

SMOKING ROOM WITH THE AIR RENEWED BY A LAMINAR FLOW

Smoking rooms are known, notably in countries in which the law has imposed rules on using tobacco in public spaces, in which smokers congregate away from convivial areas in which non-smokers are found. Most of the time these smoking rooms are unattractive, notably for two essential reasons, namely on the one hand their decoration and on the other hand their atmosphere, which, in the absence of efficacious ventilation means, is often difficult to breathe because of the disagreeable smell that they give off, which smell users find afterwards on their clothing.

It is known in fact that the ventilation means used in premises in which it is required to renew the air comfortably are generally ineffective when used to ventilate smoky premises, whether or not these ventilation means additionally provide an air conditioning function.

Most of the time these ventilation means consist of small ventilation vents that are adapted to supply a flow of clean air to the premises and to extract therefrom a flow of vitiated air. Thus if it is required to renew quickly a large volume of air in premises via small blower/suction vents, a flow of air circulating at relatively high speed is required. Under these conditions a problem arises because, beyond a certain speed, this air causes a sensation of cold on the skin of the users of the premises, even if the pulsed air is at a temperature usually considered to be a comfortable temperature when the air is not moving. This phenomenon is known as draughtiness.

One solution to providing a comfortable volume of renewed air at a reasonable speed, i.e. without making

users feel cold, is to increase the diameter of the ventilation vents and ducts.

5 A problem is then encountered in that the ducts are usually disposed in the suspended ceilings of the occupied premises and this increase in the volume of the ducts is then reflected in a loss of volume that is difficult to accept.

10 Japanese patents JP 06 229584 and JP 04 161749 propose air conditioning devices in which air is fed from the ground through a perforated plate that is pierced with a multitude of holes and covers the area of the room to be air conditioned. This air is pulsed with a "piston
15 effect" and evacuated via the ceiling which, to this end, is also pierced over the whole of its area with a multitude of holes.

It has nevertheless been established that air passing
20 through a perforated plate, in other words a thin wall, tends to generate high levels of flow noise, even whistling, when the holes are of small diameter, of the order of 2 to 5 mm, for example.

25 Now, when it is required to produce a relaxation space it is desirable on the one hand for the holes in the floor to be of small diameter in order to avoid problems linked to the small heels of women's shoes and on the other hand, and at the same time, for it to be
30 possible to benefit in said space from a silence that is not disturbed by ventilation noise.

An aim of the present invention is to eliminate these drawbacks by proposing a relaxation space in which the
35 air renewal means are able without difficulty to freshen the whole of the volume thereof without users feeling cold and without causing draughts, by effecting air renewal by laminar flow.

Another aim of the present invention is to propose the implementation of such a relaxation space in which air is fed in from the entire area of the floor and drawn
5 off from the entire area of the ceiling without the supply of air generating either draughts or perceptible air flow noise.

The present invention therefore consists in a
10 relaxation space, particularly a smoking room, of the type comprising means of renewing the air, which means are provided with supply means and suction means, said renewing means consisting of holes distributed over the entire floor and the ceiling of this space,
15 characterized in that the holes at least in the floor consist of at least two portions, namely a downstream portion opening into said relaxation space and an upstream portion larger in cross section than the downstream portion opening onto the other side of the
20 floor.

The outlet section of the downstream hole portion will preferably be of the order of one quarter the section of the upstream portion.
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The holes will usually be of circular cross section and the diameter of the downstream holes may be between 2 and 5 mm and preferably of the order of 3 mm. Moreover, the diameter of the upstream holes may be between 8 and
30 20 mm and preferably of the order of 15 mm.

In a variant embodiment the holes may consist of a downstream hole, an upstream hole, and an intermediate hole. The diameter of the upstream holes may be of the
35 order of 12 mm and the diameter of the intermediate holes may be of the order of 8 mm. The length of the downstream holes may be between 5 and 8 mm and preferably equal to 6 mm. The length of the upstream

holes may be between 20 and 60 mm and preferably equal to 40 mm. Finally, the length of the intermediate holes may be between 5 and 15 mm and preferably equal to 10 mm.

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According to the invention, the air supply means will be active via the floor of the premises and the suction means will be active via the ceiling thereof.

- 10 In a preferred embodiment of the present invention the relaxation space will include a raised floor and a suspended ceiling in which the holes are pierced, the latter holes being distributed in regular manner over the whole thereof, notably with a density of
- 15 distribution of the order of 3000/m², and notably distributed in a quincunx arrangement.

The air will preferably be blown in through the floor and drawn off through the ceiling and an upper buffer

20 volume will preferably be provided between the ceiling and a suspended ceiling into which the suction means will discharge. In a similar way a lower buffer volume will be provided between the floor and the ground into which the air supply means will discharge.

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The air supply and suction means of the floor may consist of a one-piece double-flow ventilation unit, optionally provided with a heat recovery device, and air conditioning means. The flow of air will be

30 laminar.

The air supply means will preferably include temperature and relative humidity control means, which may include means for their (remote) control,

35 modification and maintenance.

In one beneficial embodiment of the invention the relaxation space will constitute a modular system

capable of being combined with other modules of the same type. These modules will include a structure comprising the ground and a floor, a ceiling and a suspended ceiling, and lateral walls, which may be of
5 glass, provided with at least one opening, and a wall delimiting a box receiving all of the air treatment technical means. The latter may of course be independent.

10 The supply and suction of air will be effected via manifolds respectively connected to the blower means and to the suction means. The flow rate of the suction means will preferably be greater than the flow rate of the blower means so as to create in the relaxation
15 space a slightly reduced pressure compared to the exterior atmosphere.

Moreover, the base of the access door will be provided with means suitable for creating in front thereof a
20 curtain formed by a flow of air at higher speed than the speed of the treatment air in said space. The means for creating this air curtain will consist of a slot that extends at least across the width of the door and will be fed by means adapted to blow said flow of air
25 on the opening thereof.

The present invention also provides a modular box intended, by joining together a plurality thereof, to constitute a raised floor and/or a suspended ceiling of
30 a relaxation space into which there is admitted a flow of air under pressure via holes regularly distributed over the whole of the area of the floor and this flow of air is evacuated via holes regularly distributed over the whole of the area of the ceiling,
35 characterized in that the box comprises a horizontal main face pierced with said holes and lateral faces pierced with at least one communication orifice of all of the boxes, air being blown under pressure into the

relaxation space from the boxes forming the floor and drawn off in this space via the boxes forming the ceiling.

- 5 The modular box will preferably include means suitable for connecting it to the adjacent boxes.

Moreover, the holes may consist of at least two portions, namely a downstream portion discharging into
10 said relaxation space and an upstream portion of greater section than the downstream portion discharging into the interior of the box.

Finally, the modular box may be intended to constitute
15 a floor and/or a ceiling of a relaxation space having all the features described above.

One embodiment of the present invention is described hereinafter by way of non-limiting example and with
20 reference to the appended drawings, in which:

- figure 1 is a diagrammatic view in vertical section showing the operating principle of a relaxation space of the invention,
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- figures 2 to 6 are partial longitudinal sections of air supply holes of the relaxation space of the invention,

30 - figure 7 is a theoretical diagram of air supply and treatment means,

- figures 8a and 8b are diagrammatic views of a relaxation space of the invention produced in modular
35 form seen from above and in elevation, respectively,

- figure 9 is a diagrammatic view in partial vertical section of a variant embodiment of the invention,

- figure 10 is a perspective view showing a box used to supply air to and/or to draw air from the relaxation space of the invention,

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- figures 11 to 15 are variant arrangements of the boxes, and

- figure 16 is a view in cross section of a member for
10 fastening the boxes together.

Figure 1 shows a relaxation space consisting here of a smoking room 1 according to the invention that consists of an architectural envelope in the form of walls 3, a
15 ceiling 5 and the ground 7. To produce the smoking room there is at a certain distance under the ceiling 5 a suspended ceiling 9, so as to constitute between them an upper buffer volume 11 which constitutes an air manifold (see below).

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Similarly, at a distance above the ground 7 there is a support slab 13 or floor so as to provide between them a lower buffer volume 15 also forming a manifold.

25 The suspended ceiling 9 and the floor 13 are pierced over the whole of their area with holes 16 that are distributed uniformly, notably in a quincunx arrangement. The distribution density of these holes is of the order of 3000 per m². Another arrangement or
30 density of the holes could of course be adopted as a function of the flow parameters of the flow of air (see below).

It will be remembered that blower floors of the known
35 type consist of metal plates pierced over the whole of their area by a great number of holes. Because of the short length of each of these holes the flow of air that passes through them suffers no significant head

loss, but it has been established that the flow of air through these holes has the effect of generating high levels of flow noise.

5 The present invention aims to produce the floor 13 in a solid material such as wood, preferably of noble species (hardwood), marble, glass, etc. Clearly a floor produced in such materials, to be sufficiently strong to fulfill its essential supporting function, must be
10 relatively thick compared to a prior art plate. This is why, under these conditions, the holes generate high head losses, especially if they are of small diameter. Because of the inherent purpose of relaxation spaces of the invention, the holes must be of small diameter i.e.
15 have a diameter less than that of a shoe heel, notably of the so-called stiletto heel type.

The holes employed in the context of the present invention must therefore be of small diameter, generate
20 only low head losses, and nevertheless supply a high flow rate of air without the flow of air creating noise.

It has been established that providing upstream of the
25 portion of the hole that discharges into the premises to be treated another hole of greater diameter simultaneously solves the problems relating to the head loss and the problems relating to the noise generated by the flow of air through a thin member (a member of
30 the order of 5 to 6 mm thick).

In a first embodiment of the invention that is shown in figure 2, the floor 13 is made from solid wood, notably oak, with a thickness e of the order of 30 mm.
35 Moreover, the downstream portion 16a of the hole 16 that discharges into the smoking room 1 has a diameter d_1 of the order of 2 to 5 mm and preferably close to 3 mm and a length e_1 of the order of 4 to 7 mm and

preferably close to 6 mm. Upstream of this portion 16a there is another hole portion 16b with a diameter d_2 equal to at least twice the diameter d_1 of the hole portion 16a. The length of the portion 16b extends over
5 the remainder e_2 of the thickness of the floor 13.

As shown in figure 3, the floor 13 may be produced in two portions that are superposed, namely, on the one hand, a base 13a, the thickness e_2 of which may be
10 equal to that of the hole portion 16b and that could for example be produced in a material having good heat and sound absorbing properties and, on the other hand, a surface layer 13b, the thickness of which will be equal to the upper hole portion 16a and that will be
15 made of a "nobler" material in order to confer upon the floor 13 a quality appearance and that is able to resist scuffing and impact.

Moreover, giving the upstream portion 16b of the holes
20 16 a larger diameter will make it possible to facilitate correct relative positioning of the two floor portions 13a and 13b.

To improve the flow of air in the holes 16 by
25 preventing turbulence generating unwanted noise, the hole portion of diameter d_2 may be staggered, as shown in figure 4, by producing a third hole portion 16c of intermediate diameter d_3 disposed just upstream of the downstream hole portion 16a.

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As before, and as shown in figure 5, each hole portion 16a, 16b, 16c could be produced in a layer of different material, each material having specific characteristics. Thus the lower layer would constitute
35 the mechanical support and could be produced in wood of particle board type, for example, the intermediate layer could be produced in a material having good heat and sound absorbing qualities, and the surface layer

could be made from a "nobler" material in order to to confer upon the floor 13 a quality appearance and that is able to resist scuffing and impact.

- 5 As shown in figure 6, the hole portion 16b disposed upstream of the downstream outlet hole 16a could be of convergent shape, with the effect of further reducing disturbances of the flow that generate noise.
- 10 For reasons linked to their production, the holes 16 will usually be of circular cross section, but for some specific applications they could equally have other shapes, notably square.
- 15 As shown in figure 7, the lower buffer volume 15 is provided with a pressurized air supply duct 18 and the upper buffer volume 11 is provided with a suction duct 20.
- 20 It is understood, under these conditions, that the volume of the room is swept by a flow of air travelling upward, which has proved particularly effective for evacuating smoke generated in it. The air flow rates would preferably be adjusted so that the flow inside
- 25 the smoking room is laminar.

In one embodiment of the invention the air suction flow rate Q_1 will be adjusted to a value greater than the supply flow rate Q_2 so as to reduce the pressure in the

30 room slightly. This makes it possible to prevent, notably if the room is used as a smoking room, propagation to the outside of the room of smoke generated inside it.

- 35 The suction flow rate Q_1 will be such that it makes it possible to renew the air in the room between 20 and 50 times per hour and preferably around 30 times per hour. Thus in the case of a 45 m^3 room, for example, the

suction flow rate Q_1 will be between 900 and 2200 m^3/h and will preferably be of the order of 1500 m^3/h . The lower box will be supplied at a flow rate Q_2 of the order of 30% less than the suction flow rate so as to
5 reduce the pressure in the room slightly. Thus if the suction flow rate is 1500 m^3/h , for example, the blowing flow rate into the box will preferably be of the order of 1100 m^3/h .

10 It has been established under these conditions that the atmosphere in the room is more comfortable for its occupants and that they do not experience any discomfort from smells, noise, heat or draughts.

15 Figure 7 shows an example of means for supplying/extracting and conditioning the air in the room 1. The air supply duct 18 is connected via a sound damper 22 to the outlet 23 of a double-flow ventilation unit 25 and the air extraction duct 20 is connected via
20 a sound damper 26 to the inlet 27 of the ventilation unit 25. The latter draws in fresh air via its inlet duct 29.

A heat pump 31 is optionally disposed on a branch 33 at
25 the outlet of the ventilation unit 25 and used to heat or to cool the air that is pulsed into the room 1, as required.

In a variant embodiment of the invention which is shown
30 diagrammatically in figures 8a and 8b, the relaxation space is modular and transportable, i.e. all its elements form a movable autonomous assembly. This assembly thus consists of a structure formed of the ground 7 and a perforated floor 13 delimiting the air
35 supply box 15, a ceiling 5 and a perforated suspended ceiling 9 delimiting the upper suction box 11, and glass walls 3'. The far end of the room 1 is closed by a partition 35 delimiting a rear volume constituting

technical premises 37 accommodating the air supply/extraction and conditioning means. The front face may advantageously consist of glass walls 3' provided with an access door 34. Such a room may be
5 placed permanently or temporarily anywhere that electrical power supply means are available.

The various modules may be combined with each other to form an overall volume, the area of which is
10 adjustable, as a function of the requirements of users.

The relaxation space air supply and control means 25 of the invention may be provided with remote control modules for centralized monitoring of relaxation spaces
15 belonging to a plurality of users and intervention to adjust, modify or repair them remotely in a specific manner as a function of the requirements of each of them.

20 In another variant embodiment of the present invention the orifices providing access to the outside, such as the door 34 in particular and any serving hatches, could be provided with an air curtain intended to prevent smoke leaking from the interior toward the
25 exterior atmosphere in order, if the relaxation space is used as a smoking room as indicated above, to prevent pollution of the surrounding volume by smoke from the room.

30 Where the access doors 34 of the room are concerned, for example, and as shown in figure 9, by providing in the floor 13 of the premises and across the entire width of the doors 34 a slot 39 through which, on opening the doors 34, there is produced a pulsed upward
35 flow of air at greater speed than the flow of air inside the premises, this curtain of air is obtained.

To this end, as shown in figure 9, a box 41 may be produced surrounding the slot 39, for example, that is fed by pressurizing means 43 that are activated by detection of a feeler 45 connected to the door as soon as the door is opened and that are deactivated when the door is closed. A mini-box may also be produced in which the air is maintained at increased pressure at all times and that is provided with opening control means that are activated as soon as the door opens or at all times.

In a beneficial variant of the present invention, the floor and/or the ceiling of the room may consist of modular elements that are disposed and assembled adjacently side by side.

These modules could advantageously be formed of boxes, the internal volume of which forms the air distribution buffer volumes of the ceiling and the floor, respectively. As shown in figure 10, each box consists of a horizontal main face 52, of square shape in the present example, and lateral faces 54. These boxes are assembled adjacently, as shown in figure 11, i.e. they are joined together via their lateral faces 54, to fill the total area and the overall shape of the room or the room module of which they are to constitute the floor or the ceiling.

Thus square modular boxes 50 may be used, the disposition of which mirrors that of the premises. Thus they may be disposed lengthwise, as shown in figure 11, or in an L-shape or T-shape, as shown in figures 12 and 13. In order to facilitate matching the shape and the dimensions of the premises with the corresponding dimensions of the boxes 50, some of the latter, the boxes 50a in figure 14, may be of smaller size, for example half the size of the boxes 50.

Modular boxes of different shape, for example of rectangular or triangular shape, may of course be used, as shown in figure 15, in which the boxes 50c are the shape of an equilateral triangle or half an equilateral triangle 50d. Such an arrangement, apart from the resulting esthetic effect, makes it possible to "fill" the shape and the area of the premises in which a relaxation space is to be created and notably a smoking room.

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According to the invention the lateral faces 54 of the boxes 50 are pierced with openings 56 intended to allow free circulation of air from the air inlet or inlets inside the boxes. These openings 56 are disposed so that when the lateral faces 54 of two adjacent boxes are assembled together they are face to face.

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The modular boxes 50 are advantageously provided with fixing means for fastening them together and making them airtight. Thus screws may be used, or clips 55 that are disposed in recessed housings provided for this purpose, for example in the lateral faces 54, as shown in figure 16. Such clips 55 consist for example of two complementary elements that are disposed in areas of the lateral faces 54 that are face to face when the modular boxes 50 are in place. One of the complementary elements of these clips may include a deformable tongue 61 which, when one clip element is pressed onto the complementary element during fitting, is positioned in the latter to prevent it being removed.

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Clearly any other fixing element could be used enabling the various modular boxes 50 to be fastened together.

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Moreover, the principal faces 52 of the modular boxes 50 will be pierced with holes 16 for injecting the blower flow into the premises. These holes will of

course be of the same type as those described above in the embodiment of a floor with no boxes.

5 The main face 52 could either constitute the walking surface or on the contrary be covered with a plate 60 produced in a material nobler and/or stronger than the material used to construct the boxes 50.

CLAIMS

1. A relaxation space, particularly a smoking room,
of the type comprising means of renewing the air
5 (25), which means are provided with supply means
(8) and suction means (20), said renewing means
consisting of holes (16) distributed over the
entire floor (13) and the ceiling (9) of this
space, characterized in that the holes (16) at
10 least in the floor (13) consist of at least two
portions, namely a downstream portion (16a)
opening into said relaxation space and an upstream
portion (16b) larger in cross section than the
downstream portion opening onto the other side of
15 the floor (13).
2. The relaxation space as claimed in claim 1
characterized in that the outlet section of the
downstream hole portion (16a) is of the order of
20 one quarter the section of the upstream hole
portion (16b).
3. The relaxation space as claimed in either of
claims 1 and 2 characterized in that the holes are
25 of circular cross section and the diameter (d1) of
the downstream holes (16a) is between 2 and 5 mm
and preferably of the order of 3 mm.
4. The relaxation space as claimed in any one of the
30 preceding claims characterized in that the
diameter (d2) of the upstream holes (16b) is
between 8 and 20 mm and preferably of the order of
15 mm.
5. The relaxation space as claimed in any one of the
35 preceding claims characterized in that the holes
(16) consist of a downstream hole (16a), an

upstream hole (16b), and an intermediate hole (16c).

- 5 6. The relaxation space as claimed in claim 5 characterized in that the diameter of the upstream holes is of the order of 12 mm and the diameter of the intermediate holes is of the order of 8 mm.
- 10 7. The relaxation space as claimed in any one of the preceding claims characterized in that the length (e1) of the downstream holes (16a) is between 5 and 8 mm and is preferably equal to 6 mm.
- 15 8. The relaxation space as claimed in any one of the preceding claims characterized in that the length (e3) of the upstream holes (16b) is between 20 and 60 mm and is preferably equal to 40 mm.
- 20 9. The relaxation space as claimed in any one of claims 5 to 8 characterized in that the length (e2) of the intermediate holes (16c) is between 5 and 15 mm and is preferably equal to 10 mm.
- 25 10. The relaxation space as claimed in any one of the preceding claims characterized in that the air supply means are active via the floor (7, 7a) of the premises and the suction means are active via the ceiling (5, 5a) thereof.
- 30 11. The relaxation space as claimed in any one of the preceding claims characterized in that it includes a raised floor (7b) and a suspended ceiling (5a) in which the holes (16) are pierced, the latter holes being distributed in regular manner over the
35 whole thereof.

12. The relaxation space as claimed in claim 11 characterized in that the holes (16) are disposed in a quincunx arrangement.
- 5 13. The relaxation space as claimed in any one of the preceding claims characterized in that the density of distribution of the holes (16) is of the order of $3000/\text{m}^2$.
- 10 14. The relaxation space as claimed in any one of the preceding claims characterized in that the air is blown in through the floor (13) and drawn off through the ceiling (9).
- 15 15. The relaxation space as claimed in any one of the preceding claims characterized in that an upper buffer volume (11) is provided between the ceiling (9) and a suspended ceiling (5) into which the suction means (20) discharge.
- 20 16. The relaxation space as claimed in any one of the preceding claims characterized in that a lower buffer volume (15) is provided between the floor (13) and the ground (7) into which the air supply means (18) discharge.
- 25 17. The relaxation space as claimed in any one of the preceding claims characterized in that the air supply and suction means of the floor (13) consist of a one-piece double-flow ventilation unit (25), optionally provided with a heat recovery device, and air conditioning means.
- 30 18. The relaxation space as claimed in any one of the preceding claims characterized in that the flow of air is laminar.
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19. The relaxation space as claimed in any one of the preceding claims characterized in that the air supply means (25) include temperature and relative humidity control means (31).
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20. The relaxation space as claimed in any one of the preceding claims characterized in that the temperature and relative humidity control means (31) include means for their (remote) control, modification and maintenance.
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21. The relaxation space as claimed in any one of the preceding claims characterized in that it constitutes a modular system capable of being combined with other modules of the same type.
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22. The relaxation space as claimed in claim 21 characterized in that each module includes a structure comprising the ground (7) and a floor (13), a ceiling (5) and a suspended ceiling (9), and lateral walls (3), which may be of glass, provided with at least one opening (34), and a wall (35) delimiting a box (37) receiving all of the air treatment technical means.
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23. The relaxation space as claimed in any one of the preceding claims characterized in that the supply and suction of air are effected via manifolds (15, 11) respectively connected to the blower means (8) and to the suction means (20).
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24. The relaxation space as claimed in any one of the preceding claims characterized in that the flow rate (Q2) of the suction means is greater than the flow rate (Q1) of the blower means so as to create in the relaxation space a slightly reduced pressure compared to the exterior atmosphere.
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25. The relaxation space as claimed in any one of the preceding claims characterized in that the base of the access door (34) is provided with means (39, 43) suitable for creating in front thereof a curtain formed by a flow of air at higher speed than the speed of the treatment air in said space.
26. The relaxation space as claimed in claim 25 characterized in that the means for creating the air curtain consist of a slot (39) that extends at least across the width of the door (34) and is fed by means (43) adapted to blow said flow of air on the opening thereof.
27. A modular box (50) intended, by joining together a plurality thereof, to constitute a raised floor and/or a suspended ceiling of a relaxation space into which there is admitted a flow of air under pressure via holes (16) regularly distributed over the whole of the area of the floor and this flow of air is evacuated via holes (16) regularly distributed over the whole of the area of the ceiling, characterized in that the box (50) comprises a horizontal main face (52) pierced with said holes (16) and lateral faces (54) pierced with at least one communication orifice (56) of all of the boxes (50), air being admitted under pressure into the boxes (50) forming the floor (13) and drawn off via the boxes forming the ceiling (9).
28. The modular box as claimed in claim 27 characterized in that it includes means (55) for connecting it to the adjacent boxes (50).
29. The modular box as claimed in claim 28 characterized in that the holes (16) consist of at least two portions, namely a downstream portion

(16a) discharging into said relaxation space and an upstream portion (16b) of greater section than the downstream portion discharging into the interior of the box.

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30. The modular box intended to constitute the floor (13) and/or the ceiling (9) of a relaxation space as claimed in any one of claims 1 to 26.