(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 977 925 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
26.05.2004 Bulletin 2004/22

(21) Application number: **98919694.4**

(22) Date of filing: **15.04.1998**

(51) Int Cl.[7]: **E04B 1/00**, E04B 5/48, F24F 7/007

(86) International application number:
PCT/SE1998/000683

(87) International publication number:
WO 1998/048122 (29.10.1998 Gazette 1998/43)

(54) **METHOD OF INSTALLING A VENTILATION SYSTEM AND DEVICE THEREFOR**

VERFAHREN UND VORRICHTUNG ZUM INSTALLIEREN EINES LÜFTUNGSSYSTEMS

PROCEDE D'INSTALLATION D'UN SYSTEME DE VENTILATION ET DISPOSITIF DESTINE A CE SYSTEME DE VENTILATION

(84) Designated Contracting States:
DE DK FI GB NL

(30) Priority: **23.04.1997 SE 9701542**

(43) Date of publication of application:
09.02.2000 Bulletin 2000/06

(73) Proprietor: **NIVELL SYSTEM AB**
542 35 Mariestad (SE)

(72) Inventor: **JOHANSSON, Lennart**
S-542 31 Mariestad (SE)

(74) Representative: **Lundquist, Lars-Olof et al**
L-O Lundquist Patentbyra AB,
Box 80
651 03 Karlstad (SE)

(56) References cited:
DE-A- 4 417 740
GB-A- 2 171 193
US-A- 5 254 035

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 0 977 925 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present invention relates to a method of installing a ventilation system suitable for ventilating at least one room in a building and comprising a floor construction of said room and a ventilation equipment including a suction source and a duct system connected to said floor construction that is arranged above a supporting foundation of said building.

[0002] The invention also relates to a ventilation system suitable for ventilating at least one room in a building and comprising a floor construction of said room and a ventilation equipment including a suction source and a duct system connected to said floor construction that is arranged above a supporting foundation of said building, said floor construction comprises a floor material.

[0003] GB 2 171 193 A describes a ventilating system in particular for use in an office environment wherein the ventilating system comprises ducts for supplying ventilating air into the room, said ducts passing through an interspace 4 formed between a real floor 1 and a false floor 3. The ducts communicate with upwardly extending structures 8 which have primary air outlets at a height greater than 1.8 metres above the false floor, thus minimising draughts. This document does not disclose ventilation of said interspace by permitting air to flow therethrough, i.e. the interspace is not a part of the ventilating system.

[0004] The degree of insulation in private houses and other buildings which are heated has been greatly increased as a result of the constantly increasing cost of heating, amongst other reasons. This has become of renewed interest following the decision to phase out the production of energy from nuclear power. This must primarily be met by energy-saving measures and further increases in the degree of insulation may therefore be necessary in the future.

[0005] With increased insulation buildings become more air-tight, i.e. the ventilation in the houses decreases. Combined with the penetration of damp possibly occurring in living areas in houses with a basement or in houses with a basement on a concrete foundation, the reduced ventilation has caused further increases in two already relatively frequent and serious problems. The problems are damage caused by damp in the organic material in wooden houses, resulting in rotting, mildew and other damage to materials, such as changes in colour, and also by too high concentrations of the health-impairing radon gas in the indoor air when the spontaneous ventilation is reduced. The radon comes primarily from certain naturally occurring soil and rock types existing in the ground beneath the house, but in certain cases may also derive from the drinking water. In a few older houses building material containing radon may have been used which then continuously emits radon. Since a certain inner negative pressure generally prevails in a building, the risk increases of radon being drawn in from the ground beneath the building. Traditional ventilation may therefore further increase this undesired suction. The radon daughter concentration in the air should be less than the limit value 70 Bq/m^3 at new production, but the aim should of course be to reduce the concentration to the normal content of 10 Bq/m^3 of the air outdoors.

[0006] The most usual cause of damp penetration into a building is the use of defective building materials or inferior construction work, particularly in the foundation for drainage under the bottom plate. The major sources of damp are rain, meltwater from ground level and ground damp where unforeseen changes in the groundwater level may have an additional negative effect. Floors directly on the ground must always be provided with a moisture barrier if future problems of damp are to be avoided. Moisture also occurs in building materials and may give rise to as much as 3000-5000 litre water in just the cellar walls of a normal home at the initial stage of building. The building construction also absorbs moisture from the air inside. Damp should be suspected, for instance, if the colour of the surface material alters or starts flaking or bubbling. Besides the damage to a building caused by damp mentioned above, there is also risk of fungi and other micro-organisms causing a nuisance in the form of unpleasant odours or allergies. Concrete foundations that have suffered damage due to damp or mildew emit an odour even after clearing and emissions other than radon may come from the construction elements in the building.

[0007] Once damp has penetrated into the construction it may be extremely difficult to get rid of it because of the reduced ventilation. The positive effect aimed at in the form of reduced energy consumption now has an undesired result, i.e. damage to the property every year amounting to considerable sums.

[0008] In an attempt to solve the problems mentioned above it has been usual to install some form of ventilation system comprising a ventilated space under the floor against the concrete foundation, together with a mechanical ventilation device.

[0009] A traditional ventilation system of the type mentioned above, intended for a floor construction with a space between inner floor an bottom plate with room for a suction pipe, generally consists of conventional wooden joists placed out over the bottom plate to provide said ventilated space. However, there is still considerable risk of moisture still being absorbed into the joists from the surface below, with damage caused by damp as a result. When said spaces are provided, a ventilated skirting board must be constructed with a narrow gap between the skirting or edge of the floor construction and the outside of the wall. A permanent filter strip may possibly be fitted in this wall air gap, which can only be changed after removing the skirting board. Furthermore, when the flooring itself is laid it must be placed a certain distance from the wall. In this known method, therefore, the flooring cannot just be placed flush with the wall, but a careful check must be performed to en-

sure that an air gap always exists which is sufficiently wide to provide ventilation while at the same time not so wide that the skirting board does not cover it. This air gap to the wall usually runs along most or all of said skirting and it is therefore considered that suitable ventilation of the room is ensured through said ventilated space under the floor. A multitude of small holes are distributed along the suction pipe, through which the indoor air is drawn. These holes will inevitably become clogged after a certain time and the floor must be taken up if the holes are to be cleared. An analysis of a measured air flow in the air gap to the wall must also be performed, after which the floor is laid in accordance with the specific drawings produced. This entails more complicated pipe laying, gaps and other extra devices necessary for the ventilation system than with an ordinary system of joists and the workman must be specially trained, as well as having considerable experience of such work.

[0010] This ventilation method is thus both time-consuming and expensive. Besides which it does not provide a durable construction. The method results only in complicated and precise work having to be performed to obtain a ventilation system which will function for a moderate period of time.

[0011] Another, somewhat different type of ventilation system comprises a low profile floor where a thin sheet or profiled mat of rubber or plastic material is laid directly on the bottom plate with the rest of the floor construction immediately on top. The air gap to the lower floor is obtained with the aid of level-producing protrusions in various patterns. These protrusions are capable of dealing with a certain degree of spread load but are sensitive to large point loads. Since the material in the mats is relatively rigid, it will not stand being subjected to repeated bending, and cracks or splits may occur if the mats are folded or handled roughly. The material is also sensitive to excess cold since it then becomes brittle. Since only a small hole is sufficient to spread moisture to the floor material, usually of fibreboard slabs, directly above the mat, and since plastic material is also known to be susceptible to material changes with time which may destroy its properties as a moisture barrier, a relatively high risk still remains of future damage due to damp. During laying said mat is rolled out from large rolls across the whole floor, after which the joins between each strip of mat are sealed extremely carefully. This is usually performed with the aid of a splicing tissue, sealing strip, foam or jointing compound and, in the case of large floor surfaces such as day-nurseries, it is complicated to divide the area into small seas of air by means of partitioning. All inner walls, pipe lead-throughs, electricity and telephone cables, floor drains, etc., must also be sealed. All this work is generally performed after the mat has been laid and since sufficient care is not always taken, the method still results in damage and consequently expensive extra work. Thus the apparently simple expedient of just rolling out a plastic mat is merely a small part of the time-consuming total preparatory and post work required in order to obtain a good result. The surface of the under-floor must be very smooth when the mat is laid, since the whole floor construction rests directly on top of this mat and any unevenness will directly influence the finished floor, as regards both its function and its appearance. Liquid putty is thus also necessary to obtain a completely flat surface before the mat is laid. Liquid putty contains a considerable amount of liquid, as well as chemicals which emit primarily moisture, but also a number of other emissions and this liquid putty is therefore deemed to cause the allergies that have caused entire day-nurseries and schools to close down for clearance although the buildings were newly built. The use of liquid putty is also expensive not only in material and work costs but also due to the waste of time when the floor must dry out before further work can be continued.

[0012] If these known ventilation solutions are to give a satisfactory result all walls, including outer walls must also be placed above said mat. Thus when an inner wall is to be taken down and moved, it cannot just be nailed up directly at the new place on the floor, but special arrangements in the form of sealing strips and jointing foam must be used to re-seal the moisture barrier which has been unavoidably damaged during demolition.

[0013] Since the mat has a thickness of only about 10 mm, such a low building height is obtained with this system that ventilation pipes laid in the floor no longer have sufficient room. Special installations with fan boxes must therefore be arranged above the floor, which are then hidden in cupboards or similar spaces.

[0014] In conclusion, therefore, a more expensive and in many cases poorer floor is obtained as a result of the allergy-producing chemicals and the fact that even more building moisture is built into the floor in a completely unjustifiable manner.

[0015] Common to both the systems described above is that they lack any real possibility of measuring pressure drop, odour, moisture, etc., in the air drawn in along the whole length of the wall air gap and thus also a correct measured value for the inlet from the room to the ventilation system. Measurement is instead performed at a certain number of selected points which then together are supposed to correspond to the total air gap to the wall and the actual value for said length of gap is thus only approximated. Alternatively, calculation can be based on the outlet of the air flow at the holes in the extraction tube or the opening of the fan boxes to the floor. When constructing the wall air gaps, therefore, the gap is simply allowed to run around the whole room, interrupted only by the connections of said skirting board required to the wall.

[0016] After continuous intake of dust, bits of paper, etc., sucked down into the gap behind the skirting board, therefore, the open air gap to the wall behind the skirting board, or the open space under the floor will cause not only clogging of any filters but also an unavoidable deposit of particles far in under the mat. After prolonged

collection of said particles in the air pockets that are always formed under the floor as a result of the contact points of the mat against the bottom plate, which also cause considerable air resistance and thereby influences the size of the fan, and due to the inevitable variations in air flow as regards its magnitude and direction that always occur, a stop is again bound to occur and moisture damage, radon, odour or mildew, etc. will appear which must again be dealt with at additional, totally unnecessary cost. Low profile floors, particularly those using mats, have not been used to any great extent since the damage reappears. It is impossible to clean the gap under the floor and vacuum-cleaning the gap at the skirting board gives only temporary relief.

[0017] However, serious problems in the ventilation system may arise much earlier since the turbulence produced in the air gap to the wall and in the layer of air under the floor can give the somewhat surprising effect of the air being blown out instead of drawn in as intended, along parts of said gap since in reality the turbulence produces several separate air flows instead of the linear flow along the entire length of the gap, as desired.

[0018] In an office or a food store it is sufficient sometimes for inner walls or sales racks to be moved for the placing of wall air gaps to be completely ineffectual and this can then only be remedied at considerable expense and after great trouble.

[0019] The object of the present invention is to provide a method of installing a ventilation system which greatly reduces the problems of known ventilation systems.

[0020] Another object of the invention is to provide a device which can be applied quickly and simply in a floor construction so that a desired level of ventilation can be achieved.

[0021] Yet another object of the invention is to provide a method of ventilating the space beneath a floor to remove moisture, odour and radon from the construction underneath, usually a concrete foundation, and to reduce transmissions losses, thereby creating a more pleasing floor.

[0022] The method according to the invention is characterized by the steps of

- providing a free coherent space between said floor construction and said foundation for permitting air to flow therethrough by
    - arranging a plurality of joists in parallel relationship provided with level-adjusting spacers resting on said foundation, said joists being supported by said spacers at a distance from said foundation and supporting a floor material of said floor construction,
- providing a plurality of individual inlet devices intended to be applied at the periphery of the floor construction in order to form supply air ducts from said room to said free space,
- compiling data relating to parameters affecting the function of said ventilation system and including said room, said space and the air flow through said room and space,
- entering said data into a computer program to achieve a simulation of said ventilation system,
- creating by said computer program a theoretical computer model of said ventilation system on the basis of said parameters,
- requesting the computer program to calculate and indicate an optimal number and optimal individual positions of said inlet devices, thereby simulating a desired, uniformly distributed laminar flow of air over the entire floor surface of said room and creating a constant negative pressure throughout said space of said model of the ventilation system, and
- applying said provided inlet devices at the periphery of the floor construction in agreement with the ventilation system simulated by said computer program.

[0023] The ventilation system according to the invention is characterized in that said floor construction also comprises

- a plurality of parallel joists provided with level-adjusting spacers resting on said foundation, said joists being supported by said spacers at a distance from said foundation and supporting said floor material so that a free coherent space is formed between said floor construction and said foundation and being in open communication with said suction source via said duct system, and

that said ventilation equipment comprises

- a plurality of individual inlet devices applied at the periphery of the floor construction in order to form supply air ducts from said room to said free space, the optimal number and the optimal individual positions of said inlet devices being predetermined by a computer simulation.

[0024] By means of a construction method according to the invention, which entails that a simulation of an imagined floor ventilation is carried out in a theoretical computer model of a floor construction comprising a ventilated low profile floor with floor devices according to the invention for a specific object, taken for instance from a construction drawing of the floor in question, for instance, a negative pressure ventilation is guaranteed that ventilates and removes the damp air between the bottom plate and lower side of the joists or floor insulation, thus eliminating the risk of future damp and mildew damage under the new floor. The foundation plate is thus kept dry and transmission losses to the floor are reduced, with the added advantages that the floor is kept warm and finally that the indoor climate is improved

thanks to efficient air conditioning.

[0025] The present invention will be useful in removing damp problems from existing houses or as a preventive measure in new buildings. The present invention can also be used when high radon contents have been determined.

[0026] The invention will be described in more detail in the following with reference to the drawings.

[0027] Figure 1 is a cross section through parts of a building with a room provided with a floor ventilation system according to the invention.

[0028] Figure 2 is a front view of parts of the ventilation equipment forming a part of the floor ventilation system according to the invention.

[0029] Figure 3 is a side view of the ventilation equipment according to Figure 2.

[0030] Figure 4 is a side view of a support element included in a floor construction in the floor ventilation system according to the invention.

[0031] Figure 5 is a top view of the support element according to Figure 4.

[0032] Figure 6 is an end view of the support element according to Figure 4.

[0033] Figure 7 is a side view of a device included in the floor ventilation system according to the invention.

[0034] Figures 8 and 9 are a front view of, and a cross section through, the device according to Figure 7 along the line A-A.

[0035] Figure 10 is a top view of the device according to Figure 7.

[0036] Figure 11 is a top view of the floor ventilation system according to Figure 1.

[0037] Figure 12 is a diagram showing the variation in air velocity at a simulation of the floor ventilation in a computer model of the ventilation system according to the invention.

[0038] Figure 13 is a cross section through parts of a building with a room according to an alternative embodiment provided with a floor ventilation system according to the invention, also including a wall construction.

[0039] Figures 1-13 show a floor ventilation system 1 in accordance with the invention. The system 1 comprises two main components: a structural element consisting of a floor construction 2 in the embodiment shown in Figure 1, and ventilation equipment 3. The ventilation equipment 3, see Figures 2 and 3, comprises at least one suction source 4, suitably consisting of a noiseless, controllable electric fan 4, to be fitted on an outer wall 5, for instance, which extracts air via a duct system 6 connected to said floor construction 2 from an air gap 7 arranged therein. Said duct system 6 comprises various suitable, generally available components such as pipes 8, bends 9, jointing sleeves 10, end cap 11 and wall and floor lead-throughs 12, and is therefore not described in more detail. Air distributors 13 and, not shown, heat exchanger, postheater and an alarm comprising suitable sensors, e.g. a hygrostat 14 that increases the speed of each fan 4 if the humidity exceeds a pre-set value, may be connected as desired or necessary for functioning of the ventilation system 1. The capacity of the fans is determined by a required air exchange rate which, however, is normally in the vicinity of 300 cubic metres an hour. Said air distributors 13 suitably comprise a number of connections 40 with adjustable valves enabling distribution and ventilation of several closed, separate sections in the floor construction 2. The ventilation equipment 3 requires no maintenance apart from filters and impellers which may need to be replaced or cleaned at regular intervals.

[0040] The floor construction shown in Figure 1 comprises a plurality of longitudinal support elements 15 in the form of joists, see particular Figures 4 to 6, each having preferably rectangular cross section with flat, parallel, upper and lower sides 16, 17. The joists 15 are suitably of wood but may in general consist of any suitable material such as plastic or metal, e.g. steel, with the required bearing capacity.

[0041] The joist 15 is provided with a plurality of holes 18 drilled through it, arranged at suitable distances from each other and from the ends of the joist 15. These drill holes 18 extend substantially perpendicularly to the plane of the floor and are in one or more rows along the centre line 20 of the joist 15. The drill holes 18 are given screw threading with small pitch. A spacer is screwed into each drill hole 18 which, in the embodiment shown, consists of a screw 21 extending through the wooden joist 15 and has the same threading as said drill holes 18. The screw is provided with an engagement member, suitably in the shape of a hexagon 22 which is freely accessible from the upper side 16 of the joist 15 for cooperation with a turning device. Each screw 21 may also be provided with a narrower trough-hole 23 in the extension of said hexagon 22, intended for a securing device, e.g. a nail or screw to secure the joist 15 to a support element 19 which, in the embodiment shown, consists of a foundation 19, via the spacers 21. The function of the screws 21 is that, after being screwed into the drill holes 18, they protrude a certain distance below the lower side 17 of the joist 15 in order to form the above mentioned air gap 7 in the form of a space between the foundation 19 and the joist 15 and also to enable adjustment of the joists to a desired level for the finished floor surface, said screws being in strong thread engagement with the joist 15 and having the rear end 24 situated somewhat below or flush with the upper side 16 of the joist. The optimal level for each screw 21 with respect to the evenness of the foundation 19 and the vertical position of each joist 15, and thus the whole floor construction 2, is obtained by turning each screw 21 clockwise or counter-clockwise. The described spacers 21 thus offer several important advantages over traditional floor constructions in which joists are usually laid directly on the bottom plate. They allow a floor construction 2 to be installed on a relatively very uneven foundation 19, as well as creating a free space 7 below the joist 15 which can be ventilated to remove moisture or radon.

They also raise the joist 15 from direct contact with the foundation, thus offering protection against damp. In many cases it is desirable for the threaded holes 18 to be drilled directly on site and this can be performed using a suitable screw cutting tool.

[0042] Each screw 21 may also be freely placed on some type of stable support plate (not shown) in order to distribute the pressure over the foundation 19 and to facilitate turning the screw 21 when adjusting the level of the construction 2. It may be advisable to use such support plates or other pressure-distribution aids if the foundation 19 consists of anything other than a cast bottom plate 19, e.g. if a ventilated floor construction 2 is laid directly on existing ground. The joist 15 may be solid, in profile form or hollow. In the latter cases it must be ensured that the drill holes 18 have sufficiently bearing threading. The joists 15 can be supplied in different dimensions and in continuous lengths to be cut with ordinary tools, in which case they should consist of wood or plastic, and spliced in suitable manner. The spacers 21 are manufactured of a suitable hard plastic material to give them the necessary bearing capacity and which is resistant to ageing.

[0043] In the shown embodiment spacers 21 are arranged along the centre line 20 of the joist body 15. In an alternative embodiment they may be arranged in two rows, one on each side of said centre line, provided the joist 15 is wide enough. The joist 15 can thus be placed on the foundation 19 with its upper side 16 in a horizontal position.

[0044] The joists 15 constitute attachment means for the floor material 25, suitably consisting of fibreboard slabs with a covering layer determined by the use to which the room is to be put, e.g. plastic flooring, ceramic tiles, etc. Since the space 7 beneath the floor construction 2 is ventilated there is no danger of the floor feeling cold. Support members 26 are therefore arranged on the wooden joists to support an insulation layer 27 between the joists 15 which is windproof and thermally insulating, e.g. asphaboard, mineral wool or a combination of these. In the embodiment shown these support members 26 consist of rectangular, deformable plates 26 having a width less than or equal to the width of the joist 15 and a length that is greater than the width of the joist 15 in order to form free end portions 28 situated at the sides of the joist 15 to support sheets of insulation 27. Each plate 26 is screwed to the lower side 17 of the joist with a centrally placed screw 29 retaining the plate 26 to the joist 15 but permitting the plate to be turned 90° from an inner, inactive position to an outer, active position to support the insulation 27. According to a second embodiment, not shown, each support member 26 consists of a bent, galvanized plate that is hung over the upper side 16 of the joists 15 so that an air gap 7 appears between the insulation 27 thus supported, and the bottom plate 19. The joists 15 are adjusted and balanced after which the protruding parts of the spacer screws 21 are cut off flush with the upper side 16 of the joists 15, using a chisel, an axe or a saw.

[0045] The present invention eliminates the work of installing the traditional ventilation system as described above which meant that when the floor material 25 was fitted it had to be laid with a specific space to the wall 5 to allow for the wall gap. The floor material 25 can now be laid much more simply, directly against the wall 5 without having to check the existence of a sufficiently wide gap, which also must be hidden by a skirting board.

[0046] Since the screws 21 are adjustable to compensate the normal variations and unevenness occurring in the foundation 19 when the concrete is levelled for the foundation a normal standard for balancing the sliding paths of the vibrator bridge is quite sufficient.

[0047] The supply air to said space 7 beneath the floor construction is taken from the indoor air via individual inlet devices placed directly against the wall 5 of the room. In the embodiment shown these inlet devices comprise floor devices 30, see particularly Figures 7-10, which devices 30 are provided with air intakes 31 containing one or more easily exchanged air filters 32 in a filter holder 33 to prevent dust from entering under the floor construction 2. Said air filters 32 can be exchanged either by removing a grating 34 in front of said filter 32, or by the floor device 30 having a special construction, not shown, in the form of a pull-out filter box similar to a matchbox, arranged on one side of the floor device 30.

[0048] The floor device 30 also includes one or more sockets or measuring nipples 35 having an opening to the space behind the air filter 32, for an instrument to measure any odours, moisture, etc. in the air drawn in, including the current air pressure and air flow, thereby enabling the function of the floor device 30 to be controlled. If the pressure or air flow is too low the filter 32 may need to be changed or cleaned. Alternatively a sensor in the device 30 can continuously measure pressure or flow from the exhaust air and emit a signal when a predetermined value is reached.

[0049] In the embodiment shown the floor device 30 consists of a box-shaped plastic component 36 placed on edge. It is manufactured in one piece, with the exception of the movable and removable filter holder 33, and has no back. Other designs are of course perfectly feasible, such as low, elongate, closed or spherical devices of material such as metal or wood.

[0050] Said floor device 30 is attached either, as shown clearly in Figure 10, by means of suitable conventional attachment devices 37, such as screws, nails or adhesive, or by means of one or more pipes 38 protruding from the bottom of the device 30, see Figure 1, to be fitted into holes provided in the floor construction 2 described in more detail above.

[0051] The present method replaces the often unnecessarily over-dimensioned and inefficient air gap to the wall which in certain cases, e.g. when something is blocking the air flow, may even give a negative air flow, i.e. air is drawn into the room to be ventilated through said air gap. The exhaust air may also pass through a

heat exchanger if necessary although usually the energy content of the air has already been recovered by the concrete foundation 19 having absorbed the excess heat in the exhaust air, thus giving a saving in energy as well as a warm floor.

[0052] The ventilation system 1 according to the invention is dimensioned with the aid of a computer program specifically developed for the purpose, which performs a calculation of all the parameters affecting the function of the ventilation system. This is achieved by computer simulation, see Figure 12, of a floor construction 2 which may be constructed in accordance with the embodiment described above. The simulation is thus performed in a theoretical computer model of a virtual space created in accordance with the measurements and details determined by the lay-out for a certain object which may consist either of an existing building or one at the planning stage. A 2-dimensional picture of the variations in the speeds of the air flows along the floor surface 39 is shown graphically for different embodiments of said structural element 2 in the room under consideration. This helps the designer to find the optimal ventilation solution with regard both to the number and also the relative location of devices in the ventilation equipment 3, e.g. floor devices 30, air intakes 12, the most suitable fan capacity and the connection 6 required for the exhaust air, in order to obtain a desired, uniformly distributed laminar flow of air over the entire room area 39, while at the same time creating a constant negative pressure throughout the space 7 beneath the floor construction 2, thereby guaranteeing a dry and problem-free floor.

[0053] When the most favourable placing of an optimal number of floor devices 30 has been calculated, an electrician can easily apply these floor devices 30 at the desired points. The projecting performed is reported on a floor plan which also shows the fan position 4, duct system 6, exhaust air connections 40 to the floor construction, positions of floor devices 30 and any cell division of large floor areas 39 by partitions in the space 7 beneath the floor so that separate seas of air are formed in which the ventilation process can then be more easily controlled in accordance with set desires for the ventilation system 1.

[0054] Should the lay-out of the building be changed, and thus the criteria for the function of the floor ventilation system 1 installed, the floor device 30 according to the present invention can easily be removed and the hole left sealed, after which the same floor device 30 is inserted at a new optimal point calculated in accordance with the new conditions.

[0055] Since the floor devices 30 are equipped with the above-mentioned measuring nipple 35, control of the air flow, radon content, etc., can easily be performed at any time throughout the life of the building, at each floor device 30, which is a much better alternative than attempting to estimate the air flow along an air gap to the wall, for instance, that requires a considerable number of measuring points to give a more or less correct picture of the actual situation.

[0056] The procedure from projecting to finished system may be as follows: The ventilation system 1 is projected using the computer simulation program according to the floor plan of the building decided upon. At said computer simulation the ventilation system 1 is analyzed so that an optimal flow is obtained in each floor device 30 and in the air gap 7 between the bottom plate 19 and the lower side of the selected floor construction 2. The material required is delivered to the work site where an ordinary builder's labourer fits the floor, sealing all joints and splicing according to instructions, and performing any cell division of the floor construction 2 into smaller, separate cells which can be ventilated independently of each other. The same labourer or a second one fits the fan 4 and duct system 6 comprising said pipes 8, muffs 10, supply air device 12, etc., and connects said duct system 6 between the floor construction 2 and outer wall 5 or the ceiling via lead-throughs 12 provided therefor. The work is performed in accordance with instructions which also include required testing of the floor construction 2 and the ventilation equipment therein.

[0057] Specially trained personnel then fit the floor devices 30 and adjust and check the ventilation equipment 3.

[0058] The function of the ventilation system 1 thus installed is as follows: air is withdrawn form each cell at a point through an exhaust air duct 6 connected to a fan 4. Fresh air enters as required through the normal outer wall vents 12 which may be supplemented if necessary, after which the air from the room is drawn into the floor devices 30 according to the present invention. These have been arranged at the points indicated by the simulation program after a flow analysis performed in the computer model of the room or rooms under consideration above each cell in the manner described above. The optimal number of floor devices 30 and their positioning has thus been calculated. The simulation provides an optimal solution of the ventilation with desired suction over the whole floor surfaces, so that no "pockets" with insufficient ventilation flow can occur in the room.

[0059] The exhaust air form the air gap 7 under the floor is removed via one or more exhaust pipes 8 connected to the duct system 6 and fan 4. The supply air to the air gap 7 is taken from the air in the room via floor devices 30 provided with sockets 35 for measuring pressure/flow and exchangeable filters 32 so that the air is filtered as it is drawn through the devices 30 down under the floor surface 39 so that no accumulation of dust can occur.

[0060] To obtain well functioning negative-pressure ventilation it is important for the bottom plate 19 to be properly cleaned, sealed and thus free from organic material prior to the installation. It is also important that any existing installations constituting obstacles to the flows

of air across the bottom plate 19 are wedge up in such a manner that the air can flow freely over said plate 19. All absorbent organic material in contact with the bottom plate 19 must be avoided and plastic wedges should therefore preferably be used for said wedging.

[0061] It will be understood that the shape of the spacer 21 is adjusted to the support element 15 used. The latter may in principle have any cross-sectional shape.

[0062] A great advantage is that the builder's labourers can finish laying the entire floor construction 2 without having to think about the installation of the ventilation equipment 3. This is performed by a specially trained electrician after completion of the floor construction.

[0063] In the present embodiment the air can pass in all directions under the joists 15 or under the insulation 27 suspended below the joists 15, thanks to the spacer screws 21. However, these may also consist of wedges, plugs, blocks or recesses in the joist 15 itself. If necessary extra supply air devices 12 can also be arranged in order to achieve a suitable pressure level in the house.

[0064] A sealing compound can be injected round the connection between wall 5 and bottom plate 19 to guarantee complete sealing in order to prevent any odours from spreading and also to efficiently exclude any insects.

[0065] The ventilation system 1 described above can be applied both in houses being newly built or during renovation or repair projects, and is not limited to only floor constructions against a bottom plate 19 but also functions against a wall 5 or in a system of joists, see Figure 13.

Claims

1. A method of installing a ventilation system (1) suitable for ventilating at least one room in a building and comprising a floor construction (2) of said room and a ventilation equipment (3) including a suction source (4) and a duct system (6) connected to said floor construction (2) that is arranged above a supporting foundation (19) of said building, **characterized by** the steps of

   - providing a free coherent space (7) between said floor construction (2) and said foundation (19) for permitting air to flow therethrough by

     - arranging a plurality of joists (15) in parallel relationship provided with level-adjusting spacers (21) resting on said foundation (19), said joists being supported by said spacers at a distance from said foundation and supporting a floor material (25) of said floor construction (2),
     - providing a plurality of individual inlet devices (30) intended to be applied at the periphery of the floor construction (2) in order to form supply air ducts from said room to said free space (7),
     - compiling data relating to parameters affecting the function of said ventilation system (1) and including said room, said space (7) and the air flow through said room and space (7),
     - entering said data into a computer program to achieve a simulation of said ventilation system (1),
     - creating by said computer program a theoretical computer model of said ventilation system on the basis of said parameters,
     - requesting the computer program to calculate and indicate an optimal number and optimal individual positions of said inlet devices (30), thereby simulating a desired, uniformly distributed laminar flow of air over the entire floor surface (39) of said room and creating a constant negative pressure throughout said space (7) of said model of the ventilation system (1), and
     - applying said provided inlet devices (30) at the periphery of the floor construction (2) in agreement with the ventilation system (1) simulated by said computer program.

2. A method as claimed in claim 1, **characterized by** the step of mounting said provided inlet devices (30) after making said room complete with the floor construction (2).

3. A method as claimed in claim 1 or 2, **characterized by** the step of graphically showing a 2-dimensional picture of the variations in the speeds of the air flows for different embodiments of said floor construction (2).

4. A ventilation system (1) suitable for ventilating at least one room in a building and comprising a floor construction (2) of said room and a ventilation equipment (3) including a suction source (4) and a duct system (6) connected to said floor construction (2) that is arranged above a supporting foundation (19) of said building, said floor construction (2) comprises a floor material (25), **characterized in that** said floor construction (2) also comprises

   - a plurality of parallel joists provided with level-adjusting spacers (21) resting on said foundation (19), said joists being supported by said spacers (20) at a distance from said foundation and supporting said floor material (25) so that a free coherent space (7) is formed between said floor construction (2) and said foundation (19) and being in open communication with said suction source (4) via said duct system (6), and

that said ventilation equipment (3) comprises

- a plurality of individual inlet devices (30) applied at the periphery of the floor construction (2) in order to form supply air ducts from said room to said free space (7), the optimal number and the optimal individual positions of said inlet devices (30) being predetermined by a computer simulation.

5. A ventilation system as claimed in claim 4, **characterized in that** the inlet devices (30) are provided with air intakes (31) comprising one or more replaceable air filters (32) in a filter holder (33).

6. A ventilation system as claimed in claim 5, **characterized in that** said filter holder (33) comprises a pull-out device for the air filter (32), preferably in the form of a box, arranged on some sides of the floor device (30).

7. A ventilation system as claimed in any one of claims 4-6, **characterized in that** the inlet devices (30) also comprise one or more sockets or measuring nipples (35) having an opening to the space behind the air filter (32), for an instrument to measure the air flow with regard to odour, moisture, current air pressure and air flow.

8. A ventilation system as claimed in any one of claims 4-7, **characterized in that** the inlet devices (30) are manufactured in one piece out of plastic, wood or metal, with one or more openings or sockets.

9. A ventilation system as claimed in any one of claims 4-8, **characterized in that** the inlet devices (30) comprise one or more attachment devices (37) consisting of one or more pipes (38) fitting into holes provided therefor in the floor construction (2), or of suitable screws, nails or adhesive.

Patentansprüche

1. Verfahren zum Installieren eines Belüftungssystems (1), mit dem wenigstens ein Zimmer in einem Gebäude belüftet werden kann und das eine Bodenkonstruktion (2) des Zimmers und eine Belüftungsanlage (3) mit einer Saugquelle (4) und einem mit der über einem Tragfundament (19) des Gebäudes angeordneten Bodenkonstruktion (2) verbundenen Leitungssystem (6) umfasst, **gekennzeichnet durch** die folgenden Schritte:

- Vorsehen eines freien zusammenhängenden Raums (7) zwischen der Bodenkonstruktion (2) und dem Fundament (19), **durch** den Luft strömen kann, indem
  - mehrere Balken (15) , die mit Höheneinstellungsabstandshaltern (21) versehen sind, die auf dem Fundament (19) ruhen, parallel zueinander angeordnet werden, wobei die Balken **durch** die Abstandshalter in einem Abstand von dem Fundament unterstützt sind und ein Bodenmaterial (25) der Bodenkonstruktion (2) unterstützen,
- Vorsehen mehrerer einzelner Einlassvorrichtungen (30), die am Umfang der Bodenkonstruktion (2) anzubringen sind und Zufuhrluftleitungen von dem Zimmer in den freien Raum (7) bilden,
- Kompilieren von Daten, die auf Parameter bezogen sind, die die Funktion des Belüftungssystems (1) beeinflussen und das Zimmer, den Raum (7) sowie den Luftstrom **durch** das Zimmer und den Raum (7) umfassen,
- Eingeben der Daten in ein Computerprogramm, um eine Simulation des Belüftungssystems (1) zu erhalten,
- Berechnen eines theoretischen Computermodells des Belüftungssystems anhand der Parameter **durch** das Computerprogramm,
- Auffordern des Computerprogramms, eine optimale Anzahl und optimale einzelne Positionen der Einlassvorrichtungen (30) zu berechnen und anzugeben, um eine gewünschte, gleichmäßig verteilte laminare Luftströmung über die gesamte Bodenoberfläche (39) des Raums zu simulieren und einen konstanten Unterdruck im gesamten Raum (7) des Modells des Belüftungssystems zu erzeugen, und
- Anbringen der vorgesehenen Einlassvorrichtungen (30) am Umfang der Bodenkonstruktion (2) entsprechend dem **durch** das Computerprogramm simulierten Belüftungssystem (1).

2. Verfahren nach Anspruch 1, **gekennzeichnet durch** den Schritt des Anbringens der vorgesehenen Einlassvorrichtungen (30), nachdem der Raum mit der Bodenkonstruktion (2) fertiggestellt worden ist.

3. Verfahren nach Anspruch 1 oder 2, **gekennzeichnet durch** den Schritt des graphischen Anzeigens eines zweidimensionalen Bildes der Änderungen der Geschwindigkeiten der Luftströmungen für verschiedene Ausführungen der Bodenkonstruktion (2).

4. Belüftungssystem (1), das für eine Belüftung wenigstens eines Zimmers in einem Gebäude geeignet ist und eine Bodenkonstruktion (2) des Zimmers sowie eine Belüftungsanlage (3) mit einer Saugquelle (4) und einem mit der über einem Tragfundament

(19) des Gebäudes angeordneten Bodenkonstruktion (2) verbundenen Leitungssystem (6) umfasst, wobei die Bodenkonstruktion (2) ein Bodenmaterial (25) umfasst, **dadurch gekennzeichnet, dass** die Bodenkonstruktion (2) außerdem umfasst:

- mehrere parallele Balken, die mit Höheneinstellungsabstandshaltern (21) versehen sind, die auf dem Fundament (19) ruhen, wobei die Balken durch die Abstandshalter (20) in einem Abstand von dem Fundament unterstützt sind und das Bodenmaterial (25) in der Weise unterstützen, dass ein zusammenhängender freier Raum (7) zwischen der Bodenkonstruktion (2) und dem Fundament (19) gebildet wird, der mit der Saugquelle (4) über das Leitungssystem (6) in einer offenen Verbindung steht, und

dass die Belüftungsanlage (3) umfasst:

- mehrere einzelne Einlassvorrichtungen (30), die am Umfang der Bodenkonstruktion (2) angebracht sind, um Luftzufuhrleitungen von dem Zimmer in den freien Raum (7) zu bilden, wobei die optimale Anzahl und die optimalen einzelnen Positionen der Einlassvorrichtungen (30) durch eine Computersimulation vorgegeben sind.

5. Belüftungssystem nach Anspruch 4, **dadurch gekennzeichnet, dass** die Einlassvorrichtungen (30) mit Lufteinlässen (31) versehen sind, die einen oder mehrere austauschbare Luftfilter (32) in einer Filterhalterung (33) umfassen.

6. Belüftungssystem nach Anspruch 5, **dadurch gekennzeichnet, dass** die Filterhalterung (33) eine Herausziehvorrichtung für den Luftfilter (32) vorzugsweise in Form eines Kastens, der auf einigen Seiten der Bodenvorrichtung (30) angeordnet ist, umfasst.

7. Belüftungssystem nach einem der Ansprüche 4-6, **dadurch gekennzeichnet, dass** die Einlassvorrichtungen (30) außerdem eine oder mehrere Buchsen oder Messanschlüsse (35) umfassen, die eine Öffnung in den Raum hinter dem Luftfilter (32) besitzen und einem Instrument zum Vermessen der Luftströmung in Bezug auf Geruch, Feuchtigkeit, momentanem Luftdruck und Luftdurchflussmenge dienen.

8. Belüftungssystem nach einem der Ansprüche 4-7, **dadurch gekennzeichnet, dass** die Einlassvorrichtungen (30) einteilig aus Kunststoff, Holz oder Metall mit einer oder mit mehreren Öffnungen oder Buchsen hergestellt sind.

9. Belüftungssystem nach einem der Ansprüche 4-8, **dadurch gekennzeichnet, dass** die Einlassvorrichtungen (30) eine oder mehrere Befestigungsvorrichtungen (37) aufweisen, die aus einem oder aus mehreren Rohren (38), die in hierfür in der Bodenkonstruktion (2) vorgesehene Löcher eingesetzt sind, oder aus geeigneten Schrauben, Nägeln oder einem geeigneten Klebstoff bestehen.

Revendications

1. Procédé d'installation d'un système de ventilation (1) adapté pour ventiler au moins une pièce dans un immeuble et comprenant une construction de plancher (2) de ladite pièce et un équipement de ventilation (3) comprenant une source d'aspiration (4) et un système de conduite (6) raccordés à ladite construction de plancher (2) qui est agencée audessus de fondations de support (19) dudit immeuble, **caractérisé par** les étapes consistant à :

fournir un espace libre cohérent (7) entre ladite construction de plancher (2) et lesdites fondations (19) pour permettre à l'air de s'écouler entre celui-ci en agençant une pluralité de solives (15) en relation parallèle pourvues de pièces d'écartement à réglage de niveau (21) reposant sur lesdites fondations (19), lesdites solives étant soutenues par lesdites pièces d'écartement à distance desdites fondations et supportant un matériau de plancher (25) de ladite construction de plancher (2),
fournir une pluralité de dispositifs d'entrée individuels (30) destinés à être appliqués au niveau de la périphérie de la construction de plancher (2) pour former des conduites d'air d'alimentation depuis ladite pièce dudit espace libre (7),
compiler des données liées à des paramètres affectant la fonction dudit système de ventilation (1) et comprenant ladite pièce, ledit espace (7) et le flux d'air à travers lesdits pièce et espace (7),
saisir lesdites données dans un programme informatique pour obtenir une simulation dudit système de ventilation (1),
créer par ledit programme information un modèle informatique théorique dudit système de ventilation en fonction desdits paramètres,
demander au programme informatique de calculer et d'indiquer un nombre optimal de positions individuelles optimales desdits dispositifs d'entrée (30) simulant de ce fait un flux d'air laminaire souhaité réparti uniformément sur l'intégralité de la surface de plancher (39) de ladite pièce et créant une pression négative constante à travers ledit espace (7) dudit modèle du système de ventilation (1), et

appliquer lesdits dispositifs d'entrée fournis (30) au niveau de la périphérie de la construction de plancher (2) en accord avec le système de ventilation (1) simulé par ledit programme informatique.

2. Procédé selon la revendication 1, **caractérisé par** l'étape consistant à monter lesdits dispositifs d'entrée fournis (30) après avoir raccordé ladite pièce d'un seul tenant avec la construction de plancher (2).

3. Procédé selon la revendication 1 ou 2, **caractérisé par** l'étape consistant à représenter graphiquement une image en deux dimensions des variations de vitesse des flux d'air pour différents modes de réalisation de ladite construction de plancher (2).

4. Système de ventilation (1) adapté pour ventiler au moins une pièce dans un immeuble et comprenant une construction de plancher (2) de ladite pièce et un équipement de ventilation (3) comprenant une source d'aspiration (4) et un système de conduite (6) raccordé à ladite construction de plancher (2) qui est agencée au-dessus de fondations de support (19) dudit immeuble, ladite construction de plancher (2) comprenant un matériau de plancher (25), **caractérisé en ce que** ladite construction de plancher (2) comprend également

une pluralité de solives parallèles pourvues de pièces d'écartement à ajustement de niveau (21) reposant sur lesdites fondations (19), lesdites solives étant supportées par lesdites pièces d'écartement (20) à distance desdites fondations et supportant ledit matériau de plancher (25) de sorte qu'un espace libre cohérent (7) est formé entre ladite construction de plancher (2) et lesdites fondations (19) et étant en communication ouverte avec ladite source d'aspiration (4) par l'intermédiaire dudit système de conduite (6), et

en ce que ledit équipement de ventilation (3) comprend

une pluralité de dispositifs d'entrée individuels (30) appliqués au niveau de la périphérie de la construction de plancher (2) pour former des conduites d'air d'alimentation provenant de ladite pièce vers ledit espace libre (7), le nombre optimal et les positions individuelles optimales desdits dispositifs d'entrée (30) étant prédéterminés par une simulation informatique.

5. Système de ventilation selon la revendication 4, **caractérisé en ce que** les dispositifs d'entrée (30) sont pourvus d'entrées d'air (31) comprenant un ou plusieurs filtres à air remplaçables (32) dans un porte-filtre (33).

6. Système de ventilation selon la revendication 5, **caractérisé en ce que** ledit porte-filtre (33) comprend un dispositif d'extraction pour le filtre à air (32), de préférence sous la forme d'un boîtier, agencé sur quelques côtés du dispositif de plancher (30).

7. Système de ventilation selon l'une quelconque des revendications 4 à 6, **caractérisé en ce que** les dispositifs d'entrée (30) comprennent également une ou plusieurs douilles ou raccords de mesure (35) comprenant une ouverture vers l'espace derrière le filtre à air (32), pour qu'un instrument mesure le flux d'air par rapport à l'odeur, l'humidité, la pression d'air courante et le flux d'air.

8. Système de ventilation selon l'une quelconque des revendications 4 à 7, **caractérisé en ce que** les dispositifs d'entrée (30) sont fabriqués d'un seul tenant en plastique, en bois ou en métal, avec une ou plusieurs ouvertures ou douilles.

9. Système de ventilation selon l'une quelconque des revendications 4 à 8, **caractérisé en ce que** les dispositifs d'entrée (30) comprennent un ou plusieurs dispositifs de fixation (37) constitués d'une ou plusieurs conduites (38) s'insérant dans des trous prévus pour cela dans la construction de plancher (2) ou de vis, clous ou adhésifs adaptés.

Fig.1

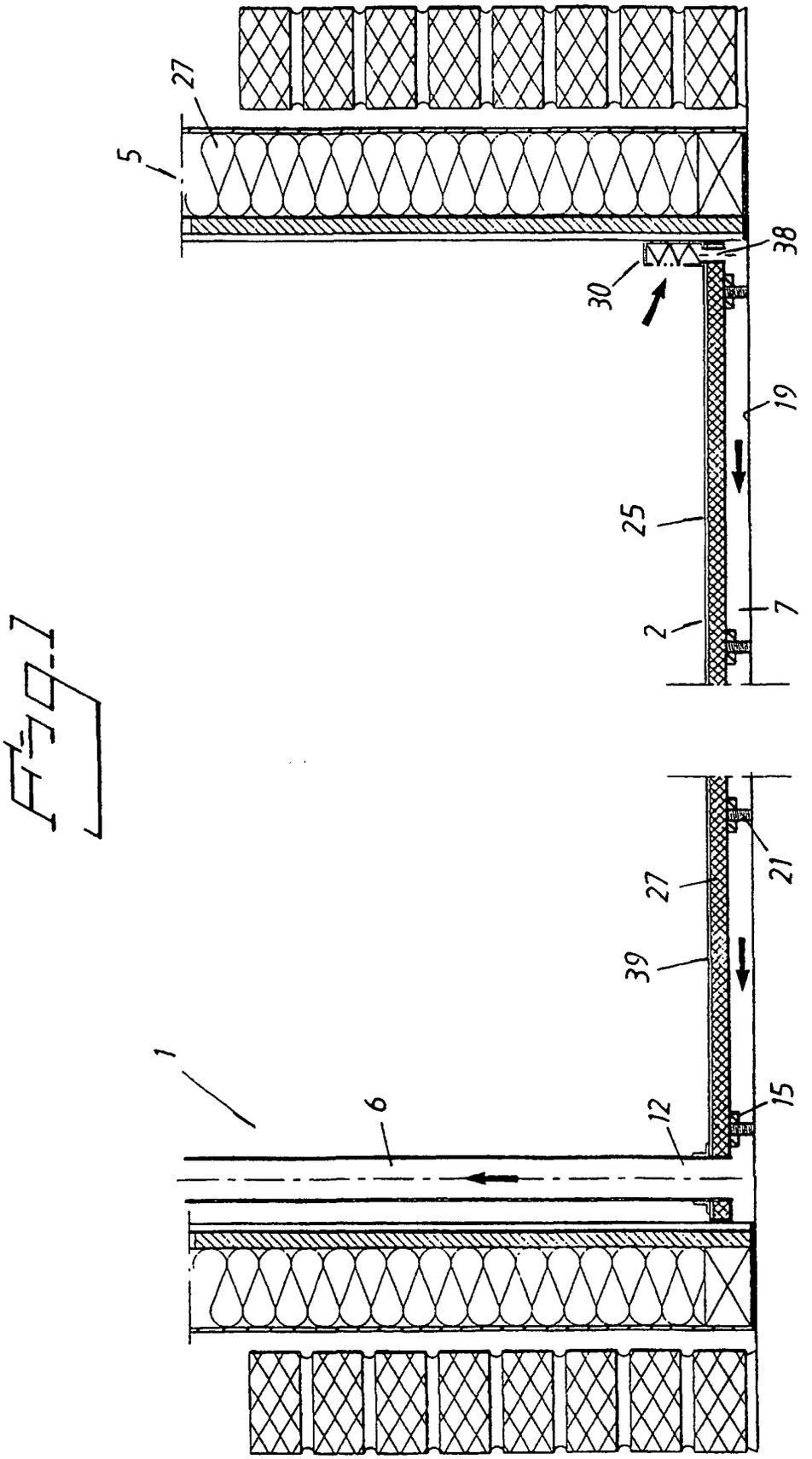


Fig. 2

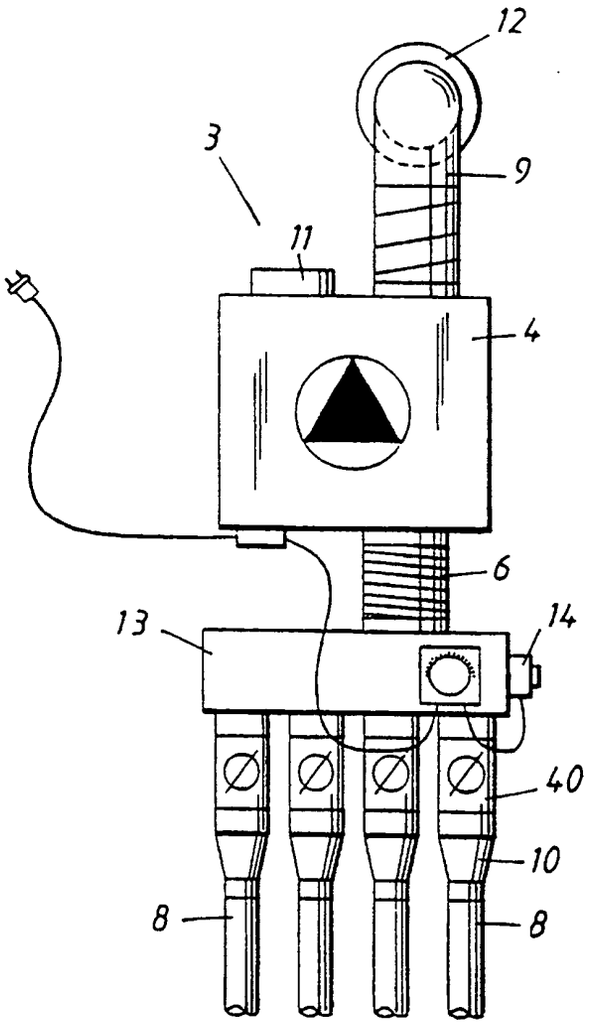
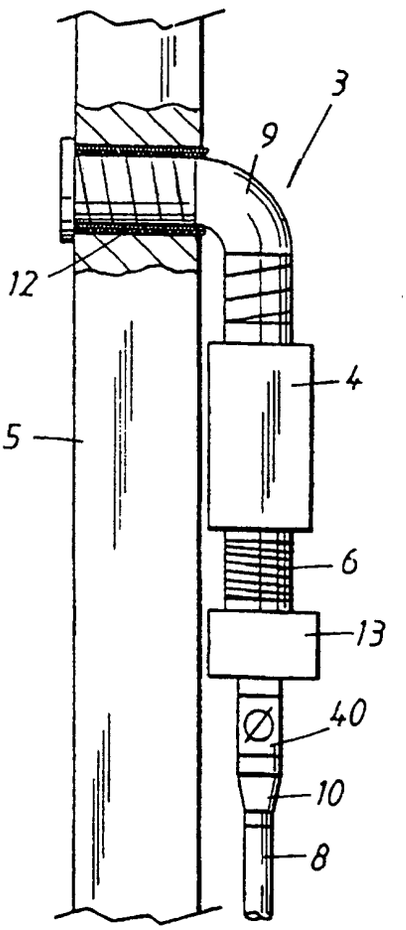


Fig. 3



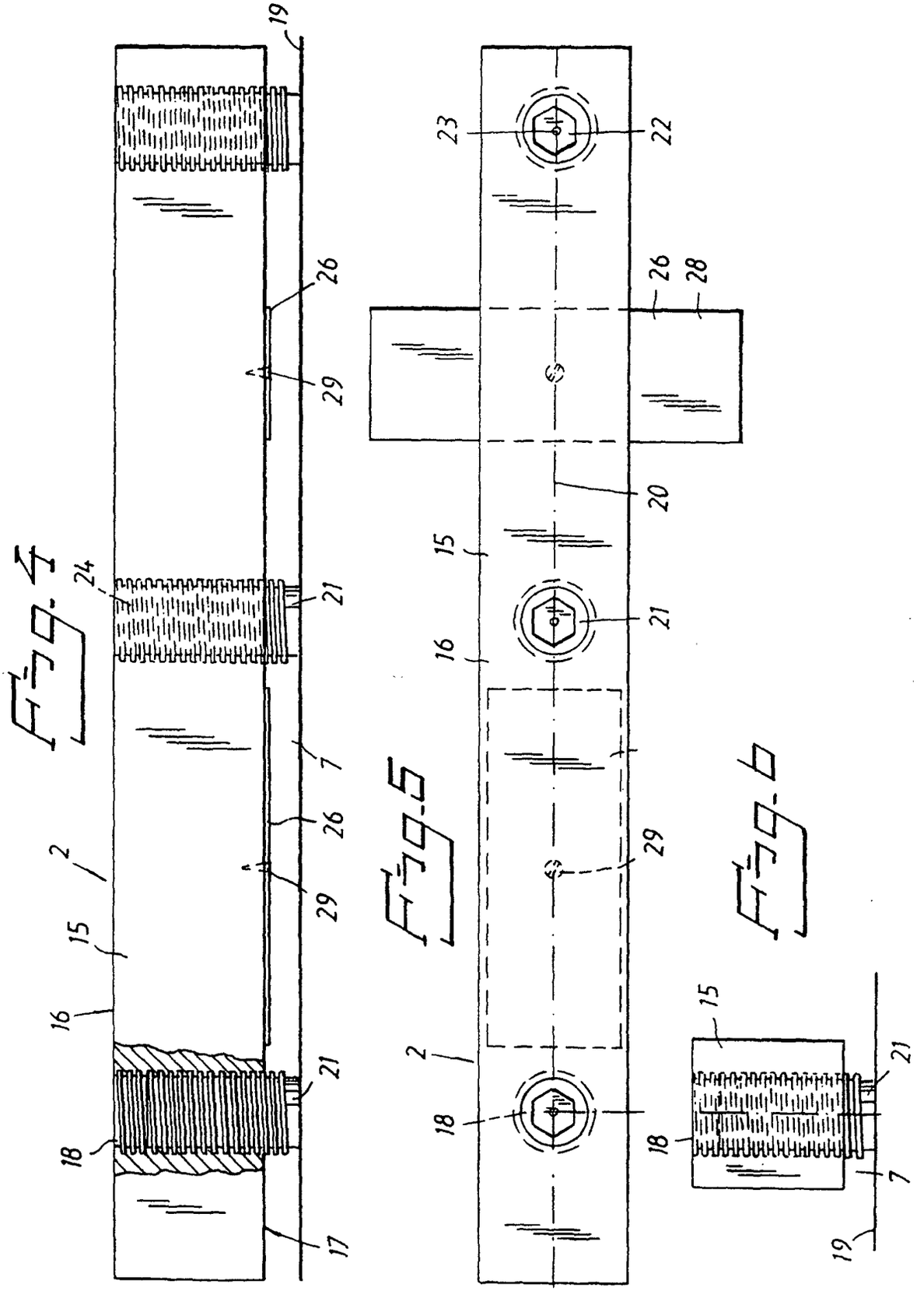

Fig. 4
Fig. 5
Fig. 6
19
26
29
24
21
7
2
15
16
18
17
23
22
28
20
A

Fig. 9

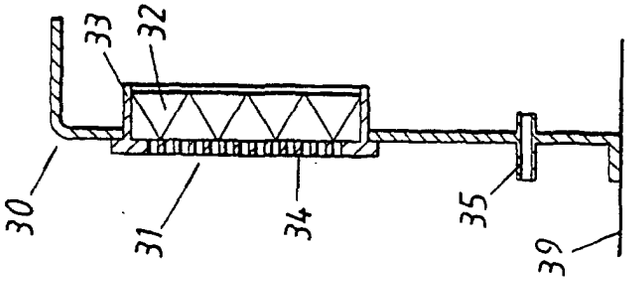


Fig. 8

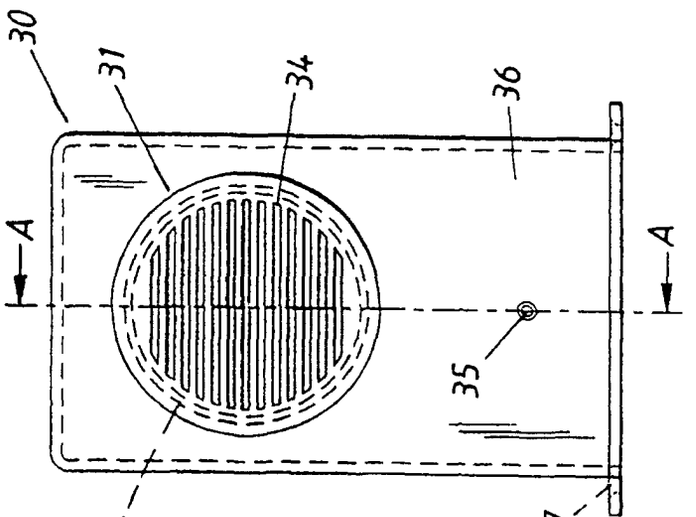


Fig. 7

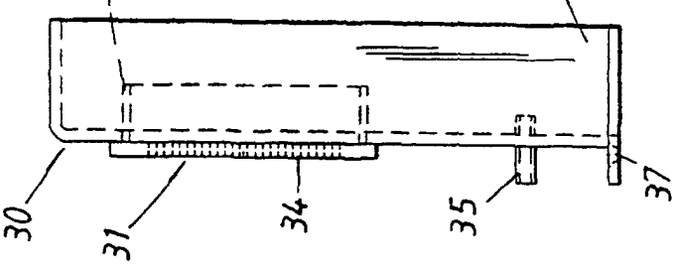


Fig. 10

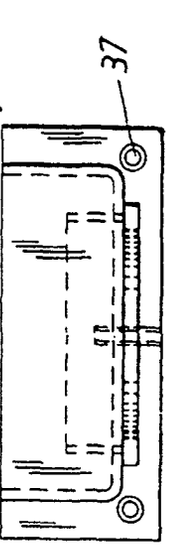


Fig.13

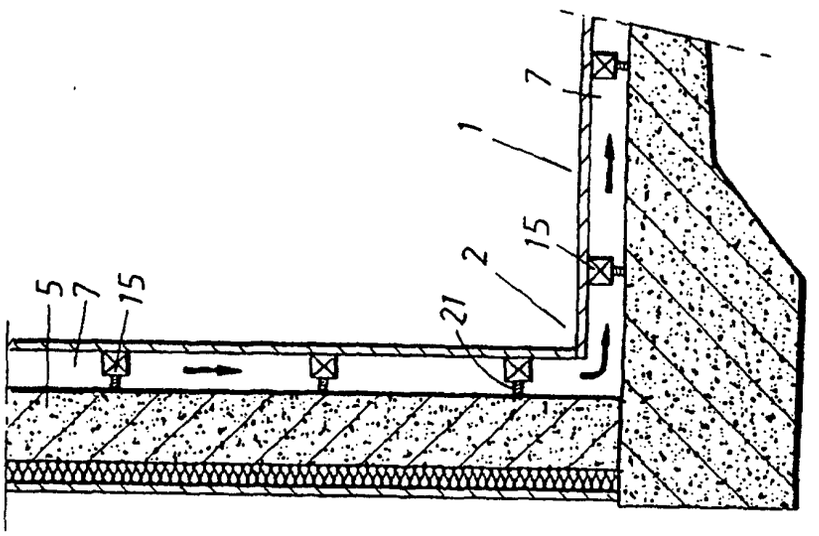
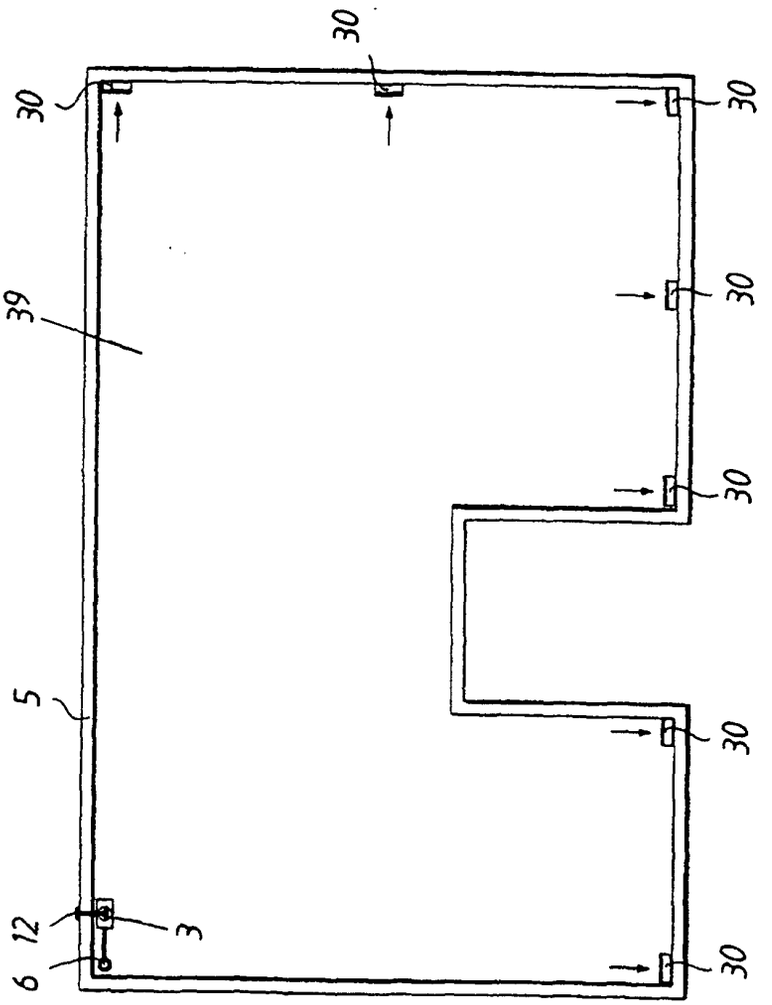


Fig.11



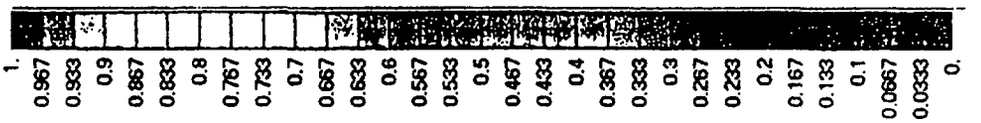
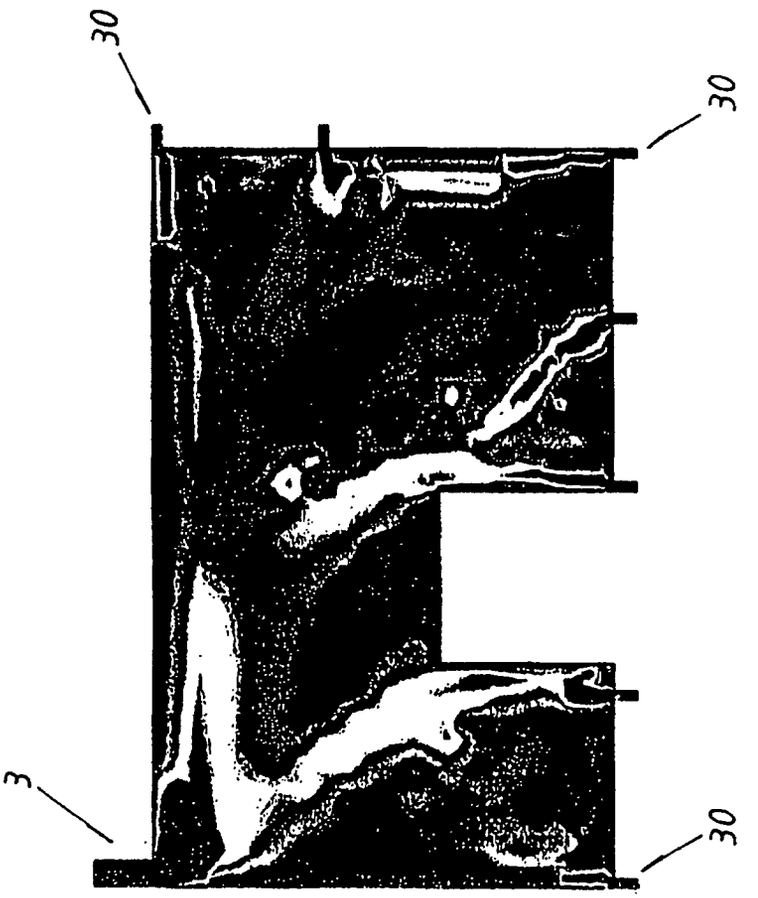

1.
0.967
0.933
0.9
0.867
0.833
0.8
0.767
0.733
0.7
0.667
0.633
0.6
0.567
0.533
0.5
0.467
0.433
0.4
0.367
0.333
0.3
0.267
0.233
0.2
0.167
0.133
0.1
0.0667
0.0333
0.

Fig.12


30
30
3
30