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

(11) EP 1 267 132 A1

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**18.12.2002 Bulletin 2002/51**

(51) Int Cl.[7]: **F24F 7/007**, F04D 29/42, F04D 29/44

(21) Application number: **02077358.6**

(22) Date of filing: **13.06.2002**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR**
Designated Extension States:
**AL LT LV MK RO SI**

(30) Priority: **13.06.2001 NL 1018285**

(71) Applicant: **CE2S N.V.**
**1790 Affligem (BE)**

(72) Inventor: **Speulman, Johannes Antonius Maria**
**2665 DP Bleiswijk (NL)**

(74) Representative:
**Dohmen, Johannes Maria Gerardus et al**
**Algemeen Octrooibureau,**
**P.O. Box 645**
**5600 AP Eindhoven (NL)**

## (54) Ventilating device and ventilating system fitted therewith

(57) A ventilating device (30) comprising means (35) for generating an air flow in a direction towards an outlet opening (29), as well as flow deflection means (73). The flow deflection means are disposed upstream of the outlet opening (29) and are configured in such manner as to prevent the occurrence of a flow in a direction substantially parallel to the outlet opening (29). A ventilating system is furthermore provided, which ventilating system comprises one or more ventilating devices (30) arranged to cause air to flow in a space in substantially virtual ducts (12 - 15) extending substantially parallel to each other in one direction in said space.

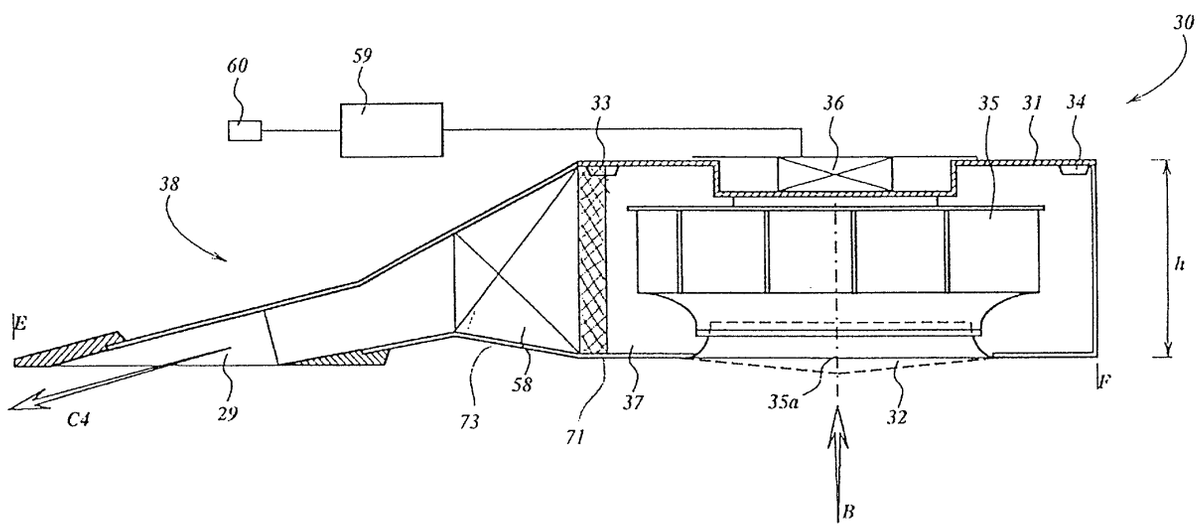


*Fig. 5*

EP 1 267 132 A1

## Description

**[0001]** The invention relates to a ventilating device comprising means for generating an air flow in a direction towards an outlet opening, as well as flow deflection means.

**[0002]** A ventilating device of this kind is known per se from Patent Abstract of Japan, Vol. 013, No 376, 21 August 1989 & JP 01 130099A.

**[0003]** Such ventilating devices are used in multi-storey car parks and traffic tunnels, for example. A few examples of multi-storey car parks fitted with such ventilating devices are the car parks "Kelfkensbos" in Nijmegen, the Netherlands, and the car park under the Museumplein in Amsterdam, the Netherlands. Said ventilating devices are designed and spatially arranged in such manner as to cause air to flow in substantially virtual ducts extending substantially parallel to each other in the longitudinal direction of the space.

**[0004]** In spaces such as multi-storey car parks, it is possible, amongst other things, to blow clean air into the car park through the virtual ducts in a quick and effective manner by means of said ventilating devices, for example in case of a fire in or just beside the virtual duct in question. In most cases, such fires are accompanied by a heavy smoke production. In spaces which are not fitted with a ventilating device, said smoke production makes it impossible to approach the centre of the fire and localise it. If heavy smoke makes it impossible to see the centre of the fire, the firefighters cannot be sure how to proceed. If it is impossible to approach the centre of the fire or, even worse, localise it, it will take longer before the fire can be effectively fought and the damage caused both by smoke and by flames will be much greater. In a multi-storey car park, for example, damage will be done to the building as well as to the cars that are parked therein.

**[0005]** A well-known system is the so-called pulse ventilating system that is marketed by PSB B.V. at Capelle a/d IJssel, the Netherlands. The pulse ventilating system comprises a number of fans which generate an air flow in the longitudinal direction of the space. Such fans are elongated and cylindrical in shape and they have a diameter of some tens of centimetres and a length of 1 to 2 metres. One such fan is required for every 300-400 $m^2$ of floor area. The installed power is 3.75 $W/m^2$, to which end 0.25 m of cable for every $m^2$ of floor area of the car park is required.

**[0006]** This prior art installation has a few drawbacks. An important drawback are the cylindrical dimensions of the fans. In a multi-storey car park, the cylindrical fans are ceiling-mounted. Because of their cylindrical shape, having a diameter in the order of 50 cm, the usable height in the car park is effectively reduced by said dimension relative to the ceiling. In a car park in which the ceiling is disposed 2.60 m above the floor, the maximum height of vehicles that can use the car park will be limited to 2.10 m, for example.

**[0007]** Other drawbacks are the fact that a relatively great number of fans and a relatively high installed power per square metre are required.

**[0008]** JP 01 130099 also discloses a pulse fan, in which at least two fans have a common outlet opening. The outlet opening of the ventilating system disclosed therein is configured to minimise the efficiency-reducing side effects of the convergence of the two air flows. The outlet opening furthermore causes the air flow to be directed slightly downwards, so as to minimise the extent to which objects are hit by the outflowing air. The thus configured outlet enhances the efficiency of the two fans.

**[0009]** One drawback of said ventilating system comprising such an outlet opening is that the presence of objects, such as directing blades, in the outlet opening causes the air flow to diverge in a direction perpendicularly to the direction of flow.

**[0010]** The object of the invention is to provide a ventilating device for a space in a building as described above, in which the ventilating device can cause air to flow in the manner as described above in case of a fire, with less power and less cable work being required whilst retaining the same efficiency as regards the removal of smoke from the space in case of a fire.

**[0011]** According to the invention, this objective is accomplished in that the flow deflection means are disposed upstream of the outlet opening and are configured in such manner as to prevent the occurrence of a flow in a direction substantially parallel to the outlet opening.

**[0012]** This prevents the presence in the air flow of flow lines which approach the outlet opening in a direction parallel to the plane of the outlet opening or at a very small angle thereto. Such flow lines can lead to harmful effects, they may for example create swirls at the edges of the outlet opening, which swirls have a harmful effect on the effectiveness of the air flow being delivered via the outlet opening. As a result of the higher efficiency of the ventilating device according to the invention in comparison with the fans that have been known so far, it is in essence possible to use less power per ventilating device and/or to use fewer ventilating devices in a space than with the known ventilating systems in order to obtain a desired ventilating effect. It will be understood that this provides advantages as regards the installation of the system, among which the fact that less cable work is required.

**[0013]** In one embodiment of the invention, the deflection means are configured so as to deflect the flow in a direction away from the outlet opening at the location of the deflection means. Thus, a very effective flow of the air being blown out by the ventilating device is achieved.

**[0014]** In one preferred embodiment of the invention, the outlet opening lies in a plane substantially parallel to the initial direction of flow; this is the direction in which the air flow propagates directly after exiting the means for generating the air flow.

**[0015]** Said preferred embodiment may furthermore be provided with a housing arranged for deflecting the air flow in such a manner that the air flow exits the outlet opening as a whole at an angle to the plane of the outlet opening.

**[0016]** The configuration of the housing and of the added deflection means fully or substantially prevents the occurrence of swirls that can disturb the convergence of the flow after exiting the outlet opening.

**[0017]** Another preferred embodiment of a ventilating device according to the invention is characterized in that the means for generating the air flow comprise a radial fan.

**[0018]** The effect that is thus achieved is that the dimensions of the ventilating device in a direction perpendicularly to the plane of the outlet opening are quite small, they will be hardly any larger than the height dimensions of the radial fan. Such a ventilating device, which is capable of generating a sufficiently large air flow, will have a height of 20 - 35 cm. With such a type of ventilating device, provided with an outlet opening which lies in a plane parallel to the initial direction of flow, it is possible to achieve the same effect as with the known fans, in particular as regards keeping a large part of a space clear of smoke in case of a fire, with less power being required. Furthermore, when such a ventilating device is used, the electric power that is required will only be 1.875 W/$m^2$, or even less, whilst the required amount of cable work will be 0.06 m per $m^2$ of floor area at most. Furthermore, only one fan per 1600 $m^2$ of floor area will be required.

**[0019]** In another embodiment, the ventilating device comprises a laminar flow aligning device, which is disposed downstream of the means for generating the air flow and upstream of the outlet opening.

**[0020]** The advantage of the addition to the ventilating device of such a flow aligning device which, in one embodiment of the invention, has a fine-meshed structure such as a gauze-like structure or a honeycomb structure, is that any swirls that have been created in the air flow upon generation of the initial air flow are eliminated by said means before the air flow exits the outlet opening. If said means are added at a location downstream of the place where the flow is deflected, for example, the flow will as a rule convert into a substantially laminar flow, which is easier to deflect without causing harmful effects.

**[0021]** The invention also relates to a ventilating system comprising one or more ventilating devices as described in at least one of the preceding claims for causing air to flow in a space in substantially virtual ducts extending substantially parallel to each other in one direction in said space, as well as a space, such as a multi-storey car park, fitted with such a ventilating system.

**[0022]** The invention will now be explained in more detail with reference to the accompanying figures and drawings, in which:

Figure 1 is a schematic top plan view of a multi-storey car park fitted with a known ventilating system.

Figure 2 is a schematic top plan view of a multi-storey car park as shown in Figure 1, which is fitted with a ventilating system according to the invention.

Figure 3 is a schematic longitudinal sectional view, along the line II-II in Figure 4, of a ventilating device according to the preferred embodiment of the invention, which is suspended in a space.

Figure 4 is a schematic cross-sectional view, along the line III-III in Figure 3, of the ventilating device according to the invention, which is mounted on the ceiling of a space.

Figure 5 is a schematic longitudinal sectional view of another preferred embodiment of the ventilating device according to the invention.

Figure 6 is a schematic longitudinal sectional view of yet another embodiment of a ventilating device according to the invention.

Figure 7 is a schematic longitudinal sectional view of yet another embodiment of a ventilating device according to the invention.

Figure 8 is a schematic bottom plan view of two ventilating devices as shown in Figure 5, which are arranged side by side.

Figure 9 is a schematic bottom plan view of two ventilating devices as shown in Figure 7, which are arranged side by side.

Figure 10 is a schematic longitudinal sectional view of another embodiment of the ventilating device as shown in Figure 5, which is fitted with a drivable rotary platform.

**[0023]** In Figure 1 a top plan view of a parking deck in a multi-storey car park is shown. The parking take is indicated by reference numeral 1. The parking deck 1 has a longitudinal direction indicated by a double arrow L, and a transverse direction indicated by the double arrow D. The parking deck 1 is accessible via a semicircular on-ramp 2 and a semicircular off-ramp 3, and the parking deck 1 can be left by way of a semicircular off-ramp 4 and a semicircular on-ramp 5. Reference numeral 6 indicates an exhaust system which is known per se, which exhaust system is normally present and which ensures that, in normal situations, the parking deck 1 is sufficiently ventilated and cleared of exhaust gases from cars with running engines that are present on the parking deck 1. Rectangles, such as the rectangle 7, indicate parked cars. For easy reference, only a limited number of rectangles are shown, but it will be understood that a large number of parking spaces for cars are present between the rectangle 7 and the rectangle 8.

**[0024]** The chain-dotted lines 9, 10 and 11 indicate virtual separations between virtual ducts 12, 13, 14 and 15. Said separations and said ducts are called virtual separations and ducts, because there are no actual physical partitions. The elongated, cylindrical fans that are usual in the prior art, such as the fans that are in-

stalled by the firm of PBS B.V. at Capelle a/d IJssel, the Netherlands, are arranged in such a manner, at locations not shown in Figure 1, that a separate air flow in the direction indicated by the arrow A can be generated in each of the virtual ducts when the fans are operative. It is a known fact that if an air flow in the direction indicated by the arrow A is generated, for example in virtual duct 14, by the known, cylindrical fans, the larger part of the air in the virtual duct 14 will be set moving in the direction indicated by the arrow A due to physical effects which are known per se, such as the venturi-effect, as a result of which an air flow, which is fairly narrow by itself, will drag along a surrounding wider air flow. By activating fans only in the virtual duct 14, it is ensured that an air flow will be present practically exclusively in virtual duct 14, whilst no such air flow will be present in the adjacent virtual ducts 13 and 15 in that case. In practice it seems, therefore, that walls are present at the location of the chain-dotted lines 9, 10 and 11, which restrict an air flow generated in one of the virtual ducts substantially to the virtual duct in question.

**[0025]** By way of illustration of the operation of the known ventilating devices, a car 16 being on fire is shown in the hatched part of Figure 1. A burning car in a car park produces a great deal of smoke which hides the centre of the fire, the burning car, from view after a short time already, fills the parking deck 1 completely with very dark smoke, in which visibility is limited to maximally a few dozen centimetres, and in which respirators are required in order to prevent poisoning. Dashed line 17 indicates a dividing line between a space 18, in which the centre of the fire is not located, and a space 19 in which the centre of the fire 16 is located. The space 18 must be clear of smoke as much as possible, whilst the space 19 does not need to be clear of smoke. In such a case, the centre of the fire 16 can be approached up to a small distance from the space 18, and the centre of the fire will be visible from a large distance already. This enables the firefighters to approach the centre of the fire 16 from the space 18 without any appreciable risk and extinguish the fire from there. As a result, the time during which the fire is burning will be significantly reduced, because it can be put out at an early stage, so that also the total amount of smoke can be reduced. Furthermore, the extent of the damage caused to the building will be limited in comparison with the situation in which the fire would burn longer. In addition to that, the risk of cars parked beside the burning car in the car park being damaged is significantly reduced. As a result of the strong supply of air in the direction indicated by the arrow A, the temperature increase caused by the fire 16 will be significantly smaller, in the space 18 at any rate, than in the situation in which there would be no supply of air in the direction indicated by the arrow A. Any intensification of the fire at the centre of the fire 16 as a result of fresh oxygen being supplied is more than compensated by the speed with which the firefighters are able to see, approach and extinguish the fire. The quick approach by the firefighters is the result both of the good visibility of the fire from the space 18 and of the relatively low temperature in the area 18.

**[0026]** For other locations on the parking deck 1 where a fire breaks out, the course of the line 17 will be different and different fans will be activated. Car parks fitted with a fire alarm system and control devices for various fans of the ventilating devices are known per se, both from the car parks that have been mentioned by way of example in the introduction and in dozens of other car parks all over the world which are fitted with a system comprising elongated, cylindrical fans having circular outlet openings installed by PSB B.V. or other companies.

**[0027]** Figure 2 shows by way of example the manner in which a space within a building, such as the parking deck that is shown in Figure 1, can be fitted with a ventilating system according to the invention, which takes up less of the available space, especially in vertical direction, and which comprises ventilating devices which are capable of generating an air flow in the direction indicated by the arrow A in the virtual ducts 12, 13,14 and 15 in a more effective manner. In Figure 2, the dashed line 20 indicates a line near a ceiling of the parking deck 1 along which outlet openings of the ventilating devices 21, 22, 23, 24, 25 and 26 according to the invention extend. The ventilating devices 21-26 have an outlet opening configured as an elongated slit which is located approximately at the level of the line 20 and which extends substantially parallel to the floor of the parking deck.

**[0028]** In the embodiment according to Figure 2, the line 20 extends at an angle $\beta$ to the longitudinal direction L. Preferably, but not necessarily, the angle $\beta$ equals 90°.

**[0029]** Figures 3 and 4 show by way of example the manner in which the ventilating device 21 is mounted in the space formed by the parking deck 1. The parking deck 1 comprises a floor 27 and a ceiling 28. The ventilating device 21 is mounted on the ceiling 28. The ventilating device 21 is provided with an outlet opening 29, via which air sucked in by the ventilating device 21 as indicated by the arrow B is blown out in the direction indicated by the arrow C. As is known per se from the known installations comprising elongated, cylindrical fans having circular outlet openings, the air is blown out in the direction indicated by the arrow C at an angle $\alpha$ to the horizontal plane 74 in which the outlet opening 29 lies. In order to obtain a satisfactory operation, the angle $\alpha$ will range between 2° and 10°. As will be apparent to those skilled in the art upon studying Figures 3 and 4, the slit 29 extends substantially parallel to the floor 27, in a direction substantially perpendicularly to the longitudinal direction L of the parking deck 1.

**[0030]** The slit 29 provides a directed air flow in one direction as indicated by the arrow C, which air flow only fans out to a very limited extent in a direction perpendicularly to the plane of drawing of Figure 3. In fact, the air flow, which is indicated by the arrow C, forms a rel-

atively thin but quickly flowing plane in the space between the floor 27 and the ceiling 28. Air present above and below the plane of the quick flow and also, up to a certain distance, to the left and to the right of the air flow indicated at C, is carried along by the quick flow. In Figure 4, the air flow according to the arrow C is directed from the plane of drawing in the direction of the observer, all this as indicated by the arrows in front elevation C1, C2 and C3.

**[0031]** In Figure 5, a preferred embodiment of a ventilating device according to the invention is indicated at 30. The ventilating device 30 comprises a housing 31 having a bottom opening 32 and points of attachment 33 and 34 for mounting the housing 31 on the ceiling 28. A radial fan in the form of an impeller wheel 35 is present in the housing 31. The impeller wheel 35 is rotatable about an axis of rotation 35a. The impeller wheel 35 can be rotated via a device 36, which will be described in more detail with reference to Figure 8. The impeller wheel 35 is so configured, in a manner which is known per se, that air is sucked in through the opening 32 in the direction indicated by the arrow B and supplied to the space 37 within the housing 31. The housing 31 comprises an outflow end, which is generally indicated at 38 and which opens into the outlet opening 29. As already described with reference to Figures 3 and 4, the outlet opening 29 is elongated in shape and extends in the longitudinal direction, perpendicularly to the plane of drawing of Figure 5.

**[0032]** In accordance with the invention, flow deflection means 73 in the form of an elevation of approximately triangular section extending inwards from the housing 31, which elevation is configured to prevent the flow of air in a direction substantially parallel to the outlet opening 29, are arranged upstream of the outlet opening 29. In the illustrated embodiment, the flow deflection means 73 lie substantially in the plane 74 of the outlet opening and extend some distance into the air flow with respect to the plane 74.

**[0033]** In this embodiment of the invention, the flow deflection means 73 are so configured that the air flow is deflected in a direction away from the outlet opening 29 at the location of the flow deflection means 73. In this way, the presence in the air flow of flow lines approaching the outlet opening 29 parallel to the plane of the outlet opening or at a very small angle thereto is prevented. Such flow lines can cause harmful effects, they may for example cause swirls at the boundary edges of the outlet opening 29, which swirls have an adverse effect on the effectiveness of the air flow delivered via the outlet opening 29. Furthermore it is possible to achieve in this way that the flow, upon exiting the outlet opening, will not include any components which propagate at a relatively small angle $\alpha$ (Figure 3), for example an angle of less than 2°. The arrow C4 indicates the direction of the air flowing from the outlet opening 29 as a result of the overpressure in the space 37.

**[0034]** To those skilled in the art it will be apparent that the flow deflection means may exhibit various shapes, they may for example be in the form of an upright edge or edges or in the form of a blade or blades which, in accordance with the invention, are located upstream of the outlet opening 29.

**[0035]** The outflow end 38 is arranged to deflect the air flow in such a manner that it will exit the outlet opening 29 as a whole at a desired angle $\alpha$ (Figure 3) to the plane 74 of the outlet opening 29.

**[0036]** Furthermore, a laminar flow aligning device 71 is added to the device, which flow aligning device is present in the flow between the outlet opening 29 and the means 35 for generating the air flow. Such a laminar flow aligning device 71, which preferably comprises a fine-meshed structure (for example gauze-like structure or a honeycomb structure), functions to suppress swirls that are produced upon generation of the air flow by the impeller wheel 35 and to enable a laminar air flow.

**[0037]** Referring to Figure 8, a bottom plan view of two ventilating devices 39 and 40 arranged side by side is shown, which ventilating devices are comparable to the ventilating device 30 of Figure 5. The ventilating devices 39 and 40 are each provided with an intake opening 41, 42, respectively, which are covered with a stainless steel protective mesh indicated at 43 and 44, are respectively. Figure 8 furthermore shows attachment hooks 45, 46, 47 and 48 for attaching the ventilating devices 39 and 40 to the ceiling 28. Each of the ventilating devices 39 and 40 is provided with a slit 49, 50, respectively. Arranged at the upper side of the ventilating devices 39 and 40, and consequently indicated by a dashed line, is a motor 51 which drives a driving belt 52. The driving belt 52 is passed over a pulley 53 of the motor 51, and also over the pulleys 54 and 55 of the fans of the ventilating devices 39 and 40, respectively. Furthermore, guide wheels 56 and 57 are shown. Referring to Figure 5 again, it will be apparent that numeral 36 indicates the belt 52 that is passed over the pulley 54. The pulleys 54 and 55 are connected to impeller wheels disposed thereunder, such as the impeller wheel 35 in Figure 5.

**[0038]** With reference further to Figure 5, the height h is about 33 cm, and the depth, i.e. the distance between points E and F, is 185 cm. The transverse dimension of the ventilating devices 30, and of the ventilating device 39 and the ventilating device 40, is 115 cm. It is noted that the dimensions listed above are dimensions used by way of example, which do no limit the invention in any way.

**[0039]** In order to achieve the numbers mentioned in the introduction of one ventilating device 30 for every 1600 $m^2$ of floor area of the space in which the fan is present, the fan 30, and also the ventilating devices 39 and 40, must displace an amount of air of at least 6.25 $m^3$/sec at an exit velocity from the slit 29 of at least 25 m/sec, preferably 27 m/sec. To that end, the driving motor will have a power of 3 kW per ventilating device.

**[0040]** Vertically disposed directing blades extending in the longitudinal direction, one of which is indicated at

58, are arranged between the space 37 and the outlet opening 29.

**[0041]** It is noted that the ventilating devices 30, 39 and 40 are not operative during normal use of the space, such as the parking deck 1. A control device 59, which is connected to one or more of fire detectors 60, is provided for controlling the ventilating devices 30, 39 and 40. When a fire detector 60 detects fire or any other sign of a fire, the fire detector 60 will deliver a signal to the control device 59 which, in response thereto, will deliver a control signal to the driving unit of the ventilating devices 30, 39 and 40 to activate said ventilating devices. All this takes place in a manner which is known per se, viz. the manner that is known from the control devices being used for the elongated, cylindrical fans having circular outlet openings, such as the fans that are used in the existing car parks as referred to in the introduction, and consequently they need not be explained in more detail herein.

**[0042]** Figure 6 shows an alternative driving arrangement for the ventilating device 30. In the case of Figure 6, the ventilating device 30 is provided with an impeller wheel 35 having an opening surrounding the axis 61, in which a motor 62 is present. The motor 62 is fixed to the housing 31 by means of a plate 63, and it will rotate the impeller wheel 35 and great speed upon being energised.

**[0043]** In the example that is shown in Figure 2, the length L of the parking deck 1 is so small that the presence of one or more ventilating devices according to the invention near one end, near the line 20, will suffice. In spaces having a greater length L, it is advisable to position another row of ventilating devices according to the invention somewhere halfway the length of the space or at one third or two-thirds of the length thereof. In that case there may be a fire on either side of the ventilating device in question, seen in the longitudinal direction. Figure 7 shows a ventilating device which can be advantageously arranged at such a position. Such a ventilating device is shown in longitudinal sectional view in Figure 7. The ventilating device 64 comprises a housing 65 accommodating a central impeller wheel 66, and it is provided with a first slit 67 and a second slit 68 extending parallel thereto. Controllable valves 69 and 70 are arranged in the housing 65. The valves 69 and 70 can move between the position illustrated in full lines and the position illustrated in dashed lines in Figure 7. The valves 69 and 70 are actuated by means of motors (not shown) which are known per se. Said motors are controlled from the control device 59. In this situation that is shown in Figure 7, air will flow out from the opening 67 when the ventilating device 64 is operative, whilst the opening 68 is closed by the valve 70. If an air flow is required on the other side of the ventilating device 64, however, which is indicated by the control device 59 in response to signals from the fire detector 60, the valve 70 will be moved to the position illustrated in dashed lines, and the valve 69 will likewise be moved to the position illustrated in dashed lines. As a result, air can no longer flow to the outlet opening 67, whereas the flow of air to the outlet opening 68 is possible.

**[0044]** Figure 9 is a bottom plan view of a dual version of a ventilating device as indicated at 64 in Figure 7. For the sake of simplicity and easy reference, the same reference numerals as in Figure 7 are used in Figure 9, with this difference that in Figure 9 the indications "-1" and "-2" are added to the numerals. With regard to those parts in Figure 9 that are not indicated by reference numerals, reference is made to corresponding, numbered parts in Figure 8.

**[0045]** Figure 10 shows the embodiment as shown in Figure 5, which is mounted on a drivable rotary platform 72. The ventilating device 30 can thus the rotatably mounted on the ceiling or the roof of a space, as is shown in Figure 2, and be rotated, if desired, so as to create an air flow in a specific desired direction in the space. A drivable rotary platform 72 such as the platform on which the ventilating device 30 is mounted may be actuated by an electromagnet (not shown) and be biassed by spring means (not shown).

**[0046]** In the foregoing, a detailed description of the use of a ventilating device in a multi-storey car park has been given. Although this seems to be the most suitable applications so far, it should be considered that also other spaces in buildings in which a fire accompanied by smoke production may break out can be protected in this manner. In this connection, department stores in which many people have to leave the department store in case of a fire may be considered. In such a case it is important that the smoke production is limited in quantity, time and extent of spreading, and that as much space remains available for escape as possible. In this regard, the use of the present invention is of great importance, because not only the space in which the smoke can spread is limited, but also because the area which can be used for people to escape and which does not become inaccessible due to excessive heat is significantly enlarged.

**[0047]** In fact, any large space in which a fire may develop and in which many people or goods may be present will benefit from the use of the present invention. In this connection, also a rival and departure halls at airports and auction rooms may be considered.

**[0048]** The great many embodiments and modifications will be apparent to those skilled in the art after reading the foregoing. All such embodiments and modifications are considered to fall within the scope of the invention.

## Claims

1. A ventilating device comprising means for generating an air flow in a direction towards an outlet opening, as well as flow deflection means, **characterized in that** the flow deflection means are disposed

upstream of the outlet opening and are configured in such manner as to prevent the occurrence of a flow in a direction substantially parallel to the outlet opening.

**2.** A ventilating device according to claim 1, **characterized in that** the deflection means deflect the flow in a direction away from the outlet opening at the location of the flow deflection means.

**3.** A ventilating device according to any one of the preceding claims, in which the generated air flow has substantially an initial direction of flow, **characterized in that** the outlet opening lies in a plane parallel to said initial direction of flow.

**4.** A ventilating device according to claims 2 and 3, **characterized in that** said flow deflection means are substantially arranged in the plane of the outlet opening.

**5.** A ventilating device according to any one of the preceding claims, comprising a housing extending at least between the means for generating the air flow and the outlet opening, **characterized in that** the housing is arranged for deflecting the air flow in such a manner that the air flow exits the outlet opening at an angle to the plane of the outlet opening.

**6.** A ventilating device according to claim 5, **characterized in that** the angle at which the air flow exits the outlet opening ranges between 2° and 10°.

**7.** A ventilating device according to any one of the preceding claims, **characterized in that** the means for generating an air flow comprise a radial fan.

**8.** A ventilating device according to any one of the preceding claims, **characterized in that** a laminar flow aligning device has been added to the means for generating the air flow at a location upstream of the outlet opening and downstream of the means for generating the air flow.

**9.** A ventilating device according to any one of the preceding claims, **characterized in that** a second outlet opening has been added to the device.

**10.** A ventilating device according to claim 9, **characterized in that** controllable valves have been added downstream of the means for generating the air flow, which valves function to close an air connection between the means for generating the air flow and at least one of the outlet openings.

**11.** A ventilating device according to claim 10, **characterized in that** a control device is present for actuating the valves.

**12.** A ventilating device according to any one of the preceding claims, **characterized in that** fire detection means have been added to the ventilating device.

**13.** A ventilating device according to claims 11 and 12, **characterized in that** said fire detection means are connected to the control device for actuating the valves.

**14.** A ventilating device according to any one of the claims 12 and 13, **characterized in that** the control device is designed to close valves on one side of a fire upon detection thereof and to open valves on a side remote from the fire with respect to the means for generating the air flow.

**15.** A ventilating device according to any one of the preceding claims, **characterized in that** the air flow exiting the ventilating device through the outlet opening during operation has a velocity of at least 25 m/sec at a flow rate of at least 6 $m^3$/sec.

**16.** A ventilating system comprising one or more ventilating devices as defined in at least one of the preceding claims for causing air to flow in a space in substantially virtual ducts extending substantially parallel to each other in one direction in said space.

**17.** A ventilating system according to claim 16, **characterized in that** at least one control device for controlling the valves of the ventilating devices is connected to the ventilating devices.

**18.** A ventilating system according to any one of the claims 16 and 17, **characterized in that** at least one fire detection device is connected to said ventilating devices.

**19.** A space, such as a multi-storey car park, fitted with a ventilating system according to any one or more of the claims 16 - 18.

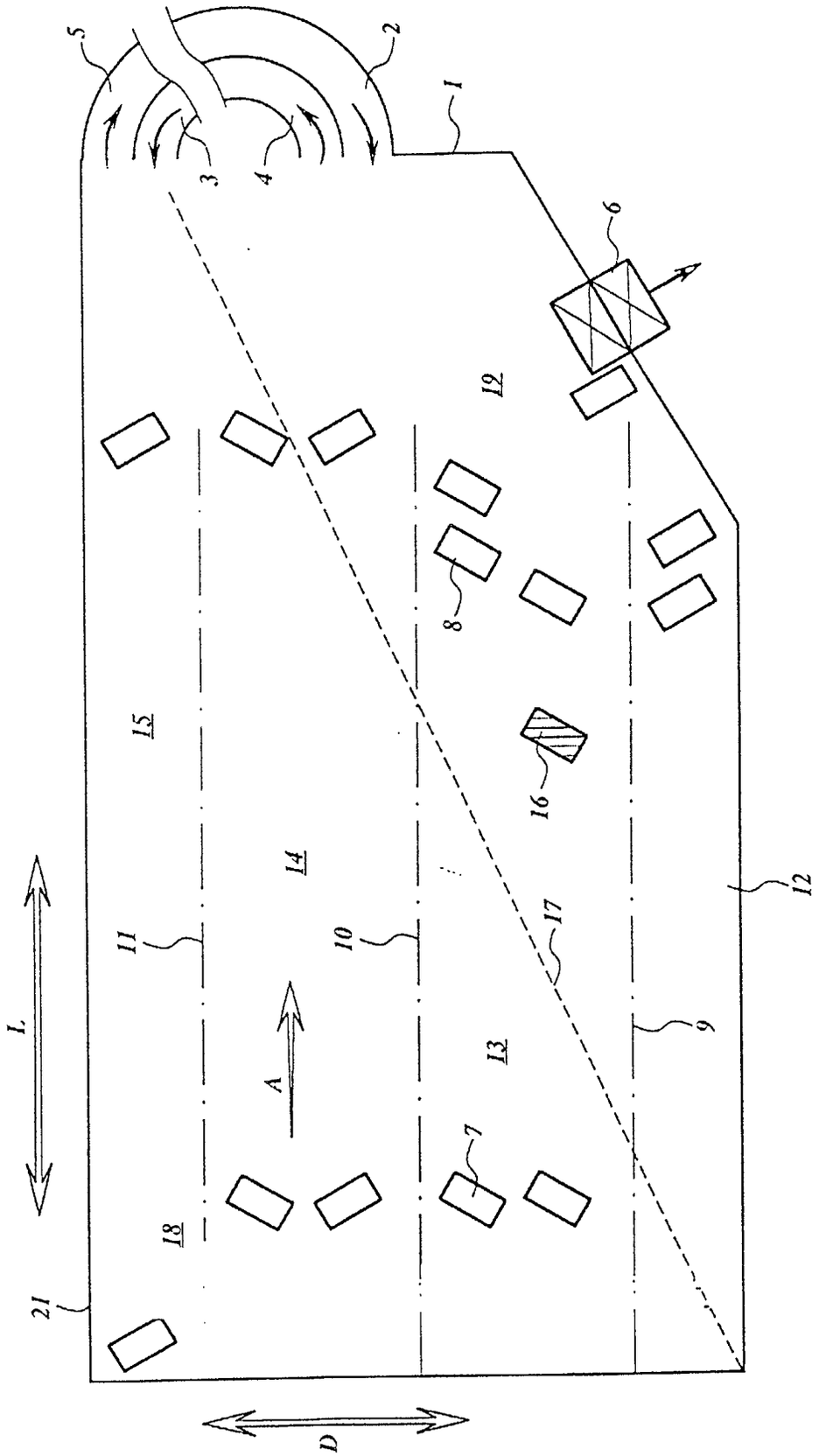


*Fig. 1* Stand van de Techniek

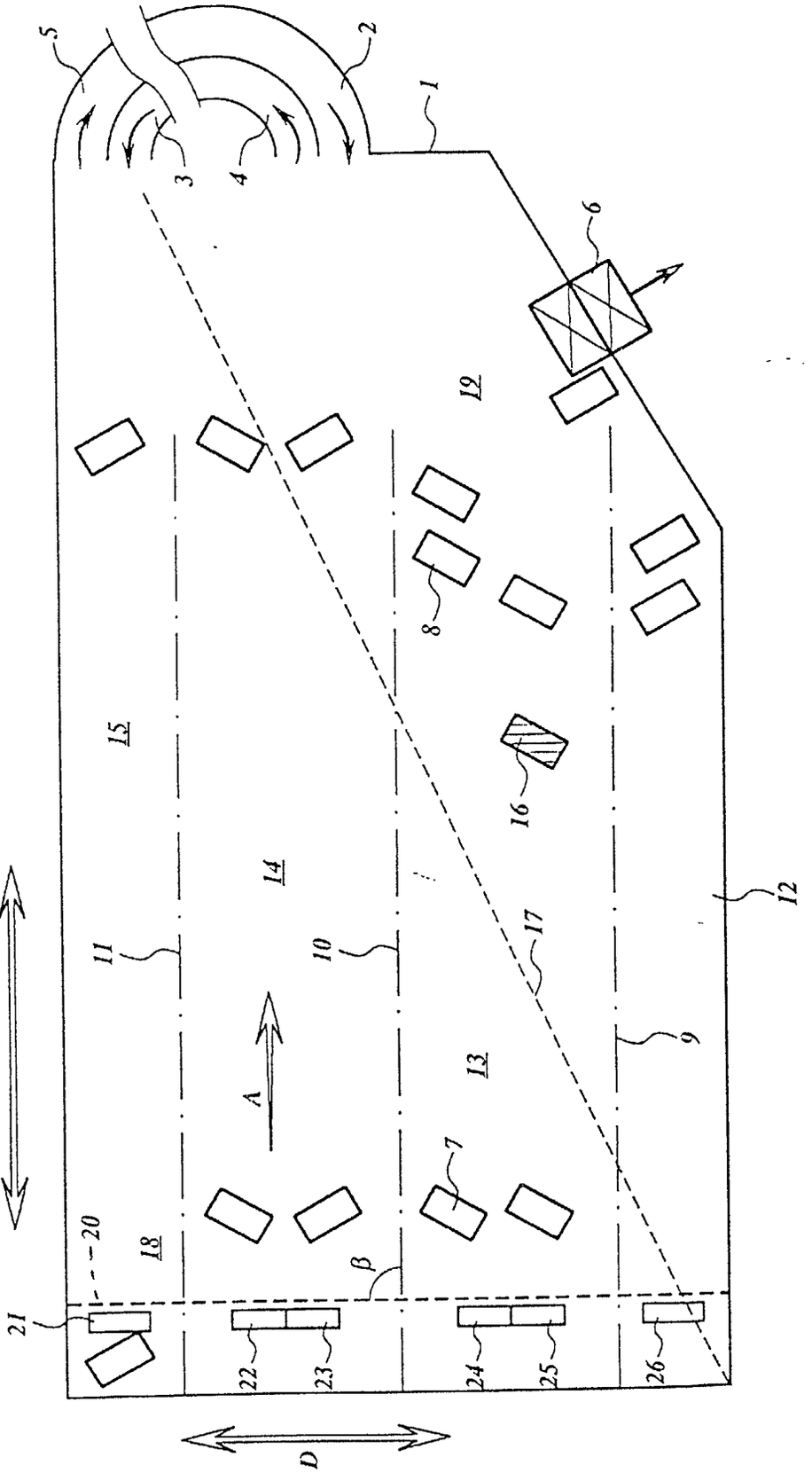


Fig. 2

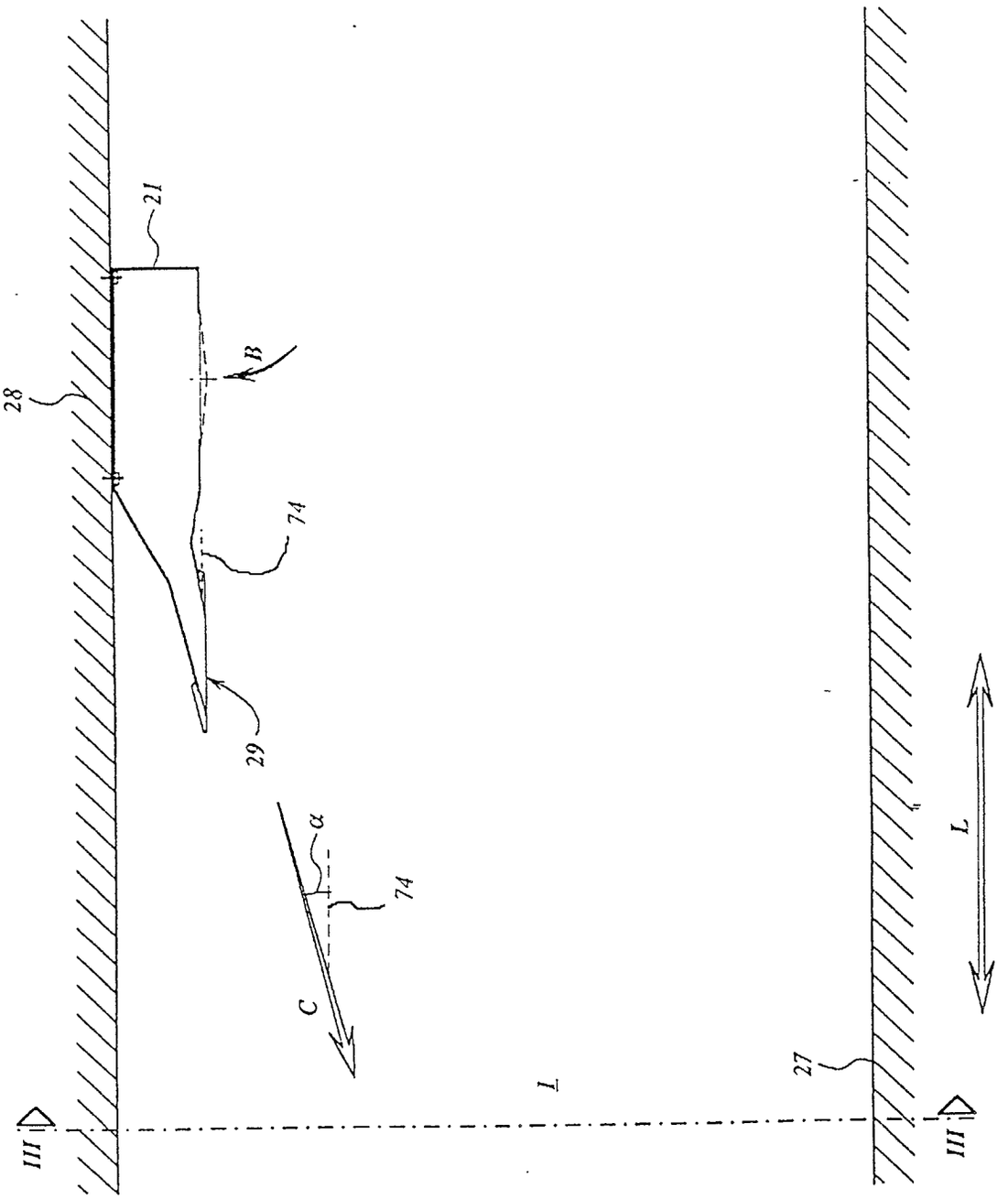


*Fig. 3*

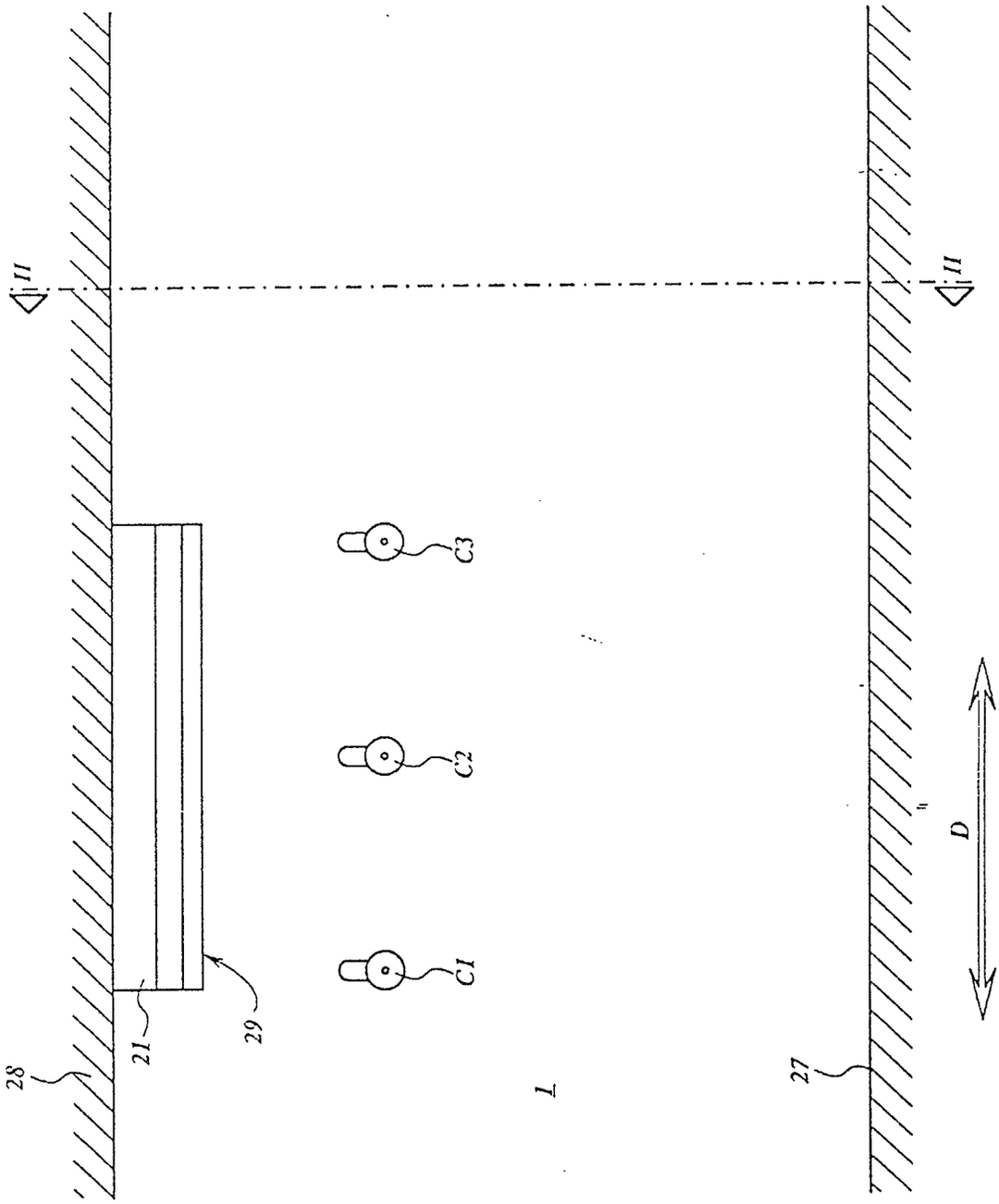


Fig. 4

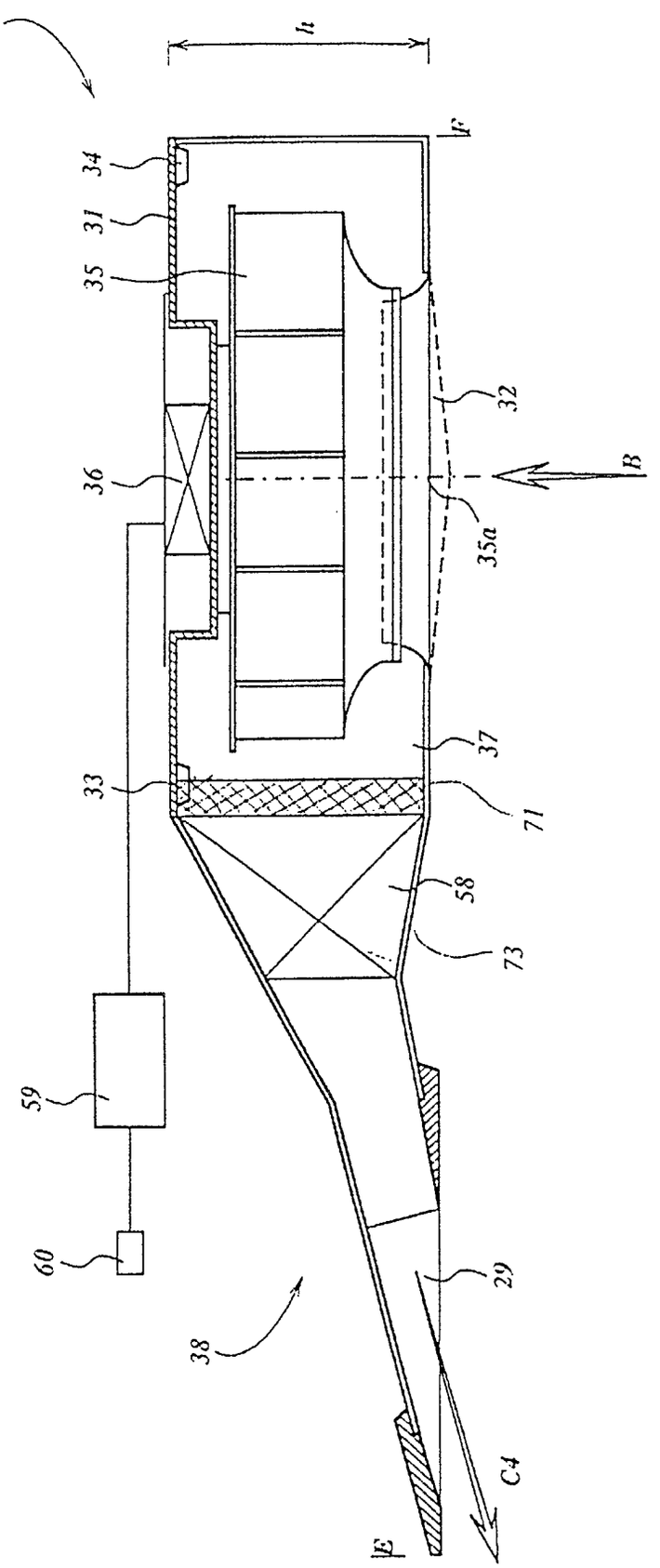


Fig. 5

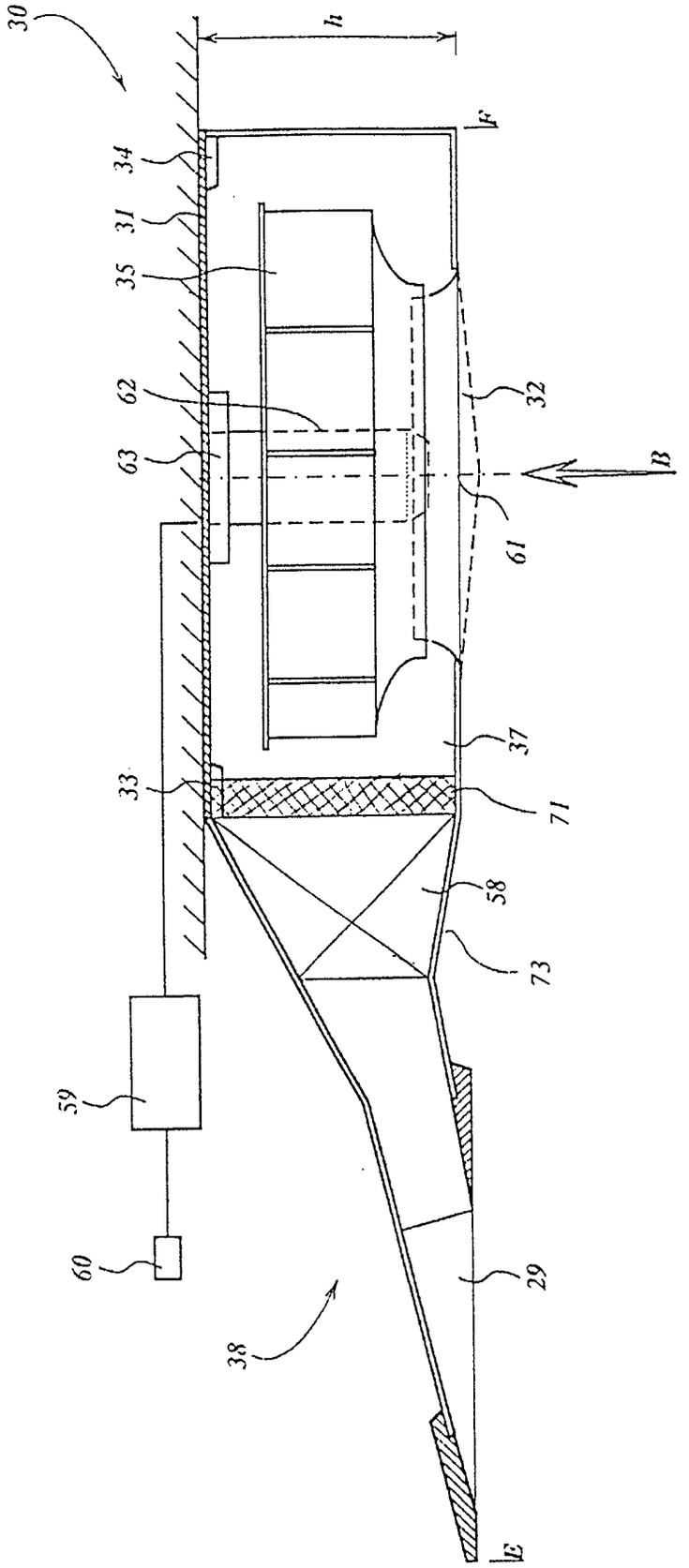


Fig. 6

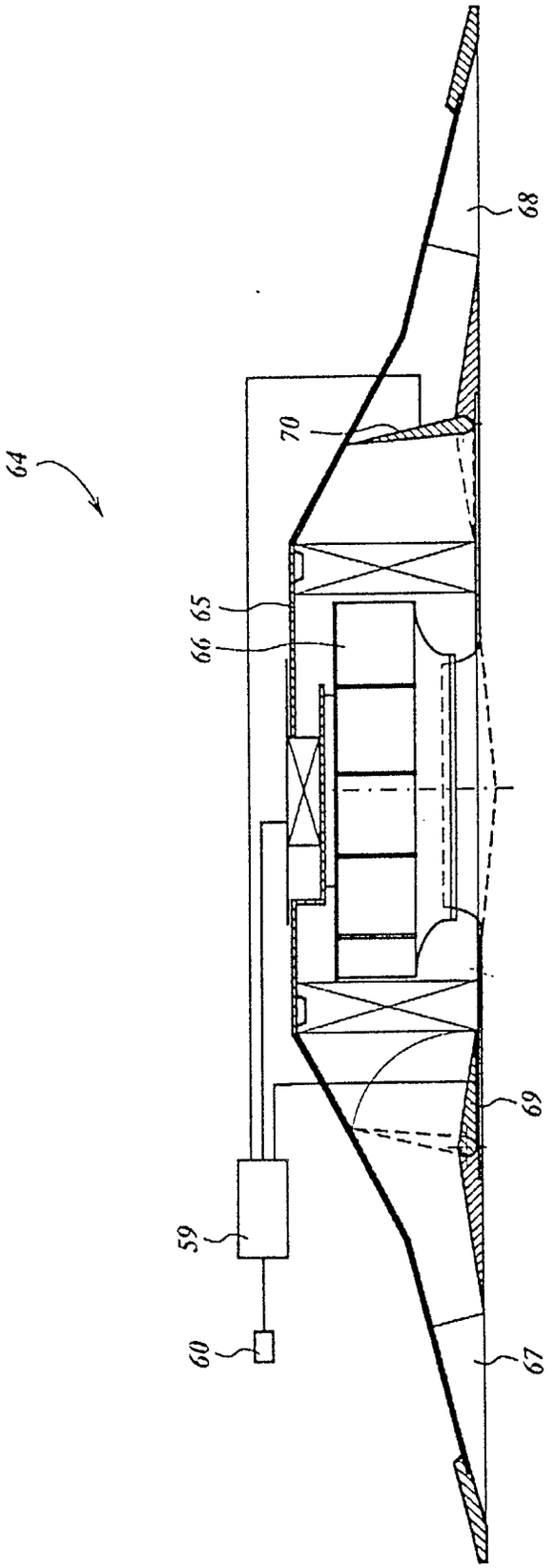


Fig. 7

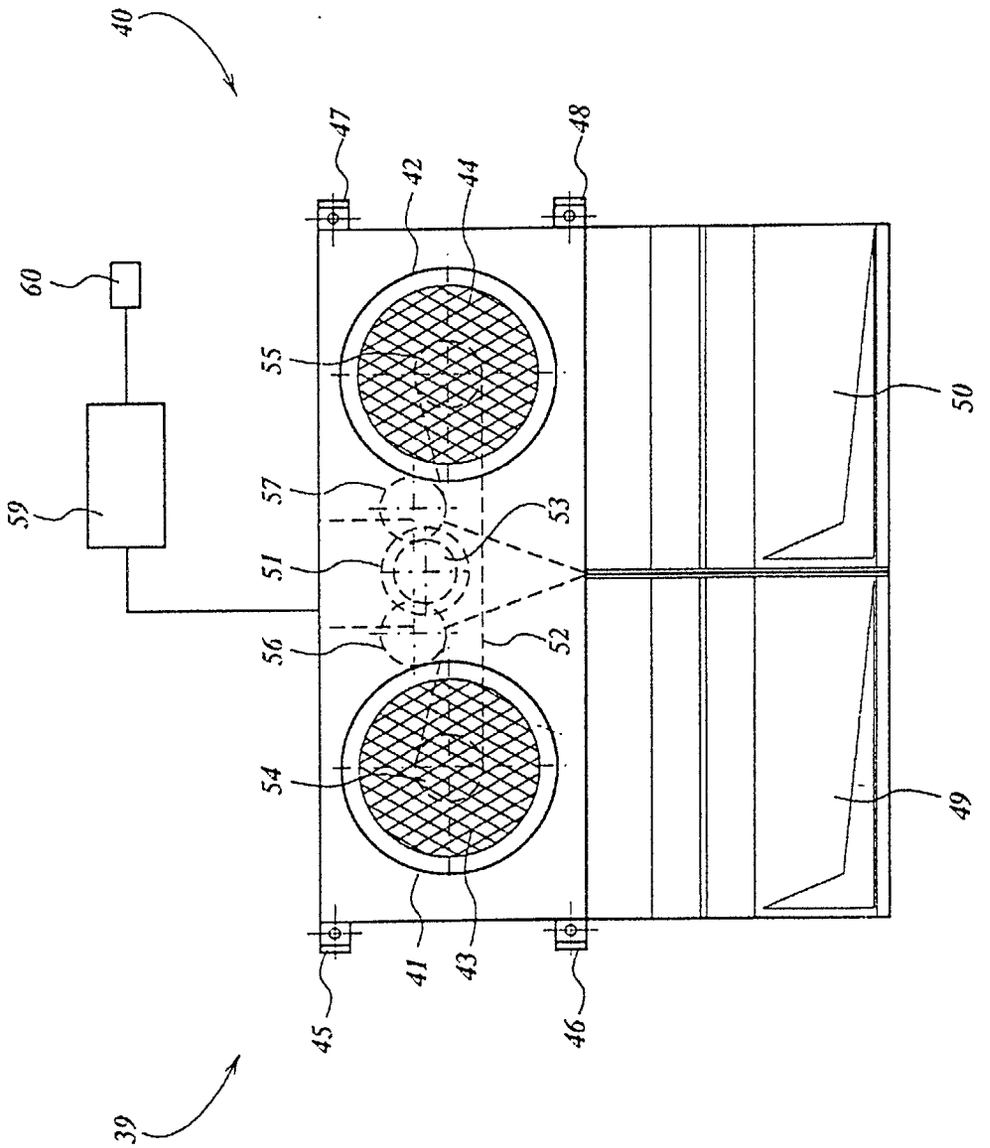


Fig. 8

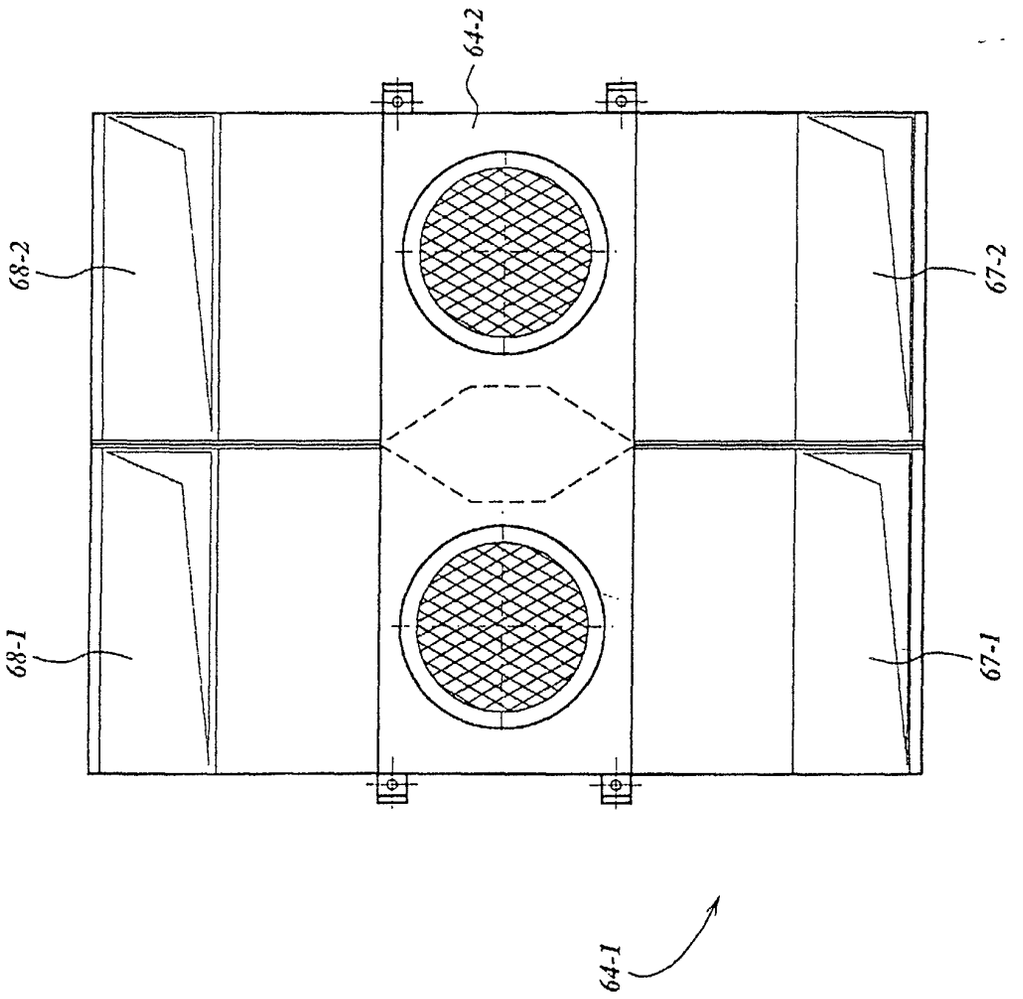


Fig. 9

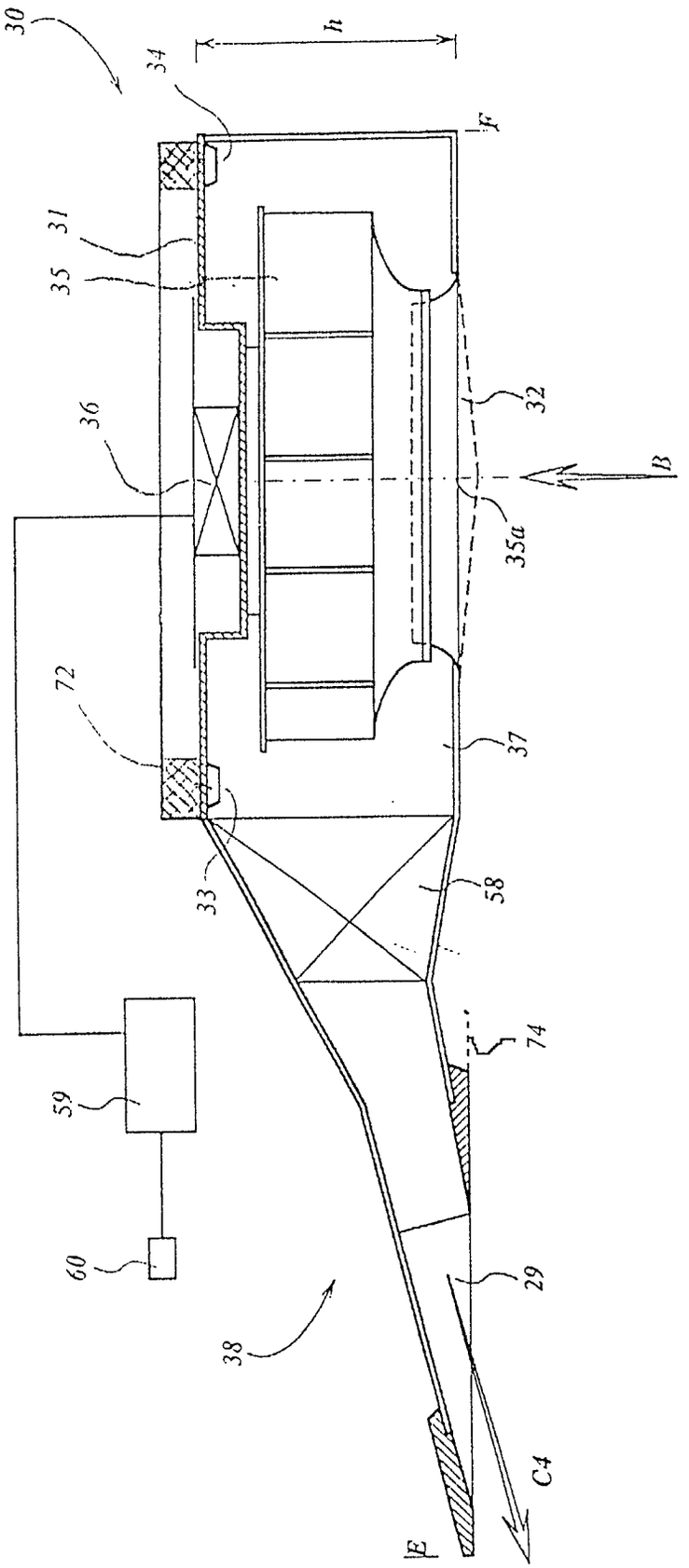


*Fig. 10*

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 02 07 7358

## 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) |
|---|---|---|---|
| X<br>Y | US 3 211 077 A (KRAMER JR FREDERICK A)<br>12 October 1965 (1965-10-12)<br>* column 3, line 46 - line 74 *<br>* figures 1-9 * | 1-3,5,7<br>4,6,9,<br>10,16,<br>17,19 | F24F7/007<br>F04D29/42<br>F04D29/44 |
| A | | 4 | |
| Y | PATENT ABSTRACTS OF JAPAN<br>vol. 009, no. 249 (M-419),<br>5 October 1985 (1985-10-05)<br>-& JP 60 101442 A (MATSUSHITA REIKI KK),<br>5 June 1985 (1985-06-05)<br>* abstract *<br>* figures 1-6 * | 4,6 | |
| Y | PATENT ABSTRACTS OF JAPAN<br>vol. 1997, no. 12,<br>25 December 1997 (1997-12-25)<br>-& JP 09 210390 A (DAIKIN IND LTD),<br>12 August 1997 (1997-08-12)<br>* abstract *<br>* figures 1-10 * | 9,10,17 | |
| Y<br>A | PATENT ABSTRACTS OF JAPAN<br>vol. 1999, no. 01,<br>29 January 1999 (1999-01-29)<br>-& JP 10 281518 A (NIPPON FLAEKT KK),<br>23 October 1998 (1998-10-23)<br>* abstract *<br>* figures 5,6 * | 16,19<br>1,17,18 | |
| X | EP 1 041 351 A (DAIKIN IND LTD)<br>4 October 2000 (2000-10-04)<br>* abstract *<br>* column 6, line 3 - column 8, line 11 *<br>* figures 1-4 *<br>-/-- | 1,2,7,9 | |

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F04D
F24F
A62C

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 1 August 2002 | De Graaf, J.D. |

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

EPO FORM 1503 03.82 (P04C01)

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 02 07 7358

## 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 | PATENT ABSTRACTS OF JAPAN<br>vol. 013, no. 376 (M-862),<br>21 August 1989 (1989-08-21)<br>-& JP 01 130099 A (FUJI ELECTRIC CO LTD),<br>23 May 1989 (1989-05-23)<br>* abstract *<br>* figures 1,2,4,5 * | 1 | |
| A | PATENT ABSTRACTS OF JAPAN<br>vol. 2000, no. 04,<br>31 August 2000 (2000-08-31)<br>-& JP 2000 028167 A (MASUDA HARMO:KK),<br>25 January 2000 (2000-01-25)<br>* abstract; figure ALL * | 15 | |
| A | US 4 131 059 A (GUSTAVSSON LENNART)<br>26 December 1978 (1978-12-26)<br>* column 4, line 2 - line 7 * | 15 | |
| A | NL 1 008 137 C (ZWAAN ADRIANUS J)<br>2 August 1999 (1999-08-02) | | TECHNICAL FIELDS SEARCHED (Int.Cl.7) |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 1 August 2002 | De Graaf, J.D. |

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

EPO FORM 1503 03.82 (P04C01)

## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 07 7358

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-08-2002

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| US 3211077 A | 12-10-1965 | NONE | |
| JP 60101442 A | 05-06-1985 | JP 1488299 C | 23-03-1989 |
| | | JP 63035903 B | 18-07-1988 |
| JP 09210390 A | 12-08-1997 | NONE | |
| JP 10281518 A | 23-10-1998 | JP 3256466 B2 | 12-02-2002 |
| EP 1041351 A | 04-10-2000 | JP 3061026 B2 | 10-07-2000 |
| | | JP 11182921 A | 06-07-1999 |
| | | EP 1041351 A1 | 04-10-2000 |
| | | CN 1285030 T | 21-02-2001 |
| | | WO 9931443 A1 | 24-06-1999 |
| | | TW 387986 B | 21-04-2000 |
| JP 01130099 A | 23-05-1989 | JP 1880340 C | 21-10-1994 |
| | | JP 6005078 B | 19-01-1994 |
| JP 2000028167 A | 25-01-2000 | NONE | |
| US 4131059 A | 26-12-1978 | DE 2609030 A1 | 08-09-1977 |
| | | AU 502857 B2 | 09-08-1979 |
| | | AU 2208377 A | 17-08-1978 |
| | | BE 851717 A1 | 16-06-1977 |
| | | BR 7701233 A | 25-10-1977 |
| | | CA 1074612 A1 | 01-04-1980 |
| | | ES 456554 A1 | 16-02-1978 |
| | | FI 770696 A ,B, | 06-09-1977 |
| | | FR 2343206 A1 | 30-09-1977 |
| | | GB 1562906 A | 19-03-1980 |
| | | IT 1071875 B | 10-04-1985 |
| | | JP 1149326 C | 14-06-1983 |
| | | JP 52108648 A | 12-09-1977 |
| | | JP 56047451 B | 10-11-1981 |
| | | MX 144230 A | 11-09-1981 |
| | | NL 7701690 A ,B, | 07-09-1977 |
| | | SE 431790 B | 27-02-1984 |
| | | SE 7701284 A | 06-09-1977 |
| | | SU 1248535 A3 | 30-07-1986 |
| | | ZA 7701241 A | 25-01-1978 |
| NL 1008137 C | 02-08-1999 | NL 1008137 C2 | 02-08-1999 |

EPO FORM P0459

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