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(54) A method and device for the supply of conditioned air.

(57) When supplying conditioned air to locations or rooms (1) on a floor or story of a multi-story building, an air conditioning unit (2) will deliver conditioned air to a cavity (3) located beneath a floor surface of the floor or story served by the unit. Box-like supply air terminal devices (10) are placed over openings provided at desired positions in the floor surface. The terminal devices comprise a centrally positioned supply channel (14) and a thermostat controlled valve means for regulating the amount of air supplied. Circulated air is introduced into the unit (2) at a level within the occupied zone of the location or room served. The floor connected supply air terminal devices lack separate fans and deliver air at a level which is less than about 1 meter above the level of the floor surface, whereas contaminated air is discharged from the location or room through exhaust air terminal devices located immediately beneath the ceiling of the location served. The supply air terminal devices (10) may be located in the vicinity of work areas, e.g. writing desks present in the location or room served, and are provided with a space through which cables can be drawn to respective work places.

Fig.1

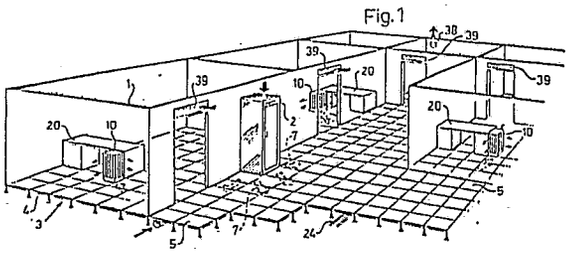
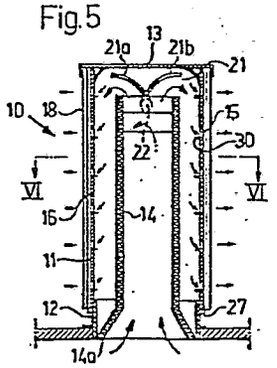


Fig.5



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Description

A method and device for the supply of conditioned air.

Field of invention

The present invention relates to a method for supplying conditioned air to one or more locations on a particular floor or story of an apartment building, or block of flats, with the aid of air conditioning plant equipment supplied with circulated air, and a box-like supply air terminal device which is located on, or capable of being placed on or in the vicinity of, the floor surface of said apartment floor or story.

The invention also relates to a box-like air supply terminal device, and more specifically to a device of the kind set forth in the preamble of claim 6.

Background prior art

Known air conditioning and air delivering methods and apparatus of the aforesaid kind are instrumental in causing draughts and in generating noise, particularly when the supply air terminal device is provided with separates fans or blowers. Furthermore, the known methods and apparatus have relatively poor ventilation efficiency, and consequently the occupied areas of a room or location served by such apparatus are not free from impurities and it is necessary to supply the air conditioning plant with air which is relatively pure, which further adds to the load on the plant. Exhaust air from the location served by the plant has, instead, exhibited a relatively low degree of contamination.

Other drawbacks associated with the known apparatus and methods reside in limited flexibilty, insomuch that the supply air terminal device cannot be readily placed in desired positions on the apartment floor (story) or room to be served by the device. The construction of the supply air terminal devices of existing systems is also relatively complicated, which has further added to the cost of these systems.

Examples of the present standpoint of techniques will be found in "VVS & Energy", No. 1, January 1986; Stockholm, Sweden, Bengt Bergqvist and Engelbrekt; "KLIMATSYSTEM AND BYGGNAD I SAMVERKAN", pages 71-75, particularly page 74, "Deplacerande inblåsning"; "VVS & Energy", No. 9, September 1983, Stockholm. , Sweden, Ragnar Järmer, "Deplacerande ventilation", pages 29-31, and Katalog 84/85 BAHCO Ventilation", July 1984, Enköping, Sweden, "System Floormaster", pages 17:1.1-17:1.4 and "Tilluftsdon GKF" pages 13:5:1-13:5.4.

Object of the invention

An object of the present invention is to eliminate the drawbacks of the aforesaid and other known systems, and to provide an improved air supply system, which, among other things, will enable air flow and air temperature to be controlled separately and effectively in individual supply air terminal devices, thereby achieving high ventilation efficiency and high temperature efficiency.

A further object is to provide an air supply system which will create an improved environment and climate, particular in occupied areas of a room served by the inventive system, while simultaneously facilitating operation of the air conditioning system and improving the efficiency thereof.

Summary of the invention

These and other objects are fulfilled by the inventive method, the main characterising features of which are set forth in the characterising clause of claim 1.

Because the air is supplied to the location being served by the system at a relatively low story at the same time as the circulation air is supplied to the air conditioning plant at a level below that at which the exhaust air leaves said location, air present in said location will be layered in varying degrees of impurity, therewith primarily improving the climate of the occupied zone of the location. Contaminated air gathers or collects at a high level, close to the ceiling of the room served by the system and is withdrawn from said location through exhaust air terminal devices installed at this level. The air present in the centre of the occupied zone or area of said location has a relatively high degree of purity and the air conditioning plant is supplied with circulation air of this kind, thereby relieving the plant of load to a commensurate extent.

The air cleansed in the plant is supplied to the space located immediately beneath the floor, where said air is mixed effectively with directly supplied fresh air. Supply air terminal devices positioned as desired in the location served by the plant will ensure that this mixture of fresh air and clean, treated air will be supplied to the room or location at a low level therein, in the absence of draughts and while being fully controlled, which in turn assists in the aforesaid layering of the air in said room.

In practice, it is preferred that the supply air is supplied at a level lower than 1.2 meters, i.e. at a level of about 1 meter above floor surface level, and that the circulation air is supplied to the plant at a level beneath 2.2 meters, preferably at a level of about 2 meters above floor surface level.

One or more exhaust air terminal devices will preferably be located at a higher position in the location or room served by the air conditioning plant, preferably in the vicinity of the ceiling of the room.

As before indicated, when applying the inventive method, fresh air is preferably mixed with the treated air in the space located beneath the floor of the room, referred to hereinafter as the floor cavity. In this respect, a substantially constant pressure is maintained in the floor cavity, preferably by controlling the speed of a fan or blower included in the air conditioning plant.

The floor cavity has mounted therein a pressure sensor which is connected to the fan motor, via a control device, such as to ensure that the floor cavity will be maintained at a set pressure level. It is

ensured in this way that all supply air terminal devices in the room or location being served will be supplied with air at a constant, predetermined pressure, which in turn will ensure that said devices will operate efficiently and reliably and each in a predetermined manner.

If the temperature in the room or location should fall in the winter months, this will be registered by the thermostat or thermostats which controls or control the throttle valves of the air supply terminal devices, so as to throttle the flow of supply air to a commensurate extent. Each supply air terminal device may be provided with a heater, so that if low ambient temperatures are constantly recorded, despite adjustments to the throttle valves, the supply air can be heated before being delivered to the room. In this case, the throttle valves will have the opposite function, i.e. a greater heating requirement will result in a corresponding wider opening of the valves.

In practice, the mixture of air treated in the air conditioning plant and fresh air will be delivered to the supply air terminal device through a centrally positioned sound insulated conduit and, subsequent to be turned through 180° in the vicinity of a throttle valve in the region of the upper part of the conduit, will be caused to depart from the device through holes or slots provided in one or more sides of the device, without increasing in pressure in said device.

This method of supplying air to the supply air terminal devices and the surrounding area will effectively dampen noise and will also ensure that the air leaving a supply aterminal device has a low impulse, i.e. creates practically no draughts, not even in the immediate vicinity of the device.

This means in practice that a supply air terminal device of the aforedescribed kind can be positioned adjacent working positions in the room or location served by the system, e.g. adjacent a desk. In fact the supply air devices may be given a form such that they themselves form part of the actual work place, i.e. in practice have the same height as a desk and form a work surface or some other surface contiguous with a desk surface.

Particular advantages are afforded when the electric cables, telephone cables, etc, leading to various equipment in the room or location served by the system are located in the floor cavity. According to one preferred embodiment of the invention, these cables are taken up from the floor cavity through a space in respective supply air terminal devices provided especially for this purpose.

This will enable cables to be drawn directly to or to the immediate vicinity of tele-computer equipment and the like placed on a desk top and therewith obviate the problem of tangled cables, which is normal in most cable arrangements of this kind.

The fan of the air conditioning plant is preferably located in or in the immediate vicinity of the floor cavity. This will enable the treated air to be supplied effectively to the floor cavity without creating a drop in air pressure as a result of further deflection air flow.

The floor cavity concerned is preferably covered with flooring tiles, slabs or the like in accordance with a module system to which the outlet part of the air-conditioning unit and the connecting parts of the supply air terminal device are also adapted. Thus, the outlet part of said unit may be given an area which corresponds in cross-section to the area of one or a certain number of flooring tiles, which also applies to the connecting bases or plinths of the air supply terminal devices.

Thus, when installing an air supply terminal device, it is only necessary to remove one or a requisite number of flooring tiles at the appropriate location in a room and to subsequently connect up and seal the device. This affords considerable flexibility to the system and enables modifications to be made readily, for instance when positional changes are to be made in the system of a location, room, or of an apartment floor in a block of apartments.

The invention also relates to an air supply terminal device which can be positioned adjacent to or on the floor surface of a room or location, the main characterising features of said device being set forth in the characterising clause of claim 6.

Further characterising features of the invention and other advantages afforded thereby will be apparent from the following description of selected embodiments of the invention.

The description is given with reference to the accompanying drawings.

Brief description of the drawings.

Figure 1 is a perspective view which illustrates part of one floor, or story, of an office block, and shows a number of offices supplied with air that has been conditioned with the aid of the inventive air conditioning system;

Figure 2 is a plan view of part of the floor, or story, shown in Figure 1 and illustrates the supply of fresh air to and the mixture of said air with air which has been processed in accordance with the invention;

Figure 3 is a sectional view of an air conditioning unit forming part of the air supply system;

Figure 4 illustrates in perspective a box-shaped air supply terminal device according to the invention;

Figure 5 is a sectional view taken on the line V-V in Figure 4; and

Figure 6 is a sectional view taken on the line VI-VI in Figure 5.

Description of preferred embodiments.

Figure 1 shows part of a floor, or story, of an office block which includes a number of offices partitioned by walls 1. Located centrally on the illustrated floor of the office block is an air conditioning unit 2, which has a vertical extension of about 2 meters from floor surface level.

Circulated air is introduced into the unit 2, through the top thereof, and is there filtered and cooled, before being passed to a cavity 3 beneath the floor surface 4 of the room or location. The floor surface 4 comprises a multiple of square flooring tiles 5. In the case of the illustrated embodiment, the area of each

flooring tile corresponds to the cross-sectional area of the unit 2, which means that only one tile is removed in the place where the unit 2 is to stand.

The flooring tiles may optionally be divided into sections, one or more of which will correspond to the cross-sectional area of the base parts or plinths on which the air supply terminal devices used are supported, these devices being generally referenced 10 in the drawings. An inventive air supply terminal device will be described in more detail hereinafter. The arrows 7 drawn in the floor cavity indicate that the conditioned air leaving the unit 2 will spread throughout the cavity 3.

As illustrated in Figure 2, fresh air is also delivered to the floor cavity 3, through a fresh air conduit 8 which is perforated with holes 9 and located adjacent the unit 2, such that air leaving the unit will be mixed with the fresh air in the conduit 8. The cut-away area in Figure 2 illustrates the approximate size of the mixing zone thus achieved.

When wishing to supply conditioned air to a selected area in a room or other location on the floor or story served by the system, e.g. a working area around a desk 20 for instance, part of a flooring tile 5 is removed and an air supply terminal device of the kind illustrated in Figure 4 is fitted over the space thus exposed.

The illustrated terminal device 10 has a main body part 11, a base or plinth 12 and a top cover 13, which may be located on a level with the top of the desk 20 and therewith itself serve as the desk top or desk working surface.

As shown in Figures 5 and 6, the device 10 also includes a centrally positioned air supply channel 14, which is lined with sound absorbing material and which widens out in the region of the base 12, to form a lower connecting part 14a.

The device 10 further comprises two side panels 16, which are perforated with outlet holes 15, and a front panel 17, which is also perforated with outlet holes. The outlet holes 15 are arranged in vertical columns and outwardly of each such column there is found a vertically extending plate 18 with inwardly bent end parts. This arrangement will ensure that the air is delivered to the surroundings gently, at a low impulse and that the air will be mixed well with the ambient room air.

Arranged in the device 10 is a throttle valve 21 which comprises two curved parts 21a and 21b and which is controlled by a temperature sensor 22 in a manner to regulate the quantity of air delivered to the surroundings. When the prevailing room temperature is low, the setting of the valve will be adjusted accordingly, so as to deliver a minimum air flow.

The valve parts 21a and 21b deflect the air entering from the channel 14 through 180°. The inner, upper corners of the air supply terminal device are curved commensurately, so as achieve deflection of the air flow substantially in the absence of turbulence.

The valve parts 21a and 21b guide the major part of the incoming air flow towards the two opposing vertical side panels 16, whereas a minor part of the air flow departs through the holes 15 located in the front panel 17.

The fourth side panel 23 of the box-like air supply terminal device consists in a vertically displaceable wall element which defines a space 24 in the device. This space is intended for the accommodation of telephone cables and electric cables 24 extending to the work place concerned. Such a cable arrangement 24 drawn through the floor cavity 3 is also shown in Figure 1.

The space 24 in the device 10 is also defined on its inwardly located side by a partition wall 25 adjacent the inlet channel 14. The main part of the device 10 is moveable vertically in relation to the plinth or base 12. This will enable the device to be given a desired vertical extension within certain limits, e.g. so that the top surface or panel 13 of the device will coincide with the level of the work surface of the desk 20. The main part of the device can be detachably secured to the base 12 with the aid of pins 27 which pass through holes provided in said base.

A nozzle 30 capable of distributing the supply air uniformly along the surfaces of the device is fitted into each of the holes 15.

The reference numeral 31 identifies an electric heater for heating the supply air, when necessary or so desired, e.g. during the winter months. When the heater is in use, the aforesaid valve 21 will function in reverse, i.e. the valve will be opened wider at lower temperatures.

The air conditioning unit 2 illustrated in Figure 3 is fitted with an air filter 35 which is effective in filtering the supplied circulated air, the filtered air subsequently being treated in a heating/cooling battery 36. A variable speed fan 37 is effective in moving the air to the cavity 3 beneath the floor surface 4. The pressure prevailing in the floor cavity 3 is sensed by means of a sensor, not shown. When a tendency towards lower pressure is sensed in the floor cavity, an impulse is sent to a control device which, in response thereto, increases the speed of the fan so as to maintain the pressure at a predetermined level.

It will be seen from Figure 1 that the supply air terminal devices will also deliver air at a level beneath 1 meter, whereas the circulating air is supplied to the unit 2 at a level which is approximately twice this height above floor level, i.e. at a level as high as about 2 meters. Contaminated air will gather in a region slightly beneath the ceiling of the room and is vented therefrom through an exhaust air terminal device 38. The system assumes that the various locations or rooms on the floor or story of the building served by the system communicate with each other, e.g. through appropriate gratings fitted above respective doors.

The high quality of the air achieved when practising the inventive method is due to the fact that the circulated air is introduced into the unit 2 at a level which is located in the occupied zone of a room or location, whereas contaminated air which collects immediately beneath the ceiling of said room is discharged through exhaust air terminal devices located on a corresponding level.

In practice, the pressure of the air in the floor cavity 3 may be from 20 to 30 Pa. An excessively high pressure in said cavity may create sealing problems in the overlying floor surface. It may also result in

problematic noise levels.

However, the illustrated configuration of the supply air terminal device provides an advantageous solution to the type of problem described in the foregoing.

Claims

1. A method for supplying conditioned air to one or more locations (1) on the floor or story of a multistory building with the aid of an air conditioning unit (2) supplied with circulated air and also with the aid of box-like supply air terminal devices capable of being positioned on or in the vicinity of the floor surface (5) of said location, the outlet opening of the air conditioning unit being connected to said floor surface (5) such that conditioned air under pressure is delivered to a cavity (3) beneath said floor surface, wherewith holes for an auxiliary member (14a) connecting with the supply air terminal devices (10) are provided in the floor surface at desired locations on said floor or story of said building, and said supply air terminal devices being mounted over said holes and sealed, characterised by supplying a displacing flow of low-impulse air to said location through the supply air terminal devices (10) at a level beneath that at which the circulated air is supplied to the air conditioning unit (2), which level is, in turn, lower than that at which exhaust air is discharged from said location; and by regulating the supply air flow in response to temperature, in individual supply air terminal devices (10).

2. A method according to claim 1, **characterised in that** the supply air is supplied at a level of beneath 1.2 meters, preferably beneath about 1 meter above the floor surface; and in that the circulated air is supplied to the unit (2) at a level beneath 2.2 meters, preferably at a level of about 2 meters above the level of said floor surface.

3. A method according to claim 1 or claim 2, in which fresh air is mixed with treated air in the cavity beneath the floor surface (4) **characterised by** maintaining a substantially constant pressure in said cavity, preferably by regulating the speed of a fan (37) coacting with the air conditioning unit (2).

4. A method according to claim 3, **characterised in that** the air conditioned in the unit (2) and admixed with fresh air is supplied to the supply air terminal devices (10) through a centrally positioned, sound insulated channel (14); in that the air is deflected through an angle of 180° in the region of a throttle valve (21) located adjacent the upper region of the channel; and in that the deflected air flow is caused to depart through holes (15) or slots provided in one or more of the side panels (16) of the device, without being subjected to an increase in pressure.

5. A method according to any one of claims 1-4, when electric cables, telephone cables and the like are drawn through the cavity (3) beneath the floor surface (4), **characterised in that** respective cables are taken up through the floor surface via a space (24) provided in respective supply air terminal devices (10) to this end.

6. A supply air terminal device for positioning on or in the vicinity of a floor surface (4) of a location or room, said device being intended for coaction with an air conditioning unit (2) which is supplied with circulated air and the outlet opening of which is intended to be connected to the floor surface, such as to enable conditioned air under pressure to be delivered to a cavity (3) beneath said floor surface, said supply air terminal device including:

a) a main body (16) having a plinth (12) and a top panel (13);

b) an air supply channel (14) provided in the device;

c) at least one side panel (16) provided with air outlet holes (15) or slots; and

d) a lower connecting part (14a) which is joined to the plinth (12) and/or the air supply channel (14) and which is intended for connection with an opening in said floor surface so as to enable conditioned air under pressure to be delivered from the cavity (3) beneath the floor surface (4) to the supply air terminal device; **characterised in that** the supply channel (14), which is preferably positioned centrally in the device (10), has fitted at the top thereof a thermostat controlled valve means (12) for controlling the amount of air which, with the exception of a minimum flow, will be deflected through 180° to a space located between the channel (14) and said panel (16) provided with outlet holes (15) or slots; and in that the supply air terminal device is constructed to deliver a displacing air flow of low impulse at a level beneath the level at which the circulated air is introduced into the air conditioning unit (2), this level, in turn, being lower than the level at which exhaust air is discharged from said location or room.

7. A device according to claim 6, **characterised in that** the valve means (21) comprises two curved parts (21a,21b) and in that the valve means is intended to control the flow of air to two opposing perforated side panels (16) of the device (10).

8. A device according to claim 7, **characterised in that** located between the two perforated side panels (16) is a third perforated side panel (17) through which air is delivered.

9. A device according to any one of claims 6-8, **characterised in that** one side panel (23) of the device (10) is moveable, or has a moveable section, and forms one defining wall of a space (24) in said device (10), said space being intended to accommodate electric cables, telephone cables or the like taken up from the

cavity (3) beneath said floor surface.

10. A device according to any one of claims 6-9, in which the holes (15) or slots in the side panel or side panels (16; 17) are disposed in vertical columns, characterised in that positioned slightly outwardly of each such column of holes or slots is a vertically extending plate (18) that has end parts which are bent inwardly towards the side panels in a manner to deflect the exiting supply air flow and create eddy currents or turbulence therein.

11. A device according to any one of claims 6-10, **characterised in that** said main part of the device is capable of being moved to different height positions in relation to the plinth (12) and detachably secured in said positions.

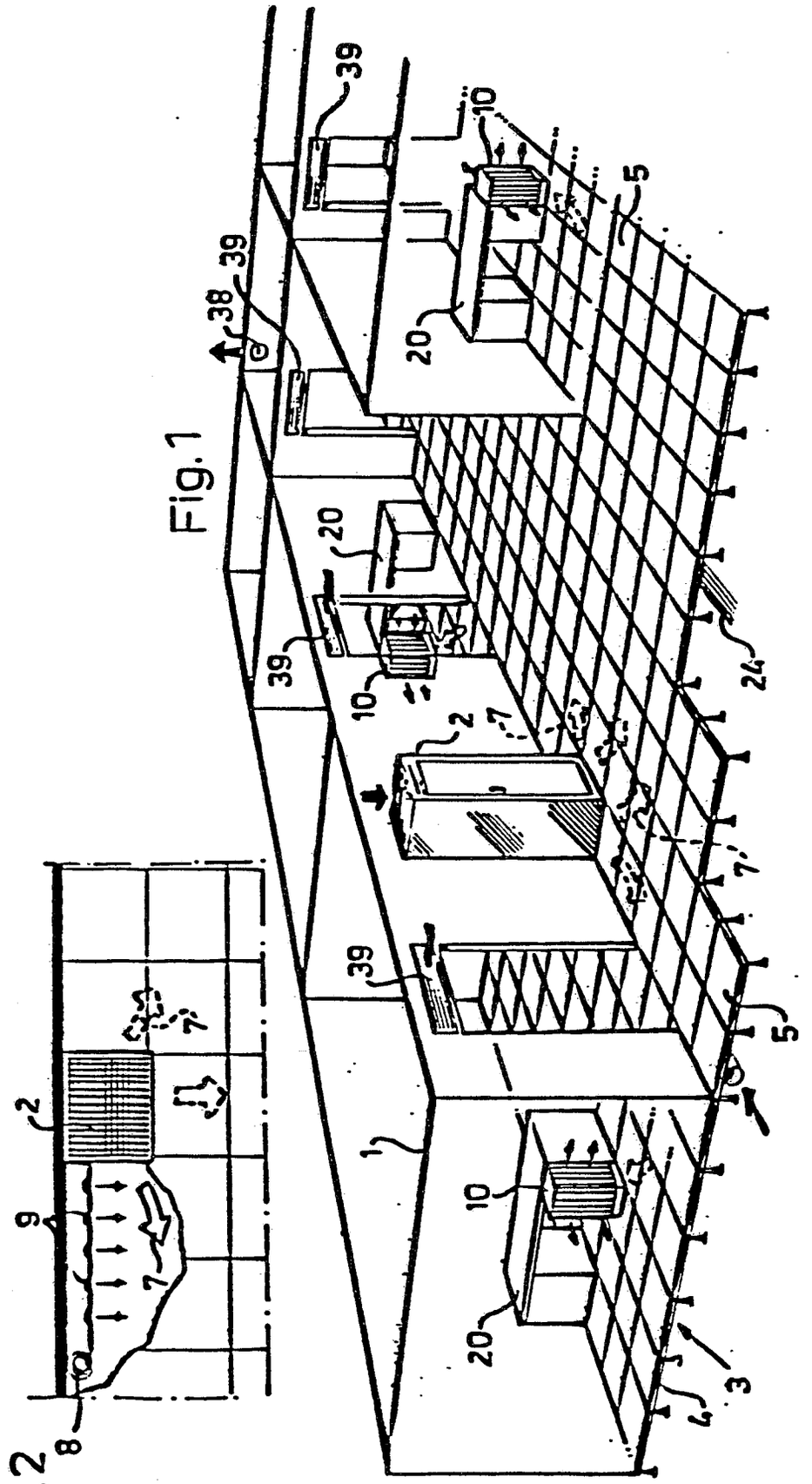

Fig. 1

Fig. 2

Fig.3

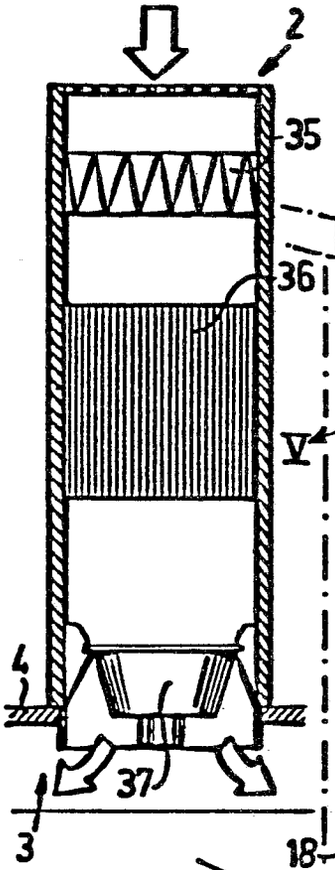

Fig.4

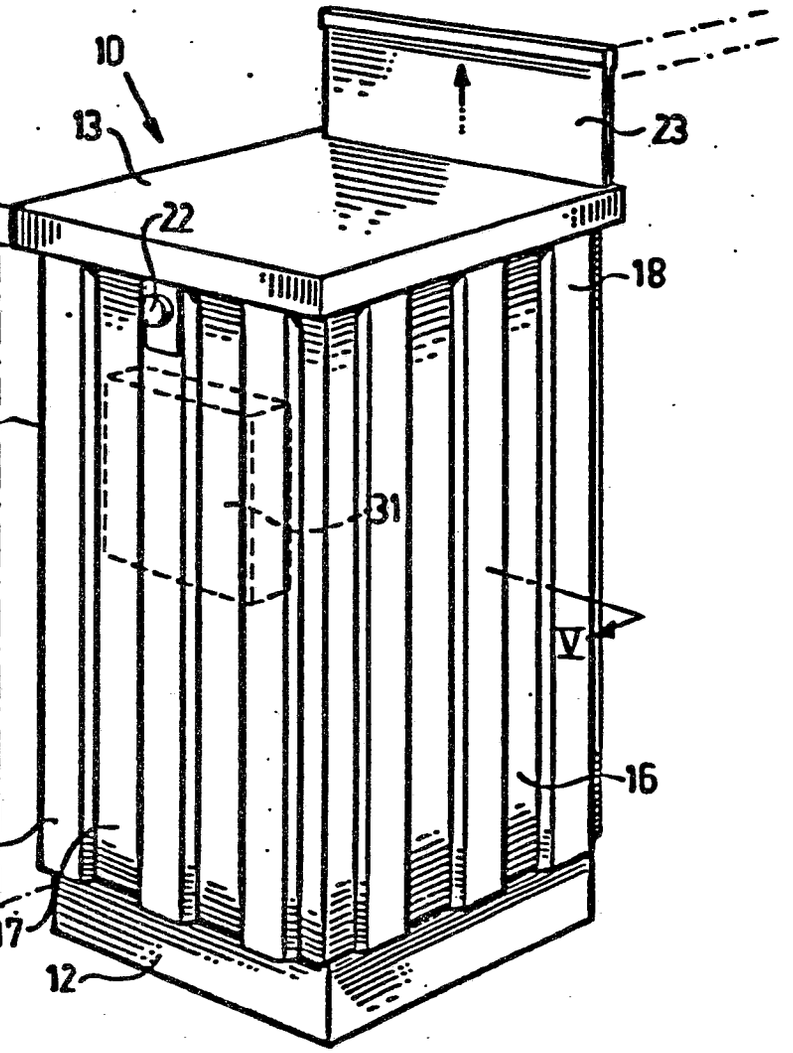

Fig.5

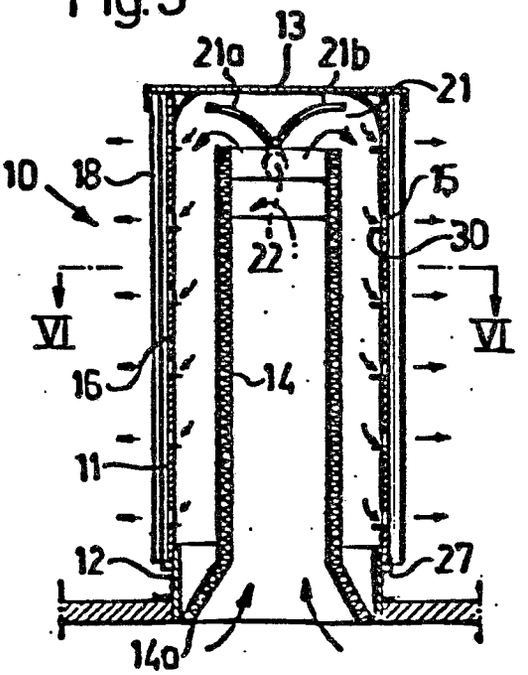

Fig. 6