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(54) **AXIAL FLOW PUMP AND HOUSEHOLD APPLIANCE EMPLOYING SUCH PUMP**

(57) An axial flow pump (10) has a motor (12) and a pump wheel (14) driven by the motor, wherein the pump wheel is rotatable about an axis of rotation and is shaped to feed fluid in a direction substantially parallel to the axis of rotation.

In accordance with the invention the pump wheel (14) comprises a carrier housing (22) driven by the motor (12) and a pump insert (34) supported by the carrier housing, wherein the pump insert is made of filter material.

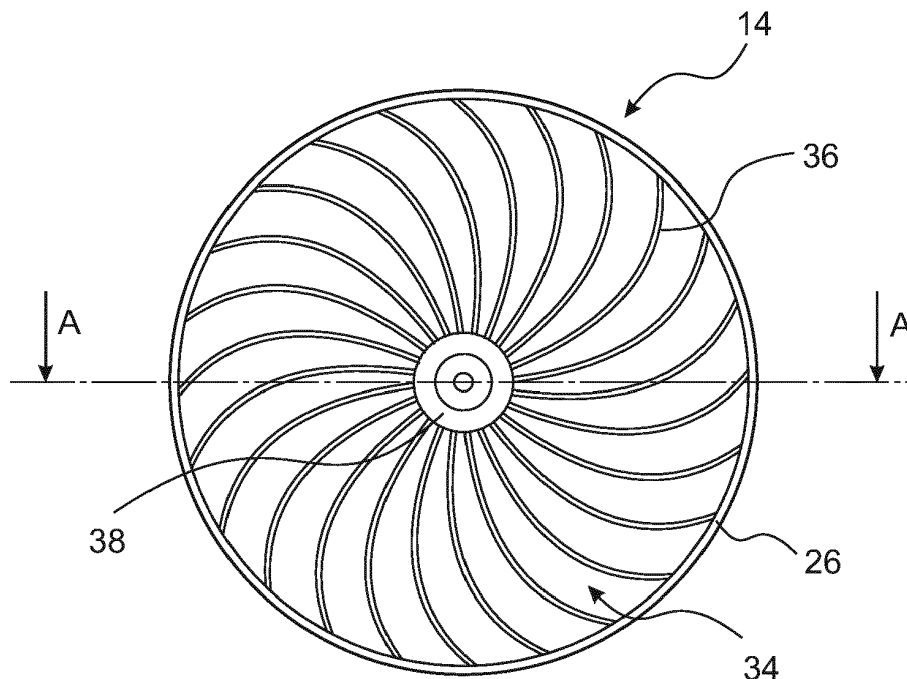


FIG. 4

Description

[0001] The present application relates to an axial flow pump and to a household appliance employing such an axial flow pump.

[0002] An axial flow pump is a fluid pump which has a tubular element in which there is arranged an impeller. The impeller is driven to rotate about an axis which generally coincides with the axis of the tubular element, so that the fluid to be pumped enters the rotating impeller axially, and wherein the pump discharges the fluid nearly axially.

[0003] Axial flow pumps are used in various household appliances, such as ovens, refrigerators and cooker hoods, to displace a fluid, such as air or liquids. Thus, for example in an oven that is configured for hot air heating, heated air is passed into the oven, and at the same time oven fumes are withdrawn from the oven so as to either be reheated and again be used for the heating process, or to be vented. In many such appliances filters are employed to clean the fluid before it is recycled into the appliance or is passed to waste. Particularly, when air is to be cleaned, such as in hot air ovens, cold products with active airflow or cooker hoods, a filter element, for example a carbon fiber mat, is arranged in the flow duct.

[0004] A problem encountered in such systems, is that the filter inherently interferes with the operation of the pump because it impedes the flow generated by the pump. Hence, in order to nevertheless provide for the required flow, the pump has to be designed for a higher capacity, which is achieved in the conventional systems either by providing for a larger pump, or by operating the pump at a higher speed. While the first of these options is disadvantageous in terms of material costs and the space required for placing the pump, the second option leads to a higher power consumption and higher sound emission during operation of the pump.

[0005] It is an object of the present invention to provide for an axial flow pump which overcomes the above problems encountered in the prior art systems.

[0006] In particular, it is an object of the present invention to provide for an axial flow pump which achieves a pump operation. In an axial flow pump having a motor and a pump wheel driven by the motor, wherein the pump wheel is rotatable about an axis of rotation and is shaped to feed fluid in a direction substantially parallel to the axis of rotation, in accordance with the present invention the above object is solved in that the pump wheel comprises a carrier housing driven by the motor and a pump insert supported by the carrier housing, wherein the pump insert is made of filter material.

[0007] The present invention thus provides for an axial flow pump in which the pump wheel provides for the double function of generating fluid flow and for removing unwanted constituents from the fluid being pumped, without the need of having to provide for a separate filter element as in prior art devices, in which such separate filter element requires additional space for its installation. Fur-

thermore, since the filter material is an integral part of the device, the axial flow pump suggested herein can be designed for a smaller flow capacity because there is no flow resistance as in a conventional device in which the pumped flow has to be pressed through a separate filter element.

[0008] Further, by providing for a pump wheel which comprises a carrier housing which is driven by the motor and which supports the pump insert, the pump insert can be made of various materials, which as such do not have to provide for the structural stability to withstand the centrifugal forces that are created by the rotation of the pump wheel during operation of the pump. Hence, during operation of the pump the filter material of the pump insert is exposed mainly to the pressing forces of the pump wheel acting on the fluid to be pumped, whereas the centrifugal forces that are caused by the rotation of the pump wheel are taken up by the carrier housing which is driven by the motor.

Preferred embodiments of the present invention are defined in the dependent claims.

[0009] Thus, the pump insert preferably defines a plurality of impeller blades for feeding fluid in a direction substantially parallel to the axis of rotation of the pump wheel. Given that the pump insert and hence the impeller blades are made of filter material, the impeller blades not only provide for an axial flow of the fluid, but also is the fluid contacted with the filter material so as to remove undesired constituents from the fluid being fed.

[0010] The carrier housing can comprise a core which is driven by the motor and a generally tubular housing element which is connected to the core and which supports the pump insert in the radial direction. While the driving forces for rotating the pump wheel thus are taken up by the core, a major portion of the centrifugal forces acting on the pump wheel during operation of the pump are received at the tubular housing element. The carrier housing provides for rotational support for the pump insert, so that filter materials can be employed for the pump insert which as such might not have sufficient stability to withstand the forces to which the pump wheel is exposed during use.

[0011] In order to minimize the cross-sectional area that is occupied by the parts of the carrier housing which connect the tubular housing element to the core, the carrier housing advantageously comprises a plurality of spoke-like members, so as to provide for a large open cross-sectional area of the pump wheel which provides for minimal impediment of the axial flow.

[0012] In embodiments in which the pump insert defines a plurality of curved impeller blades, the carrier housing can comprise a plurality of members which connect the tubular housing element to the core, wherein the cross-sectional shape of the connecting members corresponds to that of the impeller blades. Similarly as for the afore-mentioned spokes, in this manner the connecting members provide for minimal flow resistance.

[0013] Given that after a certain time of use the filter

material is to be exchanged or regenerated, the axial flow pump advantageously is designed such that the pump insert can be easily exchanged. To this end, the carrier housing can comprise at least one locking element for removably attaching the pump insert at the carrier housing, which locking element for example can be part of a snap connection or a bayonet coupling.

[0014] In preferred embodiments the filter material of the pump insert is an activated carbon material. The pump insert thus can comprise a shaped element, which can be formed for example by pressing an activated carbon powder or granulate into a desired shape, or by molding an activated carbon material, such as a powder, granulate or fiber material, wherein the activated carbon material may be mixed with one or more further material which provides for an agglomeration of the activated carbon material.

[0015] The pump wheel can comprises a plurality of impellers which are arranged to rotate about a common axis, such as a first impeller and at least one second impeller which is arranged downstream of the first impeller. By providing for a plurality of impellers, the pump insert can be designed to have a larger surface area available, which can be of particular advantage for the filtering action of the pump insert. Furthermore, by providing for a plurality of impellers, the pump wheel can be designed such that the impellers can be replaced individually.

[0016] Additionally, by providing for more than one impeller, the impellers can be made of different filter materials that can be designed for filtering different materials out of the fluid being pumped.

In embodiments having a plurality of impellers, the carrier housing preferably comprises a core that is driven by the motor and a generally tubular housing element, which commonly houses all the impellers. In the alternative, the carrier housing may comprise a corresponding plurality of housing elements, each housing one of the impellers.

[0017] The axial flow pump can be designed as a blower, such as for feeding air in an oven or refrigerator, or can be designed as a liquid pump such as in a dishwasher or washing machine. Thus, when the axial flow pump is designed for use as a liquid pump, the pump wheel is designed to provide for a higher stability as compared with a pump wheel that is designed for use as a blower, such as by providing for a larger material thickness. On the other hand, when the pump wheel is designed for use as a blower, it can be made from a thinner or less compact material which can be advantageous in terms of the dimensions and the weight of the pump insert, but also in terms of the filtering characteristics of the pump insert.

[0018] The present invention further provides a household appliance having an axial flow pump as it is described herein. The axial flow pump described herein can be employed for example in a household appliance which is an oven or range, such as an electric oven, a gas oven or a microwave oven, a refrigerator, a dishwasher, a washing machine, a cooker hood, or any other appliance

having a pump for displacing a fluid, such as air or liquid.

[0019] When using a filter material which can be regenerated by heat, the household appliance advantageously comprises means for heating the pump insert, so that the filter material of the pump insert can be regenerated periodically or occasionally, so as to prolong the service life of the pump insert.

[0020] Preferred embodiments of the present invention are described below by reference to the drawings, in which:

Fig. 1 is a schematic view of an axial flow pump in accordance with the present invention;

Fig. 2 illustrates a carrier housing of the axial flow pump of Fig. 1;

Fig. 3 is a cross-sectional view of the carrier housing shown in Fig. 2;

Fig. 4 illustrates the carrier housing of Fig. 2 which together with a pump insert forms the pump wheel for the axial flow pump of Fig. 1; and

Fig. 5 is a cross-sectional view of the pump wheel shown in Fig. 4.

[0021] As illustrated in Fig. 1, the axial flow pump 10 in accordance with the present invention comprises a pump wheel 14 and an electric motor 12 which is in driving connection with the pump wheel 14. The axial flow pump 10 is located within a tube 16 of circular cross-section which can comprise a pump housing of the axial flow pump 10, which housing comprises an inlet and an outlet which are connected to respective conduits of the household appliance. In the alternative, the axial flow pump 10 also can be fixed directly within a conduit through which a fluid is to be pumped. Motor 12 is fixed to the motor carrier 18 which in the embodiment shown in Fig. 1 is depicted as comprising two bar elements which are attached at both sides of the motor 12 at the inner wall of tube 16. In order to provide for additional stability, motor carrier 18 preferably comprises further bar elements which are oriented perpendicular to the bar elements shown in Fig. 1.

[0022] In the example shown in Fig. 1, axial flow pump 10 with motor 12 and pump wheel 14 is designed so as to provide for a flow in the direction of arrows 20, i.e. for the flow in which the fluid to be pumped, for example air, enters axial flow pump 10 at pump wheel 14 and exits axial flow pump 10 at the side of pump wheel 14 facing towards motor 12.

[0023] Fig. 2 illustrates a carrier housing 22 of pump wheel 14. Carrier housing 22 comprises the central core 24 and the tubular housing element 26 which is connected to core 24 by means of two connecting elements 28. As can be seen in Fig. 3 which shows a cross sectional view of carrier housing 22 taken along line A-A of Fig. 2,

at the outer central portion of core 24 there is arranged a tubular extension 30 which is adapted to receive the output shaft of motor 12 shown in Fig. 1. As can be seen in Fig. 2, the provision of connecting elements 28 provides for a relatively large open area 32 for passage of the fluid to be pumped.

[0024] Fig. 4 shows pump wheel 14 in the assembled state, wherein a pump insert 34 is arranged within the tubular housing element 26. Pump insert 34 which is made of shaped activated carbon comprises a plurality of impeller blades 36 which are attached with their inner ends to an annular core piece 38. In the embodiment depicted in Fig. 4, the outer ends of impeller blades 36 rest against the inner wall of tubular housing element 26. In order to provide for additional stability of pump insert 34, the pump insert 34 can be provided with an outer tubular element (not shown), which as the tubular housing element 26 shown in Fig. 4 is arranged about the outer ends of impeller blades 36, but which is formed integrally with the impeller blades.

[0025] As is shown in Fig. 5 which illustrates a cross sectional view of pump wheel 14 taken along line A-A of Fig. 4, pump insert 34 comprises several sets of impeller blades 36, so as to provide for an increased surface area available for contact with the fluid being pumped.

List of reference signs

[0026]

10	axial flow pump
12	electric motor
14	pump wheel
16	tube
18	motor carrier
20	flow direction
22	carrier housing
24	central core
26	tubular housing element
28	connecting elements
30	tubular extension
32	open area of 22
34	pump insert
36	impeller blade
38	core piece

Claims

1. An axial flow pump (10) having a motor (12) and a pump wheel (14) driven by the motor, wherein the pump wheel is rotatable about an axis of rotation and is shaped to feed fluid in a direction substantially parallel to the axis of rotation,
characterized in that
the pump wheel (14) comprises a carrier housing (22) driven by the motor (12) and a pump insert (34) supported by the carrier housing, wherein the pump

insert is made of filter material.

2. The axial flow pump (10) of claim 1, wherein the pump insert (34) defines a plurality of impeller blades (36) for feeding fluid in a direction substantially parallel to the axis of rotation of the pump wheel (14).
3. The axial flow pump (10) of claim 1 or 2, wherein the carrier housing (22) comprises a core (24) driven by the motor (12) and a generally tubular housing element (26) which is connected to the core and which supports the pump insert (34) in the radial direction.
4. The axial flow pump (10) of claim 3, wherein the carrier housing (22) comprises a plurality of spoke-like members which connect the tubular housing element (26) to the core (24).
5. The axial flow pump (10) of any one of the preceding claims, wherein the carrier housing (22) comprises a plurality of members (28) which connect the tubular housing element (26) to the core (24).
6. The axial flow pump (10) of any one of the preceding claims, wherein the carrier housing (22) comprises at least one locking element for removably attaching the pump insert (34) at the carrier housing.
7. The axial flow pump (10) of claim 6, comprising a bayonet coupling for removably attaching the pump insert (34) at the carrier housing (22).
8. The axial flow pump (10) of any one of the preceding claims, wherein the filter material of the pump insert (34) is an activated carbon material.
9. The axial flow pump (10) of any one of the preceding claims, wherein the pump wheel (14) comprises a plurality of impellers which are arranged to rotate about a common axis.
10. The axial flow pump (10) of claim 7, wherein the carrier housing (22) comprises a core (24) driven by the motor (12) and a generally tubular housing element (26) which houses the plurality of impellers.
11. The axial flow pump (10) of any one of the preceding claims, which is designed as a blower.
12. The axial flow pump (10) of any of claims 1 to 10, which is designed as a liquid pump.
13. A household appliance having an axial flow pump (10) as it is defined in any of the preceding claims.
14. The household appliance of claim 13, comprising means for heating the pump insert (34).

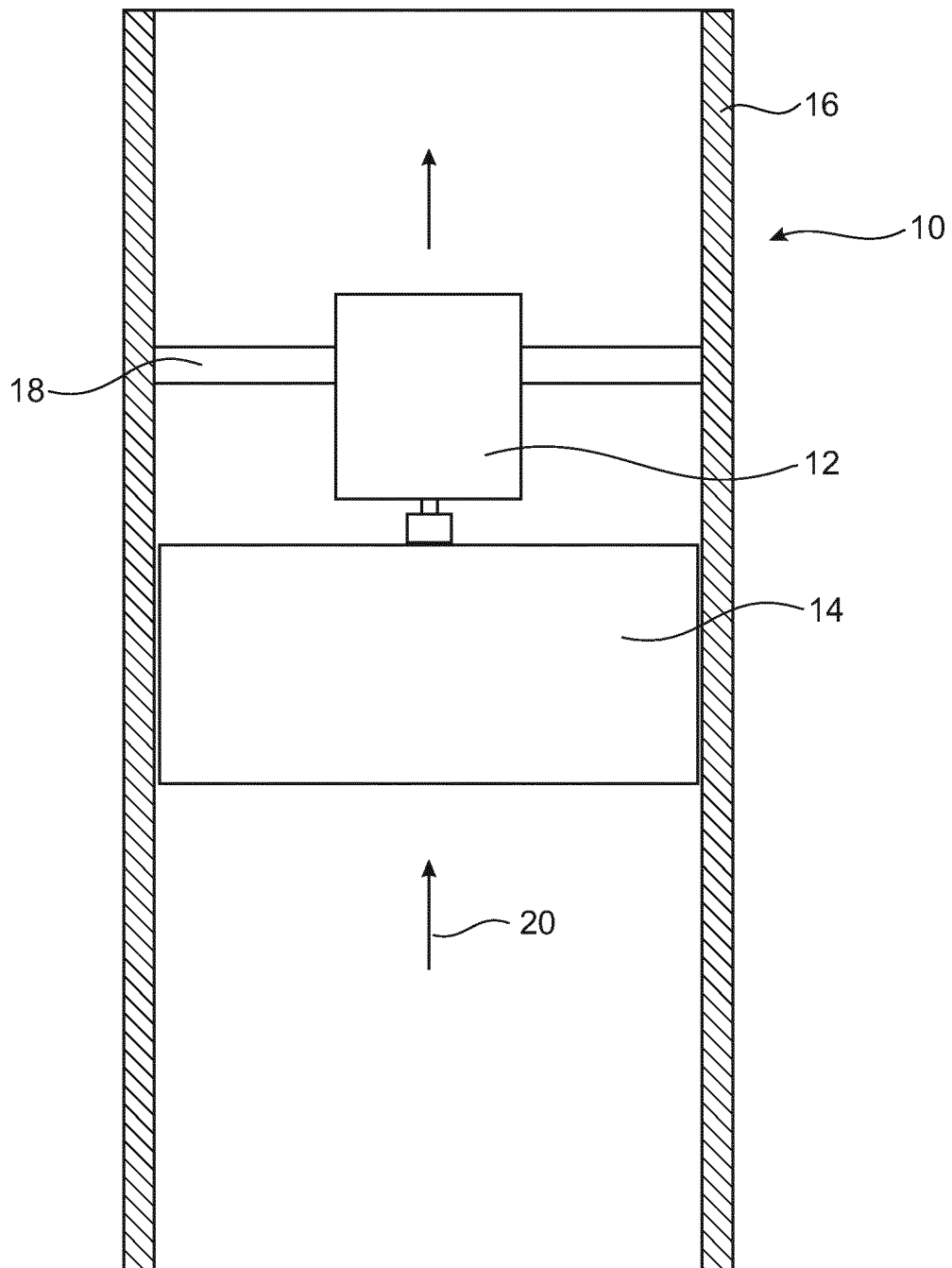


FIG. 1

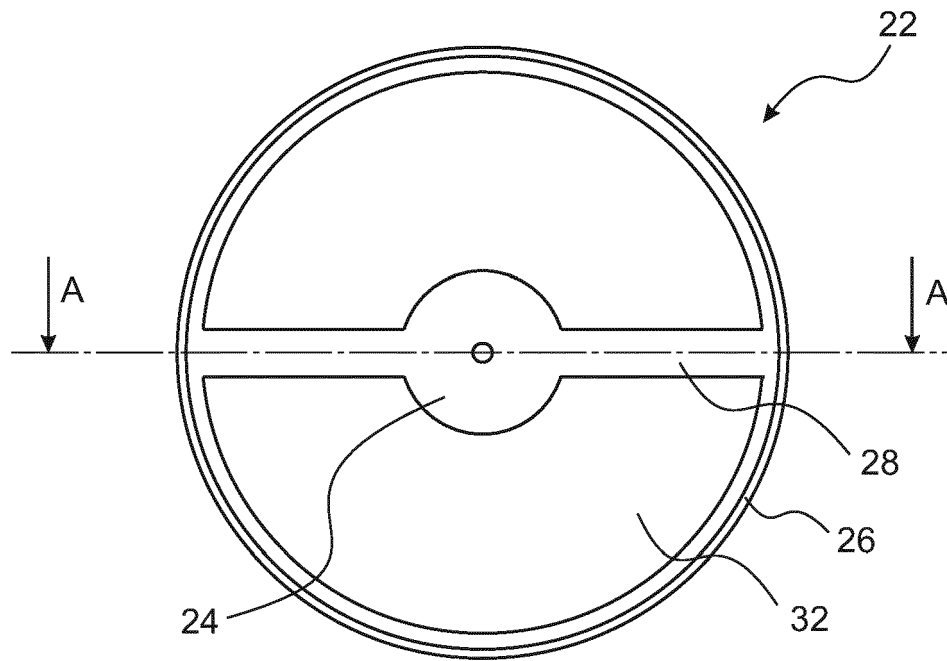


FIG. 2

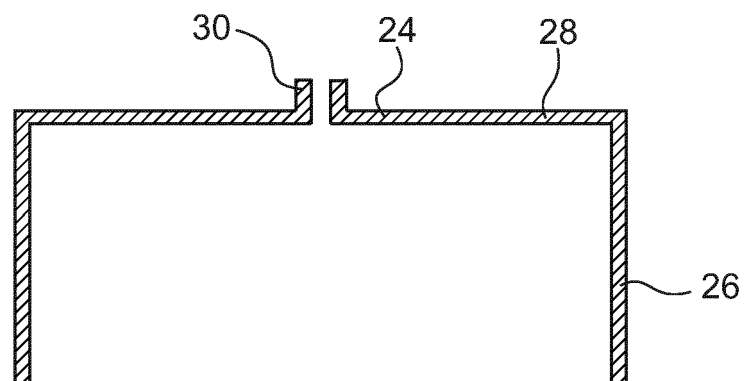


FIG. 3

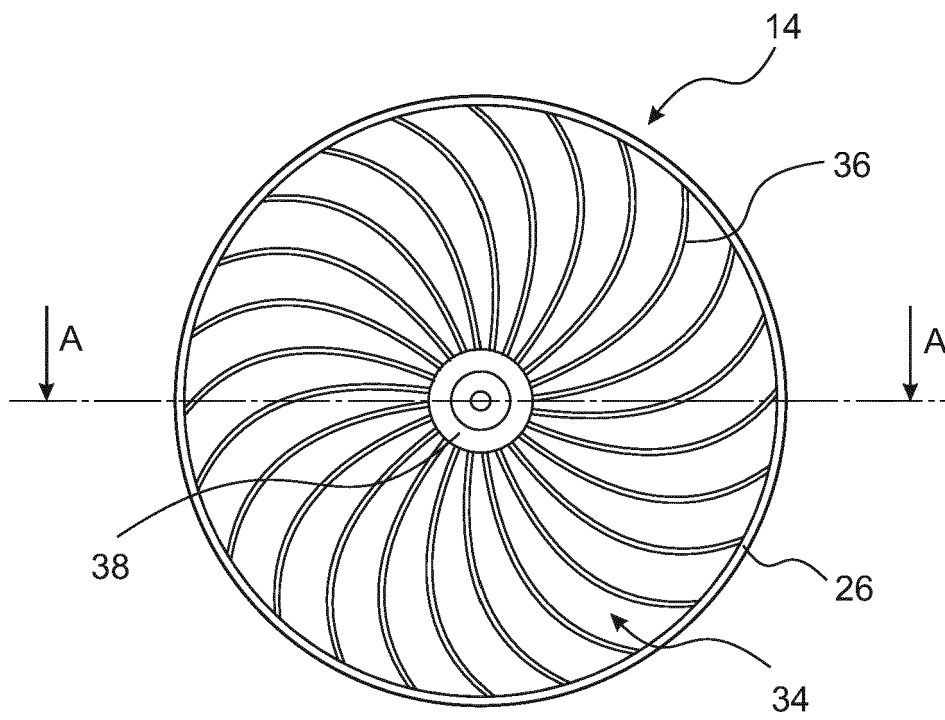


FIG. 4

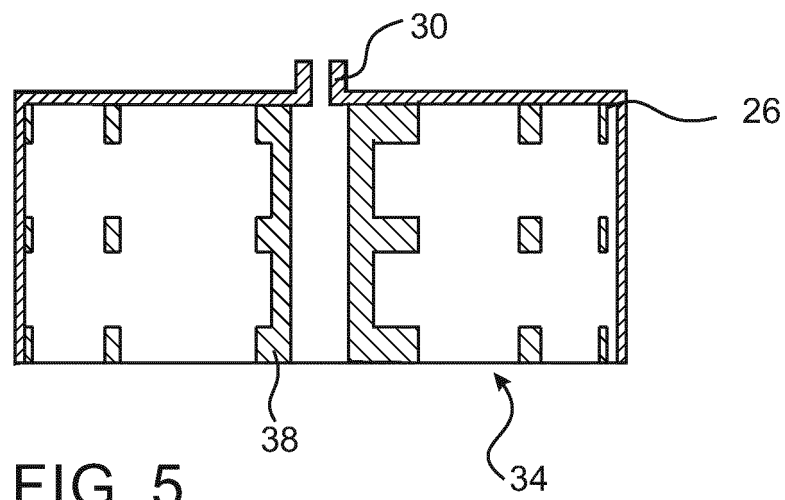


FIG. 5



EUROPEAN SEARCH REPORT

 Application Number
 EP 17 18 9734

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 9 March 2018	Examiner Ingelbrecht, Peter
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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