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(54) **Titre : CONTENEUR AMENAGE EN UNE INFRASTRUCTURE TECHNIQUEE**
(54) **Title: CONTAINER FITTED OUT AS A TECHNICAL INFRASTRUCTURE**

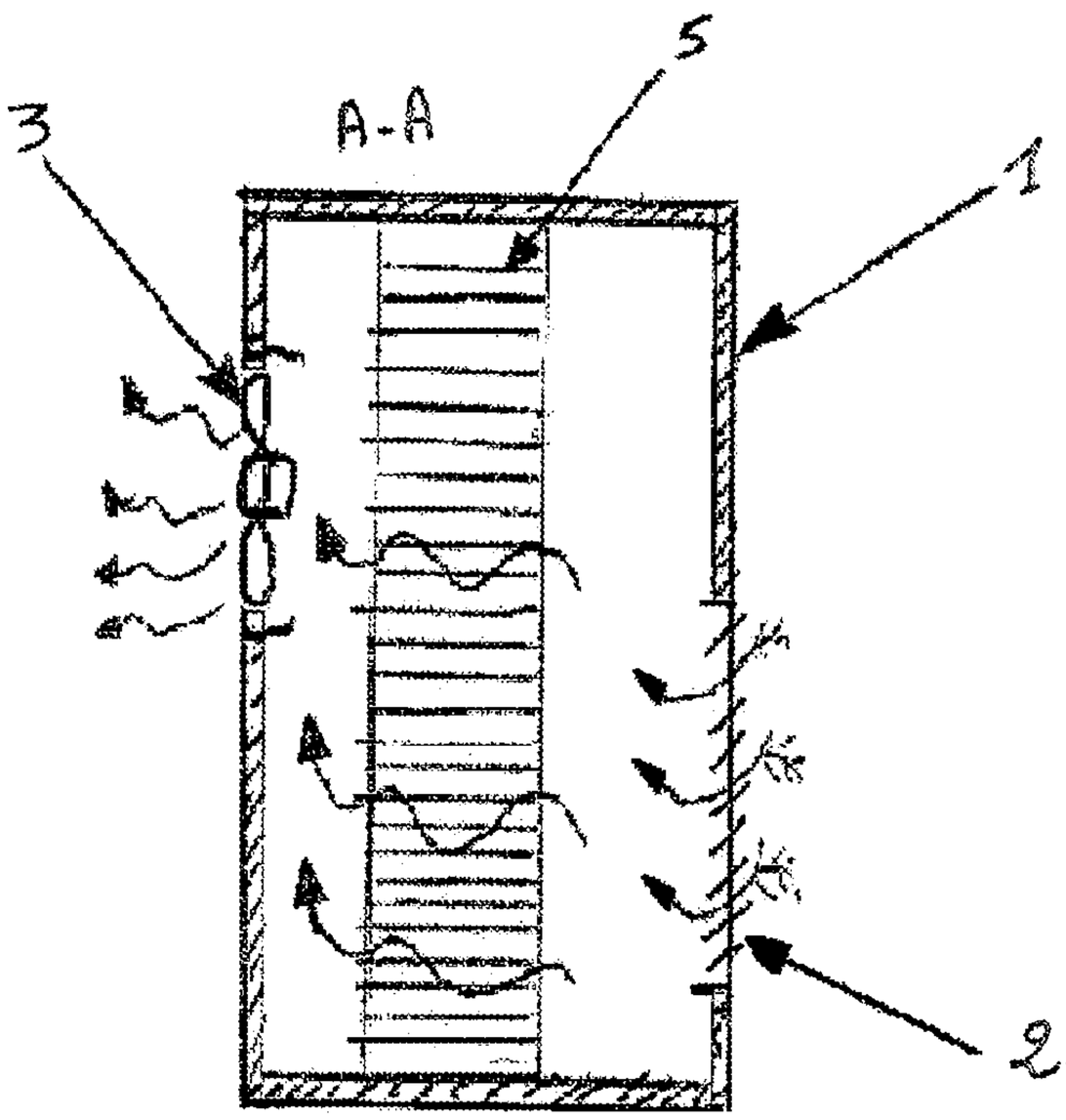

FIG.2

(57) **Abrégé/Abstract:**
Container (1) fitted in a technical infrastructure comprising -on a longitudinal side face, at least one opening (2) arranged to allow the intake of air inside the container (1); -on the opposite longitudinal side face, at least one fan (3) arranged to expel the air from the inside to the outside of the container (1); -computer racks (5) disposed in the middle of the container (1) along its longitudinal axis.

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[Suite sur la page suivante]

(54) Title : CONTAINER FITTED IN A TECHNICAL INFRASTRUCTURE

(54) Titre : CONTENEUR AMENAGE EN UNE INFRASTRUCTURE TECHNIQUE

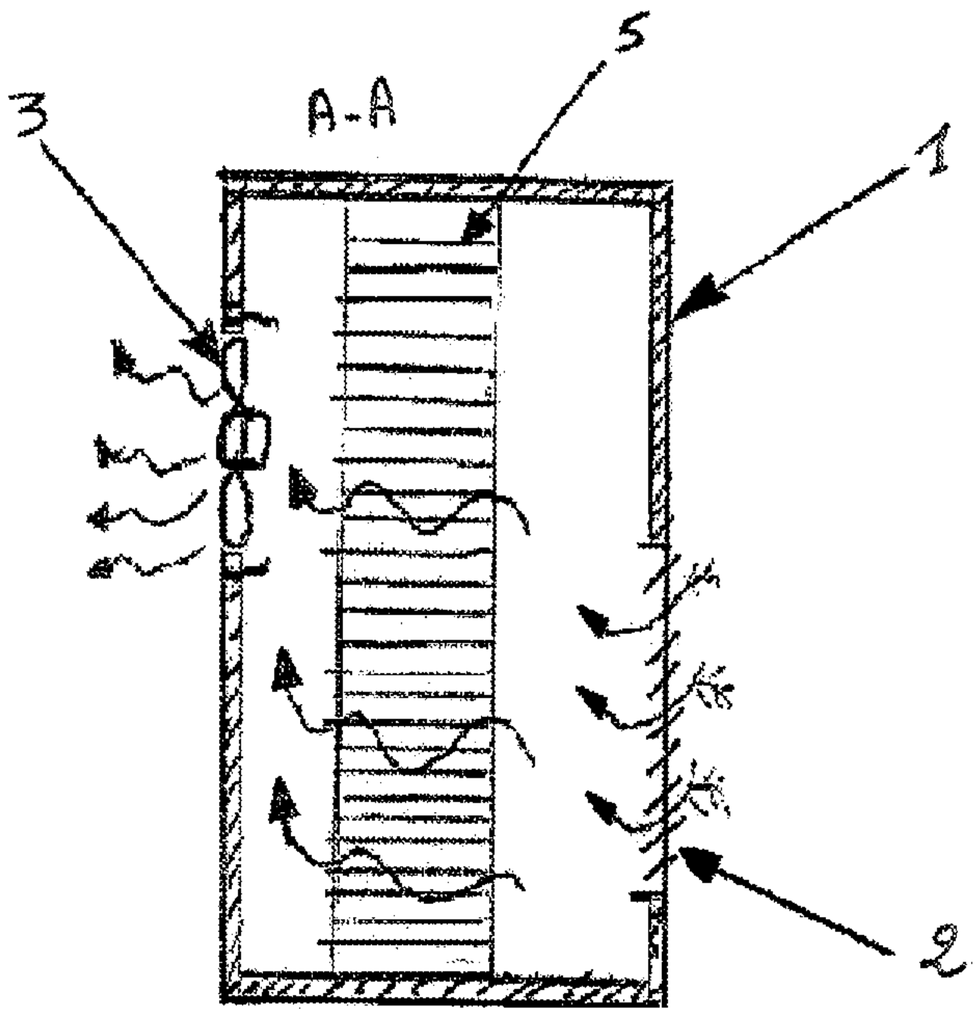

FIG.2

(57) Abstract : Container (1) fitted in a technical infrastructure comprising -on a longitudinal side face, at least one opening (2) arranged to allow the intake of air inside the container (1); -on the opposite longitudinal side face, at least one fan (3) arranged to expel the air from the inside to the outside of the container (1); -computer racks (5) disposed in the middle of the container (1) along its longitudinal axis.

(57) Abrégé : Conteneur aménagé (1) en une infrastructure technique comprenant -sur une face latérale longitudinale, au moins une ouverture (2) agencée pour permettre l'entrée d'airvers l'intérieur du conteneur(1); -sur la face latérale longitudinale opposée, au moins un ventilateur (3) agencé pour ressortir l'air de l'intérieur vers l'extérieur du conteneur(1); -des baies informatiques (5) disposées au milieu du conteneur (1) le long de son axe longitudinal.

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CONTAINER FITTED OUT AS A TECHNICAL INFRASTRUCTURE

The present invention concerns technical infrastructures, and more particularly the fitting out of said infrastructures.

As used herein, "technical infrastructure" designates any capital infrastructure dedicated to information and communication technologies such as a computing center/data center, hosting center, backup site, or telecom/carrier hotel, or server farm. These infrastructures generally take the form of computer rooms (or buildings) comprising, by way of non-limiting examples, telecommunications equipment, servers, storage systems, power supply systems, cooling systems, inverters, electrical distribution systems, and workstations.

Moreover, "fitting out" of a technical infrastructure is understood as its conditioning to meet all of the requirements during its lifecycle (i.e., design, deployment, operation, maintenance). Among these requirements are:

- energy efficiency and respect for the environment: to push the PUE (Power Usage Effectiveness) of a technical infrastructure to the most optimized ratios for economic as well as environmental reasons;
- speed of deployment: to be able to respond quickly to urgent and temporary demands by optimizing the time required to place a technical infrastructure in service;
- portability/mobility: to be able to transport a technical infrastructure to or from any place in the event of natural, political or social hazards (such as riots, earthquakes, snowstorms, hurricanes, floods, fires);
- modularity: to be able to restructure/expand a technical infrastructure at any time.

These requirements have given rise to the emergence of new designs for technical infrastructures, and particularly for data centers.

Of particular note in this domain is the containerization of data centers (i.e., placing them in a container). “Container” is understood herein as a conventional metal enclosure, parallelepiped in shape, for transporting merchandise. Indeed, computer rooms fitted in containers equipped with cooling systems are already available.

More generally, metal containers (designated as modules in the prior art) that are specially designed to house computer rooms and equipped with cooling systems have already been proposed.

However, the existing solutions are imperfect, particularly because they are not optimal. These containers/modules have limits, particularly in terms of energy efficiency and respect for the environment.

Indeed, with computer equipment that requires more and more energy and a constantly increasing power density due to cooling systems pushed to the limits of their capacities,

- setting up a computer room in a container for transportability without taking into consideration its PUE; or
- fitting out a container in the same way as a conventional computer room

risks compromising the overall cost (PUE) of data centers, as well as impacting the environment.

An object of the present invention is to remedy the aforementioned disadvantages.

Another object of the present invention is to improve the energy efficiency of a data center set up in a container.

An object of the present invention is to optimize the fitting out of a container in order to design data centers that are more energy-efficient.

Another object of the present invention is to improve the ecological footprint of a data center.

Another object of the present invention is to take environmental parameters into account in the fitting out of technical infrastructures.

Another object of the present invention is to avoid using a heavy electrical infrastructure for the cooling of a technical infrastructure.

Another object of the present invention, given the energy constraints, is to rethink the arrangement of computer rooms set up in containers.

Another object of the present invention is to propose architectures of technical infrastructures that integrate sustainable resources.

Another object of the present invention is to integrate the environmental dimension in the design of data centers.

To that end, the invention relates, according to a first aspect, to a container fitted out as a technical infrastructure comprising

- on one longitudinal lateral face, at least one opening made to allow the entry of air into the container;
- on the opposite longitudinal lateral face, at least one ventilator arranged to move the air from the interior to the exterior of the container;
- computer bays in the middle of the container along its longitudinal axis.

According to a second aspect, the invention proposes a data center comprising a plurality of containers fitted out as a technical infrastructure as defined above, said fitted-out containers being arranged in the form of a chimney, the cavity of which is open upwards.

Other characteristics and advantages of the invention will be seen more clearly and specifically from the following description of preferred embodiments, with reference to the appended drawings in which:

- figures 1 and 2 illustrate schematically a profile view and a cross-sectional side view, respectively, of a container fitted out according to one embodiment;
- figure 3 illustrates schematically an architecture of a data center obtained by arranging containers fitted out according to one embodiment.

With reference to figures 1 and 2, transformations are made to the container **1** to comprise:

- on one longitudinal lateral face, a plurality of quadrangular openings **2** (particularly in the form of ventilation louvers) arranged to allow the entry of air into the container **1**;
- on the opposite longitudinal lateral face, a plurality of ventilators **3** arranged to move the air from the interior to the exterior of the container **1**; and
- at least one door **4**.

As illustrated in the profile view of the container **1** in figure 2, the computer bays **5** (or, computer racks) are arranged in the middle of the container along its longitudinal axis in such a way as to form two open longitudinal aisles. Consequently, there is one aisle on each side of the computer bays **5** allowing unhindered access to the computer equipment. In particular, there is no restriction on the type of bays **5**, which can be of any origin.

As can be seen in figure 2, the ventilators **3** and the openings **2** are preferably vertically offset at two different heights of the two opposite longitudinal lateral faces. The ventilators **3** are higher in order to move the hot air, and the openings **2** are lower in order to better cool the bays with the incoming air assumed to be at a temperature lower than that of the interior of the container.

Moreover, figure 2 illustrates the airflow from the air intake of the fitted-out container **1**, i.e., from right to left in figure 2. Indeed, we see

- the intake of the ambient air from the force of the wind or by the low pressure generated by the ventilators **3**;
- the flow of the air through the computer equipment of the racks **5**;
- the evacuation to the exterior of the container **1** of the hot air by the ventilators **3**.

Advantageously, the two aisles on either side of the computer bays **5** favor, respectively,

- the uniform inflow of the airflows perpendicular to the direction of arrangement of the computer bays **5**, which represents an exposure that is favorable for the cooling of the computer equipment;
- the exhaust of the hot air via the ventilators **3** that are operational in line with and in the direction of the hot airflows.

The result is that the low pressure generated by the ventilators **3** at the intake of the openings **2** (i.e., the ventilation louvers), the two open aisles on either side of the computer racks **5**, and the ventilators **3** on the opposite face, provide natural ventilation of the computer room set up in the container **1**.

Advantageously, this inter-arrangement of the openings **2**, ventilators **3** and computer bays **5** promotes the optimal cooling by the ambient air of the computer room set up in the container **1**.

Indeed, said inter-arrangement of the openings **2**, ventilators **3** and computer bays **5** has the technical effect of better ventilation of the racks arranged perpendicular to the direction of propagation of the incoming airflow. The arrangement of the ventilators **3** on the face opposite that of the openings **2** favors the creation of an air current, allowing the natural ventilation of the computer bays **5**.

Therefore, by contributing to the improvement of energy efficiency of the data center, the inter-arrangement of these elements (openings, ventilators, computer bays) is particularly functional.

Consequently, the data center set up in the container **1** is completely cooled by exterior ambient air.

Preferably, filters – installed next to the openings **2** – filter dust and harmful gases from the incoming air, and regulate the humidity level. Said filters are particularly useful when the container **1** is installed in areas that are too humid or where there is a heavy circulation of dust or harmful gases (for example coastal zone, construction site, industrial zone). These filters are configured in particular to maintain the humidity level of the incoming air within a predefined interval, or if necessary, to trigger a control device to maintain the humidity level within said interval.

Preferably, the openings **3** are controlled by a system for automatically regulating the degrees of opening (ventilation louvers for example), and consequently, the flow rate of incoming air, depending on the required cooling load.

It should be noted that the number and dimensions of the openings **2**, as well as those of the ventilators **3**, are selected so as to take into account a plurality of factors, including the environment of deployment and the computer load of the technical infrastructure.

It should also be noted that additional cooling systems can be combined with the cooling system by outdoor air as described above. For example, cooling systems by

gas/liquid expansion, cold water, or water can be adopted in combination, as an option or as a fallback solution to the cooling system by outdoor air.

In combination with a liquid cooling system (water for example), two cooling systems can coexist for the data center (or hosting center) set up in the container **1**.

The fitted-out container **1** further comprises means provided for safety, fire safety, and risk management (sensors, systems for detecting water leaks and smoke for example).

In one embodiment, the fitted-out container **1** is arranged in such a way that its interior can communicate with the interior of at least one other fitted-out container **1**, and is therefore expandable.

In one embodiment illustrated in figure 3, a plurality of fitted-out containers **1** are organized to form a chimney. The resulting technical infrastructure **10** thus constitutes a building that is hollow [in the center] having a cavity **11** open upwards.

The ventilators **3**, facing the cavity **11** of the data center **1**, make it possible to send the hot air into the cavity **11**, which in turn, by the chimney effect, evacuates it towards the exterior. The chimney effect is due to the temperature difference between the hot air inside the data center (resulting technical infrastructure) **10** and the cold air from the outside, which causes an ascending movement **12** of air from the ventilators **3**.

Advantageously, the combination of the chimney effect produced by the cavity **11** and the force of the wind at the entrance of the openings **2**, made in the lateral faces of the fitted-out containers **2**, ensure natural ventilation of the data center **10**. In other words, the air is naturally caused to move through the fitted-out containers **1** of the technical infrastructure **10**. Indeed, the air blown through the wall openings **2** to the interior of the technical infrastructure **10** results in thermal draft to the cavity **11** via the ventilators **3**.

Preferably, the cavity **11** is a convex polygon, particularly rectangular or square. As a variant, the cavity **11** is a concave or crossed polygon.

The system just described has a number of advantages, including:

- a high-performance, economical technical infrastructure can be made available quickly;
- if the ambient temperature at the deployment location is lower than a predefined value, the system provides a considerable improvement in energy efficiency of the technical infrastructures;
- reduced cost of installation and operation compared to that of traditional data centers;
- the construction of ecological computer buildings.

It should be noted that the term “container” as used here includes any metal enclosure similar to a conventional container without necessarily being of the standardized dimensions of a freight container.

The preceding description is made with reference to a computer room or data center, but obviously, this example of technical infrastructure is not limiting and can refer to any other capital infrastructure dedicated to information and communication technologies.

CLAIMS

1. Container (**1**) fitted out as a technical infrastructure comprising
   - on one longitudinal lateral face, at least one opening (**2**) arranged to allow the entry of air into the container (**1**);
   - on the opposite longitudinal lateral face, at least one ventilator (**3**) arranged to move the air from the interior to the exterior of the container (**1**);
   - computer bays (**5**) disposed in the middle of the container (**1**) along its longitudinal axis.

2. Container according to the preceding claim, characterized in that it further comprises at least one filter arranged to filter the incoming air.

3. Container according to the preceding claim, characterized in that the filter is arranged to regulate the level of humidity of the incoming air.

4. Container according to any one of the preceding claims, characterized in that the opening (**2**) and the ventilator (**3**) are vertically offset at two different heights on the two opposite longitudinal lateral faces.

5. Container according to any one of the preceding claims, characterized in that it further comprises a cooling system by water.

6. Data center (**10**) comprising a plurality of fitted-out containers (**1**) in a technical infrastructure as defined in any one of claims 1 to 5.

7. Data center (**10**) according to the preceding claim, characterized in that the fitted-out containers (**1**) are arranged in the form of a chimney, the cavity (**11**) of which is open upwards.

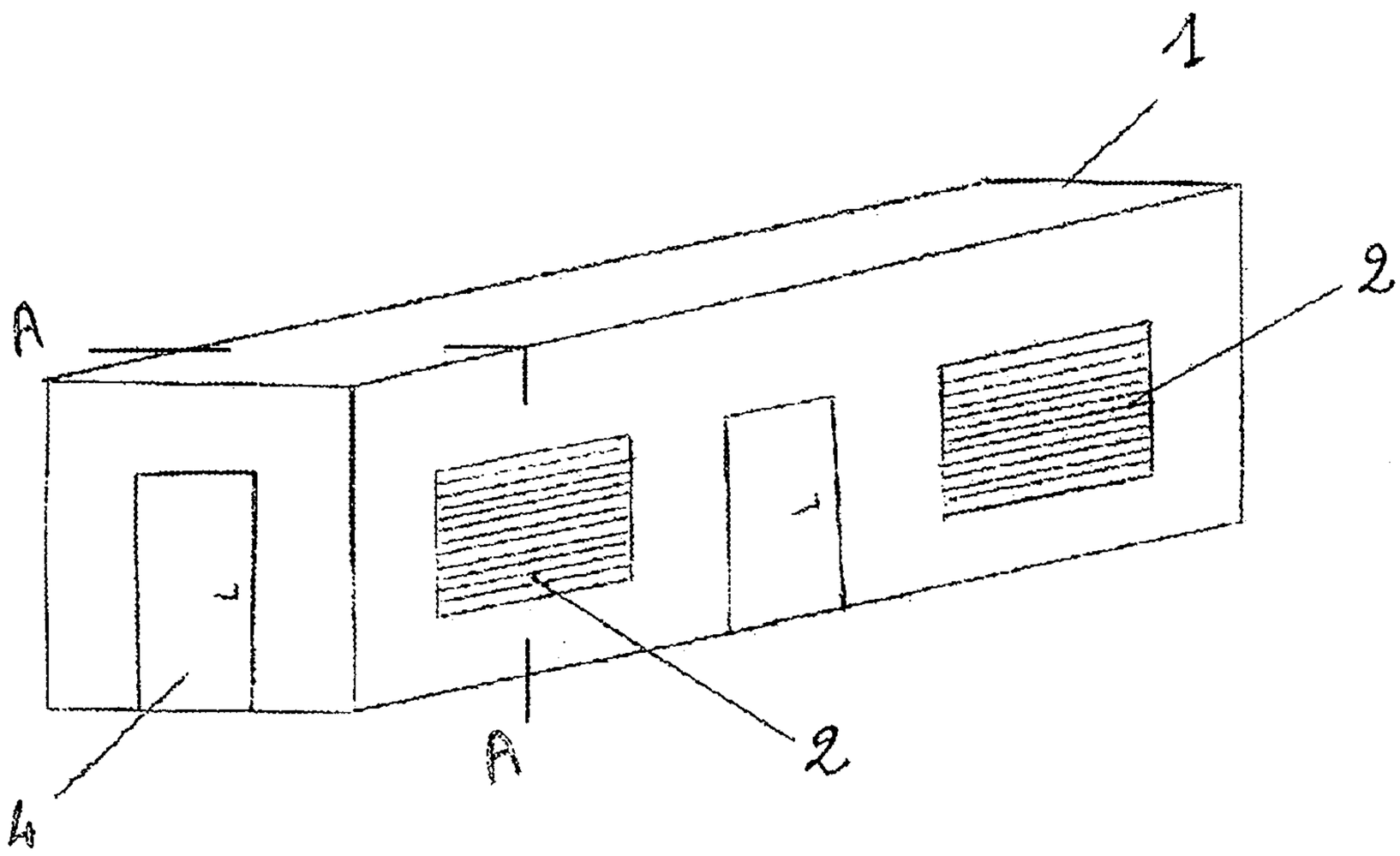

FIG.1

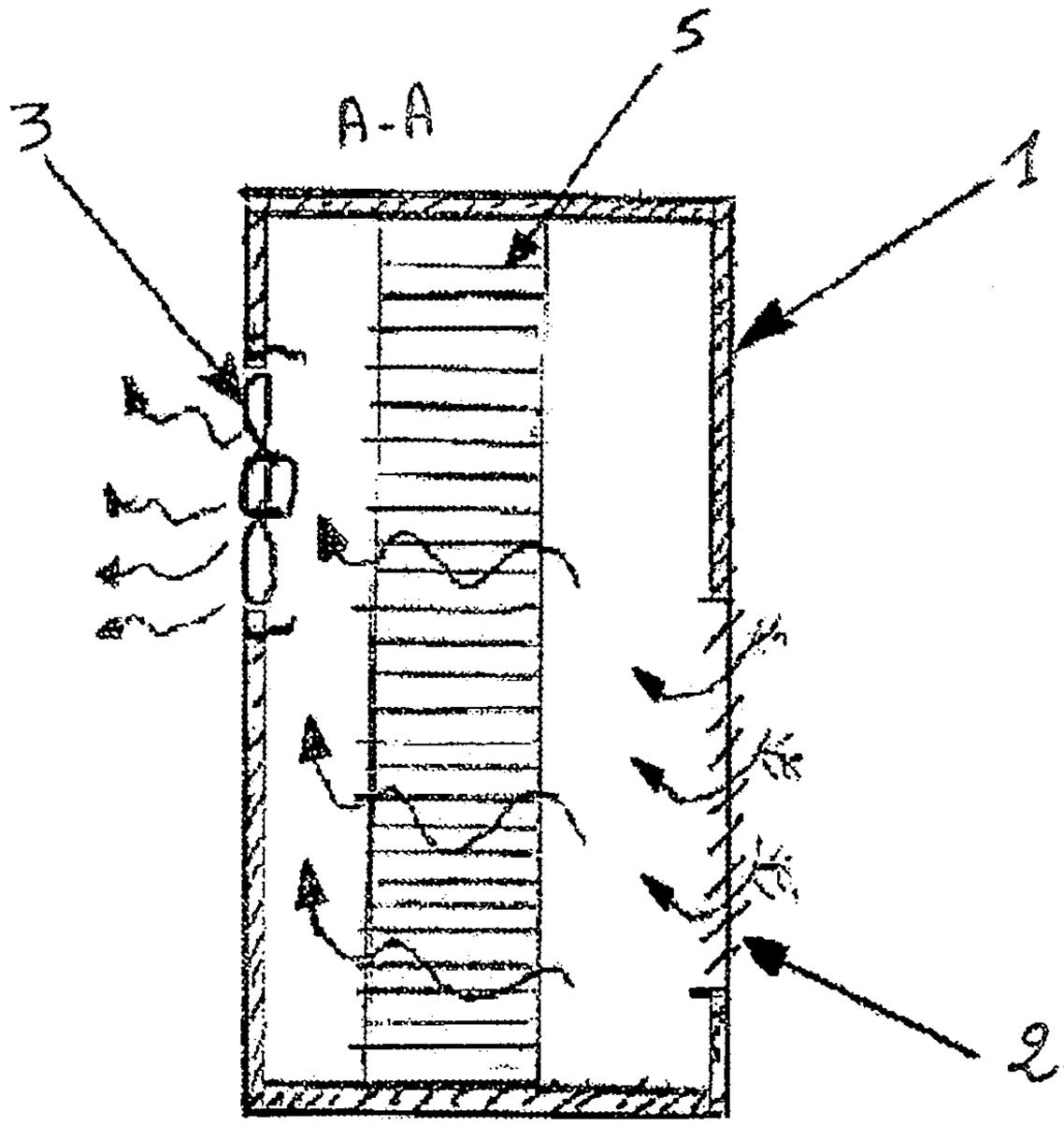

FIG.2

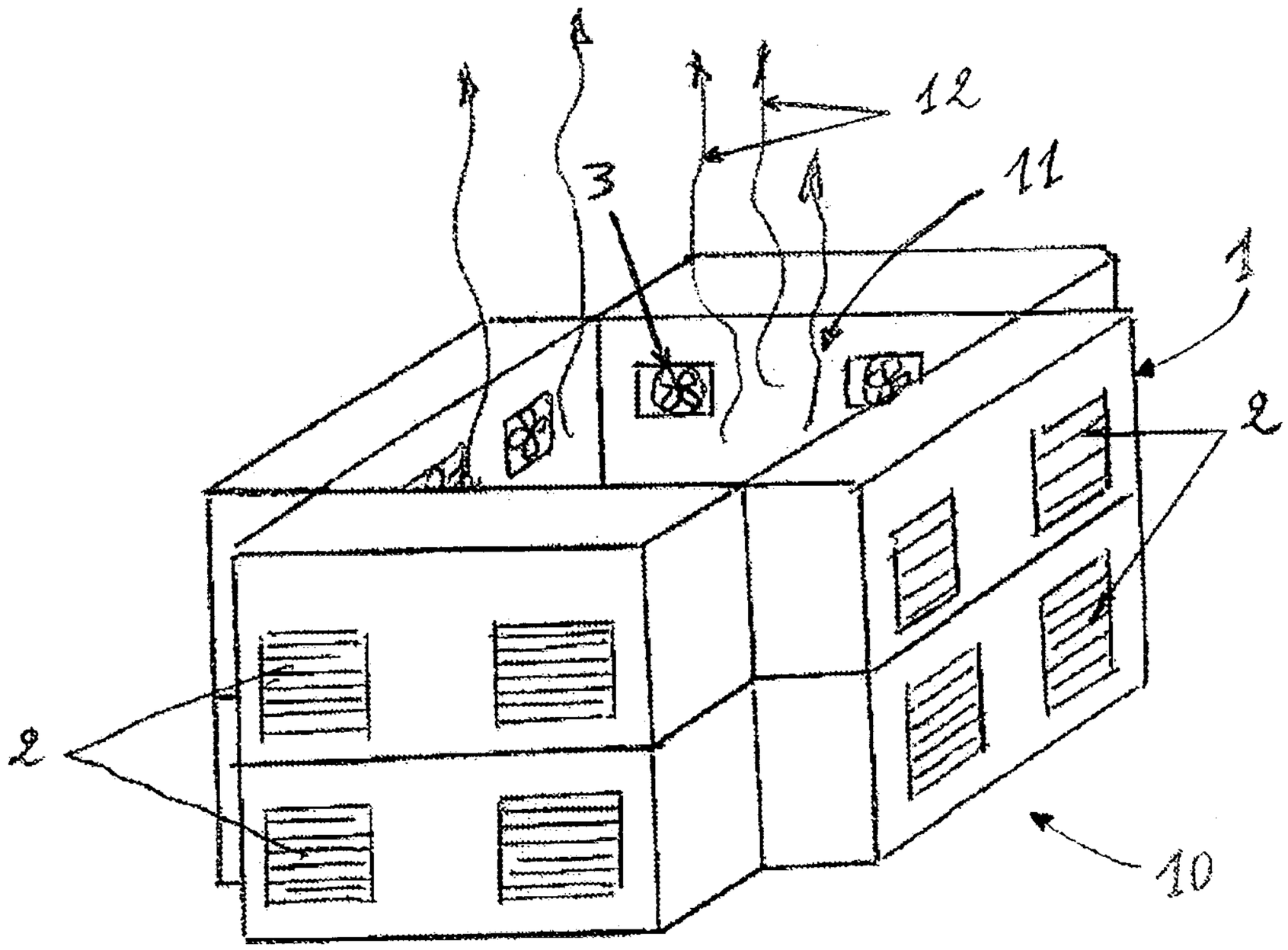

FIG.3

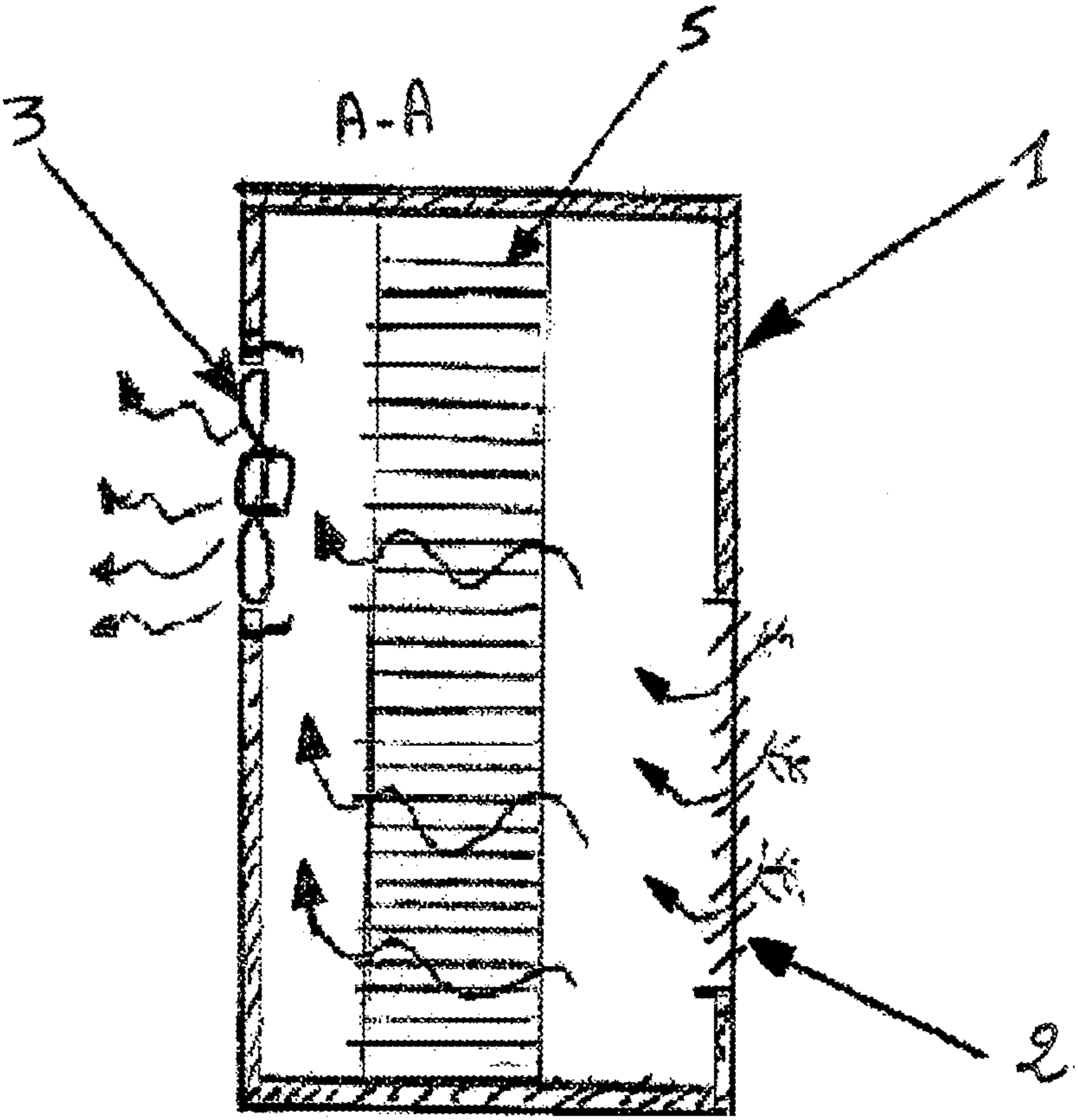

FIG.2