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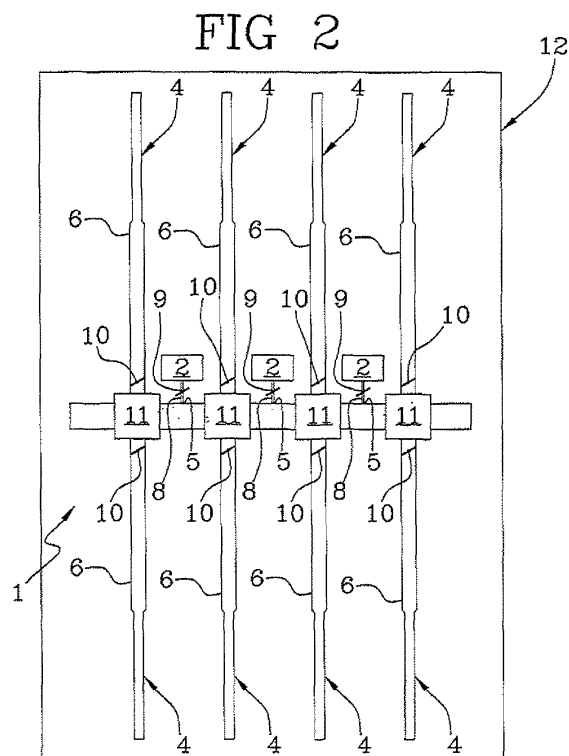
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(54) **Apparatus for air treatment**

(57) The invention relates to an air treatment plant (1) in which a plurality of air treatment units (2) generating an increase in pressure in the air to be diffused are set in fluid communication with a plenum header (3), via a plurality of respective accesses (5). A plurality of diffuser channels (6) lead off from the plenum header (3), for diffusing high-induction treated air into an environment. Alternatively the plurality of air treatment units (2) is set in fluid communication through the various accesses (5) with one or more ring headers (7) which also define the diffuser channels (6). The above structure enables sharing out the air flows of the header, such as to be able to use one having a smaller diameter and to condition the environment with the air volumes required according to actual situations and requirements, substantially without having to make structural modifications to the treatment plant.



## Description

**[0001]** The invention relates to a plant for producing treated air.

**[0002]** In particular the present invention is applicable in conditioning of environments such as swimming pools, offices, workshops etc., by means of air treatment plants which employ a plenum header or one or more ring headers, as will be more fully explained herein below.

**[0003]** As is known, the traditional systems for air treatment comprise an air treatment unit, which generates a flow, possibly a conditioned flow, of air into a header which is in turn destined to divide the flow into a plurality of branches, to which corresponding diffusers for emitting treated air into the environment are associated.

**[0004]** Typically the air treatment unit injects a flow at a central zone of the header such that the flow is divided into two branches, left and right, of the header in order then to reach the appropriately-positioned distribution channels.

**[0005]** In order to guarantee optimal flow internally of the channelling, prior-art headers are generally tapered in a distancing direction from the access of the air coming from the treatment unit.

**[0006]** Correspondingly, the separating channels are also tapered in a distancing direction from the header in order to guarantee maintaining the desired air flow exiting from the diffusers, even where the diffusers are positioned at a considerable distance from the treatment unit.

**[0007]** In other terms the dimensions of the channels are designed to provide a recuperation of the dynamics via a narrowing of the sections in a distancing direction from the air treatment units.

**[0008]** Where environments are large and voluminous, in general it is preferred to use a plurality of separate air treatment plants, substantially similar to one another and of the above-described type.

**[0009]** The above enables air treatment units that are smaller and more easily manageable with respect to a single unit having double-flow rate.

**[0010]** As can be seen in figures 1a-1c, which schematically represent some possible plants in the prior art, the arrangement and geometry of the various plant components can differ.

Figure 1a shows two substantially identical plants flanked to one another for conditioning a same environment.

Figure 1b shows the plants opposite one another on opposite sides of a same environment.

**[0011]** Note also that the distribution channels are only in contact with one another, but are fluid-dynamically isolated from one another at the halfway-line, in order to prevent problems of turbulence and erroneous flow distribution, especially in the contact zones. Figure 1c illustrates a further type of known plant in which the two plants, with the two relative headers, are both positioned

in the centre of the environment to be treated and the distribution channels carry the flow of air to the diffusers along opposite directions.

**[0012]** Air treatment plants in the prior art, though widely used, are however affected by some limitations and/or operating drawbacks and have shown themselves to be subject to improvement under some aspects.

**[0013]** Firstly, each of the plants is predisposed to operate in and optimally condition only a zone of the total volume of the environment to be treated.

**[0014]** This means that in situations where the overall power dispensed is greater than the demand, and therefore only one of the installed plants is required, there is a lack of uniformity in the conditioning of the environment, which might result in undesired temperature gradients therein.

**[0015]** It is obvious that, with the aim of obviating the drawback outlined above, it would be possible to design two plants such as to have the diffusers operating at the same volumes; however, this would not be an optimal solution from a design point of view, and therefore also from an energy-saving point of view, as the same areas of the environment would be conditioned by two different plants.

**[0016]** The only further alternative is to use plants having variable-geometry diffusers which are however more complex to realise and more difficult to manage.

**[0017]** Also note that the use of air treatment units based on a generation of flow and air treatment by compressors with batteries not working with refrigerated water, but rather direct-expansion, might lead to an actual impossibility of creating plants having important flow variations.

**[0018]** It is also obvious that in a case of malfunctioning of one of the plants, or necessary maintenance thereof, it is necessary to break off air treatment in a possibly significant portion of the environment to be treated, creating considerable discomfort resulting from a non-homogeneity of the temperature in the environment.

**[0019]** An aim of the present invention is thus substantially to resolve all the cited drawbacks.

**[0020]** A first objective of the invention is to enable an improved operating flexibility of the plant with respect to plants of the prior art.

**[0021]** A further aim is to enable optimal management of the plant under different environment treatment conditions (for example heating or cooling the environment, the mid-season periods, start-up conditions or normal operating regime).

**[0022]** A further aim of the invention is to enable interventions to be made on the plant in order to modify its potential and/or to enable maintenance/replacement of defective parts without having to completely interrupt functioning thereof.

**[0023]** A further aim of the invention is to reduce the size of the header while also improving its aesthetic appearance, as well as reducing the costs of the plant in the environment.

**[0024]** A further and no less important aim of the invention is to provide a plant that can be adapted simply to the geometry of the environment to be treated, respecting the structural requirements of the building but without losing the possibility of obtaining the best possible performance of the plant.

**[0025]** These and other aims, which will better emerge from the following description, are attained by an air treatment plant as set out in the accompanying claims.

**[0026]** Further characteristics and advantages will better emerge from the detailed description that follows of some preferred but not exclusive embodiments of air treatment plants.

**[0027]** The description will be made herein below with reference to the accompanying figures of the drawings, provided by way of non-limiting example, in which:

figures 1a-1d are plants existing in the prior art, while figures 1a'-1d' show the corresponding plants according to the invention;

figures from 2 to 4 show a plant according to the present invention, provided with a plenum header; figures 5-8 show further embodiments of plants for air treatment of the present invention, which exploit one or more ring headers;

figure 9 is a partial perspective view of a junction which can be used in the plants illustrated in figures 2-8;

figure 10 is a section in a vertical plane of the junction of figure 9;

figure 11 is an air treatment plant in a paint booth; figure 11a is the air treatment plant with a ring above a dropped ceiling provided with a filtering mattress; figure 11b illustrates the plant of figure 11 in a simplified front view, in a variant; and figure 12 is a vertical section view of a further embodiment of an air treatment plant of the present invention, for conditioning buildings having a plurality of floors.

**[0028]** With reference to the figures, 1 denotes in its entirety a plant for air treatment.

**[0029]** The plant primarily comprises a predetermined number of air treatment units 2 the main aim of which is to generate at least an increase in air pressure such as to enable the air to be diffused via the treatment plant.

**[0030]** For this purpose air treatment units can comprise ventilators destined to generate the pressure increase of an air flow internal of the plant.

**[0031]** Air treatment units can be provided with further devices for heat-treating the air flow, either cooling it or heating it according to the ambient treatment requirements.

**[0032]** For this purpose batteries of hot or cold water can be present, or other devices.

**[0033]** Further, the treatment unit can comprise humidifiers, filters or like devices for conditioning the air injected into the environment.

**[0034]** The air treatment unit 2 is in general in fluid

communication with a header 3, for example via an appropriate air feeding channel 8.

**[0035]** In this way the air flow generated can be conveyed internally of the header 3 via a respective access 5. Each air treatment plant of the invention thus comprises at least a header 3.

**[0036]** As can be seen in the accompanying figures, each header 3 exhibits respective accesses 5 directly connected to the air treatment unit 2, for example via the air supply channel 8.

**[0037]** In general at least two air treatment units 2 are present, with respective air supply channels 8 which, via the accesses 5, send an air flow into the header 3.

**[0038]** Alternatively, or in combination, a single air treatment unit 2 might have two or more air supply channels 8 which carry the flow to different points of the header 3 via different accesses 5 (see for example figure 5).

**[0039]** In the second mode the flow generated by a single air treatment unit 2 is shared through the various air supply channels 8 which are part thereof, and is introduced into the header 3 at different positions. The plant also comprises at least a diffuser 4 in fluid communication with the header 3 in order to diffuse the treated air into the environment.

**[0040]** In a first series of embodiments (figures 2-4) a plurality of diffusers 4 is present, and in general a plurality of diffuser channels 6, perforated such as to diffuse air into the environment, generating an inductive effect on the air surrounding the channel. In particular, in high-induction diffusion plants, the diffuser channels 6 exhibit a plurality of perforations possibly having different diameters specially arranged such as to move the environmental air, exploiting the high induction.

**[0041]** By appropriately dimensioning and positioning the perforations it is possible to achieve a recall of the air surrounding the diffuser, with a recalled volume which might reach 30 times the volume of the air injected into the environment via the diffuser 4. In this way optimum movement of the air is achieved, with a sharp drop in short-distance velocity from the diffuser, and a relevant degree of homogenisation of the temperatures in the environment.

**[0042]** In other terms in high-induction diffuser plants the linear load loss of the plant is limited, while the load loss localised in the perforations is considerably more important.

**[0043]** This enables realising the header with a substantially constant section as the main load losses are in the perforations of the diffuser channels.

**[0044]** Thus neither the header 3 nor the perforated channel 6 will have a set air flow direction.

**[0045]** In a plurality of first embodiments, illustrated in figures 2-4, several diffuser channels 6 leave from the header 3 such as to be designed to be able to reach the various zones of the environment to be conditioned.

**[0046]** Observing the figures, it can be seen that the air supply channel 8 which connects the air treatment units 2 to the header 3 exhibits respective closing means

9 which can selectively prevent an air flow through the supply channel 8, especially in a rest condition of the air treatment unit 2.

**[0047]** In other words the closing means 9, which are in general defined by shutters, for example slat shutters which are opposite and mobile between an open condition in which the air passage is enabled and a closed condition in which they block the flow, are destined to prevent the air contained in the header 3 from flowing back through the supply channel 8 when the air treatment unit 2 is turned off, for example by turning the ventilator in an opposite direction to the direction of normal use and thus dispersing the flow energy into the environment.

**[0048]** Note that there are also special choking means 10 which act at different positions in the described plant.

**[0049]** The choking means 10 can be active on the header 3 or between the header 3 and the diffuser 4 such that they can respectively choke the air flow in the header 3 or the air flow between the collector 3 and the diffuser 4.

**[0050]** The choking means 10 can also be in general constituted by shutters, for example oppositely-placed slats, mobile between a fully open position in which they enable the air flow to cross and a closed position in which they block the passage.

**[0051]** In general both the closing means 9 and the choking means 10, which can be of substantially similar embodiments (and different from those described), are interposed in special sections of the respective channels and are in general motorised in order to be remote-controlled or even automatic.

**[0052]** The plant can be optionally provided with respective junctions 11, each provided with at least two accesses (and up to six accesses overall).

**[0053]** In general the junctions are constituted by prismatic box structures, for example cubic, in which each of the surfaces corresponds to a potential access 11a, 11b, 11c, 11d, 11e (see figure 9).

**[0054]** The junction 11 can be positioned in different parts of the air treatment plant.

**[0055]** For example it can be interposed between two consecutive tracts 3a, 3b of a header 3 in order to selectively interrupt the fluid connection between the two portions.

**[0056]** Alternatively the junction can be positioned between a header 3 and a diffuser 4 such as to be able to interrupt the communication between the two components.

**[0057]** Further the junction can be interposed between the access channels 8 and the header 3 such as to make the fluid connection between the two parts selective. Figure 9 illustrates one of the junctions 11 in a perspective view.

**[0058]** In particular the junction exhibits an air access channel 8 located superiorly to receive a deliver from the air treatment unit 2, through the access 11a.

**[0059]** The closing means 9 are located at the access surface 11a, which closing means 9 are constituted by a motorised shutter (see figure 10) having opposite slats.

**[0060]** The junction schematically represented in figure 9 is interposed along the header 3 and in particular between two consecutive portions 3a and 3b, and can be closed by choking means 10, also constituted by shutters having opposite slats in order selectively to block the flow between the portions 3a and 3b. Further, respective two-diffuser channel 6 accesses 11c and 11e are present, such that the fluid communication between the header 3 and the diffuser channels 6 can be interrupted when so desired by use of the choking means 10 constituted by motorised and opposite slat shutters (figure 10).

**[0061]** Figure 10 shows the junction (schematically illustrated in figure 9) in a vertical cross-section. The section illustrates in detail the closing means 9 and the choking means 10 interposed respectively between the access channel 8 and the header 3 and between the header 3 and the two diffuser channels 6 which lead off therefrom.

**[0062]** The air treatment plants whose components have been described herein above can give rise to a plurality of different configurations, characterised by excellent adaptability to the environment to be conditioned and by advantageous characteristics which will be described in detail herein below.

**[0063]** Passing to the illustrated embodiments, figures 2, 3 and 4 illustrate three possible configurations of the air treatment plant of the invention which use a self-balancing plenum header.

**[0064]** Figure 2 shows a plant in which the header 3 is arranged centrally of an environment 12 to be conditioned.

**[0065]** Three air treatment units 2 are connected to the header 3 along an axial development of the header 3, each of which units 2 has its own air supply channel 8 and its own closing shutter 9.

**[0066]** The plenum header 3, generally made of metal and lacking holes or vents for air diffusion (except, in some plants, for anti-condensation perforations), exhibits the same section along its whole development.

**[0067]** Note that in plants where the load loss is concentrated at the diffusion holes arranged on the diffuser channels 6, it is necessary to have some dynamic recuperation with section narrowings in the header 3 and/or the distribution channels 6.

**[0068]** A junction 11 of the above-described type is located at each branching-off point from the header 3.

**[0069]** In particular, the junctions 11 represented exhibit at least sectioning or choking means 10 at the connection between each diffuser channel 6 and the collector 3.

**[0070]** Possibly, though not necessarily, the junctions can be fitted with opposite closing slat shutters even at contiguous portions of the header in order to interrupt the flow in the header 3 at preselected zones.

**[0071]** With the flow variation (turning-off of one or more treatment units), the regulation of the perforated length (thanks to the closing of the shutters of the junctions 11 where considered appropriate) equal-

ifies (i.e. returns to optimal values) the outlet velocity from the holes, and thus the induction.

**[0072]** By using the configuration illustrated in figure 2 it will be possible to use the air treatment plant at full regime, i.e. with all three air treatment units 2 functioning and the maximum air flow per linear metre in the plant itself.

**[0073]** This condition might be in an air treatment plant during the summer season.

**[0074]** During the winter season the illustrated plant might function as a heating plant for the environment.

**[0075]** It is known that smaller volumes of conditioned air are needed for heating.

**[0076]** In this situation possibly only two air treatment plants 2 might be required, or even one alone where there is a situation not particularly requiring much heating.

**[0077]** In this situation each channel 8 connecting the plenum header 3 to the non-functioning air treatment unit 2 is closed via the closing means 9 in order to prevent loss of the conditioned air through the non-functioning treatment unit.

**[0078]** It is further possible to selectively intervene on the means 10 when deciding whether to send the treated air flow only to some of the eight diffuser channels 6 illustrated.

**[0079]** This enables considerable plant operating flexibility, leading to optimising consumption and performance according to the operating needs of the environment to be treated, the time of year, the type of conditioning required.

**[0080]** Figure 3 illustrates a different type of plant with a plenum header 3 arranged exclusively on one side of the environment 12 to be treated.

**[0081]** In this case four air treatment units 2 are present, all in fluid communication with the plenum header 3, each unit 2 being provided with respective closing means 9 and the respective choking means 10 for interrupting air flow between the header 3 and the diffuser channel 6.

**[0082]** Apart from all the advantages described herein above with reference to the plant of figure 2, note also that the described plant might be designed with only two air treatment units 2, with further accesses 5 for enabling other units to be added at a later date. An initial requirement might be to create only an air treatment plant for heating an environment as it requires a certain volume of conditioned air per unit of time.

**[0083]** If it were then required to add a conditioning function to the plant it would probably be necessary to provide a greater air flow and therefore further units 2 could be added, all connected to the same plenum header 3 as described herein above.

**[0084]** The diagram of figure 4 describes a further embodiment in which two plenum headers 3 are present, one for each larger side of the environment 12 to be treated, each plenum header 3 being provided with its own air treatment units 2 in fluid connection and the respective junctions 11 at each connection of the plenum header 3

with the diffuser 4.

**[0085]** Note that the diffuser channels 6 connect a plenum header 3 to another, thus defining a multi-connected structure.

**[0086]** Of particular importance is the fact that the air treatment plant of figure 4, like the ones described previously herein, is self-balancing, as substantially they do not generate air flows having specific directions internally of the plant; this is due to the fact that the load losses in the conduits are significantly lower than the load losses localised at the diffuser holes present on the diffuser channels 6.

**[0087]** In this case too, apart from the special and advantageous characteristics described herein above, it can be seen how the adoption of the plenum header 3 of the invention enables the treatment units 2 to be arranged, but also the headers 3, in the most advantageous positions, taking account of the geometry and the structure of the environment to be conditioned.

**[0088]** Further, in a case of malfunctioning of a treatment unit 2, it will be possible to disconnect the unit 2 from the circuit, which will continue to function independently (obviously no longer at full regime) and it will be possible to divide the air flow advantageously over the whole environment to be conditioned.

**[0089]** Figures 5, 6, 7, 8 illustrate an alternative configuration of the plant which exploits a self-compensating ring header 3 (or several rings)

**[0090]** Figure 5 illustrates a ring header 7 which follows the perimeter of the environment 12 to be conditioned.

**[0091]** Note in particular that a plurality of air treatment units 2 are present, and that one of these 2a is connected to the plenum header 3 at various accesses 5 via respective supply channels 8 which start from the same treatment unit 2.

**[0092]** In the illustrated example, thanks to the division of the flows in arrival from the air treatment units 2, the section of the header channel can be reduced. Should a flow rate of 30,000 m<sup>3</sup>/hour be necessary, if this flow were injected via a single access 5 in a ring header, this would require the ring header to have a section able to entrain and process 15,000 m<sup>3</sup> of air/ hour for each segment (left and right) of the ring header facing the access 5.

**[0093]** On the other hand, by dividing the flow over several air treatment units 2 (and also subdividing the flow of an air treatment unit 2 over several air access channels 8) it is clear how the access zones would receive lower amounts of cubic metres of air per hour, and will require smaller conveying sections. This will lead to the possibility of having smaller ring header sections with an improved aesthetic impact and a considerable reduction in costs. Further, the ring header 3 can continuously follow the geometries of the environment to be treated, without the air treatment plant's being affected from the fluid-dynamic point of view by the said geometries.

**[0094]** Also worthy of note is the fact that in the specific case, in the example of figures 5-8 the ring header 3 mainly functions as a diffuser 4.

**[0095]** By making the ring header 3 of metal and appropriately perforating it, the conditions are created whereby the ring header is able to perform the air diffusion towards the environment 12 to be treated while enabling optimal homogeneity of the environmental temperatures, with perfect control of the residual velocity at ground level.

**[0096]** However it is also possible to vary the air launch angle (or rather evolve the angle), by appropriately rotating the tracts of channel defining the ring header 7 about the longitudinal development.

**[0097]** The plant of figure 6 substantially correspond to the one in figure 5, but it exhibits four junctions 11 located at the corners of the environment to be conditioned.

**[0098]** The use of these junctions 11, and in particular the respective choking means 10, enable a choked ring header 3 to be obtained in which apart from functioning at full power and with the ring open it is also possible to obtain, for example, operation on only two opposite sides.

**[0099]** By turning off the uninvolved air treatment units 2 and closing the fluid communication at the junctions 11, two smaller plants are obtained on the opposite sides of the room, each being provided with a header supplied by its own air treatment unit 2 which can launch air towards the environment.

**[0100]** The treatment plant of figure 7 comprises use not only of the self-compensating header 3 but also of a plurality of diffuser channels 6 or discharge channels which interconnect opposite portions of the ring header.

**[0101]** Also note that an air treatment unit 2a can also be associated to the diffuser channels 6, which air treatment unit 2a can for example divide the flow it generates over each of the connecting channels.

**[0102]** The plant of figure 8 illustrates a solution comprising two ring headers 7 interconnected to one another by means of interposed junctions 11 supplied by two air treatment units 2.

**[0103]** A possible use of multiple ring headers 3 in plants is illustrated in figure 12, where a possible air treatment plant for conditioning environments on two different floors of a building is illustrated, achieved with a single air treatment unit 2 which divides its flow over respective rings 3 in the higher floor and rings 3 in the lower floor.

**[0104]** Also, as shown in the figure, by suitably orientating the flow launch angle it is possible to direct, possibly according to the season of the year and the type of conditioning to be obtained, the treated air flow towards appropriate zones of the environment to be conditioned.

**[0105]** If the plants described herein have up to this point been designed for being arranged on the ceiling of the environment to be conditioned, it should be noted that the solution of the present invention could also be applied in other types of plants.

**[0106]** Looking at figure 11 in particular, a booth 15 is illustrated for painting vehicles 14, in particular carriages for trains, or motor vehicles.

**[0107]** Figure 11a illustrates the standard arrangement

(open paint booth) of an air treatment plant with a ring header for realising process plants such as for example the diffusion of the air in the space of a open paint booth for vertical or horizontal laminar-flow diffusion in a paint booth.

**[0108]** With the solution of the present invention (figure 11b), a ring header 3 of the present invention is alternatively located at a lateral wall 15a of the booth.

**[0109]** Observing the front view of figure 11b, an air treatment unit 2 is illustrated, provided with an appropriate ventilator which, via an air supply channel 8, carries the treated air flow to four different accesses 5 of the ring header 3.

**[0110]** The ring header 3, which is also a diffuser, generates a plurality of air flows directed horizontally towards the paint booth 15.

**[0111]** By using a filter member 13 the various fluid lines are made parallel and substantially constant in such a way as to generate a substantially laminar flow in order to optimise the painting processes.

**[0112]** By appropriately varying the flow rate in the ring header 3 currents can be generated, for example from 0.35 to 0.5 metres per second for the various removal operations of the paint, drying or other powders produced by operations performed in the booth.

**[0113]** The invention provides important advantages.

**[0114]** As clearly indicated herein above, the use of a linear or ring plenum header enables the treatment plant to be adapted to the type of conditioning to be implemented in the particular environment.

**[0115]** The plenum header enables maintenance operations to be carried out without having to turn the plant off, and also to divide the flows according to particular needs at any time (increasing the plant dimensions, regime situations) or to the season of the year (winter or summer).

**[0116]** Further, the plants are easily adaptable to the structure of the building as access to the plenum header can be performed at any point thereof; the plants can be modified by intervening for example in order to increase the power and/or flow rate per linear metre without having to disrupt the original design specifications.

## Claims

1. A plant for air treatment, comprising:

- a predetermined number of air-treatment units (2) designed to generate at least a pressure increase in the air to be diffused;
- at least a header (3) in fluid communication with the predetermined number of treatment units (2);
- at least one diffuser (4) in fluid communication with the header (3) for diffusing the treated air in an environment,
- characterised in that** the header (3) has at

least two distinct accesses (5) for receiving the treated air from said predetermined number of treatment units (2).

2. A plant as claimed in the preceding claim, **characterised in that** it comprises a plurality of air-treatment units (2), each of which is brought into fluid communication with said header (3) at least at a respective access (5) to the header (3). 5
3. A plant as in any one of the preceding claims, **characterised in that** the air-treatment unit (2) comprises a fan for generating said pressure increase, the air-treatment unit (2) preferably comprising means for conditioning the air temperature and possibly a filter for purifying the air itself. 10 15
4. A plant as in any one of the preceding claims, **characterised in that** said at least one diffuser (4) comprises a plurality of holes or gauged apertures adapted to admit air into the environment to be treated for generating an inducting effect in the ambient air surrounding the diffuser, said diffuser (4) preferably being a diffusion channel (6) with holes distributed over the side wall. 20 25
5. A plant as in any one of the preceding claims, **characterised in that** at least a tract of the header (3) also defines said diffuser (4) or **in that** said diffuser (4) leads off away from said header (3), preferably a plurality of diffusion channels (6) leading off from the header (3). 30
6. A plant as in any one of the preceding claims, **characterised in that** said header (3) defines at least a path that is closed upon itself, one or more ring headers (7) for example. 35
7. A plant as in any one of the preceding claims, **characterised in that** it further comprises an air-supply channel (8) to bring the air-treatment unit into fluid communication with the header (3), and closing means (9) to close the feeding channel (8) and prevent passage of an air flow through the feeding channel (8), particularly under rest conditions of the air-treatment unit (2). 40 45
8. A plant as claimed in anyone of the preceding claims, **characterised in that** it further comprises choking means (10) acting on the header (3) or between the header (3) and the diffuser (4) for choking the air flow in the header (3) or between the header (3) and the diffuser (4). 50
9. A plant as in any one of the preceding claims, **characterised in that** it further comprises a predetermined number of junctions (11) each having at least two accesses (11a, 11b, 11c, 11d, 11e) defined be-

tween consecutive portions (3a, 3b) of the header or between the header (3) and the diffuser (4) or between the supply channel (8) and the diffuser (4), the junction (11) having choking means (10) for choking the flow between the two accesses (11a, 11b, 11c, 11d, 11e).

10. A plant as in any one of the preceding claims, **characterised in that** the linear flow resistance in the header (3) and the diffusion channels (6) is lower than the localised flow resistance in the holes of the diffusion channel. (6).

FIG 1a

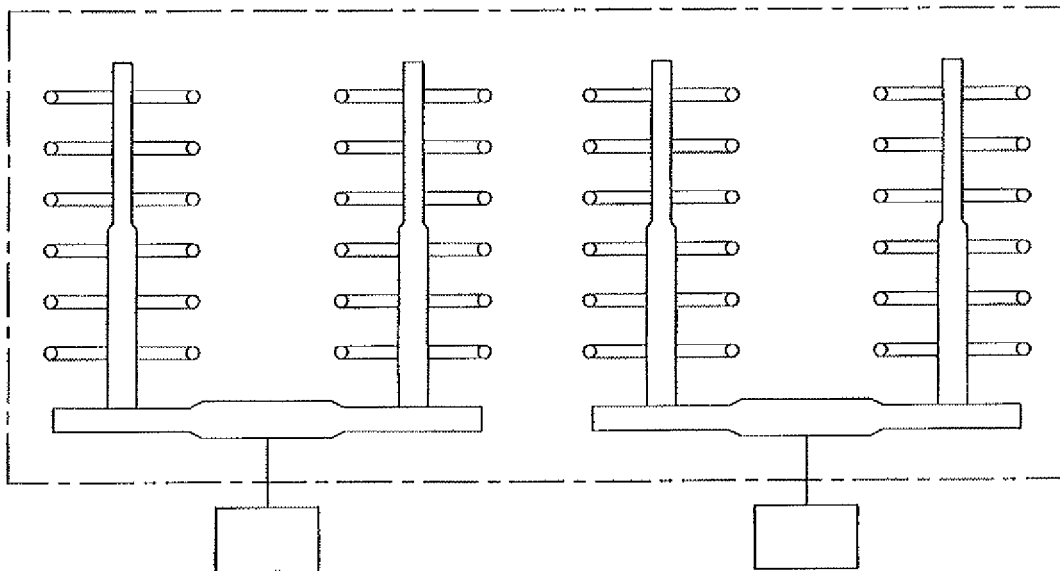
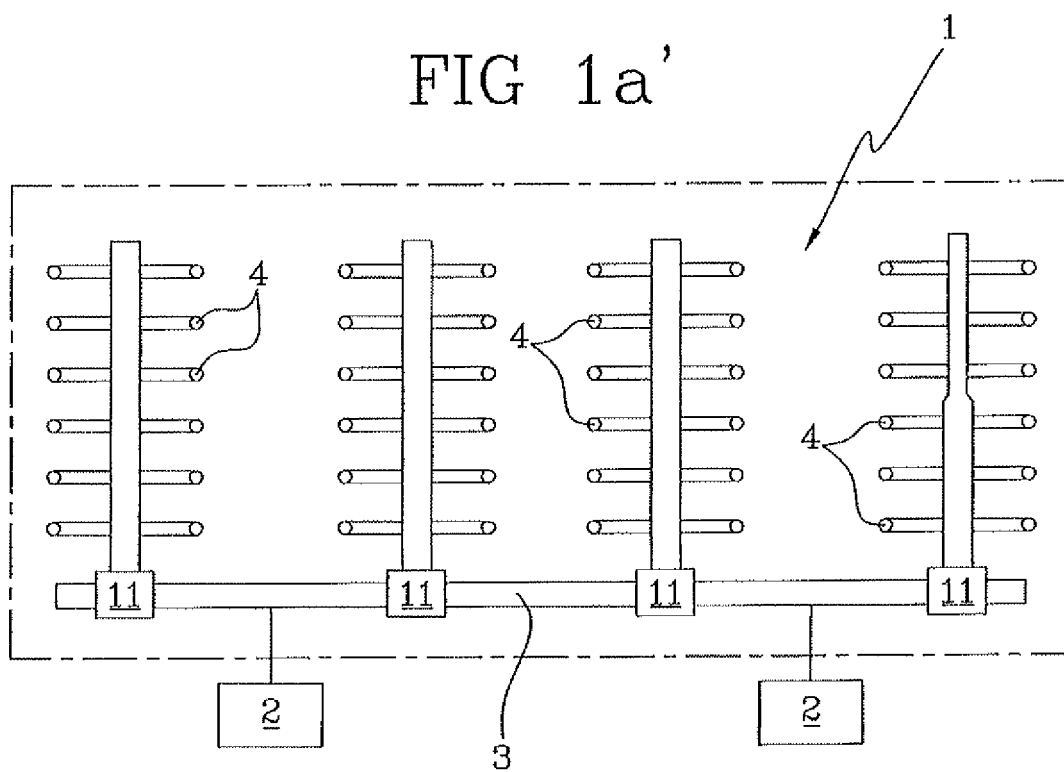
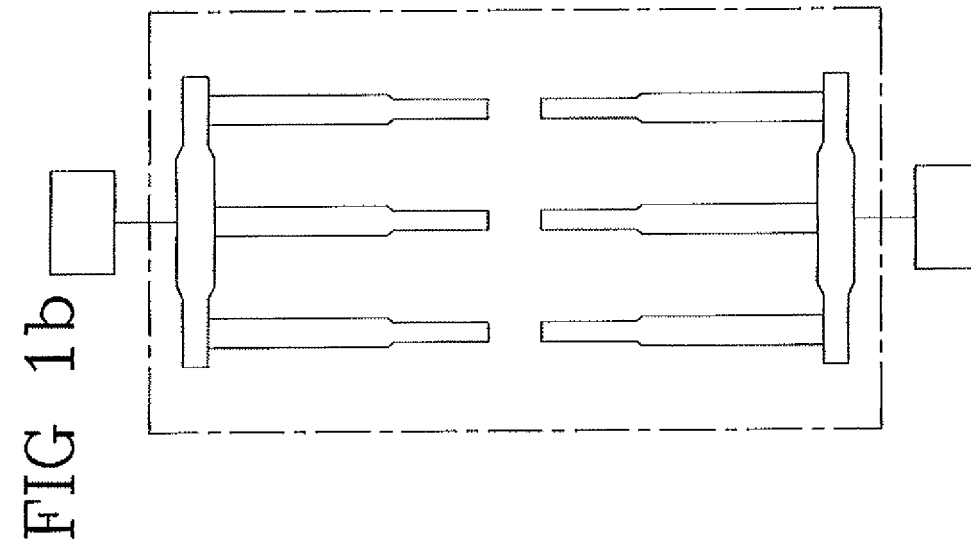
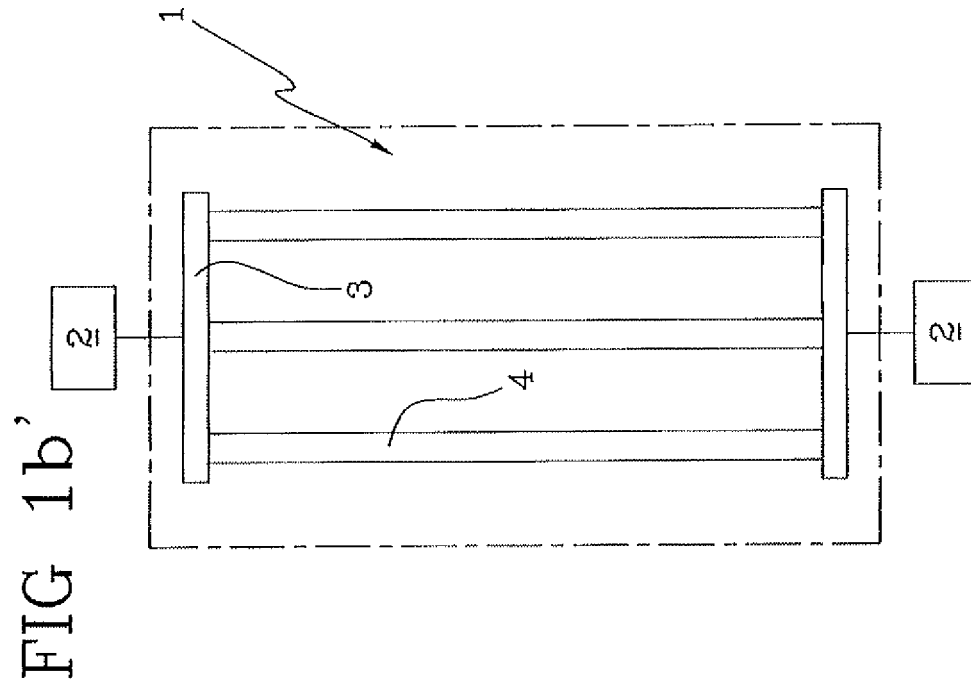


FIG 1a'







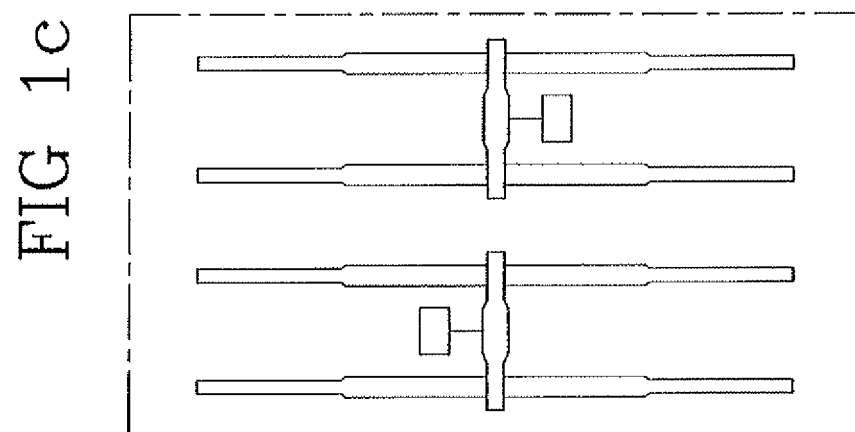
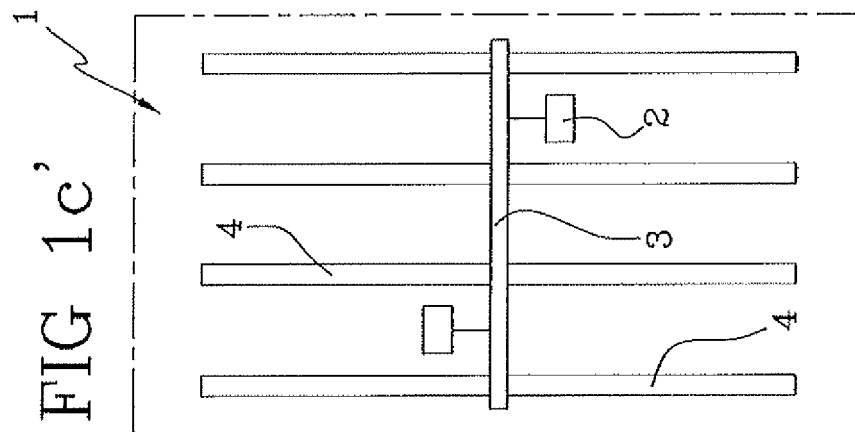


FIG 1d

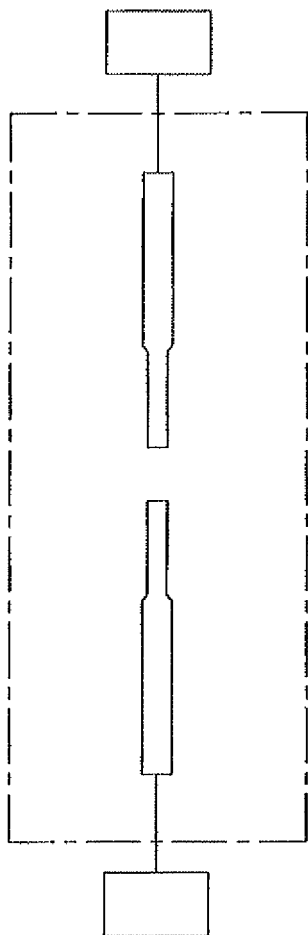


FIG 1d'

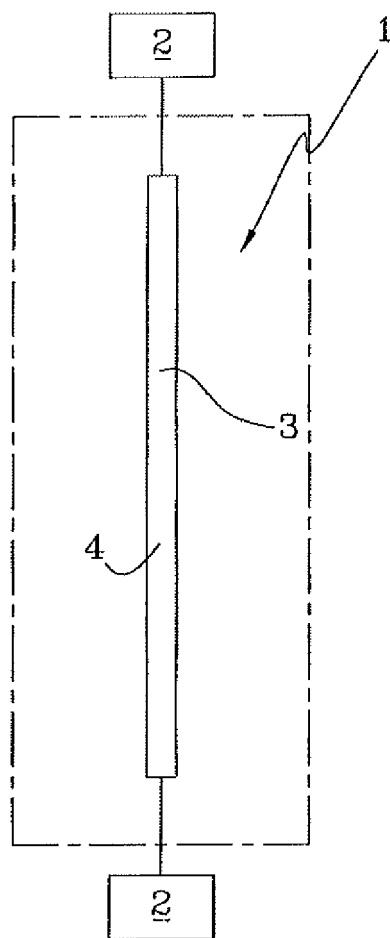


FIG 3

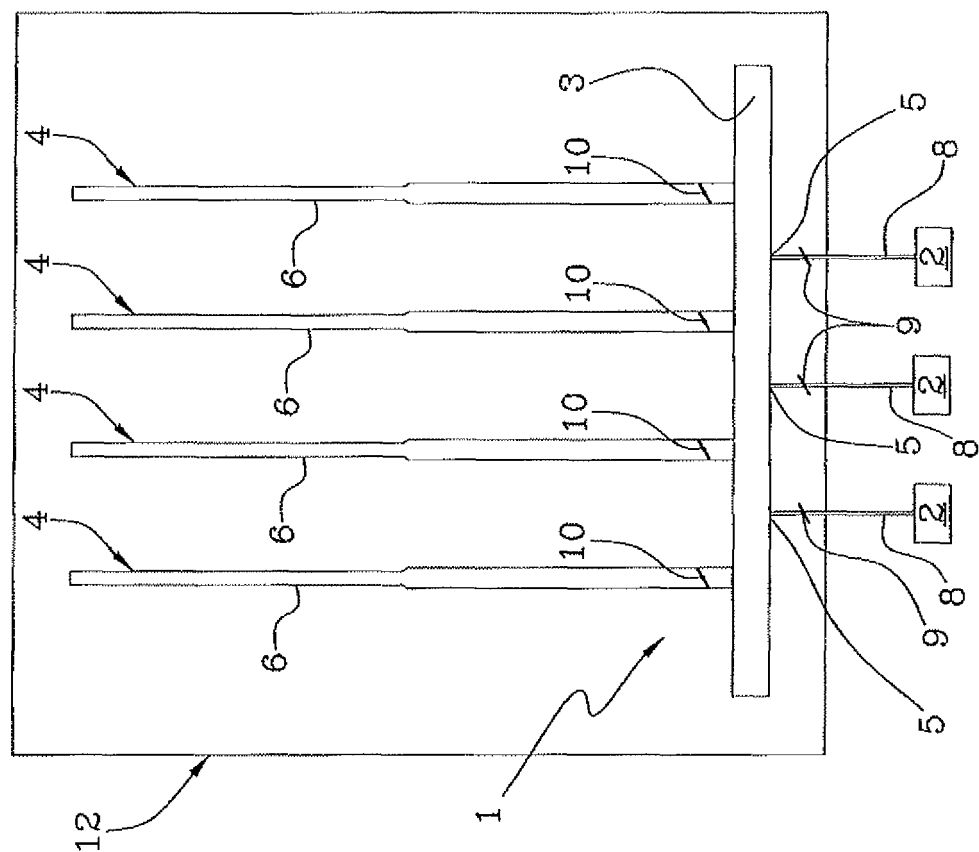
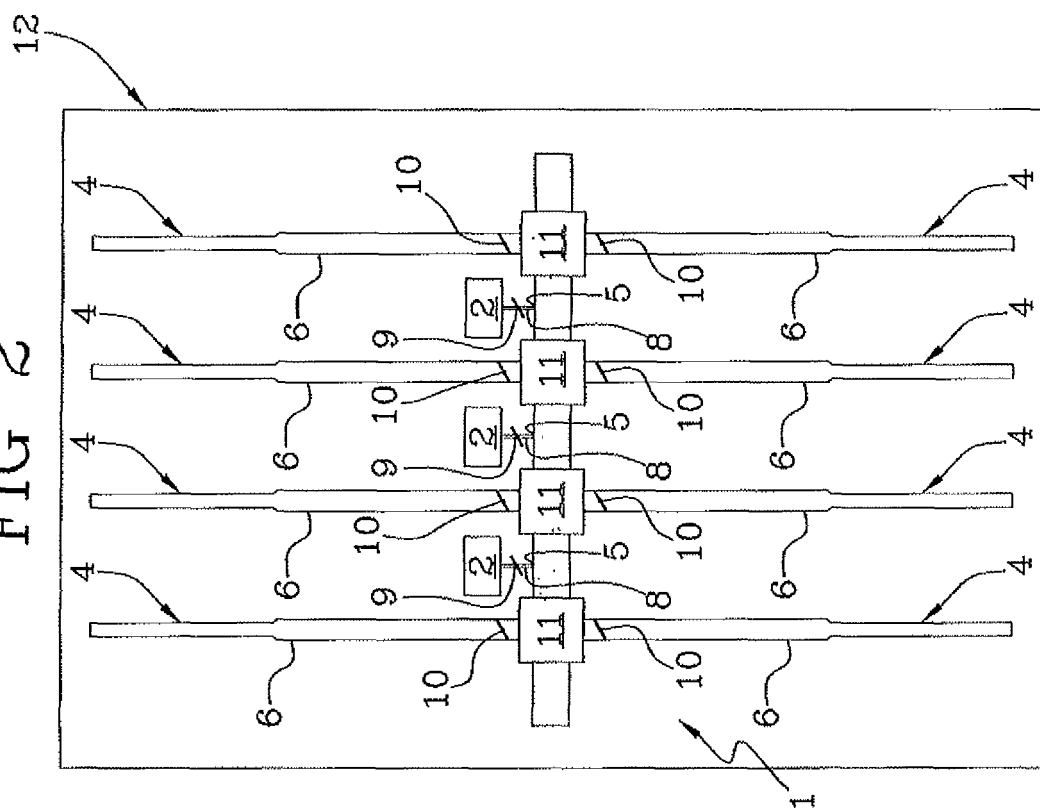


FIG 2



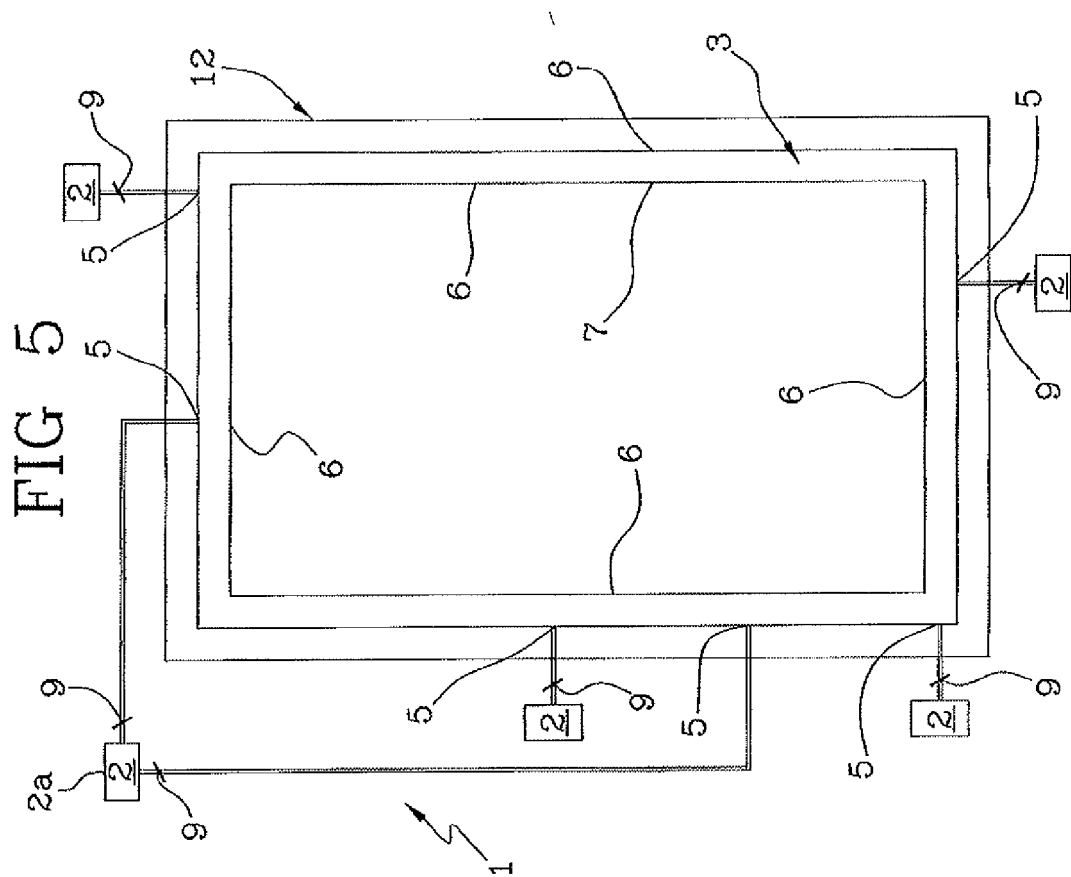
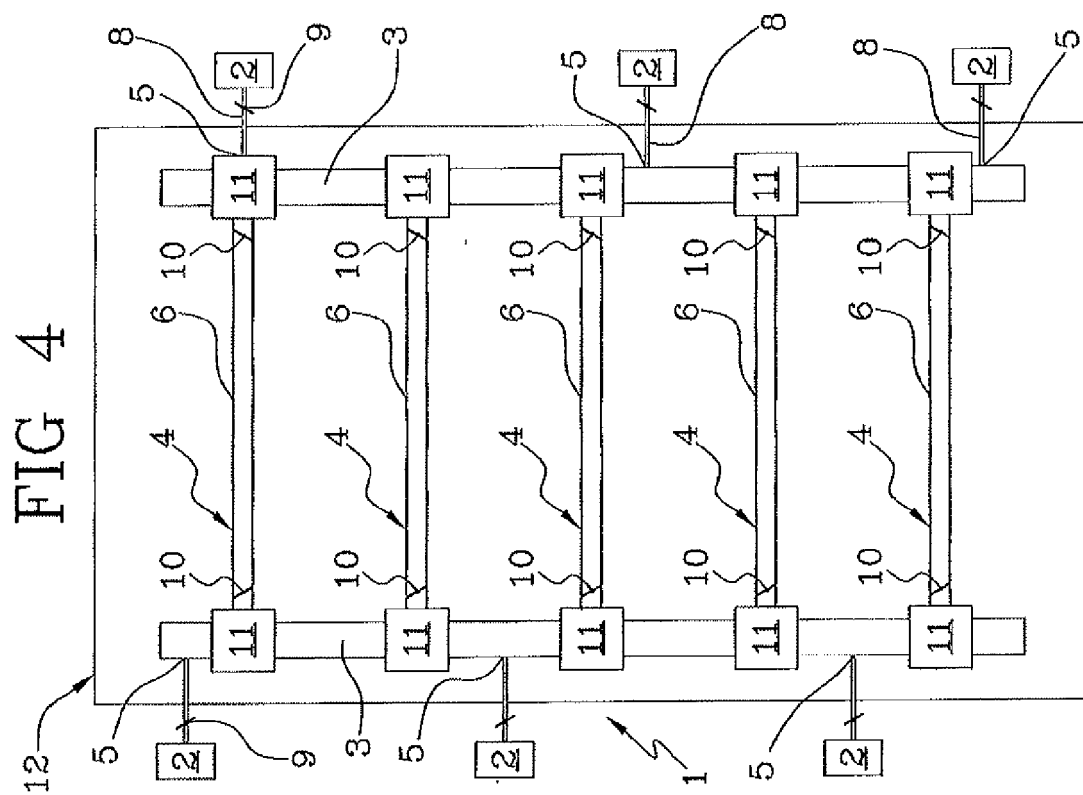
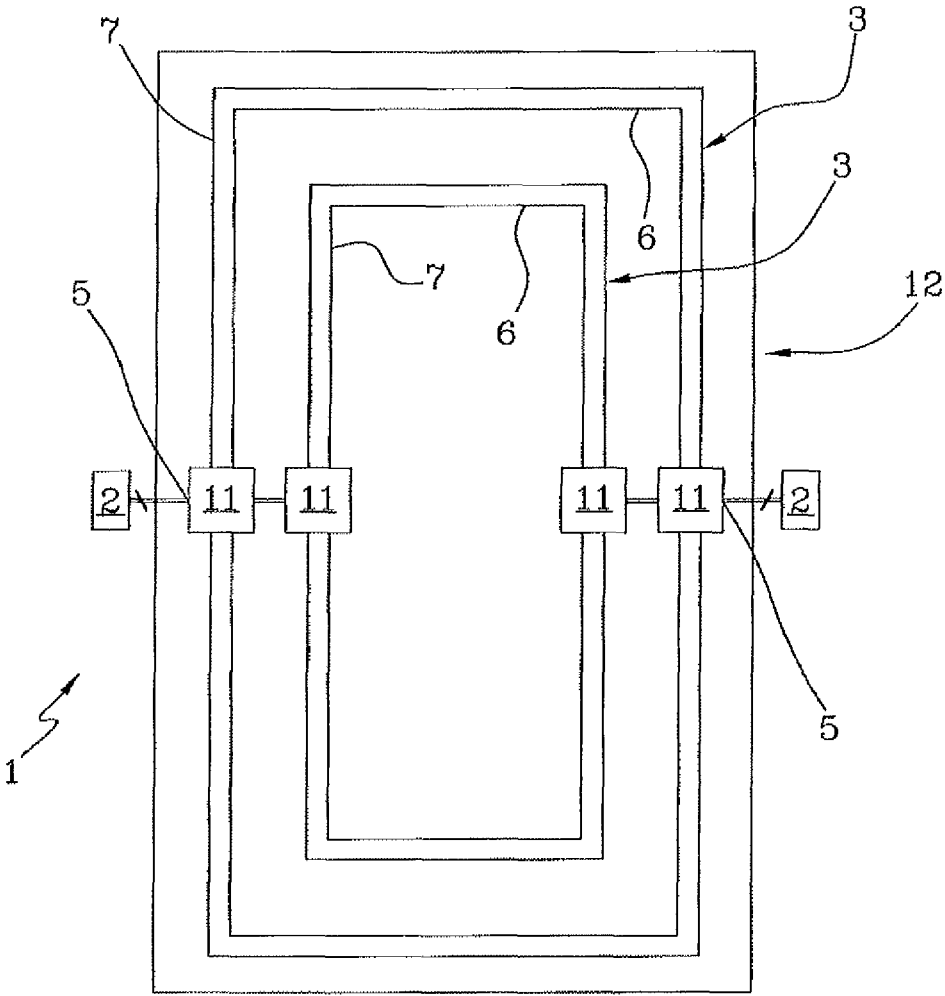
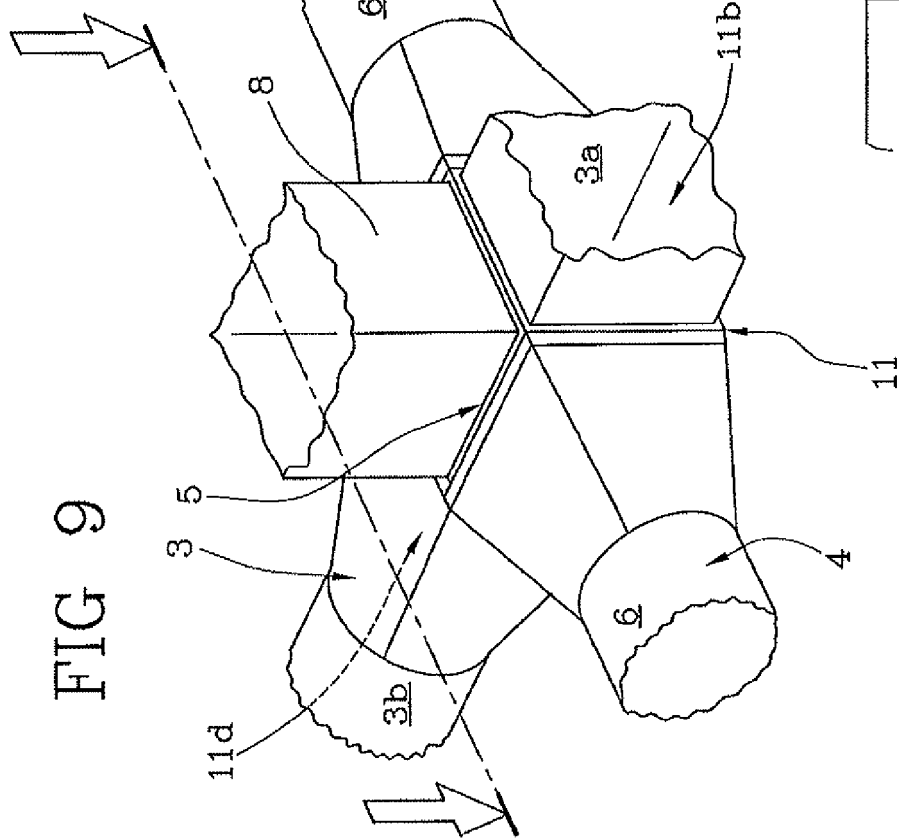




FIG 8





**FIG 10**

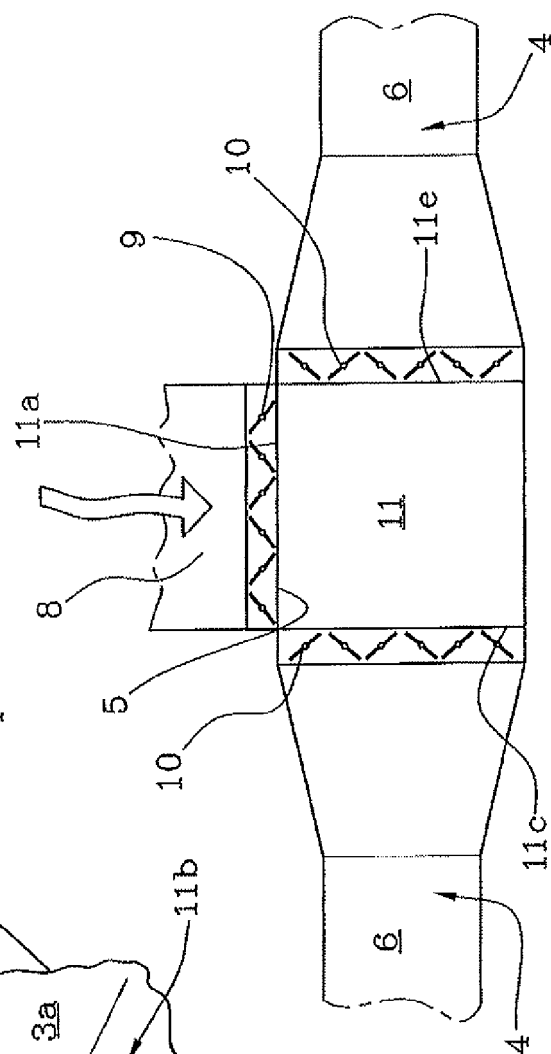




FIG 11

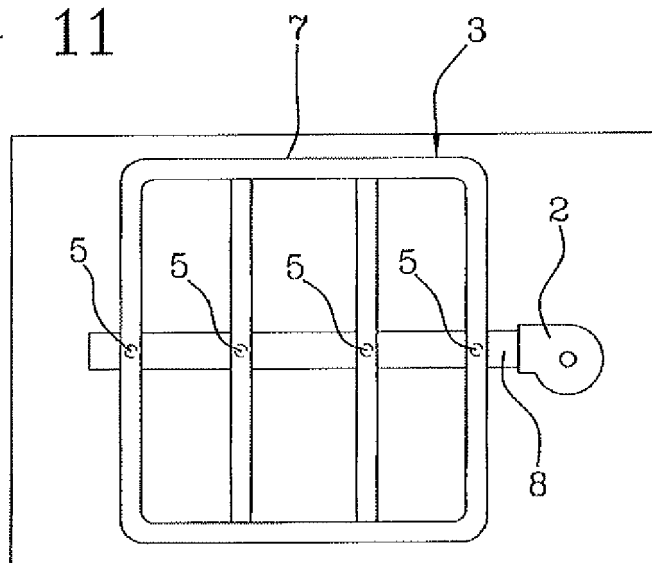


FIG 11a

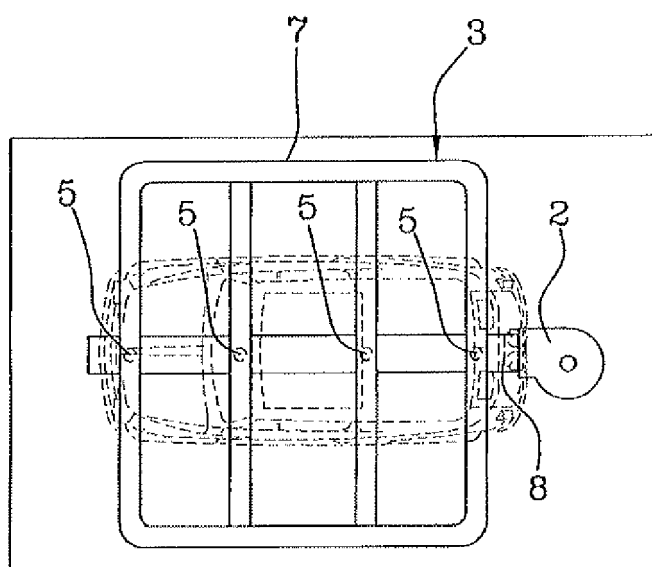


FIG 11b

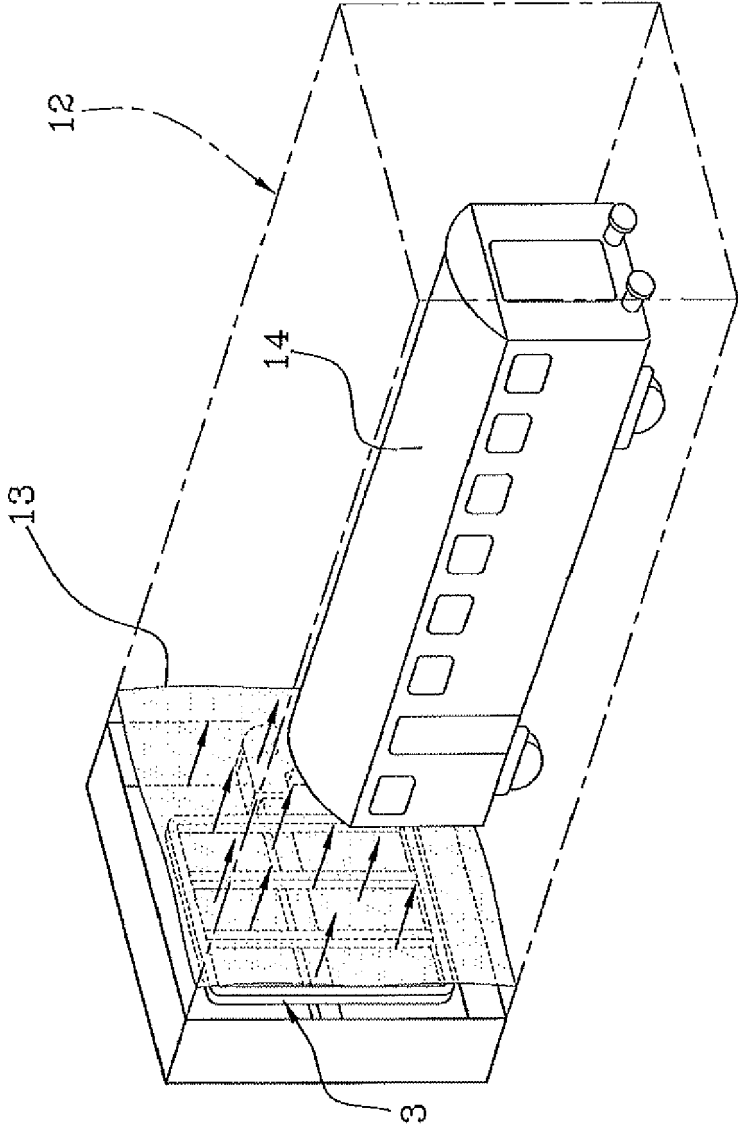
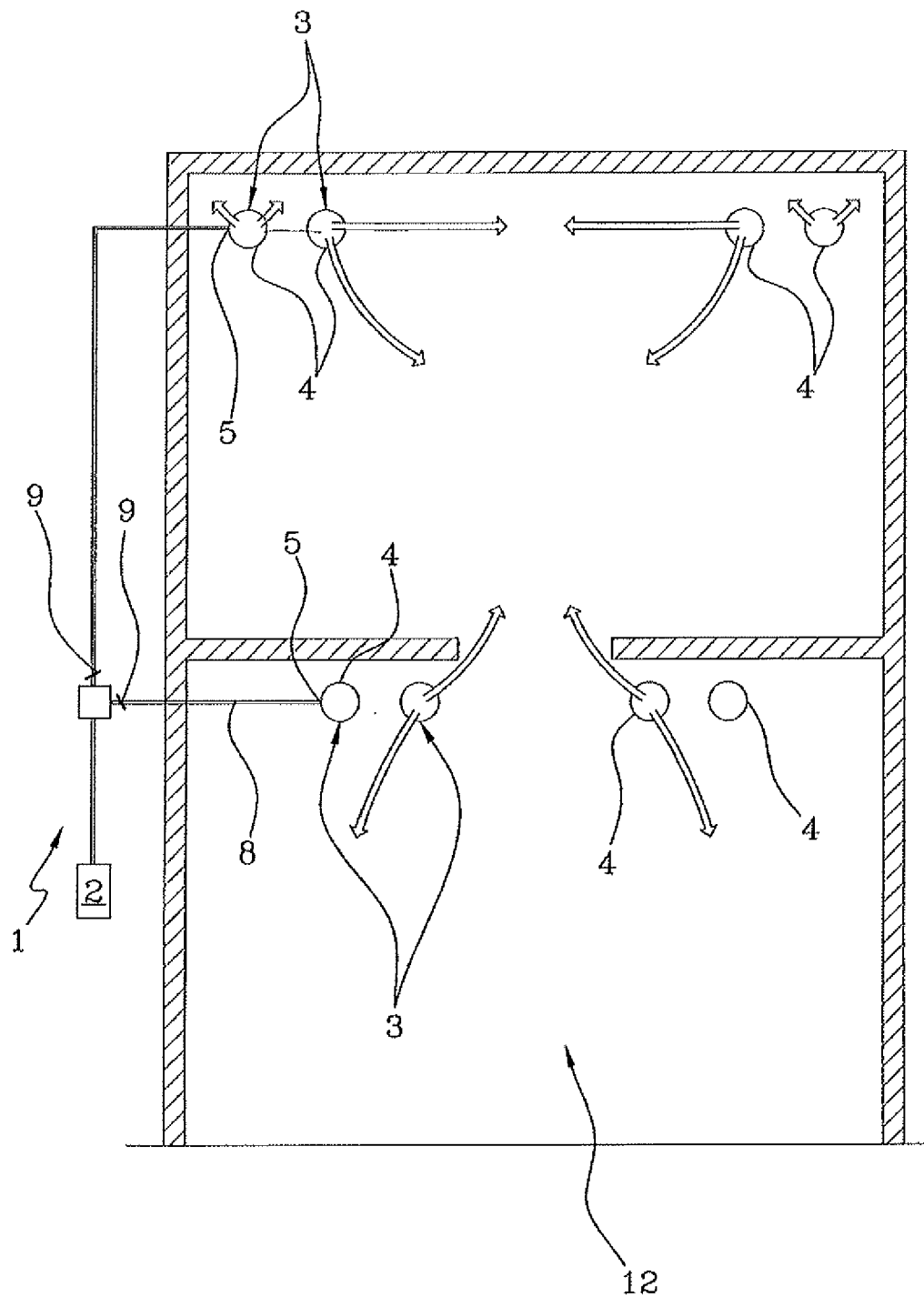


FIG 12





## EUROPEAN SEARCH REPORT

Application Number  
EP 10 15 9863

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                               |                                                      |                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------|-----------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim                                    | CLASSIFICATION OF THE APPLICATION (IPC) |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | US 3 818 814 A (OBLER H ET AL)<br>25 June 1974 (1974-06-25)                   | 1-10                                                 | INV.<br>F24F3/044<br>F24F13/06          |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | * column 3, line 66 - column 4, line 58;<br>figure 1 *                        | 1-10                                                 |                                         |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | US 2 804 816 A (HOYER JAMES L)<br>3 September 1957 (1957-09-03)               | 1-10                                                 |                                         |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | * column 2, line 20 - line 36; figure 1 *                                     | 1-10                                                 |                                         |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | EP 0 899 519 A1 (ZAMBOLIN MARCO [FR])<br>3 March 1999 (1999-03-03)            | 1-10                                                 |                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | * paragraph [0026] - paragraph [0033];<br>figure 1 *                          |                                                      |                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                               |                                                      | TECHNICAL FIELDS SEARCHED (IPC)         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                               |                                                      | F24F                                    |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                               |                                                      |                                         |
| Place of search<br>Munich                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                               | Date of completion of the search<br>6 September 2010 | Examiner<br>Valenza, Davide             |
| <p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone<br/>Y : particularly relevant if combined with another document of the same category<br/>A : technological background<br/>O : non-written disclosure<br/>P : intermediate document</p> <p>T : theory or principle underlying the invention<br/>E : earlier patent document, but published on, or after the filing date<br/>D : document cited in the application<br/>L : document cited for other reasons<br/>&amp; : member of the same patent family, corresponding document</p> |                                                                               |                                                      |                                         |

1  
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 10 15 9863

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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06-09-2010

| Patent document<br>cited in search report |    | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|----|---------------------|----------------------------|---------------------|
| US 3818814                                | A  | 25-06-1974          | NONE                       |                     |
| US 2804816                                | A  | 03-09-1957          | NONE                       |                     |
| EP 0899519                                | A1 | 03-03-1999          | DE 69702056 D1             | 21-06-2000          |