid to close said lower hatch;

- the ventilation and air-conditioning means of each module have at least one respective vertical or horizontal heat exchanger juxtaposed horizontally to said respective filter and said internal circuit has an output plenum chamber between said heat exchanger and the respective air-blowing connector; for example, said heat exchanger of each module is of a heat-exchanging fluid circulation type, the energy supply means have an inlet pipe for heat-exchanging fluid and a return pipe for heat-exchanging fluid common to all the air-processing modules and the connection means that connect the ventilation and air-conditioning means of each module to

the energy supply means comprise two tubes to convey said heat-exchanging fluid respectively connected to the inlet pipe and to the return pipe and facing an outside face of said module and a respective adjusting valve in one of said tubes, facing a front outside face of said module and connected to said respective adjustable regulation means; the valve is thus easily accessible for adjustment and maintenance; naturally, the term heat exchanger refers both to an air-heating exchanger and to an air-cooling exchanger or to a combination of air-heating and air-cooling exchangers, it being understood that an air heating exchanger of the heat-exchanging fluid circulation type may also be replaced by electric heating resistors;

- the ventilation and air-conditioning means of each module have a respective motorised fan adjoining the respective air blowing connector and each module has means for mounting and demounting the motorised fan accessible through a front outside face adjoining the respective air blowing connector; maintenance is thus easily performed on the motorised fan.

The motorised fan is preferably of a variable speed type connected to respective adjustable regulation means to permit adaptation of the flowrate of air through each air-processing module and into the respective room to the temperature regulation.

According to a preferred embodiment, especially when designed for the ventilation and air-conditioning of inhabited rooms, the installation of the invention has means to supply the air-processing modules with fresh air.

Naturally, once all the air-processing modules are grouped together in the same plant room, the fresh air supply means preferably have a fresh air pipe common to all the air-processing modules and respective means

connect the respective air suction connector of each module to said fresh air pipe, said connecting means having fresh air flowrate regulating means; as an alternative, the internal air circuit of each module can be connected to the fresh air pipe by respective means separate from said air suction connector but, like the latter, located on an outside face of the module and comprising respective fresh air flowrate regulating means that are advantageously integrated into the module itself; the fresh air flowrate regulating means may be independent but are advantageously controlled by adjustable regulation means specific to the corresponding air-processing module; the fresh air pipes advantageously run across the plant room ceiling parallel to the battery of juxtaposed air-processing modules in a rational and compact arrangement.

The ducts inside the plant room and the means for connecting the ventilation and air-conditioning means to the energy supply means are preferably flexible, at least locally, enabling an air-processing module to be moved relative to the others without first detaching it from the ducts and from said connection means, i.e. with no need for direct access to these means when the modules are juxtaposed, with the modules as close as possible to the ceiling of the plant room when they are suspended according to the preferred embodiment of the invention described above; furthermore, this helps prevent transmission of vibration from a module to the ceiling of the plant room and an installation according to the present invention is therefore particularly silent and discreet.

Other features and advantages of the invention will emerge from the following description of a non-limiting example and from the appended drawings which are an integral part of this description.

Figure 1 is a diagram showing the layout of an air-processing installation according to the present invention.

5 Figure 2 shows a top view of a first preferred embodiment of an air-processing module of this installation capable of being suspended and juxtaposed horizontally to other identical modules, this module being shown in its suspended position.

10 Figure 3 shows a view in a lateral elevation in the direction of the arrow III of figure 2 of the same module as it appears when suspended in a battery of juxtaposed modules of this type in operation.

Figure 4 shows a perspective view of a detail of the suspension means of the module.

15 Figure 5 shows a sectional view in a vertical plane of a preferred type of air-blowing opening for a false ceiling.

20 Figure 6 shows a lateral elevation view similar to that of figure 3, showing a second preferred embodiment of an air-processing module according to the present invention also capable of being suspended and juxtaposed horizontally to other identical modules, said module being shown in its suspended state in a battery of juxtaposed modules of this type in operation.

25 Figure 7 shows a bottom view of the module of figure 6 in the direction of the arrow VII in figure 6.

Figure 8 shows a view of the module of figure 6 in the direction of the arrow VIII in figure 6.

30 Figure 9 shows a partial view similar to that of figure 6 an alternative method of suspension and connection to the fresh air supply means of the second embodiment of the module.

35 Reference will be made firstly to figure 1 which schematically illustrates three rooms 1, 2, 3 to be ventilated and air-conditioned and a plant room 4 in

which are grouped air-processing modules 5, 6, 7, respectively associated with these three rooms 1, 2, 3; naturally, this example is in no way limiting on the invention and the number of rooms that can be air-conditioned from a single plant room, i.e. the number of air-processing modules grouped together in the plant room, will generally be greater than three, a single plant room being provided, for example, for the air-processing modules corresponding to all the rooms of one floor of a building.

Each of the rooms 1, 2, 3, is advantageously provided, in a false ceiling, with at least one air suction or recovery opening 8, 9, 10 and at least one air blowing opening 11, 12, 13, the choice and optimum arrangement of which are within the scope of the normal abilities of persons skilled in the art; when the room 1, 2, 3 is provided with a window 14, 15, 16, the air blowing opening 11, 12, 13 is preferably between the air suction opening 8, 9, 10 and this window 14, 15, 16 and of a type comprising a thermostatically controlled flap to orient blown air, controlled in accordance with the blowing temperature, as described, with respect to the air blowing opening 11, with reference to figure 5.

Figure 5 shows a schematic view of a horizontal false ceiling 17 which leaves above it, i.e. between it and a ceiling slab (not shown), an intermediate space 18 in which there is placed, above the air blowing opening 11, an air inlet chamber 19 comprising a connector 20 for an air duct 21 (also shown in figures 1 and 3); there is a chamber of this type (not shown) associated with each of the other air blowing openings 12, 13, said chamber being used to connect a respective air duct 22, 23, and with each air suction opening 8, 9, 10, there is associated a similar chamber used to connect respective air ducts 24 (also visible in figures 1 and 3) 25, 26;

each of these duct connecting chambers is preferably provided with internal heat and sound insulation.

The air blowing openings 11, 12 and 13 are in the form of a longitudinal extrusion seen in cross-section in figure 5; referring still to the air blowing opening 11, this extrusion 27 is placed parallel to the window 14 and in an upper part communicating directly with the chamber 19 it internally delimits a single longitudinal channel 28 which is divided at the bottom into three juxtaposed longitudinal channels 29, 30, 31; the channel 29 closest to the window 14 is bent towards the window from its connection to the channel 28, while the other two channels 30 and 31, which together have a cross-section greater than that of the channel 29, for example twice the cross-section of this channel, are bent away from the window from their connection to the channel 28; the channel 30 is immediately adjacent the channel 29 and is separated from it by a longitudinal partition 32 of the extrusion 27 and at the top of this partition 32 there is a longitudinal flap 34 which is hinged to this partition 32 about a longitudinal axis 33 and which is also an extrusion, as shown in the figure and as will be evident to persons skilled in the art, so that by pivoting about the axis 33 with respect to the partition 32 it can occupy either a position shown in full line in figure 5 wherein it isolates the channel 29 from the chamber 19 by opening a maximum flow cross-section between the chamber 19 and the channels 30 and 31 or a position shown in dashed line in figure 5 wherein it blocks the channels 30 and 31 with respect to the chamber 19 by opening a maximum flow cross-section between the chamber 19 and the channel 29 or any intermediate position in which the channels 29, 30 and 31 are opened towards the chamber 19 with a cross-section of the latter towards the channel 29 changing in inverse proportion to the cross-section of

the chamber 19 towards the channels 30 and 31, depending on the orientation of the flap 34; this orientation is thermostatically controlled, for example by a temperature sensor 35 on the flap 34 measuring the air blowing temperature. The detection of an increase in this temperature, resulting from a drop in temperature in the room 1 sensed by means described below, opens a flow section for the air through the channel 29, i.e. towards the window, that is directly proportional to the blown air temperature. The detection of a drop in the blown air temperature opens a flow section for the air through the channels 30 and 31 which is inversely proportional to the blown air temperature; other types of air blowing opening and other modes of distribution of blown air in each room as a function of the temperature of this air can of course be chosen without going beyond the scope of the present invention; this method is known per se and air blowing openings thermostatically controlled in this manner are manufactured and marketed in France under the brand name "OPTIMIX" by the firm CARRIER S.A. which is a subsidiary of the CARRIER CORPORATION of Paris (France).

The various air ducts 21, 22, 23, 24, 25, 26 advantageously have a constant cross-section, which is identical from one duct to another, and are flexible, and each of them can thus be extended continuously without any intermediate connector from the room in which the respectively associated air blowing opening or air suction opening is located to the plant room 4.

Inside this room, as can be seen in figures 1 and 3, the air ducts 21 and 24 respectively corresponding to the air blowing opening 11 and the air suction opening 8 of the room 1 are respectively connected to an air blowing connector 35 and an air suction connector 36 of the air processing module 5 associated with this room 1; similarly, the air ducts 22 and 25 respectively

associated with the air blowing opening 12 and the air suction opening 9 of the room 2 are respectively connected inside the plant room 4 to an air blowing connector 37 and an air suction connector 38 of the air-processing module 6 associated with the room 2, and the air ducts 23 and 26 respectively connected to the air blowing opening 13 and the air suction opening 10 of the room 3 are respectively connected inside the plant room 4 to an air blowing connector 39 and an air suction connector 40 of the processing module 7 associated with the room 3; there is no intercommunication, i.e. no mixing of air, between the various air ducts 21, 22, 23 connected to the air blowing openings 11, 12, 13 corresponding to the different rooms and no communication, i.e. no mixing of air, between the air ducts 24, 25, 26 connected to the air suction openings 8, 9, 10, of the various rooms.

Similarly inside each of the modules 5, 6, 7, the air travels through a circuit which is independent from one module to another, i.e. this circuit allows no mixing of the air that travels through the respective internal circuits of the various modules 5, 6, 7.

As shown in figure 3 with respect to the air processing module 5, the internal circuit through which the air travels from the suction connector 36 to the blowing connector 35 is generally U-shaped, the air suction connectors 36, 38, 40 of the various modules 5, 6, 7 facing upwards like their air blowing connectors 35, 37, 39; on travelling through the circuit 41, the air arriving through the connector 36 inside the module 5 passes in succession through a filter 42 and a heat exchanger 43 which heats or cools it before it is recovered by a motorised fan 45 opening onto the blowing connector 35 and providing both air suction via the opening 8 in the room 1 and air blowing via the air

blowing opening 11; similarly, the air coming to each of the modules 6 and 7 via the respective suction connectors 38, 40 passes in succession through a filter, a heat exchanger and a motorised fan before leaving through the respective blowing connector 37, 39, the modules 5, 6, 7, being identical in the preferred embodiment of the invention shown here.

Note that before reaching the air suction connector 36, 38, 40 of the respective associated air processing module 5, 6, 7 the air removed from each room 1, 2, 3 via the respective air suction opening 8, 9, 10 is mixed with fresh air from a horizontal fresh air supply duct 46 common to all the air processing modules 5, 6, 7 and suspended from the ceiling of the plant room 4; the respective associated air duct 24, 25, 26 is connected to each air suction connector 36, 38, 40 by a respective Tee piece 47, 48, 49 which is also connected to the fresh air duct or pipe 46 through a respective flowrate regulator 50, 51, 52 providing a constant pre-determined flowrate of fresh air from the fresh air pipe 46.

In the preferred embodiment of the invention shown, each of the modules 5, 6, 7 has a shape such that the various modules can be suspended and juxtaposed in a single horizontal row 53 to which the fresh air duct 46, which is then rectilinear, is advantageously parallel, while providing optimum possibilities of access.

The design of the modules 5, 6, 7, to this end, will now be described with reference to figures 2 and 3 which show only the module 5, in view of the fact that the modules 5 and 7 are identical to it, barring any differences in their settings, as will emerge below; the module 5 will be described in its suspended position, as shown in figures 2 and 3.

As shown in these figures, the module 5 is in the

form of a metal chamber made by assembling metal plates which define an external contour described next and an internal contour which defines the internal air circuit 41 and is at least approximately geometrically similar to the external contour and is therefore not described since it can be easily deduced from the external contour.

This external contour is characterised in particular by the presence of two parallel flat lateral faces 54, 55 perpendicular to the row 53 of modules 5, 6, 7 which are juxtaposed two by two at these faces 54 and 55; to prevent direct contact between the metal plates of the modules juxtaposed in this way, the face 54 is provided with attached projecting buffers 56, 57 and the face 55 is provided with attached projecting buffers 58, 59, these buffers constituting spacers which maintain mutual spacing between, for example, the face 54 of the module 5 and the face 55 of the module 7 adjacent the face 54 and between the face 55 and the face 54 of the module 6 adjacent the face 55; the buffers 56, 57, 58, 59 are advantageously made of a vibration-absorbing material such as felt or rubber which slides easily on sheetmetal to facilitate the separation of a module from the other modules through a movement described below; for the same reason, the positions of the buffers 56, 57 on the face 54 are staggered with respect to the positions of the buffers 58 and 59 on the face 55 so as to prevent the respective buffers from being in mutual contact when the modules are juxtaposed.

Note that, ignoring the buffers 56, 57, 58, 59, the module 5 is entirely located between the geometrical planes (not shown) of its lateral faces 54 and 55.

Externally, the module 5 is further delimited by outside faces 60, 61, 62, 63, 64, 65 which are perpendicular to the faces 54 and 55 they join together and are flat in the example shown, although other shapes

may also be suitable.

The outside faces 60 and 62 are horizontal and respectively form an upper outside face and a lower outside face 62 of the module 5; the outside face 61 which connects them is a front face inclined at a few degrees to the vertical, a vertical plane through its connection to the lower outside face 62 being set back with respect to a vertical plane through its connection to the upper face 60; the outside faces 63, 64, 65 together define a front face of the module 5; the faces 63 and 65 are respectively connected to the lower face 62 and the upper face 60 on approximately the same vertical line and are inclined a few degrees to the vertical, in opposite directions, such that they converge in the direction away from the opposite front face 61; these two faces 63 and 65 are connected together by the face 64 which, because the height of the face 65 is greater than that of the face 63 and because the inclination to the vertical of the faces 63 and 65 is greater than that of the front face 61, has an equal but opposite inclination to the vertical to the face 61.

The chamber thus defined is hermetically sealed with exceptions described next.

Near the joining of the upper face 60 with the front face 61, the metal plate defining this upper face 60 has a cylindrical hole 67 with a vertical axis 66 to which the tubular air suction connector 36, which is also a body of revolution around the axis 66, is joined and sealed.

Between the hole 67 and the connection of the upper outside face 60 with the outside face 65, the metal plate defining this upper outside wall 60 has a second hole 68 forming an upper hatch for mounting and demounting the heat exchanger 43 which is placed vertically inside the module 5 and is removably received within the module in

vertical slides 69 shown in a schematic way as they can be easily designed by those skilled in the art; to seal the module 5 at the hole 68 when the module is in operation, an upper lid 70 is advantageously joined to the heat exchanger 43 and removably joined to the metal plate forming the upper outside face 60 of the module 5, above this face 60, so that the heat exchanger 43 can be removed from the module 5 by pulling vertically upwards on the lid 70 after it has been disconnected from the metal plate defining the upper outside face 60 of the module 5; to this end, the lid 70 advantageously has a grasping handle 71 which projects upwards, i.e. outside the module 5.

The upper lid 70 is also and advantageously used as a passage for means to connect the heat exchanger 43 to energy supply means; these energy supply means are shown in this example in the form of two pairs of pipes which also supply the heat exchangers of the various modules and are advantageously suspended from the ceiling of the plant room 4 in a horizontal rectilinear arrangement parallel to the row 53, namely one cold water inlet pipe 72 and one cold water return pipe 73 connected to standard refrigerating means (not shown), one hot water inlet pipe 74 and one hot water return pipe 75 connected to standard heating means (not shown); the heat exchanger 43 both heats and cools air in the circuit 41 through heat exchange with a heat-exchanging fluid, namely water; however, the air can be heated by electrical heating resistors, in which case the pipes 74 and 75 and the heating means are dispensed with; the electrical heating resistors are connected to an electrical supply in a manner not shown but easily conceivable by those skilled in the art, using connection means that pass through the lid 70 in a manner that will also be evident to those skilled in the art; similarly, in a simplified

alternative, it is possible to eliminate the refrigerating means and connect the cold water pipes 72, 73 to a system for supplying the building with drinking water to use this drinking water as cooling water in the heat exchanger 43.

To connect the heat exchanger 43, to each of the ducts 72, 73, 74, 75, four tubes for conveying heat-exchanging fluid pass vertically through the upper lid 70, namely a hot water inlet tube 76, a hot water return tube 77, a cold water inlet tube 78 and a cold water return tube 79; these four tubes, made of a rigid material, are bent at 90° immediately above the upper lid 70 and extend horizontally along the upper face 60 of the modules up to the position where this face is joined to the front face 61, extending along the connector 36; where the faces 60 and 61 join, the two inlet tubes 78 and 76 are bent vertically downwards and the two return tubes 77 and 79 run along the front face 61 and are then bent towards the vertical so as to run parallel to the tubes 76 and 78 up to a level slightly above that of the lower face 62 of the module; the four tubes 76, 77, 78, 79, are connected rigidly but in an easily removable way to the faces 60 and 61 of the module.

In front of the front face 61, near where it joins the lower face 62, i.e. preferably at shoulder height, the two cold water tubes 78, 79 are provided with a solenoid valve 80 and the two hot water tubes 76, 77 are provided with a solenoid valve 81; at a level below that of the solenoid valves 80 and 81, the tubes 76, 77, 78 and 79 are connected by quick-fit connectors (not shown) to a respective hose 82, 83, 84, 85 which is itself connected to the hot water inlet pipe 74, the hot water return pipe 75, the cold water inlet pipe 72 and the cold water return pipe 73, respectively.

The valves 80 and 81 consequently make it possible

to adjust the cold water and hot water flowrates, respectively, in the heat exchanger 43 in a manner regulated by adjustable temperature regulating means (and preferably air flowrate regulating means) of the module 5, independent of the respective corresponding means of the other modules, and incorporated in a unit 86 which is preferably attached to one of the outside faces 60 to 65 of the module 5 at a position chosen so that this unit 86 can be easily reached in order to adjust the regulation means when the module 5 is suspended with its lateral faces 54 and 55 juxtaposed to the other modules; the valves 80 and 81 are connected to this unit 86 by respective electrical conductors 87 and 88 extending along the outside faces of the module 5; as an alternative, not shown, the unit 86 can be housed inside the module 5, in which case one of the outside faces 60 to 65 of this module 5 would have an access hatch to the unit 86 provided with a detachable lid, in a manner that will be evident to those skilled in the art, or it can be dissociated from the module 5 and, for example, integrated with the corresponding units 105, 106, respectively, of the other modules 6, 7 in a central control panel or desk.

The metal plate defining the lower outside face 62 of the module 5 has, between a vertical plane through the slides 69 and a vertical plane through a hole 67, a hole 89 forming a lower hatch for mounting and demounting the filter 42, which is received inside the module 5 by vertical slides 90, in a manner that will be evident to those skilled in the art, and consequently shown only schematically, so that the filter 42 can be inserted in and removed from the module 5 by vertical sliding through the hole 89; when the module is in service, this hole 89 is closed and sealed by an attached lid 91 which holds the filter 42 in position within the module 5; in the

example shown, the lid 91 is releasably held in a position in which the hole 89 is closed by a toggle device 92, but other methods for releasably holding the lid 91 can be chosen without exceeding the scope of the present invention.

The filter 42 is thus closely juxtaposed with the heat exchanger 43; an optimum distribution of the air in the circuit 41, bringing it into contact with a maximum surface area of the filter 42 and with a maximum surface area of heat exchange inside the heat exchanger 43, is ensured by the fact that, with the metal plates defining the lateral faces 54 and 55 of the module, the metal plates defining the faces 60, 61 and 62 delimit an inlet plenum chamber 93 inside the module 5, between the air suction connector 36 and the filter 42, and the metal plates defining the outside faces 62, 63, 64, 65, 60 define an outlet plenum chamber 94 with respect to the exchanger 43.

The inlet plenum chamber 93 communicates with the air suction connector 36 through the hole 67 and the outlet plenum chamber 94 communicates with the air blowing connector 35 of the module 5 through a hole 95 forming a hatch in the metal plate forming the face 64 of the module 5 and through the motorised fan 45 which forms with the air blowing connector 35 a structural unit 96 removably attached, with a seal around the hole 95, to the face 64 of the module 5; for example, the unit 96 is removably suspended by hooks 97, 98, attached to the face 65 of the module 5 and pressed against the face 64, around the hole 95, by a toggle device 99 which is itself mounted on the face 63; naturally other modes of removably joining the structural unit 96 to the other elements of the module 5 can be chosen without exceeding the scope of the present invention, and likewise the motorised fan 45 can be removably attached to the other

elements of the module 5 without forming a structural unit with the air blowing connector 35; however, the great ease with which the motorised fan 45 can be mounted and demounted as a result of the structure shown and described above is worthy of note.

The motorised fan 45 is advantageously a variable speed motorised fan connected by conductors 100 to the adjustable means for regulating the temperature and flowrate of the module 5, incorporated in the unit 86. In a simplified version, the variable speed motorised fan can be replaced by a fixed speed motorised fan, preferably disposed in the same way.

Naturally, the module 5 further has all accessory arrangements and devices known per se in the field of fan-assisted convectors, and in particular a condensates draining device 101 provided in the metal plate defining the lower outside face 62 of the module 5 and draining means 102, 103 respectively for the hot water circuit and the cold water circuit of the heat exchanger 43; these draining devices 101 and draining mean 102, 103, may discharge freely onto the floor of the plant room, as shown here, or (not shown) they may be connected to collecting pipes common to the various modules.

Note that the air processing module 5 just described is structurally independent of the other modules 6 and 7 and that consequently it can also be functionally independent of these other modules.

In accordance with the invention, the adjustable regulation means incorporated in the unit 86 of the module 5 are remote controlled from the associated room 1, independently of the corresponding means fitted into the other modules.

For this purpose, the adjustable regulation means built into the unit 86 associated with the module 5 are connected, as shown schematically at 103, to remote

control means 104 inside the room 1, in which they can take the form of a fixed unit placed on a wall, for example, or the form of a movable unit placed on a desk in the room; the remote control means 104 have a
5 temperature sensor that measures the temperature in the room 1 and means for setting a temperature to control the operation of the heat exchanger 43 through the adjustable regulating means incorporated in the unit 86, i.e. to control the temperature of the air blown through the
10 opening 11 by action on the solenoid valves 80 and 81 and to control the speed of the motorised fan 45, if it is of the variable speed type, to control the flowrate of air sucked in via the opening 8 and blown in via the opening 11, for example, depending on the state of the solenoid
15 valves 80 and 81 as set automatically; if necessary, the remote control means 104 may comprise means for setting other parameters to influence the operation of the associated module 5 from the room 1; for example, these means may comprise a sensor to detect whether the room 1
20 is occupied, or a switch which is operated automatically if the room is not occupied or deliberately to stop the module 5 or to cause it to maintain a comparatively low minimum temperature in the room 1; stopping the module 5 implies shutting the valves 80 and 81 and stopping the
25 motorised fan 45; similarly, the adjustable regulating means respectively associated with the two modules 6 and 7 and incorporated in the respective units 105, 106 of these modules are respectively connected to remote control means 107 located in the room 2 and remote
30 control means 108 located in the room 3, as shown schematically by connections 109 and 110, respectively, said remote control means 107 and 108 being similar in all respects to the remote control means 104; each module 5, 6, 7 is thus remote controlled from the respectively
35 associated room 1, 2, 3 independently of the other

modules; the adjustable regulating means incorporated in the units 86, 105, 106 are connected to a common electrical supply 111 as shown by respective connections 112, 113, 114.

5 Naturally, it is also possible to provide centralised technical control means 142 located in or outside the plant room and electrically connected to the adjustable regulating means incorporated in the units 86, 105, 106, as shown schematically by the respective
10 connections 143, 144, 145, to control these regulating means with priority over the respectively associated remote control means 104, 107, 108, for example to impose limits on settings or adjustments that can be made by remote control from a determined room, e.g. to fix a
15 minimum and a maximum temperature in this room, or to impose defined conditions, especially of temperature, in a room or a group of rooms momentarily without the facility for remote control from the respective room(s), or to forcibly shut down one or more modules.

20 The modules 5, 6, 7, being preferably identical, as indicated above, it is possible to effect a basic setting of the regulation means in the units 86, 105, 106, i.e. to effect these settings in a centralised way in the plant room 4, and to vary the settings individually from
25 associated rooms 1, 2, 3.

 Locating the unit 86, the valves 80, 81, the lid 91 providing access to the filter 42, the device 92 for removably fixing this lid, the structural unit 96, the means 99 for removably fixing it on the front outside
30 faces and lower outside faces of the modules 5, 6, 7, is preferred because this makes it possible to perform very frequent setting and maintenance operations on each module while these modules have their plane lateral sides, i.e. sides 54 and 55 in the case of the module 5,
35 juxtaposed; working on the heat exchanger 43, accessible

via the upper outside face of the module, requires the separation of this module from the other modules because the modules are preferably as close as possible to the ceiling 115 of the plant room 4, as shown in figure 3, but this is a minor disadvantage inasmuch as work on the heat exchanger is relatively infrequent.

However, to facilitate this action, i.e. to facilitate mounting and demounting of each module independently of the other modules, a mode of suspension has been chosen in the embodiment of the invention shown in figures 2 to 4 which will now be described with reference to module 5, it being understood that the other modules 6, 7 are suspended in exactly the same way, independently of one another and of the module 5.

As shown more particularly in figures 2 and 3, the module 5 has a "silentbloc" mount 118 on its upper outside face 60, in an area 116 between the hole 68 and the junction of the side 60 with the side 65, mid-way between the lateral faces 54 and 55, as precisely as possible on a vertical line through the centre of gravity 117 of the module in its suspended position, joined at the bottom to the metal plate defining the upper outside wall 60 of the module 5 and at the top to a rectilinear vertical rod 119 having an axis 120 that passes as precisely as possible through the centre of gravity 117 of the module 5 in its suspended position.

At the top, i.e. above the mounting 118, the rod 119 has a head 121 with dimensions transverse to the axis 120 greater than those of the rod 119 so as to define, at the bottom, a peripheral shoulder 122 around the rod 119; this shoulder 122 at the bottom of the head 121 rests on a horizontal flat flange 123 of a U-shaped bracket 124; the rod 119 goes through this flange 123 in the immediate vicinity of the head 121; the bracket 124, specific to the module 5, the rod 119, its head 121 and the mounting

118, has a vertical flat web 125 above the flange 123, said vertical flat web 125 being joined at the bottom to the flange 123 and at the top to a flange 126 which is also flat and horizontal; a bolt 127 goes through the flange 126 along the axis 120 to support it on the bolt head 128 and is screwed above the flange 126 into a slide 129 housed inside a rectilinear rail 130 placed along the row 53, with which this rail is coincident in figure 1; the rail 130 is fixed to the ceiling 115 of the plant room 2; each module (e.g. the module 5) has its own slide (e.g. the slide 129) independent of the slides respectively associated with the other modules (e.g. the modules 6, 7), but the rail 130 is common to all the juxtaposed models in the row 53; as shown in figure 3, it has a rectangular section defined by two horizontal flat flanges 131, 132 connected together by two vertical flanges 133, 134, the horizontal flange 132 under the horizontal flange 131 being provided with a slit 135 throughout the length of the rail 130 to permit the passage of each of the bolts like the bolt 127, each of the slides (e.g. the slide 129) being retained inside the rail 130 and sliding independently of the other slides along the row 53; it is thus possible to juxtapose the different modules 5, 6, 7 optimally via their respective lateral faces like the faces 54 and 55.

To enable easy hooking and unhooking of each module (e.g. the module 5) independently of the other modules, the bracket 124 is advantageously of a type shown in figure 4, the web 125 of which is parallel to the row 53; this type of bracket 124 is marketed under the registered trademark MUPRO and is characterised by the presence of a slot 136 straddling the flange 123 and the web 125 with a median plane 137 shown schematically in figure 2, perpendicular to the row 53 and including the axis 120 of the rod 119 in the suspended position shown in figure 3;

the slot 136 has a dimension perpendicular to this plane 137 corresponding substantially to the dimensions of the rod 119 transverse to its axis 120, especially in the immediate vicinity of its head 121, in the flange 123 and over part of the height of the web 125 in the immediate vicinity of the connection of this web 125 with the flange 123; at approximately mid-height on the web 125, the slot 136 has a localised enlargement 138 to enable the passage of the head 121 of the rod 119 through the web 125; by movement of the module 5 and the rod 119, considered as a unit, along directions included in the plane 137, i.e. perpendicular to the row 53, the module 5 can be hooked onto the bracket 124 or unhooked from it while the neighbouring modules 6, 7 remain in position since the faces 54, 55 or more precisely by buffers 56, 57, 58, 59 of these faces of the module 5 can slide over the respectively corresponding faces of the two juxtaposed modules 6, 7; thus, a module can be unhooked, if necessary, in order to work on its heat exchanger 43 or simply to replace it without having to unhook the other modules; owing to the flexibility of the ducts 21 and 24, the connections 82, 83, 84, 85 of the valves 80 and 81 with the pipes 72, 73, 74, 75 and the connections of the unit 86 with the associated remote control means 104 and with the electrical supply 111 of the module 5, for example, the hooking and unhooking can be done while it remains connected, minimising the period for which it is out of operation; furthermore, in order to unhook a module it is not necessary to first demount the corresponding Tee piece (e.g. the Tee piece 47), making it possible to place the air suction connector such as 36 as close as possible to the ceiling 115 of the plant room 4, independently of any mounting and demounting requirement; for this purpose, a section of flexible pipe 139, 140, 141 is advantageously provided between the

fresh air supply pipe 46 and each flowrate regulator 50, 51, 52, as shown, or between each flowrate regulating means 50, 51, 52 and the respectively associated Tee connector 47, 48, 49 (not shown).

5 Naturally, the embodiment of the invention that has just been described is only a non-limiting example and alternative embodiments can be provided for without exceeding the scope of the present invention.

10 In particular, these alternative embodiments may relate to the internal arrangement of the air-processing modules which preferably remain capable of being suspended with their respective plane and mutually parallel lateral faces juxtaposed, which faces preferably have none of the elements on which action might have to be taken for setting or maintenance, for simple repairs or for demounting the module, which elements are preferably grouped together on outside faces which are freely accessible even when the modules are juxtaposed.

20 An alternative of this type is shown in figures 6 to 8 which show an air processing module 205 capable of being substituted for the air-processing module 5 to serve the room 1, in a manner identical to that described with respect to the module 1, this module 205 being juxtaposed in the same way as the module 5, in the suspended state, with two other identical modules respectively serving the rooms 2 and 3.

25 The module 205 is similar in a great many respects to the module 5 and the elements previously described under the respective references 21, 24, 35, 36, 41 to 43, 45, 46, 50, 54, 55, 58, 60 to 64, 72 to 89, 91, 93 to 95, 100, 101, 103, 112, 115, 117, 139, are seen again in at least some of figures 6 to 8 under the references 221, 224, 235, 236, 241 to 243, 245, 246, 250, 254, 255, 258, 260 to 264, 272 to 289, 291, 293 to 295, 300, 301, 303, 312, 315, 317, 339, either identically or with

differences described below.

Externally, these differences include a vertical orientation of the front outside faces 261 and 263, joined together by the lower outside face 262 which has the shape of a hopper defined by three plane facets perpendicular to the lateral faces 254 and 255, namely two end facets 262a and 262b which converge towards the bottom, respectively from the face 261 and from the face 263, and an intermediate horizontal facet 262c connecting the two facets 262a and 262b at the bottom to define the lowest zone of the module 265 comprising the condensates draining device 301; this draining device, which discharges freely onto the floor of the plant room as stated with reference to the air-processing module 5 shown in figure 3, in this example discharges into a condensate recovering pipe 400 specific to the module 205 leading to a collecting pipe 401 common to the various juxtaposed modules; an assembly of this type can naturally be adopted in the case of the modules 5, 6, 7.

While the facets 262a and 262c, apart from the draining device 301, are defined by solid metal plates which also delimit the internal air circuit 241, the facet 262b includes a lower hatch 289 occupying much of its area, corresponding to the hatch 89 described above and normally closed and sealed by a flat lower lid 291 hinged for this purpose about a horizontal axis 402 on hooks 403 provided on the face 263 and also enabling it to be unhooked when it occupies an opening position shown in chain-dotted line in figure 6 and can be locked in the closing position of the hatch 289, shown in full line, by means of a lock 404 on the facet 262c.

The lid 291 advantageously carries the unit 286 containing the means for regulating the air temperature and air flowrate of the module 205, either outside the module 205 as shown in full line or inside it as shown in

chain-dotted line; in the closed position, the lid 291 partially delimits the internal air circuit 241, as do the metal plates respectively defining the facets 262c and 262a; for aerodynamic reasons, the facet 262a and the combination of the facet 262b and the lid 291 in the closed position are at about 30° to a horizontal plane and the dimensions of the facet 262c are as small as possible, allowing for the presence of the condensates draining device 101 and the lock 404, but other arrangements can be adapted without exceeding the scope of the present invention.

Inside the internal air circuit 241, in its closed position, the lid 291 carries a cradle 405 (shown in chain-dotted line with the lid 291 open in figure 6) that forms a minimum obstacle to the passage of air in the internal circuit 241; unlike the filter 42 of the module 5, the filter 242 occupies a horizontal position inside the internal air circuit 241 when the lid 291 is closed; when the lid 291 is open, the filter 242 is accessible beneath the module 205 and can be detached from its cradle 405 for cleaning or changing before closing the lid 291 again; the filter 242 can simply slot into the cradle 405, for example.

In the closed position of this lid, the horizontal filter 242 contiguous to metal plates respectively defining the front peripheral wall 263 and the lateral walls 254 and 255 extends approximately half the horizontal distance between the faces 262 and 263, up to an edge 407 which is perpendicular to the lateral faces 254 and 255 and through which the filter 242 is connected and sealed to a sealed partition 406 essentially defined by a flat metal plate joined and sealed to the metal plates defining the lateral faces 254 and 255; from its connection with the edge 407 of the filter 242, the partition 406 rises towards the front outside face 263,

at an angle of about 45° to the horizontal in the example shown, and is connected and sealed at the top to a metal plate defining the front outside face 264 which is inclined in the reverse direction, i.e. rising towards the face 261 from its connection with the face 263, also at an angle of about 45° to the horizontal in this example, until its direct connection to the horizontal upper outside face 260 of the module 205.

The partition 406 and the metal plates which respectively define the faces 263, 264, 254, 255, together define, above the filter 242, the inlet plenum chamber 293 of the module 205; a hole 408 in the metal plate defining the face 264 between the joining of this face with the partition 406 and with the metal plate defining the face 263 forms the air suction connector 236; between its connection with the partition 406 and its connection with a metal plate defining the upper face 260, the metal plate defining the face 264 has a hole 295 which forms the air blowing connector 235; in this embodiment of the invention, the air blowing connector 235 and the air suction connector 236 are therefore juxtaposed on the same front outside face 264 of the module 205 and face upwards; the sealed internal air circuit 241 delimited by the module 205 is U-shaped between the connectors 235 and 236, as will emerge from the remainder of the description.

The metal plate defining the upper outside face 260 of the module 205 is not perforated and is connected to a metal plate defining the vertical front outside face 261 by means of a flat metal plate 409 which, unlike the above-mentioned metal plates which are permanently joined and sealed to each other, is removably joined in a manner that does not provide a seal to the metal plates that respectively define the peripheral walls 260 and 261 and to the metal plates that respectively define the lateral

walls 254 and 255; this metal plate 409 thus defines a front outside face 410 of the module 205. This face 410 is flat and perpendicular to the side faces 254 and 255 and joins the outside faces 260 and 261 to each other; from the face 261, the face 410 rises towards the face 263 until it joins the face 260 at an angle of 60° to the horizontal, this figure of 60° being a non-limiting example.

Inside the module 205, with the metal plates respectively defining the lateral faces 254 and 255, the outside faces 260 and 261, the partition 406 and that part of the metal plate that defines the peripheral wall 264 located between the partition 406 and the metal plate defining the outside face 260, the metal plate 409 defines the outlet plenum chamber 294 in which the variable speed motorised fan 245 is placed in this embodiment of the invention; this variable speed motorised fan 245 is shown in this example in the form of a centrifugal fan comprising a spiral housing 411 removably attached to the metal plate defining the face 255 with its suction inlet 413 on a horizontal axis 412 inside the outlet plenum chamber 294. This spiral housing 411 has its discharge 414 directly facing and sealed to the hole 295.

Furthermore, in this embodiment, a fresh air suction connector 416 discharges into the outlet plenum chamber 294 through a central hole 415 in the metal plate 409, to which the fresh air suction connector 416 is joined. The connector 416 is connected by a push-on hose 339 to the fresh air supply pipe 246; inside the outlet plenum chamber 294 and immediately facing the connector 416 is the fresh air flowrate regulator 250 joined to the metal plate 409; as will be seen further below, the metal plate 409 carrying the fresh air suction connector 416 and the fresh air flow regulator 250 can be replaced by a

solid metal plate in an alternative embodiment of the module 205 which will be described as part of the description of figure 9.

As it follows the internal air circuit 241, the air
5 that has passed through the filter 242 passes through the
heat exchanger 243 which heats or cools it before it
reaches the outlet plenum chamber 294 provided with the
variable speed motorised fan 245 and, in the example
shown, with the fresh air regulator 250; unlike what has
10 been described with reference to the module 5, in the
module 205 this heat exchanger 243 is horizontal and
juxtaposed horizontally to the filter 242, between the
edge 407 of this filter and the metal plate defining the
front peripheral wall 261 through which pass and to which
15 are sealed the tubes 276, 277, 278 and 279 respectively
corresponding to the tubes 76, 77, 78, 79 described
above; the heat exchanger 243 is connected to the filter
242 by a horizontal sealed partition 417 which is also
sealed to the metal plates respectively defining the side
20 walls 254 and 255; the heat exchanger 243 is also
contiguous with and sealed to the metal plates defining
the walls 254 and 255 in this embodiment; it could
instead be removable, for example mounted on slides
similar to the one described with reference to module 5,
25 except for its orientation, similarly, a permanent
assembly can also be chosen for a vertical orientation of
the heat exchanger similar to the one described with
reference to the module 5; between the filter 242 and the
heat exchanger 243, on the one hand, and the metal plates
30 defining the face 262 and the lid 291, on the other hand,
the internal air circuit 241 passes through an
intermediate plenum chamber 454 in which the air is
deflected by 180°.

Note that because the tubes 276, 277, 278, 279
35 leave the air-processing module 205 through the front

outside face 261 of this module, they can be as short as possible and can support the solenoid valves 280 and 281 respectively on the tube 279 and on the tube 276 directly in front of this face, the solenoid valves 280 and 281 remaining directly accessible to an operator if necessary and being connected by respective hoses 285 and 283 to the pipes 273 and 275 respectively corresponding to the pipes 73 and 75 described above, while the tubes 276 and 278 are connected by respective hoses 282 and 284 to the pipes 274 and 272 respectively corresponding to the pipes 74 and 72 described above; the connection of each of the hoses with the respectively corresponding pipe is advantageously by way of a respective quick-fit connector, making it easier to demount the module 205 if necessary.

Naturally, the heat exchanger 243 may be modified in the same ways as the heat exchanger 43, with the same consequences as regards its energy supply.

Note that, compared with the module 5 described with reference to figures 2 and 3, the module 205 just described can have a smaller height, making it possible to house a row of modules of this type, aligned horizontally, between the top of an entrance door to the plant room and the ceiling slab 315 of this room, i.e. making it possible to limit the floor area needed for the plant room.

This heightwise compactness of the module 205 is also helped by the preferred modes of suspending this module 205 from the ceiling 315 of the plant room shown in figures 6 and 8 and in figure 9.

Referring to figures 6 and 8 and especially to figure 6, the module 205 is suspended from the ceiling 315 by means of a rail 330 which is fixed to the ceiling 315 and is common to all the juxtaposed modules, like the rail 130 described above, but via a chamber 418 also used

to connect the air suction duct 224 and the air discharge duct 221 respectively corresponding to the ducts 24 and 21 described above to the connector 236 (the hole 408) and the connector 235 (the hole 295), respectively.

5 Since the air-processing module 205 is juxtaposed via its flat lateral sides 254 and 255 to other identical modules, the chamber 418 is delimited by two flat lateral faces 419 and 420 which are respectively coplanar with the faces 254 and 255 and these faces 419 and 420 are
10 juxtaposed with similar chambers used to suspend two air processing modules (not shown) adjacent to the module 205 and to connect these two modules with the respective air suction opening and air-blowing opening; like the air-processing modules (e.g. the module 205) to which they
15 correspond, the suspension and connection chambers are structurally and functionally independent of each other.

 Buffers 421, 422, 423, are preferably attached to one side face of the chamber 418 (the face 420 in the example shown) or both side faces (not shown), to form
20 projections constituting spacers between the different juxtaposed chambers capable of absorbing vibration and making it easier for a chamber to slide on adjacent chambers in the event of demounting.

 Between the side faces 419 and 420, the chamber is
25 delimited by a set of flat outside faces 425, 426, 427, 428 and 429 perpendicular to these faces 419 and 420 and defined, like these latter faces, by respective metal plates which are joined and sealed to delimit a sealed internal volume 424 within the chamber 418.

30 The outside face 425 has the same inclination as the face 264 of the module 205, facing downwards while the face 264 faces upwards, and is applied flat against this face 264 via a gasket 430, especially around the holes 408 and 264 respectively defining the suction
35 connector 236 and the blowing connector 235, the gasket

430 providing airtight isolation between these two connectors; the face 425 is joined, respectively at the top and at the bottom, to the vertical face 426 which is oriented identically to the face 261 of the module 205 and to a horizontal lower face 429; the face 426 has hooks 431 on which the module 205 is suspended, to hinge on a horizontal axis 432 perpendicular to these faces 254 and 255, by rings 433 attached to its face 264, substantially vertically above its centre of gravity 317; the face 429 has, in the vicinity of its junction with the face 425, a vertical rim 434 cooperating with a lock 435 carried by the face 263 of the module 205; the module 205 and the chamber 418 can be locked in a position in which the faces 264 and 425 are mutually supported and apply heavy pressure to the gasket 430 but, after releasing the lock 435, the module 205 can pivot on the axis 432 with respect to the chamber 418 until, after sufficient tilting, the module can be unhooked from the hooks 431 if the air-processing module 205 needs to be demounted or replaced by another similar module hooked onto the hooks 431 and then tilted to a position where the gasket 430 is crushed between the faces 425 and 264, with the lock 435 locked onto the rim 434.

At the top, the face 426 is connected to the upward facing horizontal upper face 427 which is itself joined to the lower face 429 by the face 428 which is vertical and faces in the opposite direction to the face 426.

Near its junction with the face 428 and its junction with the face 426, respectively, the upper face 427 of the chamber 418 has respectively fixed and removable horizontal lugs 436 and 437 for hooking them onto a horizontal flange 332 of the rail 330 which these two lugs enter via a slit 335; the horizontal flange 332 and the slit 335 respectively correspond to the horizontal flange 132 and the slit 135 of the rail 130,

to which the rail 330 is quite similar when seen in cross-section as in figure 6, except that it is lower and wider than the rail 130 and the slit 335 is much wider than the slit 135, so much so that the horizontal flange 332 is limited to two horizontal shoulders narrower than the slit 135 which separates them; the detachable lug 437 is, for example, bolted to a horizontal lug 438 which is attached to and overhangs the face 426, and is supported under the flange 332 of the rail 330, enabling separation of the lugs 437 and 438 to release the chamber 418 from the rail 330; note that the upper face 260 of the module 205 is, for this purpose, slightly offset downwards with respect to the lug 438 and the bolt connecting it to the lug 437.

The metal plate defining the face 428 of the chamber 418 has, on respective horizontal axes 439 and 440, two circular holes 441, 442 each of which is extended along its axis, beyond the face 428, by a respective tubular connector 443, 444 to which the air-blowing duct 221 and the air suction duct 224, respectively, can be removably fitted; inside the volume 424, the hole 441, which is higher than the hole 442 and offset towards the face 420 of the chamber 418 with respect to this hole 442, opens into a bent tubular duct 445; the hole 441 is thus connected and sealed to a hole 446 in the metal plate defining the lateral face 425 and opening directly in front of the hole 264 defining the air-blowing connector 235 of the module 205; this connection is sealed from the remainder of the interior volume 424 of the chamber 418; the hole 442 is in direct communication with the remainder of the internal volume 424 of the chamber 418, which communicates with the hole 408 defining the air suction connector 236 via a hole 447 in the metal plate defining the face 425 of the chamber 418 immediately facing this hole 447.

This method of suspending the module 205 achieves great heightwise compactness beneath the ceiling 315 and considerably facilitates demounting and remounting of a module (e.g. the module 205) since prior demounting of the air suction duct 224 or the air blowing duct 221 is not needed.

The arrangements that have just been described also reduce the overall size of the module 205 in the plant room since it is possible to attach the chamber 418 by its face 422 to a wall 448 of this plant room, said wall 448 being drilled in the vicinity of the ceiling 315 for the connectors 443 and 444 and the ducts 221 and 224, advantageously housed on the other side of the wall 448 between the ceiling 315 and a false ceiling 349; an assembly of this type is possible without restricting the optimum conditions of access to the inside of the air-processing module 205, and especially to the filter 242 which can be reached through the lower hatch 289 after opening the lid 291 and to the motorised fan 245 which is advantageously mounted in a detachable way within the outlet plenum chamber 294 and is accessible by demounting the metal plate 409 to expose, between the metal plates respectively defining the faces 260, 261, 254, 255 of the module 205, a front hatch 450 for which the metal plate 409 acts as a lid.

In an alternative embodiment of the module 205 which, in other respects, remains unchanged, the above-described metal plate 409, provided with a hole 415, a connector 416 and a flowrate regulator 250 for the introduction of fresh air from the fresh air pipe 246 into the outlet plenum chamber 294, can be replaced by a solid plate which acts solely as a detachable lid for closing and sealing the front hatch 450 for access to the motorised fan 245, the module 205 being connected to the fresh air supply pipe 246 at a chamber 518 replacing

chamber 418.

A chamber 518 of this type is shown in figure 9 where the same references as those of figure 6 incremented by 100 designate the various parts of this chamber, which is identical to the chamber 418 in all respects except that its vertical faces, namely its lateral faces (e.g. the face 519) and its outside faces 526 and 528 are higher than the lateral faces 419 and 420 and the outside faces 426 and 428 respectively of the chamber 418 and that in the metal plate defining the lateral face 526 there is a circular hole 552 extended along a horizontal axis 551 out of the chamber 518 by a coaxial tubular connector 553 to which a duct (not shown) connecting with the fresh air supply pipe 246 is removably attached. Moreover, the chamber 518 remains unchanged, especially as regards its cooperation with the air-processing module 205 and the rail 330.

An alternative embodiment of this type of the chamber 518 for the connection and suspension of the air-processing module 205, by connecting the connectors 543 and 544 respectively to an air blowing duct 221 and an air suction duct 224, as stated with respect to the chamber 418, and by further connecting the connector 553 to the fresh air supply pipe 246 through a flow regulator (not shown) corresponding to the flowrate regulator 50 of the mode of embodiment of the invention shown in figure 3, makes the air-processing module 205 work identically to the air-processing module 5, namely, by introducing a mixture of stale air from the room associated with the module 205 coming through the duct 224 and fresh air at a specific flowrate from the air pipe 246 into the internal air circuit 241 through the air suction connector 236; in this case there would also be provision for a flowrate regulator (not shown) to regulate the flowrate between the connector 544 and the stale air suction duct 224,

this flowrate regulator and the flowrate regulator between the connector 553 and the fresh air supply pipe 246 being controlled by the adjustable regulation means of the module 205 in the unit 286 and being coupled so that the respective flowrates of air entering the chamber 518 through the connectors 544 and 553 are mutually complementary, depending on the flowrate setting of the motorised fan 245; the flowrate regulator 250 of the air processing module 205 shown in figure 6 can also be controlled by the adjustable regulating means of this module, in which case there will preferably be provision for a flowrate regulator at the connector 544 or the connector 236; it is also possible to make the chamber 518 work identically to the chamber 418 by sealing off the connector 553, connecting the connectors 543 and 544 to the ducts 221 and 224 in the manner described with respect to the connectors 443 and 444, respectively, and providing a fresh air supply to the outlet plenum chamber 294 in the manner shown in figure 6; this chamber 518 offers the further possibility of blocking off the connector 544, in the absence of the duct 224, assuming that the room with which the module 205 is associated is also provided with stale air suction means of any type known per se, and connecting the connector 553 to the fresh air supply pipe 246 and the connector 543 to the air-blowing duct 221 to supply the latter exclusively with fresh air heated or cooled to a desired temperature when passing through the exchanger 243 and blown at a flowrate depending on the speed of the variable speed motorised fan 245; an approach of this type is also suitable for a module 5 of the type shown in figure 3, by eliminating the air suction duct 24, enclosing the corresponding side of the connecting Tee piece 47 and eliminating the flowrate regulator 50 in the connection between this Tee piece 47 and the fresh air supply pipe 46.

CLAIMS

1. Air-processing module, including:

- an air suction inlet (36, 236);
- an air blowing outlet (35, 235),
- 5 - an internal air circuit (41, 241) connecting said air suction inlet (36, 236) and said air blowing outlet (35, 235),
- ventilation and air-conditioning means (42, 43, 45, 242, 243, 245) in said internal air circuit (41, 241),
- 10 - means (76 - 81, 112, 276 - 281, 312) for connecting the ventilation and air-conditioning means (42, 43, 45, 242, 243, 245) to energy supply means (72 - 75, 111, 272 - 275),
- means (86, 286) to regulate the ventilation and air-
- 15 conditioning means (42, 43, 45, 242, 243, 245) at least in terms of air temperature,

said module (5, 205) being delimited externally by two mutually parallel plane lateral faces (54, 55, 254, 255) and by outside faces, respectively mutually
20 opposed front faces (61, 63 - 65, 261 and 410, 263 and 264), a top face (60, 260) and a bottom face (62, 262), which outside faces (60 - 65, 260 - 264, 410) join said lateral faces (54, 55, 254, 255) together and include support means (118 - 129, 418, 419) for said module (5,
25 205), said air suction inlet (36, 236), said air blowing outlet (35, 235), said connecting means (76 - 81, 112, 276 - 281, 312) to energy supply means (72 - 75, 111, 272 - 275) and access means (68, 89, 289, 430) to said ventilation and air-conditioning means (42, 43, 45, 242,
30 243, 245),

said module being characterised in that:

- the air suction inlet (36, 236) comprises an air suction connector (36, 236) adapted to receive an air suction duct (24, 224),
- 35 - the air blowing outlet (35, 235) comprises an air



blowing connector (35, 235) adapted to receive an air blowing duct (21, 221),

- the regulation means (86, 286) comprise adjustable and remote controlled means (86, 286) for regulating the ventilation and air-conditioning means (42, 43, 45, 242, 243, 245) at least in terms of air temperature,

- said lateral faces (54, 55, 254, 255) do not include any members on which action may be required for purposes of adjustment, maintenance, basic repair or demounting of the module (5, 205), which members are grouped together on outside faces (60 - 65, 260 - 264, 410) that are freely accessible even when modules (5, 205) are juxtaposed at said lateral faces (54, 55, 254, 255).

2. Module according to claim 1 characterised in that it carries said adjustable regulation means (86, 286) and in that said outside faces (60 - 65, 260 - 264, 410) include access means (289) to said adjustable regulation means (86, 286).

3. Module according to claim 1 characterised in that the support means (118 - 129, 418, 518) are adapted to enable deliberate displacement of said module (5, 205) in directions parallel to said plane lateral faces (54, 55, 254, 255).

4. Module according to claim 1 characterised in that the support means (118 - 129, 418, 518) include suspension means (118 - 129, 418, 518) for suspending said module (5, 205) in a suspension position in which said plane lateral faces (54, 55, 254, 255) are vertical.

5. Module according to claim 4 characterised in that said suspension means (118 - 129, 418, 518) are located in an upper peripheral zone (106, 435) vertically above the centre of gravity (117, 317) of the module (5, 205) in said suspension position.

6. Module according to claim 4 characterised in



that said air suction and air blowing connectors (35, 36, 235, 236) face upwards in said suspension position and in that said internal air circuit (41, 241) of the module (5, 205) has a U shape between said air suction and air blowing connectors (35, 36).

7. Module according to claim 4 characterised in that the suspension means (118 - 129, 418, 518) include an intermediate chamber (418, 518) for connection of said air suction and air blowing connectors (235, 236), on the one hand, and the respectively corresponding ducts (221, 224), on the other hand, and means (431, 433, 434, 435) for removably joining said intermediate chamber (418, 518) to the module (205) on an outside face (264) of the latter.

8. Module according to claim 7 characterised in that the intermediate chamber (418, 518) externally has two lateral faces (419, 420) which extend said lateral faces (254, 255) of the module (205) in a coplanar way and outside faces (425 - 429, 526, 528) grouping together means (443, 444, 543, 544, 553) for connection with the air suction and blowing ducts (235, 236), means (431, 434) for removable joining to the module (205), and means (436 - 438) for suspension of the intermediate chamber (418, 518).

9. Module according to claim 6 characterised in that the ventilation and air-conditioning means (42, 43, 45, 242, 243, 245) comprise a filter (42) and at least one heat exchanger (43) horizontally juxtaposed with each other and vertical in said suspension position and in that said internal circuit (41) has an inlet plenum chamber (93) between said filter (42) and air suction connector (36) and an outlet plenum chamber (94) between said heat exchanger (43) and the air blowing connector (35).

10. Module according to claim 9 characterised in



that it includes means forming vertical slides (90) for removably receiving the filter (42), a lower hatch (89) for mounting and demounting the filter (42) by sliding in said vertical slides (90) on a lower outside face (62) of the module (5) and a removable lower lid (91) to close said lower hatch (89), "lower" meaning relative to said suspension position.

11. Module according to claim 9 characterised in that it includes means forming vertical slides (69) for removably receiving the heat exchanger (43), an upper hatch (68) for mounting and demounting the exchanger (43) by sliding in said vertical slides (69) on an upper outside face (60) of the module (5) between said air suction and air blowing connectors (35, 36) and a removable upper lid (70) to close said upper hatch (68), and in that the means (76 - 81, 112) for connecting the ventilation and air-conditioning means (42, 43, 45) to the energy supply means (72 - 75, 111) are connected to the heat exchanger (43) at said removable upper lid (70), "upper" meaning relative to said suspension position.

12. Module according to claim 6 characterised in that the ventilation and air-conditioning means (42, 43, 45, 242, 243, 245) include a filter (242) and at least one horizontal heat exchanger (243) horizontally juxtaposed in said suspension position, and in that said internal air circuit (241) has an inlet plenum chamber (293) above said filter (242) and between it and the air suction connector (236), an intermediate plenum chamber (454) beneath said filter (242) and said heat exchanger (243), and an outlet plenum chamber (294) above said heat exchanger (243) and between it and the air blowing connector (235), all these directions being relative to said suspension position.

13. Module according to claim 12 characterised in that it includes a cradle (405) to receive removably the



filter (242), a lower hatch (289) for demounting said filter (242) on a lower outside face (262) of said module (205), and a removable lower lid (291) to close said lower hatch (289), bearing said cradle (405), "lower" meaning relative to the suspension position.

14. Module according to claim 9 or claim 12 characterised in that said heat exchanger (43, 243) is of a heat-exchanging fluid circulation type and in that the connection means (76 - 81, 112, 276 - 281, 312) to connect the ventilation and air-conditioning means (42, 43, 45, 242, 243, 245) to energy supply means (72 - 75, 111, 272 - 275) comprise respective heat-exchanging fluid feed and return tubes (76 - 79, 276, 279) facing an outside face (60, 61, 261) of the module (5, 205) and an adjusting valve (80, 81, 280, 281) in one of said tubes (76 - 79, 276 - 279) facing a front outside face (61, 261) of the module (5, 205), "front" meaning relative to the suspension position, and connected to said adjustable regulation means (86, 286).

15. Module according to claim 6 characterised in that the ventilation and air-conditioning means (42, 43, 45, 242, 243, 245) include a motorised fan (45, 245) adjoining the air blowing connector (35, 235) and in that it includes means (97, 98, 99, 409) for mounting and demounting the motorised fan (45, 245) accessible through a front outside face (63 - 65, 410) of the module (5, 205), "front" meaning relative to the suspension position.

16. Module according to claim 15 characterised in that the motorised fan (45) constitutes a structural unit (96) with the air blowing connector (35) and in that the module (5) comprises a front hatch (95) on said front outside face (93 - 95) adjoining the air blowing connector (35) and means (97, 98, 99) for removably fixing said structural unit (96) around and facing said



front hatch (95).

17. Module according to claim 15 characterised in that the motorised fan (245) is removably housed inside said internal air circuit (241), and in that the module
5 (205) has, facing said motorised fan (245), a front hatch (450) on said front outside face (410) and a removable front lid (409) to close said front hatch (450).

18. Module according to claim 1 characterised in that the ventilation and air-conditioning means (42, 43,
10 45, 245) comprise a variable speed motorised fan (45, 245) connected to said adjustable regulation means (86, 286).

19. Module according to claim 1 characterised in that it includes a connector (416) to connect said
15 internal air circuit (241) to fresh air pipe on an outside face (410).

20. Module according to claim 19 characterised in that said connector (416) comprises flowrate regulating means (250).