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(54) **Air curtain with flow control.**

(57) The invention relates to an air curtain device (1) comprising a housing (3) to be arranged close to a passage opening in a building (2), which housing is provided with an elongate air outflow opening (6), air supply means connected to the opening (6) and air guiding means (7) for causing directed outflow out of the opening (6) of air supplied by the air supply means (10,30). The air supply means (10,30) herein comprise flow control means with which the supplied amount of air can be varied. The device further comprises valve means (11) for varying the active surface of the air outflow opening (6).

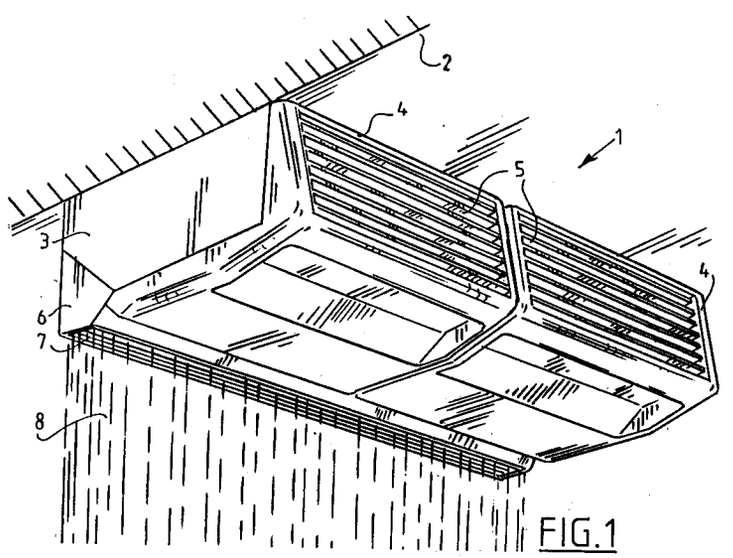


FIG.1

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The invention relates to an air curtain device as known from the European patent application EP-A-0 362 958.

An air curtain device is arranged close to a passage opening of a building such as a shop or department store. Such air curtain devices are also used in banks, office buildings and business premises. The air curtain generated by the device at the location of the passage opening is intended to maintain a separation between the climate in the building and the climate outside it.

The invention has for its object to further improve an air curtain device of the type specified in the preamble.

With the air curtain device according to the invention characterized in claim 1 the amount of air blown out can be varied in order to adapt the curtain to changing operating conditions. The active surface of the air outflow opening can simultaneously be varied so that the outflow speed of the air can likewise be varied, either independently of the amount of outflowing air or not.

When it is for instance desired to supply more heat with the air curtain device because the outside temperature has for instance fallen, this can take place with the device according to the invention by increasing the amount of air. It is then unnecessary to increase the temperature of the outflowing air, which could be unpleasant for passers-by. When conditions are further unchanged, the active surface of the air outflow opening can be enlarged proportionally with the valve means so that the speed of the outflowing air remains the same and the efficiency and good operation of the device are retained. The step of claim 2 is preferably applied for this purpose. Holding the air speed constant is important because when the air speed increases the turbulence in the air flow increases, thereby resulting in increased mixing with the ambient air, in particular the outside air, which on the one hand results in immediate waste of energy and on the other causes some discomfort in the room area.

A suitable embodiment of the device according to the invention is characterized in claim 3. When the amount of delivered air is increased by operation of the flow control means the buffer plate will be moved into another position as a result of the impulse of the air colliding therewith. Due to the active connection with the valve means the active surface of the air outflow opening is simultaneously altered.

A further favourable development is characterized in claim 4. The supplied air strikes against the valve member whereby this functions as buffer plate which is moved by the outflowing air. The end edge of the valve member covers a larger or smaller portion of the air guiding means in accordance with the position of the valve member and thus varies the active surface of the air outflow opening.

Another suitable embodiment of the device according to the invention is characterized in claim 5. When the perforations in the first and second perforated plate coincide, the active surface of the air outflow opening is maximal. By shifting the second plate the perforations will be mutually covered to an increasing extent whereby the active surface of the air outflow opening is reduced. The actuator with which the second plate is shifted in relation to the first can for instance be an electric motor with a suitable transmission for gradually varying the active surface of the outflow opening. Instead of this the actuator can also be a two-way actuator such as an electromagnet which can position the assembly of perforated plates in an open and a closed position. With a number of pairs of first and second perforated plates which can be opened or closed separately a stepwise variation of the active surface can thus be effected.

With the step of claim 6 is herein achieved that a good distribution of the air flow over the whole outlet surface is obtained. With enlarging of the active surface of the air outflow opening according to the invention there would otherwise be a danger of an uneven air speed distribution.

In preference the step of claim 7 is applied. In order to vary the speed of the electric motor the control means will generate a varying electrical voltage. This can be used, whether adapted or not, for adjusting the valve means for varying the active surface of the air outflow opening.

A simpler control is achieved with the step of claim 8. The air curtain device has one unvarying opening for the lowest setting of the fan. For each stepwise increase in the rotational speed one valve is opened so that the active surface is enlarged proportionally.

The invention will be further elucidated in the following description with reference to the embodiments shown in the figures.

Fig. 1 shows a perspective view of an air curtain device according to the invention.

Fig. 2 shows a cross section of the device of fig. 1.

Fig. 3 shows a section corresponding with fig. 2 of another embodiment of the device according to the invention.

Fig. 4 shows in perspective view a detail of the device of fig. 3 according to arrow IV therein.

The air curtain device 1 shown in fig. 1 is mounted above a passage opening in a building 2. This passage opening can be for instance the entrance or a connecting opening between two areas of the building.

The device 1 comprises a housing 3 which is provided with an elongate air outflow opening 6. Air

supply means, which in the embodiment shown and described here are formed by fans accommodated in the housing 3 of the device 1, are connected to the air outflow opening 6. The air is drawn in through inlet grids 5, which are formed in covers 4 closing off the housing 3. Arranged in the outflow opening 6 are elements 7 which reduce the turbulence of the blown out air. The flat stream of air 8 leaving the opening 6 penetrates to the bottom of the passage opening and thus forms in further per se known manner a separation between the two climates on either side of the air curtain 8.

In the device 1 the flow control means are formed by electrical or electronic means (not shown) which can vary the rotation speed of the electric motor, designated schematically with 15, of the fan 10. The flow rate is increased by increasing the rotational speed and vice-versa.

As shown in fig. 2, a valve member 11 is mounted hingedly in housing 3 close to the outlet opening 16 by means of a hinge 12. Valve member 11 is loaded by a spring 13 in the direction counter to the air flow. Valve member 11 thus extends transversely of the air flow direction. The air designated with arrows and leaving the outlet opening 16 of fan 10 collides with the valve member 11. The latter is pivoted by the impulse of this outflowing air counter to the preloading of the spring 13. At a high flow rate setting of the flow control means the valve member 11 will be pivoted further in clockwise direction as seen in fig. 2.

As further shown in fig. 2, an end edge 14 of valve member 11 extends close to the air guiding means formed by the elements 7 in the air outflow opening 6. Valve member 11 hereby covers the part of the air guiding means situated to the left of end edge 14 as seen in fig. 2. Through a pivoting movement on the pivot shaft 12 the valve member 11 can therefore vary the active surface of the air outflow opening 6.

When the flow control means are set to a higher flow rate, with the result that the electric motor 15 is driven at a higher rotational speed, the air flow leaving the outlet opening 16 will exert a greater force on valve member 11 and, as noted above, adjust this in clockwise direction. The end edge 14 of valve member 11 hereby moves to the left whereby a larger part of the surface of the air outflow opening is left open. In the embodiment of fig. 2 the flow control means and the valve means for varying the active surface of the air outflow opening 6 are thus functionally coupled such that, when there is a change in the supplied amount of air through adjustment of the flow control means, the valve means change the active surface of the air outflow opening 6 in the same sense. Through a suitable choice of the characteristic of spring 13 and/or through a suitable placing thereof a desired relation can be obtained between the operation of the flow control means and of the valve means. It is for instance possible that the valve means vary the active surface of the air outflow opening in proportion to the supplied amount of air so that the outflow speed of the air from air outflow opening 6 remains constant.

In the device 21 according to the invention shown in fig. 3 the valve means are controlled separately of the flow control means. The device 21 comprises a housing 23 with covers 24 corresponding with the device 1. Mounted in housing 23 is a fan 30 which is driven by a schematically shown electric motor 35. It is otherwise self-evident that, although only one fan 30 is shown in fig. 2 and 3, the air curtain device according to the invention may comprise a number of such fans adjacently of each other.

Arranged in the device 21 under the housing 23 is tray 25 in which are received the valve means to be described further and at the bottom end of which the air outflow opening 26 is formed. Also arranged in air outflow opening 26 is a number of aligning elements 27 which ensure that the outgoing air flow flows out properly in the same direction.

The air outflow opening 26 is divided into three sections, of which the left-hand one is always open. Arranged in the two right-hand sections closely above the air guiding means formed by the elements 27 is a first perforated plate which, as shown in fig. 3, consists in this embodiment of two reverse V-shaped profiles. Onto each of the two thus formed ridges is positioned in each case a second perforated plate 29. The first plate 28 and the second plates 29 have corresponding perforations and the second plates 29 are placed such that the perforations 36 can coincide therein with the perforations 37 in the first plate 28 lying thereunder.

By sliding each second plate 29 above the first plate 28 through a distance equal to or slightly greater than the width of each perforation 36, 37, the latter no longer coincide at all and a closure is thus formed. The active surface of outflow opening 26 can thus be varied by sliding the second plates 29 relative to the first plate 28. This sliding can take place proportionally, whereby the active surface of air outflow opening 26 varies uniformly.

It is possible instead to slide each second plate 29 between two positions, a first wherein perforations 36, 37 coincide and a second wherein the perforations do not coincide at all. This latter possibility is applied in the device 21.

The displacement of each second plate 29 is herein achieved by means of an actuator in the form of an electromagnet 31, the movable core of which is connected via an arm 39 to each plate 29. Electromagnet 31 has a rest position defined by a

spring 40 which corresponds for example with the open position of plates 28, 29, and an activated position which corresponds for example with the closed position. In order to facilitate sliding of each plate 29 over plate 28 a number of strips of teflon tape 38 is adhered fixedly to plate 28, whereby the friction between both plates is reduced to a minimum.

As shown in fig. 3, two electromagnets 31 are applied which can move two second plates 29 separately over the first plate 28 between an open and a closed position. By successively activating the electromagnets 31 the active surface of air outflow opening 26 can thus be varied in stepwise manner.

In this embodiment the control means (not shown) for the electric motor 35 can switch the latter into three positions. In the first, lowest setting the total output of the fan is blown out through the uncovered left-hand part of air outflow opening 26. In the second setting, in which approximately twice as much air is delivered by fan 30, the valve on the middle part of the outflow opening is opened. Finally, in the third step, wherein the fan 30 operates at full power, three times as much air is delivered as in the lowest setting and the right-hand valve is also opened.

As shown in fig. 3, the outflow opening 26 has a considerable width in the fully opened position of valves 29. However, the perforated plates 29, 28 form a relevant flow resistance to the air, whereby in the space above outflow opening 26 a relevant higher pressure will prevail than outside of it, whereby a good distribution of the air over the full width of the outflow opening will take place. The left-hand part of the outflow opening not covered by a valve is of course provided in similar manner with a flow resistance which can for instance also be formed by a correspondingly perforated plate.

It is noted that the embodiments shown in the figures are not the only possible ones. The valve means in particular can be embodied in very many different ways. The embodiments show only two of these many possibilities. Nor are the air supply means limited to fans driven by electric motors. The air supply can for instance also take place from a central point via a conduit. The flow control means can then for instance be formed by control valves accommodated in these conduits. Although the coupled operation of the valve means and the flow control means forms a favourable embodiment for obtaining a constant outflow speed of the air, the invention is not limited thereto. The parameters according to which the flow control means and the valve means are adjusted may be for instance the inside and outside temperature, the wind speed outside and the like. Manual operation of the flow control means and the valve means to set an optimum desired result is of course also a possibility.

Claims

1. Air curtain device comprising a housing to be arranged close to a passage opening in a building, which housing is provided with an elongate air outflow opening, air supply means connected to the opening and air guiding means for causing directed outflow out of the opening of air supplied by the air supply means, wherein the air supply means comprise flow control means with which the amount of air supplied can be varied and wherein the device further comprises valve means for varying the active surface of the air outflow opening.

2. Air curtain device as claimed in claim 1, wherein the flow control means and the valve means are functionally coupled such that when there is a change in the amount of air supplied by the flow control means the valve means change the active surface of the air outflow opening in the same sense.

3. Air curtain device as claimed in claim 2, wherein a movable buffer plate urged by preloading means in a direction counter to the air flow is arranged in the housing transversely of the air flow direction, which plate is actively connected to the valve means for adjusting these latter.

4. Air curtain device as claimed in claim 3, wherein the valve means comprise a valve member which is pivotable on a shaft parallel to the air guiding means and which is arranged in the air flow direction in advance of the air guiding means and an end edge of which extends close to the air guiding means.

5. Air curtain device as claimed in claim 1 or 2, wherein the valve means comprise a fixedly mounted first perforated plate and a second corresponding perforated plate guided slidably thereon and an actuator for sliding the second plate relative to the first.

6. Air curtain device as claimed in claim 5, wherein the percentage of openings in the perforated plate is limited such that a relevant flow resistance is formed.

7. Air curtain device as claimed in claim 5, wherein the air supply means comprise at least one fan driven by an electric motor and the

actuator is an electrical actuator such as an electromagnet or electric motor and wherein in the device are arranged control means controlling both the electric motor and the actuator.

8. Air curtain device as claimed in claim 7, wherein the control means can adjust the rotational speed of the electric motor in a number of steps and wherein the valve means comprise a number of valves equal to that number of steps minus one.

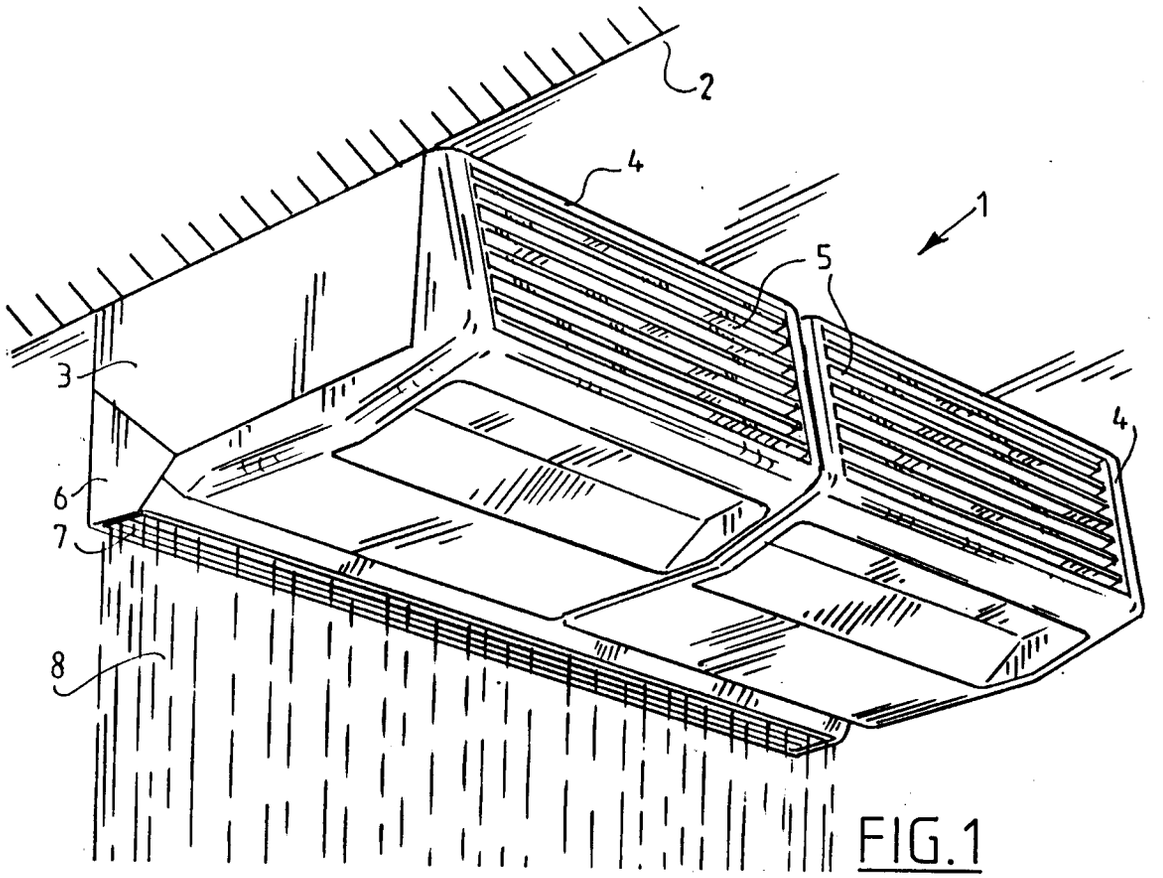


FIG.1

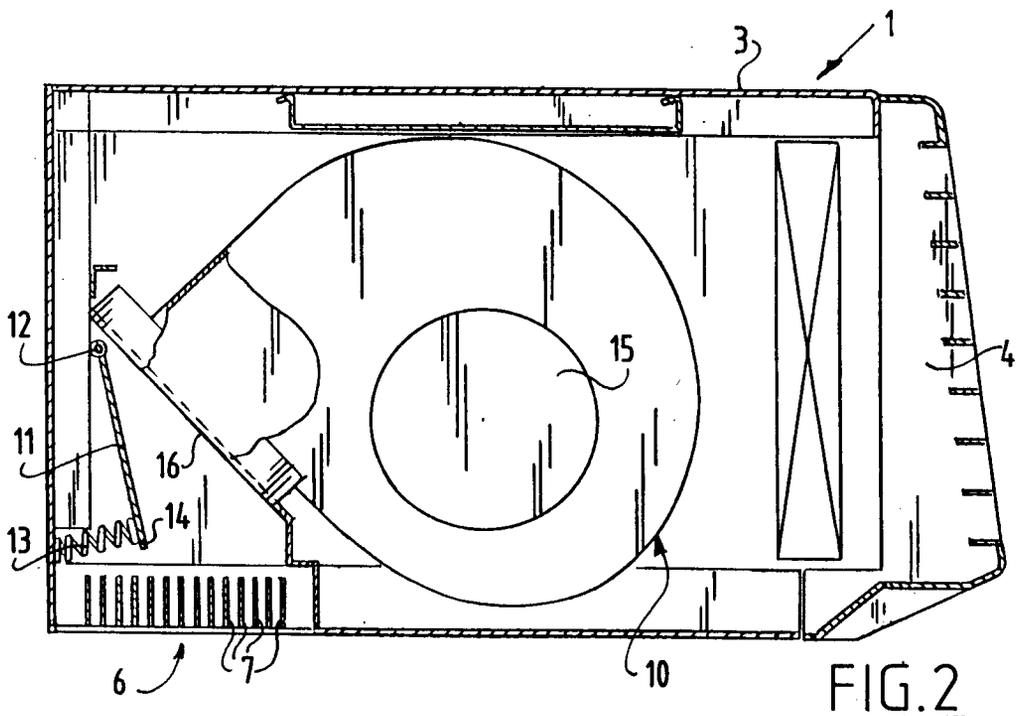


FIG.2

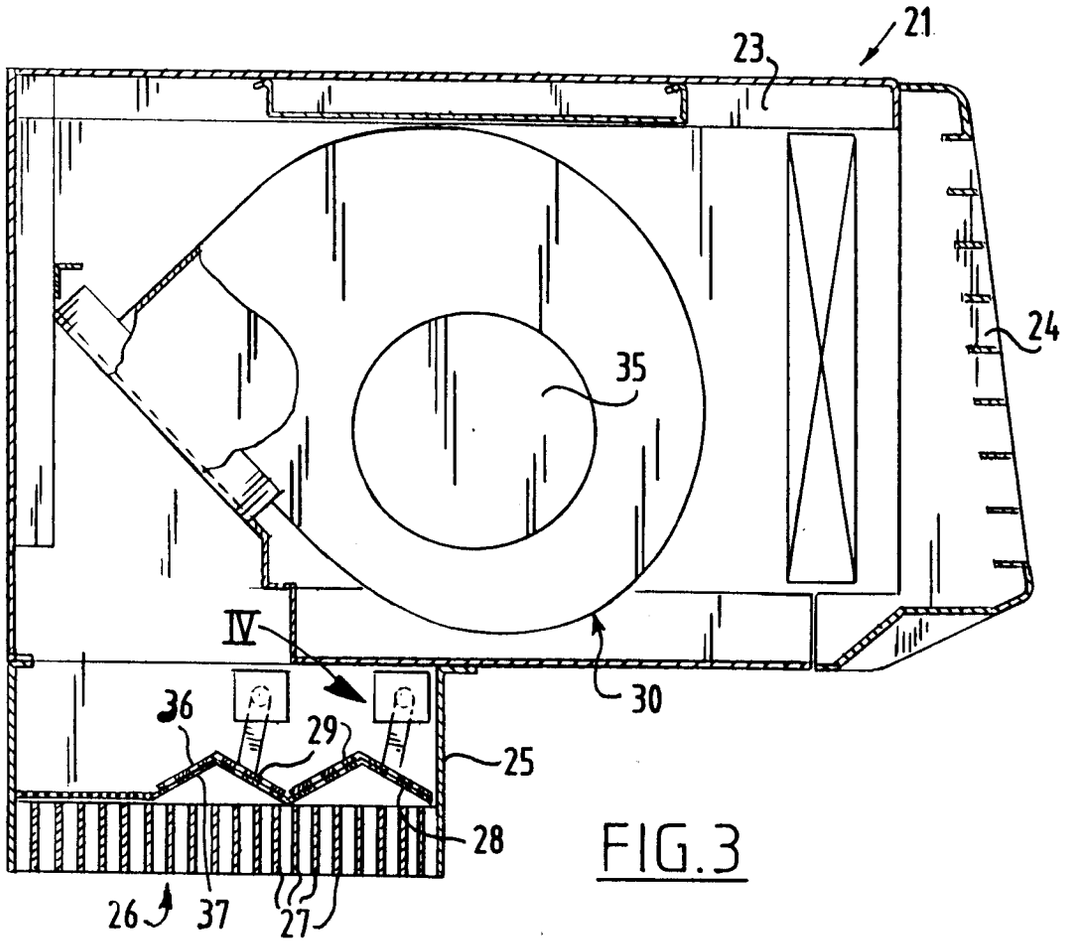


FIG.3

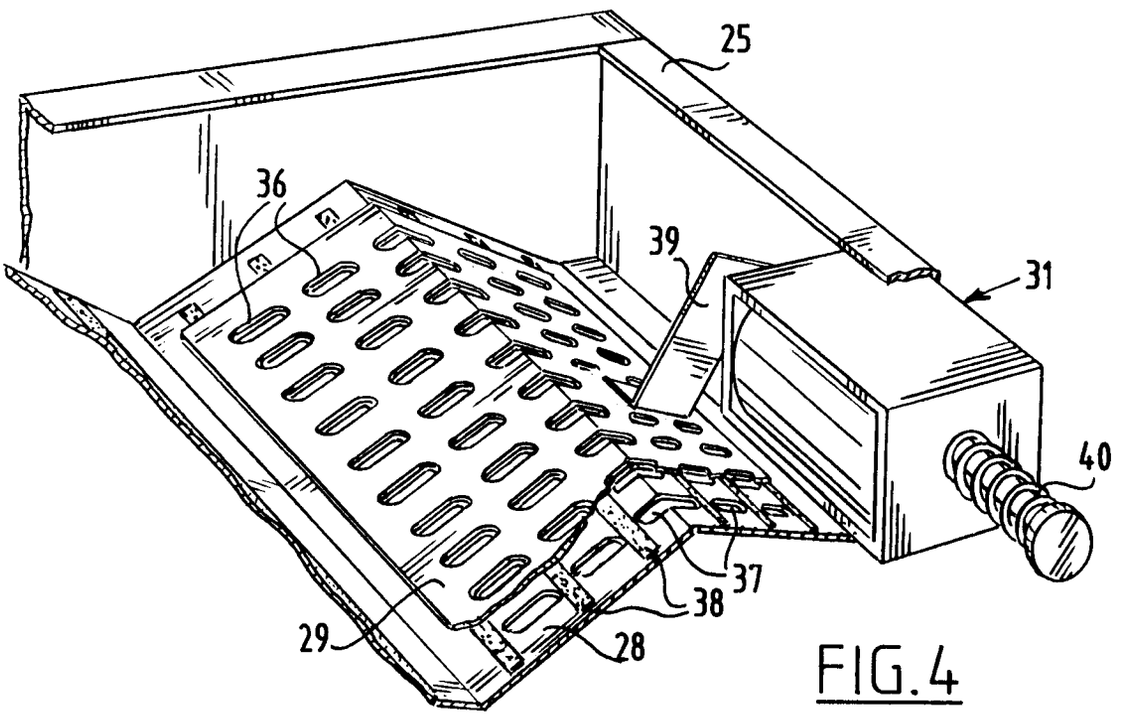


FIG.4

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EUROPEAN SEARCH REPORT

Application Number
EP 94 20 0340

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.5)
X	DE-A-35 23 937 (TIEPOLDT) * abstract; figures 1,2 *	1	F24F9/00 F24F13/12
A	---	2	
A	DE-A-26 00 478 (MÜLLER) ---		
A	CH-A-370 897 (KARLRICHARD MÜLLER) -----		

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

F24F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	6 June 1994	Peschel, G

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