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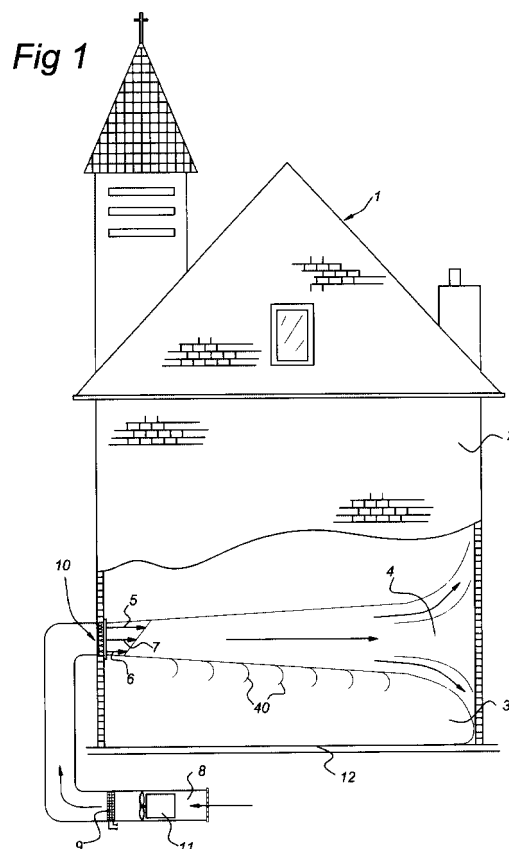
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(54) **Method for heating a large and high room, such as in a church, and device for carrying out this method and blowing grate intended in particular for use in the method**

(57) The invention relates to a method for heating a large and high room, such as in a church, a hangar, a hall, etc. At a height of at least approximately 2.5 m above a floor on which people can walk, a layer of heated air is blown horizontally into the room. The horizontal velocity of the air at the top of the layer of air blown in is higher than at the bottom of the layer of air blown in. The invention also relates to a device for carrying out the method according to the invention. The invention also relates to a blowing grate, intended in particular for use in the method according to the invention, comprising a multiplicity of vanes which extend horizontally, are positioned with a spacing between them and are substantially V-shaped in cross section, the pointed sides of the V shape pointing in the opposite direction to the blowing direction. The vertical spacing between adjacent vanes can decrease along the grate from the bottom upwards, and furthermore the vertical spacing between adjacent vanes can be adjusted.



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Description

[0001] The present invention relates to a method for heating a large and high room, such as in a church, a hangar, a hall, etc., in which a layer of heated air is blown horizontally into the room at a height of at least approximately 2.5 m above a floor on which people can walk.

[0002] A method of this type is known, inter alia, from Sint-Willibrordus Church in Utrecht, where an installation made by the applicant for carrying out this method has been installed since 1993.

[0003] When heating large and in particular also very high rooms of this nature, the problem arises that the heat tends to collect at the top of the room and to press the cold which is present in that area downwards, leading to drafts and meaning in particular that a large amount of time and energy are required to heat a large and high room of this type to a pleasant temperature. The abovementioned known method overcomes this problem in part by dividing the room, by means of the layer of air blown in, into a top section, in which the cold is retained, and a bottom section, which is heated. In this case, the layer of air blown in has the task of keeping the cold air from the top part at the top, as it were, and thus preventing draughts caused by cold air streams directed from the top downwards.

[0004] The object of the present invention is to improve the method of the type described in the introduction. The object of the present invention in particular is to improve the separation ability of the layer of air blown in and, at the same time, to improve the energy performance of the method.

[0005] According to the invention, the above objects are achieved by the fact that the horizontal velocity of the air blown in is higher at the top of the layer of air blown in than at the bottom of the layer of air blown in. On account of the higher velocity of the air at the top of the layer of air blown in, the layer of air blown in is less calm at the top and is more able to keep the cold air situated above it in place above it, which colder, higher air keeps the layer of air blown in and the heated part of the room situated below it pressed downwards, as it were. On account of the lower velocity at the bottom of the layer of air blown in, the bottom section of the layer of warm air blown in is better able to mix with that part of the room which lies below it and thus to heat this bottom part of the room.

[0006] According to a preferred embodiment of the invention, the height of the layer of air blown in at the location where it is blown in will be at least approximately 25 cm, such as approximately 35 cm or more. Depending partly on the overall height of the room and the overall volume of the bottom part which is to be heated, the thickness of the layer of air blown in may vary from approximately 30 cm up to approximately 100 cm or even more if necessary.

[0007] With a view to on the one hand the separating ability of the layer of air blown in and on the other hand

the heating capacity with respect to that part of the room which lies below the layer of air blown in, according to the invention it is particularly advantageous if the blowing velocity at the top of the layer of air is at least approximately 40%, preferably approximately 50%, higher than at the bottom of the layer of air.

[0008] According to the invention, good heating properties from the layer of air blown in are obtained in particular if the blowing velocity at the bottom of the layer of air is at most approximately 6 m/sec, preferably at most approximately 3 m/sec. At a blowing velocity of this level, the ability of the bottom part of the layer of air to mix with that part of the room which lies below it still proves satisfactory.

[0009] In particular with regard to the separating ability of the layer of air blown in, according to the invention it is advantageous if the blowing velocity at the top of the layer of air is at least approximately 6 m/sec, preferably at least approximately 8 m/sec.

[0010] To prevent the blown, heated air from rising too quickly out of the layer of air blown in, according to the invention it is preferable if the heated air blown in is at a temperature of at most approximately 45°C. If the temperature of the air blown in becomes too high, the upwards impulse to which the air blown in is subjected will become too great and consequently the distance covered by the air blow in will decrease.

[0011] In order, after sufficient heating of that part of the room which lies below the layer of air blown in, to maintain the separation between that heated bottom part of the room and the cold top part of the room, and at the same time to counteract further heating of the bottom part of the room, it is in this situation preferable for the heated, blown air to be at a temperature which is approximately equal to or generally slightly (up to for example 5°C) higher than the desired temperature. This desired temperature will generally be what is known as room temperature, from 18°C to 22°C, but if appropriate, certainly in churches, may also be a temperature of approximately 15°C. According to an advantageous embodiment, the heated air blown in will therefore be at a temperature of at least approximately 15°C to 22°C.

[0012] According to a further aspect, the present invention relates to a device for carrying out the method according to the invention, comprising:

heater means for heating the air which is to be blown in;

- blowing means for blowing in the heated air via a grate positioned at least 2.5 m above the floor, characterized in that the device furthermore comprises distributor means designed to blow in the air at a higher velocity at the top of the grate than at the bottom of the grate. Distributor means of this type may adopt numerous forms. For example, it is conceivable for two blowing nozzles, each with their own fan, which blow air into the room through the grate at different velocities, to be provided behind

the grate, one above the other. Alternatively or in addition, the distributor means may also comprise a gauze which is positioned in front of the bottom section of the grate and thus reduces the velocity of the air passing through the gauze. Furthermore or in addition, the distributor means may also be obtained by a special design of the grate, in particular its vanes.

[0013] According to yet another aspect, the present invention relates to a blowing grate, intended in particular for use in the method according to the invention, comprising a multiplicity of vanes which extend horizontally and are positioned with a spacing between them, characterized in that the vanes are substantially V-shaped in cross section, the pointed side of the V shape facing in the opposite direction to the blowing direction. The V-shaped vanes will preferably be aerodynamically shaped. The use of V-shaped vanes of this type leads to the layer of air blown in having a relatively uniform pressure build-up and therefore also a relatively uniform velocity build-up. In particular, alternating zones at higher and lower pressures as seen in the vertical direction of the layer of air are prevented. This phenomenon occurs, for example, if plate-like vanes which are alternately inclined in one direction and the other direction are used, in which case diverging and converging flow passages are alternately obtained, as seen in the vertical direction of the grate.

[0014] Moreover, according to the invention with a blowing grate of this type it is possible to effectively and reliably achieve the distribution of the velocity over the layer of air if the vertical spacing between adjacent vanes at the top of the grate is smaller than at the bottom of the grate. According to a preferred embodiment, this vertical spacing between adjacent vanes can gradually decrease along the grate from the bottom upwards. The air emerging from the grate will be at a higher velocity where the passage between the vanes is smaller, given an otherwise identical supply velocity of air to the grate.

[0015] In a blowing grate according to the invention, it is particularly advantageous if the V-shaped vanes are composed of in each case two vane blades which can pivot with respect to one another at the pointed side of the V-shape. In this way, it is possible, in terms of production, to use only one type of blowing grate which, in terms of its horizontal length and vertical height, can if appropriate be adjusted to size, and for this grate to be adjusted in situ as a function of the conditions of use, by adapting the distance between adjacent V-shaped vanes. This is particularly important when used in churches, since in practice these are never designed identically. According to the invention, in order to be able to manipulate as much as possible the adjustability of the vane blades, on the one hand, and the ability to set the behaviour of the air stream to be blown in, on the other hand, it is preferable if in each case both vane blades of a vane are arranged pivotably.

[0016] To allow the vane blades to be adjusted efficiently and easily when installing the grate and/or after the grate has been installed, for the purpose of fine tuning possibly on the basis of sensors, according to the invention it is preferable if the top vane blades of each vane are connected to a common top-blade actuating rod, which extends substantially transversely with respect to the longitudinal direction of the vanes, preferably via in each case a top-blade actuating arm; and/or if the bottom vane blades of each vane are connected to a common bottom-blade actuating rod, which extends substantially transversely with respect to the longitudinal direction of the vanes, preferably via in each case a bottom-blade actuating arm. An embodiment of the invention which is structurally simple and in particular allows very accurate adjustment and fine tuning provides for the top-blade actuating rod and/or the bottom-blade actuating rod to be a rod provided with an external screw thread, on which for each top or bottom vane blade there is a nut member connected to the said respective vane blade, in such a manner that, when the top-blade actuating rod or bottom-blade actuating rod is turned, the nut members provided thereon together move upwards or downwards along the said respective actuating rod.

[0017] One adjustment option which in particular takes very good account of the velocity profile of the air stream emerging along the grate according to the invention provides for the nut members on the respective actuating rod to have the same screw thread as one another, and for the actuating rod to be positioned at an angle with respect to the plane enclosed by the longitudinal directions of the vanes, in such a manner that the actuating rod is closer to the said plane enclosed by the longitudinal directions at the top of the grate than at the bottom of the grate.

[0018] The present invention will be explained in more detail below with reference to an exemplary embodiment which is diagrammatically depicted in the drawing, in which:

Fig. 1 shows a diagrammatic cross section through a church for the purpose of illustrating the method according to the invention, using a device according to the invention and a blowing grate according to the invention;

Fig. 2 shows a vertical longitudinal sectional view of a blowing grate according to the invention;

Fig. 3 shows a detail of a side view of a fully folded-together V-shaped vane of a grate according to the invention;

Fig. 4 shows a detail of a side view of a fully folded-open V-shaped vane of a grate according to the invention;

Fig. 5 shows a detail of a plan view of the blowing grate shown in Figure 2;

Fig. 6 shows a detail of a plan view of a V-shaped vane for a grate according to the invention; and

Fig. 7 shows the back view in the direction of arrow

VII from Fig. 6.

[0019] In Fig. 1, 1 diagrammatically indicates a church in which there is a particularly high room which needs to be heated by means of hot-air or warm-air heating for the benefit of visitors to the church. With a view to achieving a separation, the temperature of the air blown in will preferably be at least approximately 18°C to 22°C and at most approximately 45°C. The interior of the church is subdivided into a top space 2 and a bottom space 3, which are separated from one another at least when using the method or during operation of the device according to the invention by means of a layer of warm air 4 which has been blown in. The velocity profile of the layer of air 4 blown in at the location of the blowing grate 10 according to the invention is illustrated by the arrows 5, 6 and 7. The arrow 5 located in the top half of the layer of air 4 represents a higher velocity than the arrow 6 located in the bottom half of the layer of air 4. Working on the basis of a linear velocity profile, arrow 7 indicates the mean velocity, corresponding to the velocity of the layer of air 4 in the centre of the said layer of air. The relatively higher velocity, arrow 5, in the top section of the layer of air 5 causes more turbulence in the layer of air 4 blown in, as a result of which, inter alia, it is less easy for the layer of air 4 blown in to mix with cold air in the top space 2, and therefore the layer of air 4 blown in is better able to keep the cold in the top space 2 above it. On account of the relatively lower velocity, arrow 6, in the bottom part of the layer of warm air blown in, this bottom part is better able to mix with the bottom part 3 of the room in the church, as illustrated by curls 40 in Fig. 1, and thus to heat this bottom part 3 of the room.

[0020] The air which is to be blown in is sucked in from the outside or if appropriate from the church via inlet 8, is heated by heater means 9, and is passed to the grate 10 by fan means 11 or other types of blower means. The grate 10 is arranged at a height of approximately 3.5 m above the floor. Arranging the grate 10 at this level means that visitors to the church who are on its floor 12 will scarcely notice the air stream blown in at a relatively high velocity. Depending on the conditions, the height H may also be lower, but will generally be at least 2.5 m above the floor 12. The applicant has found that with a height of approximately 3.5 m and a blowing velocity of approximately 5 m/sec, the visitors to the church will scarcely be disturbed by this air. Furthermore, in test simulations, the applicant has found that with a blowing velocity of this type at the bottom of the layer of air 4, it is possible to achieve successful heating of the bottom part 3 of the room and to achieve a good separating ability at a blowing velocity of over approximately 7.5 m/sec at the top of the layer of air 4 (arrow 5).

[0021] Figs. 2 and 5 show, in vertical longitudinal section and in a plan view, respectively, the ventilation grate 10 according to the invention. The ventilation grate comprises a multiplicity of vanes which are parallel to one another, extend horizontally and are each composed of

a top vane blade 21 and a bottom vane blade 22. As seen in vertical section, these vanes 20 are in the form of a V shape lying on its side. The pointed side of the V shape in each case faces in the opposite direction to the blowing direction (as indicated by arrows 5, 6, 7). At the pointed side of the V shape, the top 21 and bottom 22 vane blades are arranged in such a manner that they can pivot about a substantially horizontal rotation pin 23 with respect to one another and also with respect to the solid ground. The bottom pivoting blades 22 are provided with a bottom-blade actuating arm 25, and the top vane blades 21 are provided with a top-blade actuating arm 24. When the top-blade actuating arm 24 pivots upwards in the clockwise direction, the top vane blade 21 connected thereto pivots downwards, in the clockwise direction. When the top-blade actuating arm 24 is pivoted downwards in the anticlockwise direction, the top vane blade 21 connected thereto pivots upwards, in the anticlockwise direction. The same applies to the bottom actuating arm 25 and the bottom vane blade 22.

[0022] The top-blade actuating arms 24 are each provided with a nut 26 which can run along a top-blade actuating rod 28 provided with a mating screw thread when the said actuating rod 28 is rotated. In a corresponding way, the bottom-blade actuating arms 25 are provided with a nut 27 which is able to run along a bottom-blade actuating rod 29 provided with a mating screw thread. At their top ends, the top-blade actuating rod 28 and the bottom-blade actuating rod 29 are connected to one another by means of gearwheels 30 and 31, respectively. The gearwheels 30 and 31 are identical to one another, so that when the top-blade actuating rod is rotated in the clockwise direction as shown in Fig. 3, the bottom-blade actuating rod 29 is rotated anticlockwise through the same angle.

[0023] As can be seen from Fig. 2, the vertical distance V1-V9 between adjacent vanes V1-V9 at the top of the grate is smaller than at the bottom of the grate. This vertical distance V1 to V9 increases in steps from the top downwards. The spacings V1-V3 are substantially equal, the spacings V4-V6 are substantially equal and the spacings V7-V9 are substantially equal. As can be seen, this can be achieved by varying the length of the top-blade and bottom-blade actuating arms. The rotation pins are accommodated and displaceable in slots which are substantially at right angles to the actuating rods 28 and 29. The connection between the actuating arms 24 and 25 and the nut members 26 will preferably allow the actuating arms 24 and 25 to pivot or tilt in some other way with respect to the nut members. The latter can be achieved, for example, by bending the actuating arms 24 and 25 into a U shape at the nut ends and accommodating the nut members loosely, with play, in these U-shaped bent sections.

[0024] The actuating rods 28 and 29 extend between a top frame part 32 and a bottom frame part 31, which delimit the grate at the top and bottom, respectively. Downstream of the horizontal vanes 20, as seen in the

direction of flow, a multiplicity of vertical vanes 33 extend in the vertical direction between the top frame part 32 and the bottom frame part 31. The angular positions of the vertical vanes 33 may if appropriate be adjustable with respect to one another, so that their angular positions can be adapted to the conditions on site, in order to be able to adjust the way in which the layer 4 of hot air blown in fans out in the plane perpendicular to the plane of the drawing shown in Fig. 1 or, if appropriate, to be able to regulate this during operation.

[0025] Fig. 3 shows, as a detail, a side view of a V-shaped vane 20 of a grate according to the invention in its fully folded-together position, in which the nuts 26 and 27 have been moved apart.

[0026] Fig. 4 shows a view corresponding to Fig. 3, but with the V-shaped vane 20 in its fully folded-open position, in which the nuts 27 and 28 are located at approximately the same height. Since two threaded rods 28 and 29 are being used, if appropriate it is also conceivable for nut 26 to be rotated further downwards and nut 27 to be rotated further upwards, in such a manner that nut 26 comes to lie below nut 27.

[0027] As a detail, Fig. 6 shows a plan view of a V-shaped vane which has been removed from the grate according to the invention, and Fig. 7 shows a back view in the direction of arrow VII from Fig. 6.

Claims

1. Method for heating a large and high room, such as in a church, a hangar, a hall, etc.,
in which a layer of heated air is blown horizontally into the room at a height of at least approximately 2.5 m above a floor on which people can walk,
characterized in that
the horizontal velocity of the air blown in is higher at the top of the layer of air blown in than at the bottom of the layer of air blown in.
2. Method according to Claim 1, characterized in that the height of the layer of air blown in at the location where it is blown in is at least approximately 25 cm.
3. Method according to Claim 1 or 2, characterized in that the blowing velocity at the top of the layer of air is at least approximately 40%, preferably approximately 50%, higher than at the bottom of the layer of air.
4. Method according to one of the preceding claims, characterized in that the blowing velocity at the bottom of the layer of air is at most approximately 6 m/sec, preferably at most approximately 3 m/sec.
5. Method according to one of the preceding claims, characterized in that the blowing velocity at the top of the layer of air is at least approximately 6 m/sec, preferably at least approximately 8 m/sec.
6. Method according to one of the preceding claims, characterized in that the heated air blown in is at a temperature of at most approximately 45°C.
7. Method according to one of the preceding claims, characterized in that the heated air blown in is at a temperature of at least approximately 15°C to 22°C.
8. Device for carrying out the method according to one of the preceding claims, comprising:
 - heater means for heating the air to be blown in;
 - blowing means for blowing in the heated air via a grate positioned at least 2.5 m above the floor;**characterized in that**
the device furthermore comprises distributor means designed to blow in the air at a higher velocity at the top of the grate than at the bottom of the grate.
9. Blowing grate, in particular intended for use in the method according to one of Claims 1-7, comprising a multiplicity of vanes which extend horizontally and are positioned with a spacing between them,
characterized in that
the vanes are substantially V-shaped in cross section, the pointed side of the V shape facing towards the blowing device.
10. Blowing grate according to Claim 9, characterized in that the vertical spacing between adjacent vanes at the top of the grate is smaller than at the bottom of the grate.
11. Blowing grate according to Claim 10, characterized in that the vertical spacing between adjacent vanes gradually decreases along the grate from the bottom upwards.
12. Blowing grate according to one of Claims 9-11, characterized in that the V-shaped vanes are composed of in each case two vane blades which can pivot with respect to one another at the pointed-side of the V shape.
13. Blowing grate according to Claim 12, characterized in that in each case both vane blades of a vane are arranged pivotably.
14. Blowing grate according to Claim 12 or 13, characterized in that the top vane blades of each vane are connected to a common top-blade actuating rod, which extends substantially transversely with respect to the longitudinal direction of the vanes, pref-

erably via in each case a top-blade actuating arm;
and/or the bottom vane blades of each vane are
connected to a common bottom-blade actuating
rod, which extends substantially transversely with
respect to the longitudinal direction of the vanes, 5
preferably via in each case a bottom-blade actuat-
ing arm.

15. Blowing grate according to Claim 14, characterized 10
in that the top-blade actuating rod and the bottom-
blade actuating rod is a rod provided with an exter-
nal screw thread, on which for each top or bottom
vane blade there is a nut member connected to the
said respective vane blade, in such a manner that, 15
when the top-blade actuating rod or bottom-blade
actuating rod is turned, the nut members provided
thereon together move upwards or downwards
along the said respective actuating rod.

16. Blowing grate according to Claim 15, characterized 20
in that the nut members on the respective actuating
rod have the same screw thread as one another,
and in that the actuating rod is positioned at an an-
gle with respect to the plane enclosed by the longi-
tudinal directions of the vanes, in such a manner 25
that the actuating rod is closer to the said plane en-
closed by the longitudinal directions at the top of the
grate than at the bottom of the grate.

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Fig 1

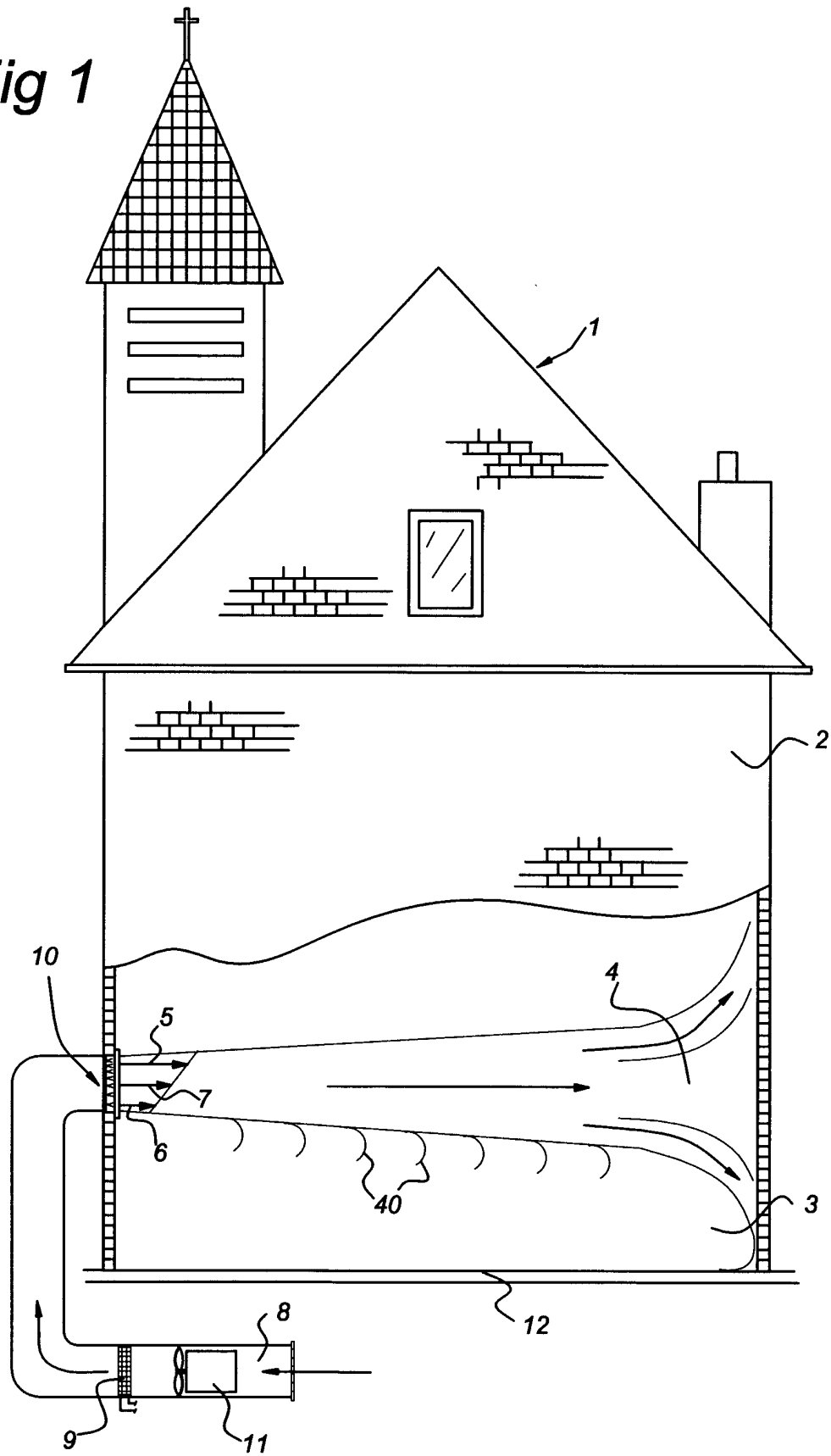


Fig 2

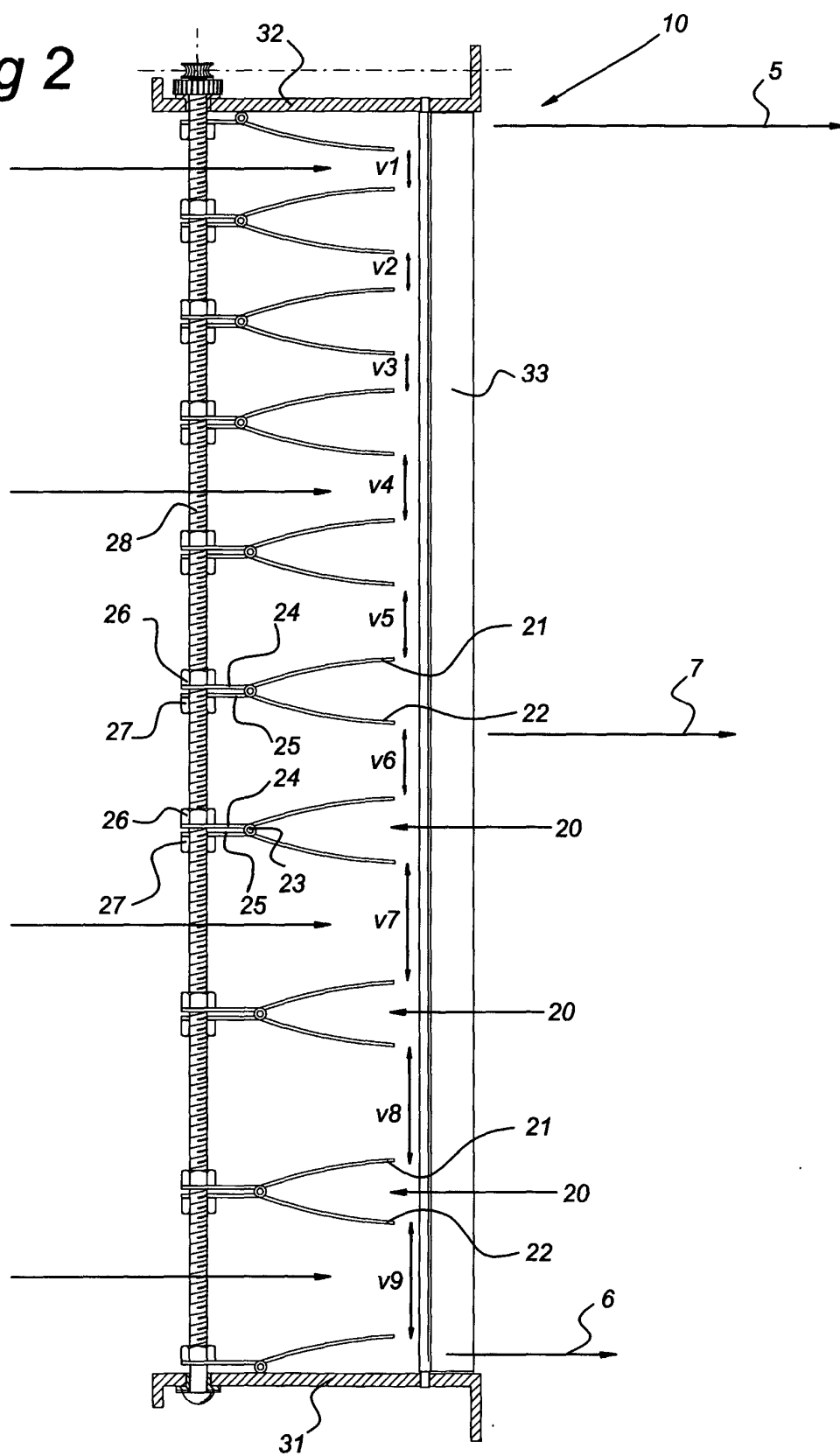


Fig 3

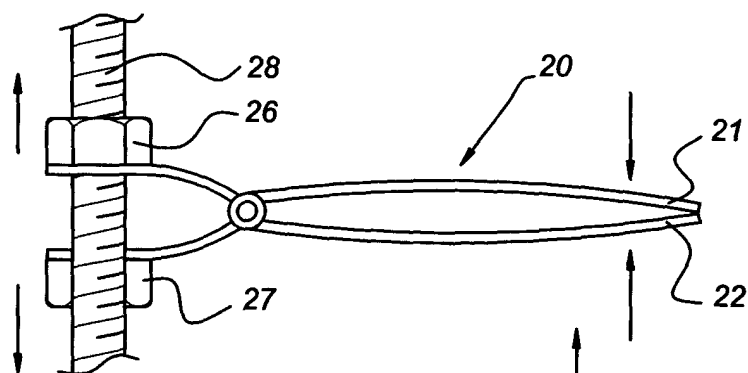


Fig 4

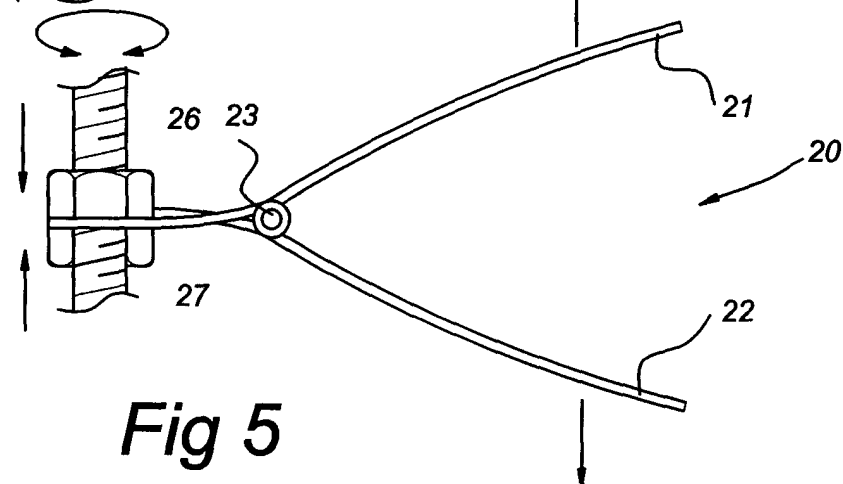


Fig 5

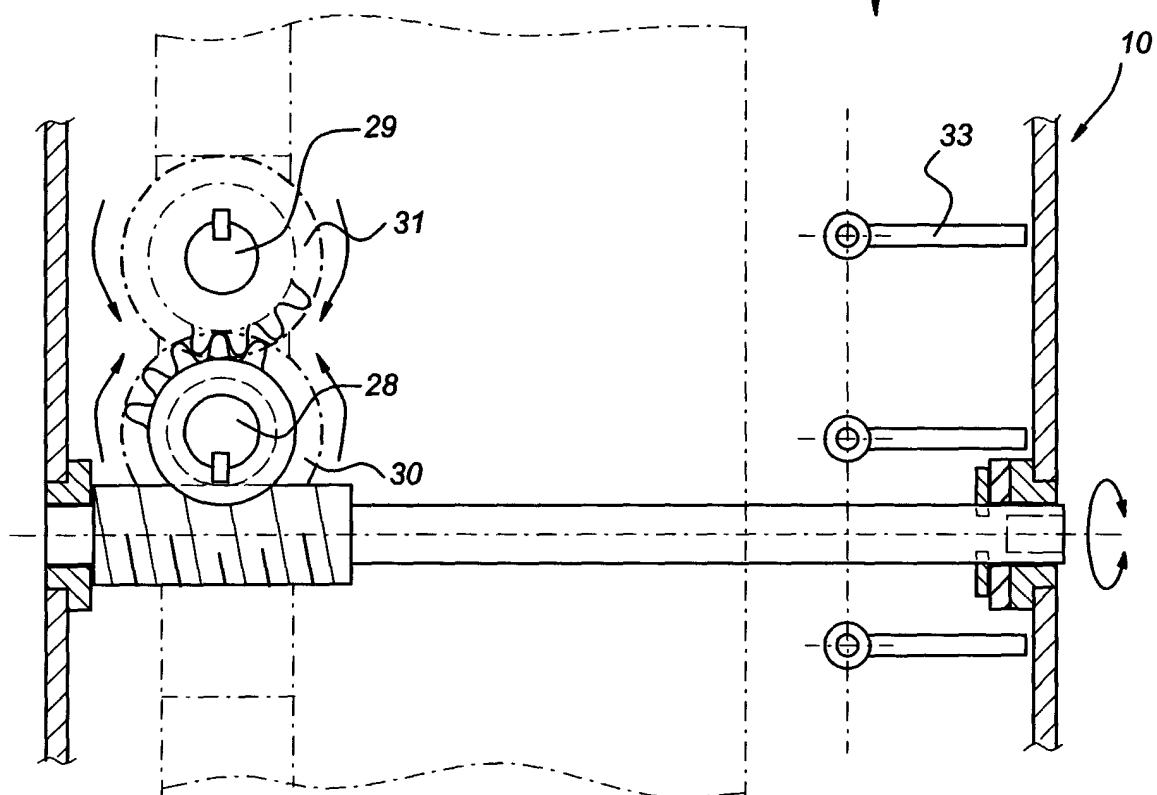


Fig 6

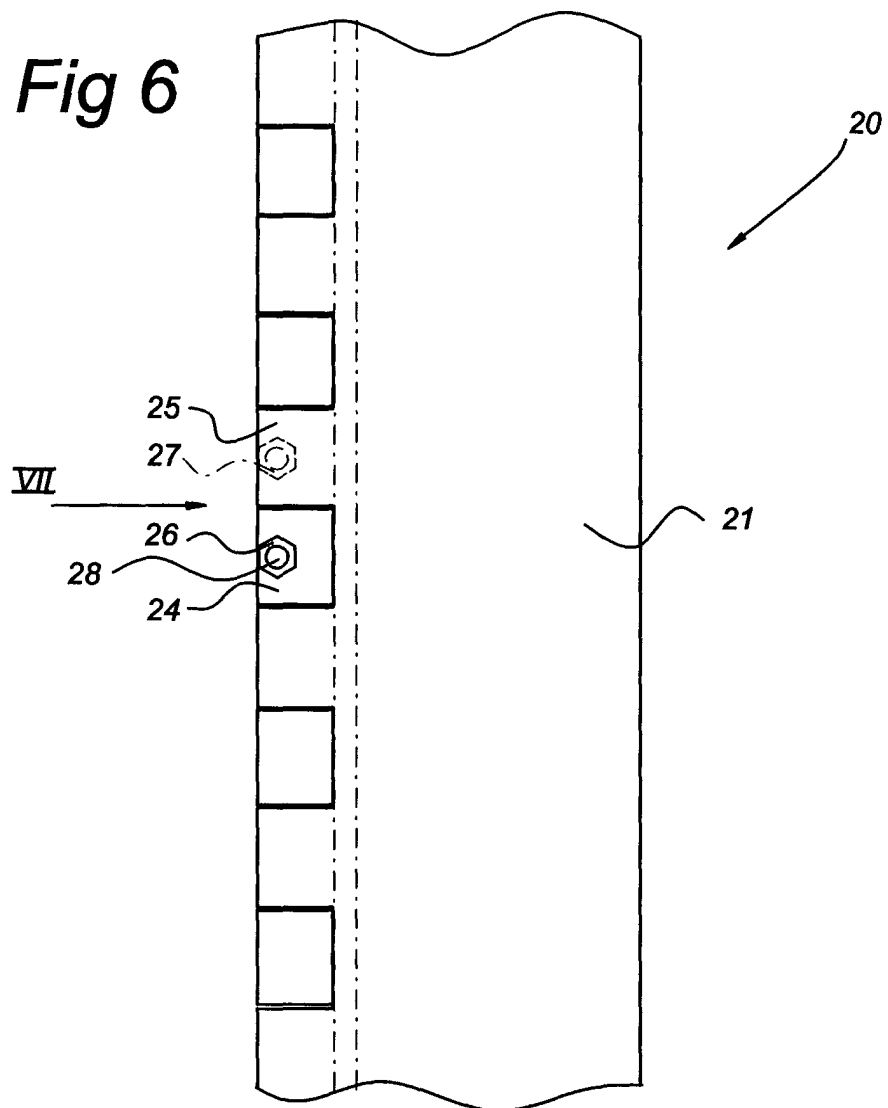
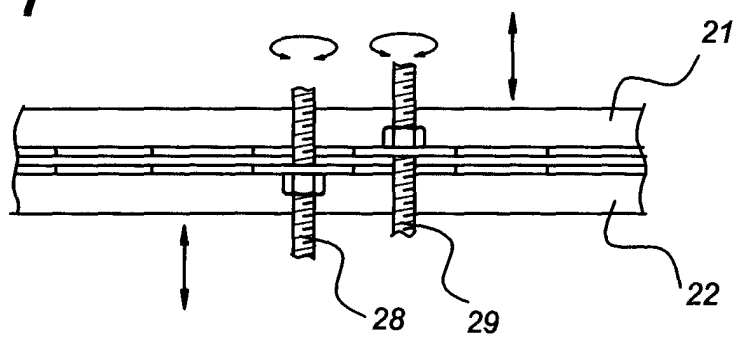


Fig 7





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 00 20 4484

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	NL 59 429 C (N.V. TOT EXPLOITATIE VAN HET VERWARMINGS- EN KLIMATISEERINGSSYSTEEM) 16 December 1946 (1946-12-16) * claims; figures * ---	1,8,9	F24D5/02
A	DD 134 671 A (HEGNER HANS JOERG;DELMHORST PETER; GUENZEL WALTER; KADEN LUTZ) 14 March 1979 (1979-03-14) * page 4; figure * ---	1	
A	DE 38 01 585 A (AL KO POLAR MASCHF GMBH) 3 August 1989 (1989-08-03) * claims 1,2; figures * -----	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			F24D F24F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 27 March 2001	Examiner Van Gestel, H
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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

EP 00 20 4484

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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27-03-2001

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
NL 59429	C	NONE	
DD 134671	A	14-03-1979	NONE
DE 3801585	A	03-08-1989	NONE

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82