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(54) Device for regulating the air flow rate in a ventilation device

(57) The invention relates to a device for regulating the air flow rate in a ventilation device (1), comprising an independently operating valve (3) which is provided in an air passage duct (2) of the ventilation device (1) and which automatically adjusts the air passage opening as a function of the pressure difference between the inlet (4) and the outlet (5) of the air passage duct (2), the flap (3) is deformable at a first deformation point (7) up to a maximum deformation when the pressure difference increases, wherein, after deformation at the first deformation point (7), the flap (3) is further deformable up to a maximum deformation at a second deformation point (8).

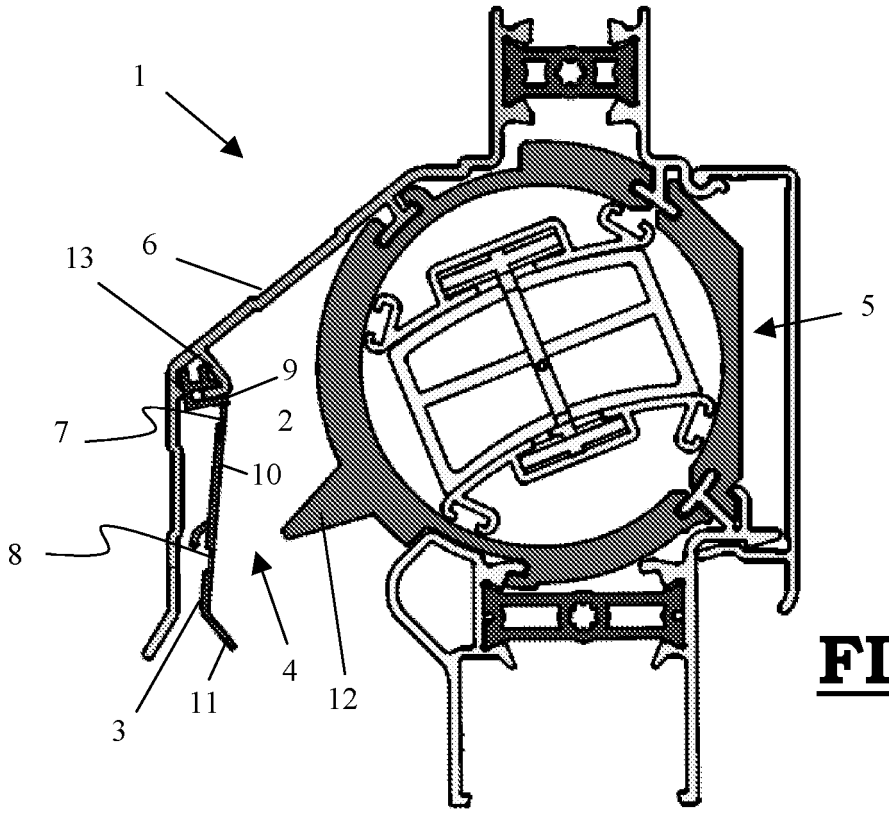

FIG. 1

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Description

[0001] The invention relates to a device for regulating the air flow rate in a ventilation device, comprising an independently operating flap which is provided in an air passage duct of the ventilation device and which automatically adjusts the air passage opening as a function of the pressure difference between the inlet and the outlet of the air passage duct, the flap being deformable at a first deformation point up to a maximum deformation position when the pressure difference increases.

[0002] The term independently operating flap is to be understood as a flap which is not actuated by means of a sensor or motor.

[0003] The pressure differences across components of buildings, including ventilation facilities, are subject to constant change due to changes in temperature differences, wind speed and wind direction and the way the building is used (opening of doors and windows, use of ventilation facilities). As a result, the air flow rate of conventional ventilation facilities is constantly changing. With certain ventilators, the air passage opening (cross section of the passage) is automatically adjusted, and so, as a result, is the air flow rate, depending on the pressure difference across the ventilator (the ventilation device). They are usually referred to as self-regulating. Below, the term self-regulating flap is used to refer to a flap which automatically adjusts the cross section of the air passage opening of a ventilation device when the pressure difference across the ventilation device changes.

[0004] From a certain pressure difference across the ventilation device on, the self-regulating flap ensures a more or less constant air flow rate when the pressure difference increases. The nominal pressure difference at which the air flow rate has to be kept constant in order to define the ventilation device for natural air supply as self-regulating, differs from country to country due to different standards or legislation; e.g. in The Netherlands from 1 Pa, in Belgium from 2 Pa and in France from 20 Pa. In The Netherlands, the Building Decree stipulates that the air flow rate in a self-regulating ventilator for natural air supply should not differ by more than 20% from the nominal flow rate at 1 Pa, and this across a pressure range of 1 to 25 Pa. In Belgium, a similar stipulation applies with respect to the nominal air flow rate at 2 Pa and, furthermore, a distinction is made between classes with a certain degree of adjustment depending on the pressure difference. Except for the difference in nominal air flow rate, the requirements for the most stringent class in Belgium correspond to those of The Netherlands.

[0005] A distinction can be made between self-regulating flaps, which are controlled with or without an actuator or motor. This invention relates to a flap of this type which works without an actuator or motor (independently operating flap). This means that the flap serves both as a control element and as a sensor.

[0006] On the one hand, there are self-regulating flaps of this type in the form of a flexible uniform diaphragm which can bend over its entire surface area at pressure differences up to 100 Pa.

[0007] Thus, for example, FR 2 729 746 describes such a flexible diaphragm which can move freely, so that the air passage opening in the air passage duct is automatically adjusted, depending on the pressure difference. In FR 1 527 197 and FR 2 030 547, the adjustment of the air passage opening in the air passage duct is controlled, as a function of the pressure difference, to a relatively great degree by the shape of the ribs which limit the movement of the flexible diaphragm.

[0008] However, these systems have various drawbacks. The solution of FR 1 527 197 is a solution which conforms to the French requirements, where self-regulation is only important from air pressure differences of more than 20 Pa. However, in order to be able to meet the Dutch and Belgian requirements, a flap has to be able to adjust at lower air pressure differences. In order to deform quickly, such a flap has to be flexible, on the one hand, but also has to apply sufficient counterforce in order to prevent vibrations which are caused by quick but small changes in air pressure difference across the flap as a result of, for example, wind effects, on the other hand.

[0009] One solution for preventing vibrations can be found in FR 2 030 547. In the latter, the diaphragm is of a sufficiently flexible design to deform quickly. Furthermore, the diaphragm is provided with additional projections which in turn provide the necessary counterforce. However, the drawback of such a diaphragm is that it requires an additional finishing step during production in order to provide these additional projections on the diaphragm, thus leading to an increase in the production costs.

[0010] The diaphragm as described in FR 2 729 746 exhibits both the drawback of the diaphragm as described in FR 1 527 197, namely that this diaphragm starts to vibrate if it is sufficiently flexible so as to be able to adjust at sufficiently small pressure differences, and the drawback of the diaphragm as described in FR 2 030 547, namely that an additional finishing step is required during the production of this diaphragm, as this diaphragm has a round opening.

[0011] On the other hand, there are self-regulating flaps which have no uniform composition, as a result of which they perform a bending movement locally in order to regulate the air flow rate in the ventilation device.

[0012] A flap of this type is described in BE 1 011 024. In this case, a facility is described for regulating the air stream in a ventilation device with a self-regulating flap which is arranged in a passage duct of the ventilation device so that it can be oriented and which automatically regulates the air stream through the ventilation device, as a function of the air pressure difference between the inlet and the outlet of the ventilation device, between a maximum passage opening and a minimum passage opening without the use of a sensor or motor. The self-regulating flap is provided with a flexible soft plastic profile section, acting as a flexible suspension connection, for

stabilizing the air flow rate when the pressure differences vary, and in which the self-regulating flap with the suspension connection consists of a two-component composition of at least one hard plastic profile and one flexible soft plastic profile.

[0013] Furthermore, EP 0 655 587 describes a flap of this type which comprises a fixed part, which is connected to a flexible part on the housing of the passage duct. The flap is able to bend at this flexible part.

[0014] EP 1 063 384 describes a flap similar to that in BE 1 001 024, the flap comprising a relatively thick and a relatively thin section, so that it will bend at the relatively thin section. In order to limit the movement, wings are attached to the relatively thick section in order to define the maximum bending angles.

[0015] The drawback of the self-regulating flaps described above is that the degree of adjustment as a function of the pressure difference is too small, resulting in unnecessary waste of energy and draught. This means that the flow rate is not sufficiently constant at low pressure differences from 1 Pa or that the air flow rate still varies too much at a varying pressure difference above the nominal pressure difference.

[0016] This problem is solved in EP 1 568 947, in which an independently operating flap is described which is rotatably suspended about a free suspension point in the air passage duct and is designed in such a manner that when the pressure difference increases, the flap moves in the air passage duct by first rotating about the free suspension point up to a maximum angle of rotation and then deforming without further rotation about the free suspension point.

[0017] It is therefore an object of the invention to provide an alternative device for regulating the air flow rate, from 1 Pa (The Netherlands) and 2 Pa (Belgium), in a ventilation device according to the preamble of the first claim, in which the air flow rate in the device is kept as constant as possible when the pressure difference increases.

[0018] This object is achieved by providing a device for regulating the air flow rate in a ventilation device, comprising an independently operating flap which is provided in the air passage duct of the ventilation device so as to be movable and which automatically adjusts the air passage opening in the air passage duct as a function of the pressure difference between the inlet and the outlet of the air passage duct, wherein the flap is first deformable at a first deformation point up to a maximum deformation, and after deformation at the first deformation point is further deformable up to a maximum deformation point at a second deformation point when the pressure difference increases.

[0019] In this manner, the air flow rate in the device is kept virtually constant when the pressure difference increases, just like in EP 1 568 947, from 1 Pa (The Netherlands) and 2 Pa (Belgium). The greater the pressure difference across the flap, the smaller the air passage opening at the flap becomes. Furthermore, the flow rate remains within acceptable limits for the nominal flow rate in this manner, so that there is no additional waste of energy because of excessive ventilation and, furthermore, there is no draught. This means that in this manner a great degree of adjustability as a function of the pressure difference is achieved.

[0020] In one particular embodiment of a device according to the invention, the flap is further deformable at the second deformation point without deforming further about the first deformation point.

[0021] Preferably, the first deformation of a device according to the invention starts at a pressure difference of 1 Pa, thus meeting the Dutch requirements.

[0022] The maximum deformation of the first deformation is preferably reached at an air pressure difference of 5 Pa.

[0023] In a preferred embodiment of device according to this invention, the flap is provided to be deformed at the flexible connecting parts which are provided between two relatively less flexible parts

[0024] In a more preferred embodiment of a device according to the invention, a protuberance is provided in the ventilation device which determines the maximum deformation of the first deformation of the flap.

[0025] In a particularly preferred embodiment of a device according to the invention, the flap is provided to be deformed by means of bending, the deformation points consisting of bending points.

[0026] A particular embodiment of the device according to the invention is achieved by suspending the flap in a fixed position in the ventilation device.

[0027] In a preferred embodiment according to the invention, the flap is made of plastic.

[0028] Below, this invention will be described in more detail with reference to the following detailed description of a preferred embodiment for regulating the air flow rate in a ventilation device according to the invention. The intention of this description is only to give an illustrative example and in order to indicate further advantages and characteristics of this device according to the invention, and should therefore not be interpreted as limiting the area of application of the invention or the patent rights which are requested in the claims.

[0029] In this detailed description, reference numerals are used to refer to the attached drawing, in which:

- ***Figure 1*** shows a cross section of a ventilation device provided with a device according to the invention;
- ***Figure 2*** shows a cross section of the ventilation device as illustrated in Figure 1, in which the self-regulating flap is deformed at the first deformation point up to the maximum deformation position;
- ***Figure 3*** shows a cross section of the ventilation device as illustrated in Figure 1, in which the self-regulating flap is deformed further at the second deformation point after reaching the maximum deformation position;

- ***Figure 4*** shows a graph, in which the flow rate (1/s) is plotted against the pressure difference (Pa), in which:
  - curve A plots the flow rate against the pressure difference with a non-self regulating ventilator;
  - curve B plots the flow rate against the pressure difference in a ventilation device according to the prior art;
  - curve C plots the flow rate against the pressure difference in a ventilation device according to the invention.

[0030] A ventilation device (1) as illustrated in Figures 1 to 3 comprises an air passage duct (2) in which an independently operating flap (3) (also referred to as self-regulating flap) is provided. This self-regulating flap (3) automatically adjusts the air passage opening in the air passage duct (2) as a function of the air pressure difference between the inlet (4) and the outlet (5) of the air passage duct (2). The flap (3) is in this case suspended in a fixed position in the air passage duct (2). In this embodiment of a ventilation device as illustrated in Figures 1 to 3, the flap (3) is suspended in a fixed position in a rail-shaped cavity (13) which has been provided in the housing (6) of the ventilation device (1).

[0031] As is illustrated in Figure 2, the self-regulating flap (3) is designed to be deformed at a first deformation point (7) up to a maximum deformation when the pressure difference increases. Following deformation at the first deformation point (7) up to a maximum deformation, the flap (3) can further be deformed at a second deformation point (8), as illustrated in Figure 3. The flap (3) is preferably provided to be deformed at the location of flexible connecting parts (7, 8) which are provided between two relatively less flexible parts (9,10; 10,11). The deformation points (7, 8) are therefore preferably designed as flexible connecting parts. In the ventilation device as illustrated in Figures 1 to 3, a protuberance (12) is provided which determines the maximum deformation of the first deformation of the flap (3).

[0032] The first deformation starts at an air pressure difference of 1 Pa. The maximum deformation during the first deformation, as illustrated in Figure 2, is reached at an air pressure difference of approximately 5 Pa.

[0033] The flap (3) is preferably provided to be deformed by means of bending. In this way, the deformation points (7, 8) are bending points and the maximum deformation position (as illustrated in Figure 3) is a maximum bending angle.

[0034] As can be concluded from Figure 4, in a ventilation device which is not provided with a flap which automatically adjusts the air passage opening in the air passage duct as a function of the pressure difference between the inlet and the outlet of the air passage duct (also referred to as non-self-regulating ventilator), the air flow rate continues to increase when the pressure difference increases. In ventilation devices according to the prior art which are provided with a flap which automatically adjusts the air passage opening in the air passage duct as a function of the pressure difference between the inlet and the outlet of the air passage duct, such as described, for example, in BE 1 011 024, the air flow rate increases to $\pm$ 35 dm^3/s at a pressure difference of 12 Pa, and then remains reasonably constant. In a ventilation device (1) which is provided with a device according to the invention, the air flow rate remains virtually constant at 20 dm^3/s within the boundaries of $\pm$ 20% from a pressure difference of 2 Pa. This clearly shows the quicker (= at relatively low pressure differences) action of the flap (3) of a device according to the invention compared to the existing prior art devices.

[0035] The flap (3) according to the invention is preferably made of plastic, such as PVC, but may also be made of any other material.

[0036] Such ventilation devices (1) which are provided with a device according to the invention may be used on or under the glass in a window or a door, on the window frame itself or in the wall.

Claims

1. Device for regulating the air flow rate in a ventilation device (1), comprising an independently operating valve (3) which is provided in an air passage duct (2) of the ventilation device (1) and which automatically adjusts the air passage opening as a function of the pressure difference between the inlet (4) and the outlet (5) of the air passage duct (2), wherein the flap (3) is deformable at a first deformation point (7) up to a maximum deformation when the pressure difference increases, **characterized in that**, after deformation at the first deformation point (7), the flap (3) is further deformable up to a maximum deformation at a second deformation point (8).

2. Device according to claim 1, **characterized in that** the flap (3) is further deformable at the second deformation point (8) without deforming further at the first deformation point (7).

3. Device according to claim 1 or 2, **characterized in that** the first deformation starts at an air pressure difference of 1 Pa.

4. Device according to one of claims 1 to 3, **characterized in that** the maximum deformation of the first deformation is reached at an air pressure difference of approximately 5 Pa.

5. Device according to one of claims 1 to 4, **characterized in that** the flap (3) is provided to be deformed at the flexible connecting parts (7, 8) which are provided between two relatively less flexible parts (9, 10, 11).

6. Device according to one of claims 1 to 5, **characterized in that**, in the ventilation device, a protuberance (12) is provided which determines the maximum deformation of the first deformation of the flap (3).

7. Device according to one of claims 1 to 6, **characterized in that** the flap (3) is provided to be deformed by means of bending, wherein the deformation points (7, 8) consisting of bending points.

8. Device according to one of claims 1 to 7, **characterized in that** the flap (3) is suspended in a fixed position in the ventilation device.

9. Device according to one of the preceding claims, **characterized in that** the flap (3) is made of plastic.

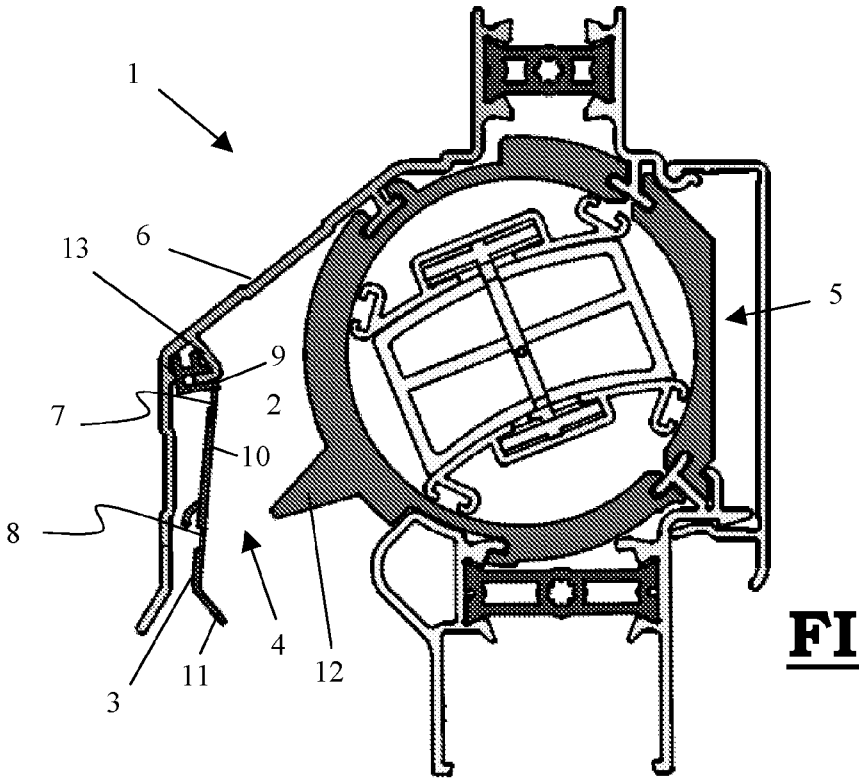


FIG. 1

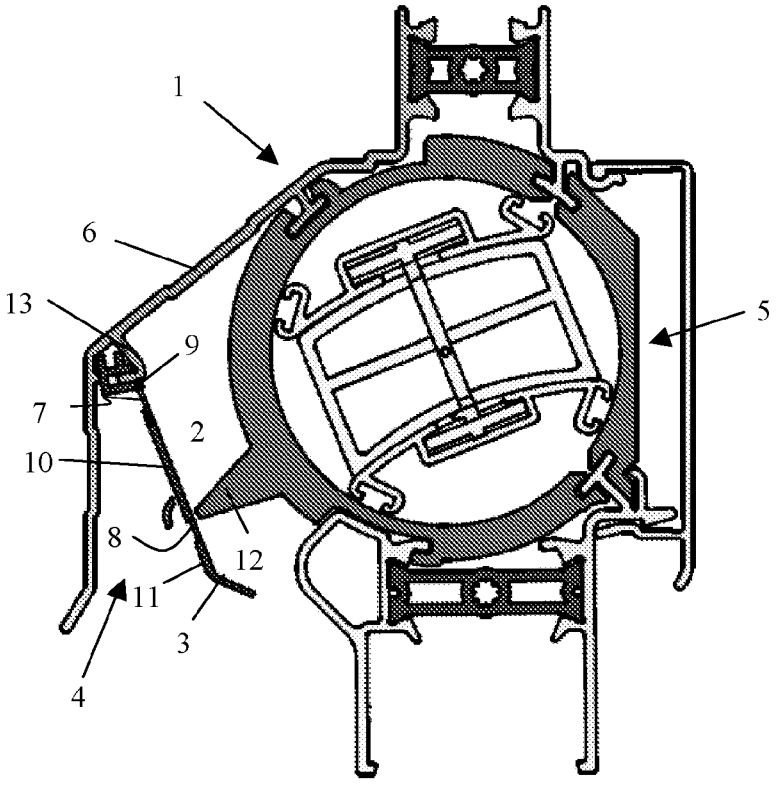


FIG. 2

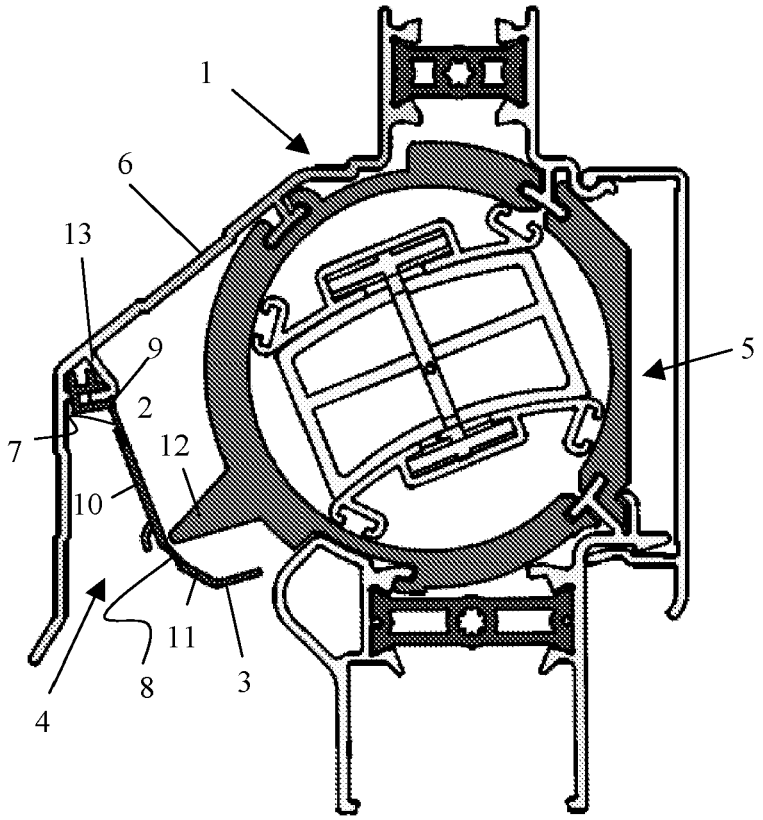
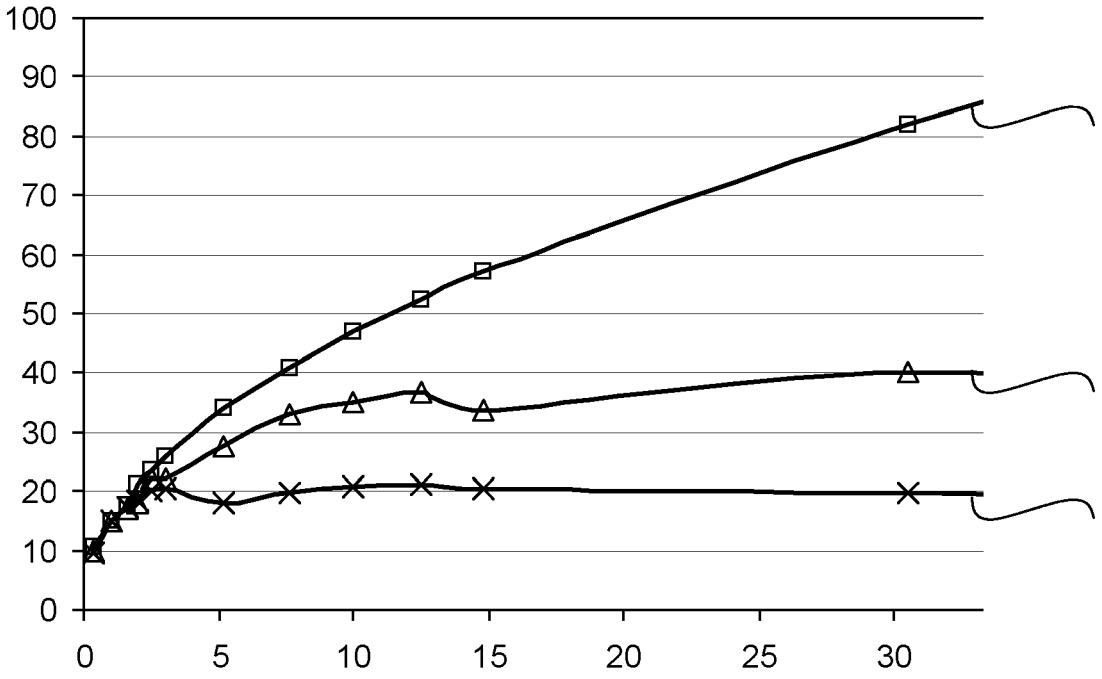


FIG. 3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EUROPEAN SEARCH REPORT

Application Number
EP 07 10 6442

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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X	FR 2 691 789 A1 (ZANIEWSKI MICHEL [FR] ZANIEWSKI MICHEL) 3 December 1993 (1993-12-03) * page 5, line 5 - page 6, line 24; figures 2-4,2a,2b *	1	
A	BE 1 011 024 A5 (RENSON N V [BE]) 3 August 1999 (1999-08-03) * claims; figures *	1	
A	EP 1 063 384 A2 (SIEGENIA FRANK KG [DE]) 27 December 2000 (2000-12-27) * column 15, line 38 - line 41; figure 6 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

F24F
E06B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 August 2007	GONZALEZ-GRANDA, C

CATEGORY OF CITED DOCUMENTS

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

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- FR 1527197 **[0007] [0008] [0010]**
- FR 2030547 **[0007] [0009] [0010]**
- BE 1011024 **[0012] [0034]**
- EP 0655587 A **[0013]**
- EP 1063384 A **[0014]**
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