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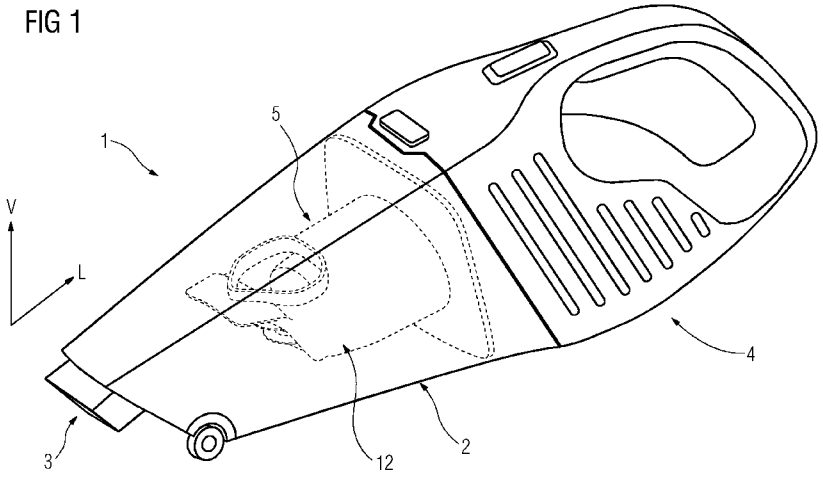
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(54) Title: HANDHELD VACUUM CLEANER

FIG 1



(57) Abstract: The invention relates to a handheld vacuum cleaner (1), comprising a housing (2) with an inlet (3) for air which is charged with dust and/or dirt at one location of the housing (2) and a suction unit (4) arranged at a second location of the housing (2) for creating an air flow from the inlet (3) through the housing (2), wherein a filter element or filter carrier (5) is arranged between the inlet (3) and the suction unit (4) within the housing, wherein the filter element or filter carrier (5) has a face side (6) facing the inlet (3). To allow a secure separation of liquid from the air flow and collection of the same the invention proposes that the face side (6) comprises at least one deflector surface (7) which has a concave shape against which the air flow is led during the operation of the suction unit (4).

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Description

Handheld Vacuum Cleaner

The invention relates to a handheld vacuum cleaner, comprising a housing with an inlet for air which is charged with dust and/or dirt at one location of the housing and a suction unit arranged at a second location of the housing for creating an air flow from the inlet through the housing, wherein a filter element or filter carrier is arranged between the inlet and the suction unit within the housing, wherein the filter element or filter carrier has a face side facing the inlet.

A handheld vacuum cleaner of the generic kind is well known in the art. An example is shown in Fig. 1. The vacuum cleaner 1 has a housing 2 with a longitudinal axis L. During intended use the vacuum cleaner sucks dirt or dust from a horizontal plane; thus a vertical axis V can be defined. The longitudinal axis L extends substantially in a direction perpendicular to the vertical axis V, i. e. into a horizontal direction. The housing 2 has an inlet 3 at one of its ends in longitudinal direction L. Near the other end in longitudinal direction L a suction unit 4 is mounted. Between the inlet 3 and the suction unit 4 a filter element or filter carrier is arranged. The air which is sucked by the suction unit 4 is thus sucked in from the inlet 3 into the housing and is guided through the filter element / filter carrier 5 where dust and dirt is filtered. While the filtered air leaves the housing 4 via the suction unit 4 the dust and dirt is retained from the filter and is collected in a dust compartment 12.

Problems occur when a liquid, e. g. water, is contained within the dust or dirt which is sucked in the vacuum cleaner. It is aimed for to also retain such liquid in the vacuum cleaner and more specifically in the dust compartment as it is not acceptable that the liquid leaves the vacuum cleaner again via the suction unit.

Thus, in a handheld vacuum cleaner which is usable for wet and dry purposes the challenge is to separate the airflow and water in a very narrow surrounding. This is the result from the fact that the vacuum cleaner must be quite small. The problem is that small space within the housing of the vacuum cleaner and a high airflow velocity easily catch and drag small water droplets along. A water droplet which touches a surface or wall within the housing will split into a multitude of small droplets; thus, it becomes even more difficult to separate the liquid from the airflow.

A possibility to ease this problem is to design a relatively wide container which leads to low airspeed inside the dust compartment. At first the contaminated water flow is forced downwards at an angle similar as at the front of a speed boat. Then, the stream becomes slower thanks to the wide container area; the water droplets can fall out from the air stream and fall into the dust compartment due to the gravity force. The quite slow air flow cannot entangle the water from its resting place in the dust compartment. Also, the low airspeed cannot turn upwards the droplets toward the filter due to the gravity.

This method doesn't work when it is aimed for a quite small design of the handheld vacuum cleaner as the mentioned space is not available.

Thus it is an object of the present invention to allow a secure separation of liquid from the air flow and collection of the same in the dust compartment of the handheld vacuum cleaner even in the case that a small design of the vacuum cleaner is realized.

The solution of this object according to the invention is characterized in that the face side of the filter element or filter carrier comprises at least one deflector surface which has a

concave shape against which the air flow is led during the operation of the suction unit.

Preferably, the deflector surface is concave in two directions which are perpendicular to another.

Furthermore, a plurality of deflector surfaces can be arranged at the face side. In this regard it is advantageous that two rows of deflector surfaces are arranged side by side; the two rows can then be arranged along a vertical axis (in the meaning as explained above). Preferably, a ridge is arranged between the two rows of deflector surfaces.

Furthermore, each row of deflector surfaces can have more than one deflector surface. A preferred embodiment of the invention suggests that two, three or four deflector surfaces are arranged in each row. Also here, a ridge can be arranged between two adjacent deflector surfaces of one row.

A specific preferred embodiment suggests that two rows of deflector surfaces are arranged, wherein each row has three deflector surfaces.

The face side of the filter element or filter carrier can be arranged under an angle relatively to a longitudinal axis of the housing against the vertical direction. This angle lies preferably between 15° and 45°. The mentioned direction of the face side can be defined by the envelope of the contour of the face side.

A dust compartment is preferably arranged below the face side of the filter element or filter carrier when the vacuum cleaner is in the regular position during use as described above.

The filter element or filter carrier is preferably made of plastic material. Then, it can be made by an injection moulding process.

Thus, the present invention concerns a wet & dry vacuum cleaner which is able to suck up liquids in distinction to ordinary vacuum cleaners which are not made to suck up any liquid.

The solution according to the present invention solves thus two major problems. A first aspect is not to split the water drops into smaller droplets. The second aspect is not to recapture resting water in the dust compartment.

This is performed by an aircushion technology - established by the concave deflector surfaces -, which is achieved by preferably six local high-pressure zones right in front of the inlet, i. e. at the face side arranged at the filter element / filter carrier facing the inlet.

Each of those high-pressure zones is concave in such a way that every droplet hitting the surface is forced at a downward angle. The effect causes slow retardation of the incoming water without splitting it to a significantly extent. This is beneficial for solving the first problem. The water is then allowed to pour down in a controlled manner due to its own gravity and speed.

As it is not possible to completely avoid the airflow going through the resting water, it is a problem to prevent recapturing of resting water. A forced airstream into the water will entangle the water again and therefore it is crucial to make sure that no fast flowing airstream goes into the water. In the claimed design the air cushion works like an imaginary flow director which separates the main airflow from the water and leads it sideways upwards towards the filter inlet.

The inlet of the machine would benefit of a placement at the top of the container at some distance from the back part of the dust bin to ensure free movement of the machine in the most frequently used positions without entangling the water into the airstream.

It should be noted if the wet & dry vacuum cleaner is hold upwards vertically it is possible for the water in the tank (if there is a lot of water in the tank) to get into the fan if the intake is placed to far back.

In a handheld cleaner the space is very limited and with demands for increased power and esthetical wishes for sleeker designs the airspeed reaches much higher values than in vacuum cleaner with bigger space in the housing. However, by using the described aircushion method these demands are taken into account and solved.

Thus, it becomes possible to obtain a high air performance and water separation in a very limited surrounding space.

Thus, the vacuum cleaner according to the invention is equipped with an efficient water trap to separate water, dust and dirt from the airstream which is sucked into the vacuum cleaner.

In the drawing an embodiment of the invention is depicted.

Fig. 1 shows a perspective view of a handheld vacuum cleaner according to the state of the art,

Fig. 2 shows an explosion view of a part of the handheld vacuum cleaner as shown in Fig. 1 according to the invention and

Fig. 3 shows a perspective view of the filter element / filter carrier of the vacuum cleaner.

Fig. 1 shows the general construction of a handheld vacuum cleaner 1, wherein a design according to the state of the art is depicted. Reference is made to the explanations above. A handheld vacuum cleaner 1 according to the invention is shown in Fig. 2. Here the core feature is the design of the filter element or filter carrier 5 which is shown in Fig. 3.

To allow a separation of liquid in the air which is sucked in via the inlet 3 and to retain the liquid then in the inner of the housing and more specifically in the dust compartment 12 the specific design of the filter element or filter carrier 5 is proposed:

The filter element or filter carrier 5 has a face side 6 which is facing the inlet 3. This face side is equipped with a plurality of deflector surfaces 7 as can be seen in Fig. 3. Each of the deflector surfaces 7 is formed as a bowl-shaped contour, i. e. a double-concave surface is given. That is, the form of the surface along two directions a and b (see Fig. 3) which are perpendicular to another is concave.

As can be seen from Fig. 3 two rows 8 and 9 of such deflector surfaces 7 is arranged, wherein each row 8, 9 has several adjacent deflector surfaces 7. In the depiction according to Fig. 3 each row has four deflection surfaces, so that in total eight deflection surfaces are present.

Another specifically preferred embodiment comes up with two rows 8, 9 and three deflection surfaces 7 in each row, i. e. with six deflection surfaces 7 in total.

Between the two rows 8, 9 a ridge 10 is formed which divides the deflector surfaces 7 of both rows 8, 9 from another. Also ridges 11 are arranged between the deflector surfaces 7 of each row 8, 9. The ridges 10, 11 form banks at which water droplets can be drained.

The whole face side 6 is arranged under an angle α against the vertical direction V (see Fig. 2). In the depicted embodiment the angle α is about 30°.

The deflector surfaces form during regular use of the vacuum cleaner aircushions for the water droplets in the stream of

charged air. Thus, the aircushion technology consisting preferably of six high pressure cells (deflector surfaces 7) in a doubly concave surrounding that enables the water to separate from the main airflow in a distinguished and controlled manner.

List of reference numerals

1	Handheld vacuum cleaner
2	Housing
3	Inlet
4	Suction unit
5	Filter element / filter carrier
6	Face side
7	Deflector surface
8	Row
9	Row
10	Ridge
11	Ridge
12	Dust compartment

a	First direction
b	Second direction
V	Vertical direction
α	Angle
L	Longitudinal axis

Claims

1. Handheld vacuum cleaner (1), comprising a housing (2) with an inlet (3) for air which is charged with dust and/or dirt at one location of the housing (2) and a suction unit (4) arranged at a second location of the housing (2) for creating an air flow from the inlet (3) through the housing (2), wherein a filter element or filter carrier (5) is arranged between the inlet (3) and the suction unit (4) within the housing, wherein the filter element or filter carrier (5) has a face side (6) facing the inlet (3),
characterized in that
the face side (6) comprises at least one deflector surface (7) which has a concave shape against which the air flow is led during the operation of the suction unit (4).

2. Handheld vacuum cleaner according to claim 1, characterized in that the deflector surface (7) is concave in two directions (a, b) being perpendicular to another.

3. Handheld vacuum cleaner according to claim 1 or 2, characterized in that a plurality of deflector surfaces (7) is arranged at the face side (6).

4. Handheld vacuum cleaner according to claim 3, characterized in that two rows (8, 9) of deflector surfaces (7) are arranged side by side.

5. Handheld vacuum cleaner according to claim 4, characterized in that the two rows (8, 9) are arranged along a vertical axis (V).

6. Handheld vacuum cleaner according to claim 4 or 5, characterized in that a ridge (10) is arranged between the two rows (8, 9) of deflector surfaces (7).

7. Handheld vacuum cleaner according to one of claims 4 to 6, characterized in that each row (8, 9) of deflector surfaces (7) has more than one deflector surface (7).

8. Handheld vacuum cleaner according to claim 7, characterized in that two, three or four deflector surfaces (7) are arranged in each row (8, 9).

9. Handheld vacuum cleaner according to claim 8, characterized in that a ridge (11) is arranged between two adjacent deflector surfaces (7) of one row (8, 9).

10. Handheld vacuum cleaner according to claim 8 or 9, characterized in that two rows (8, 9) of deflector surfaces (7) are arranged, wherein each row (8, 9) has three deflector surfaces (7).

11. Handheld vacuum cleaner according to one of claims 1 to 10, characterized in that the face side (6) of the filter element or filter carrier (5) is arranged under an angle (α) relatively to a longitudinal axis (L) of the housing (2) against the vertical direction (V).

12. Handheld vacuum cleaner according to claim 11, characterized in that the angle (α) is between 15° and 45°.

13. Handheld vacuum cleaner according to one of claims 1 to 12, characterized in that a dust compartment (12) is arranged below the face side (6) of the filter element or filter carrier (5).

14. Handheld vacuum cleaner according to one of claims 1 to 13, characterized in that the filter element or filter carrier (5) is made of plastic material.

15. Handheld vacuum cleaner according to claim 14, characterized in that the filter element or filter carrier (5) is made by an injection moulding process.

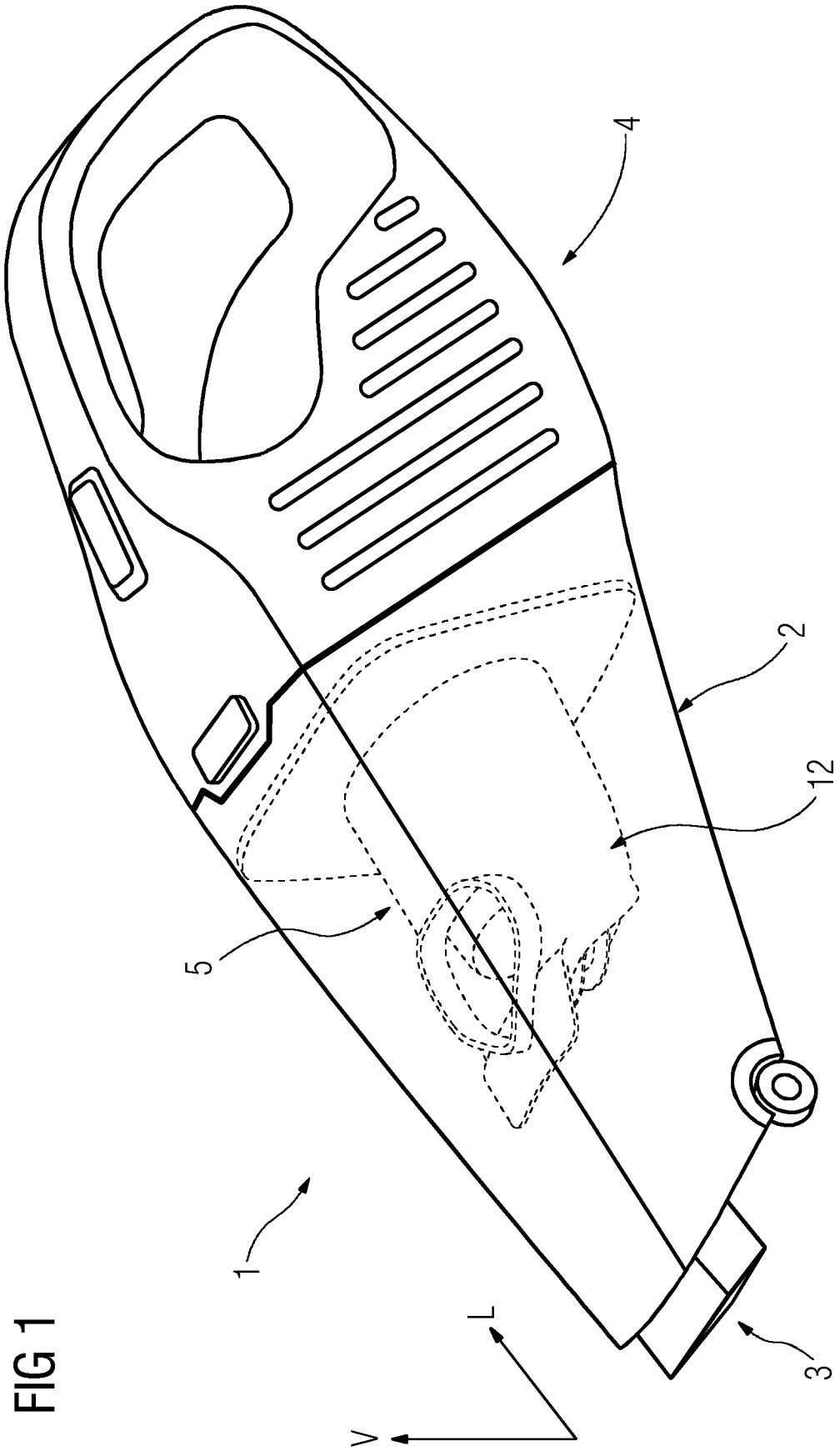


FIG 1

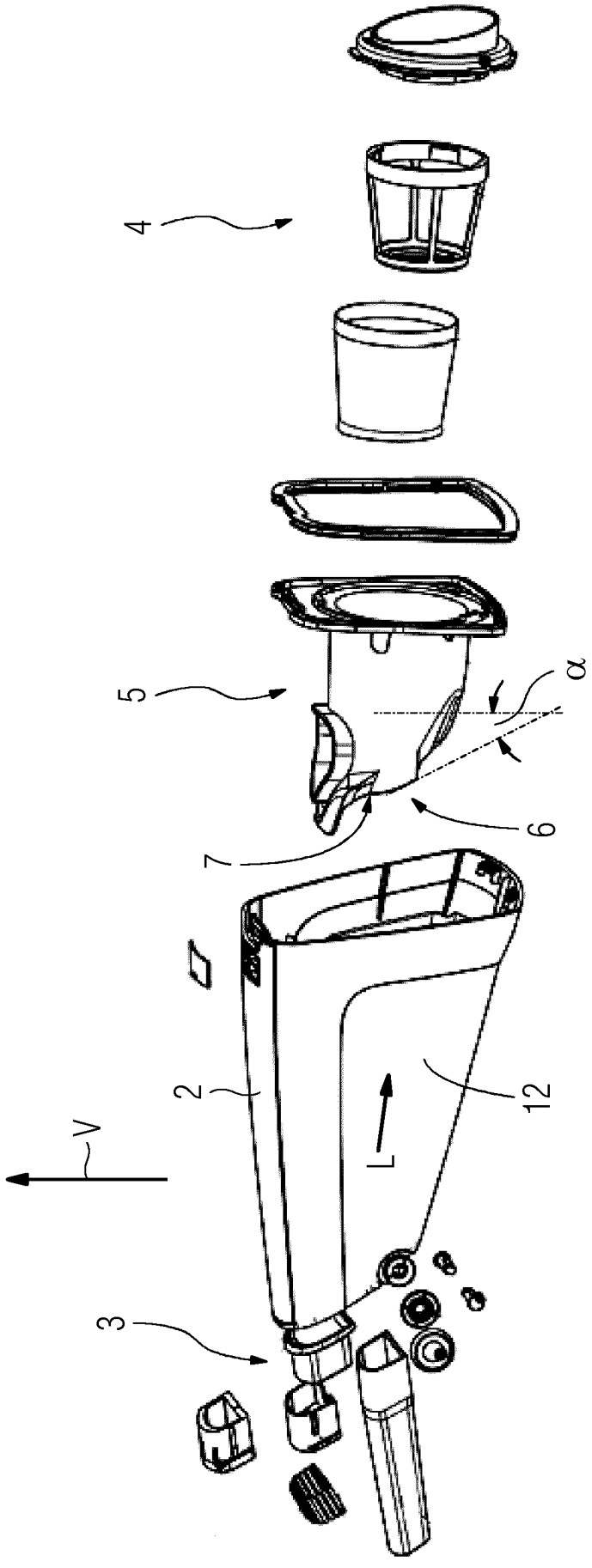


FIG 2

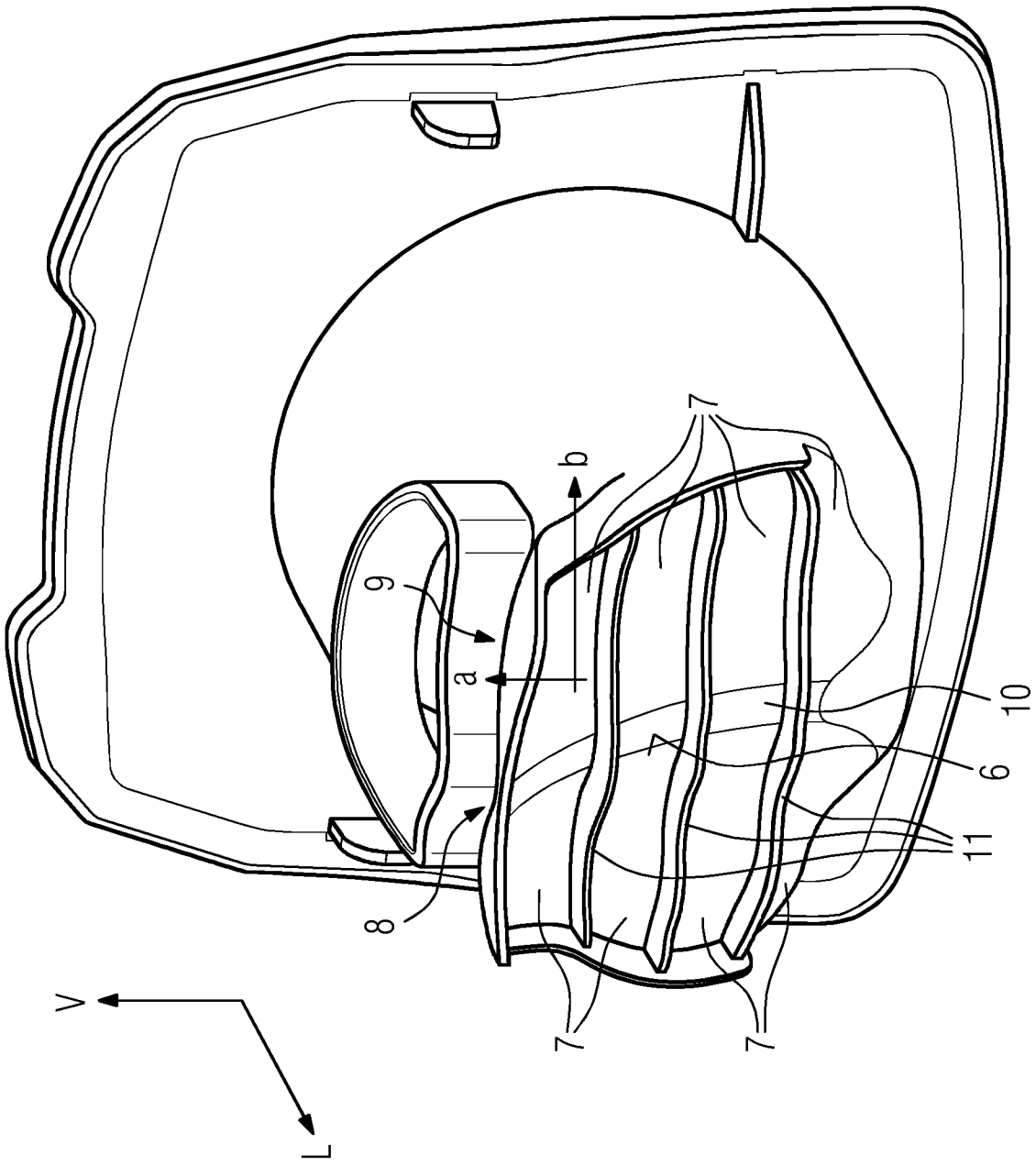


FIG 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/060336

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L5/24 A47L7/00 A47L9/12
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A47L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	EP 1 523 916 A2 (BLACK & DECKER INC [US]) 20 April 2005 (2005-04-20) paragraph [0063]; figures 26-28	1-3, 13-15
X	US 5 020 187 A (KOSTEN RICHARD B [US] ET AL) 4 June 1991 (1991-06-04) the whole document	1,3, 11-15
X	WO 2006/131706 A1 (GREY TECHNOLOGY LTD [GB]; GREY NICHOLAS GERALD [GB]) 14 December 2006 (2006-12-14) pages 1-3	1,3, 11-15

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/060336

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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