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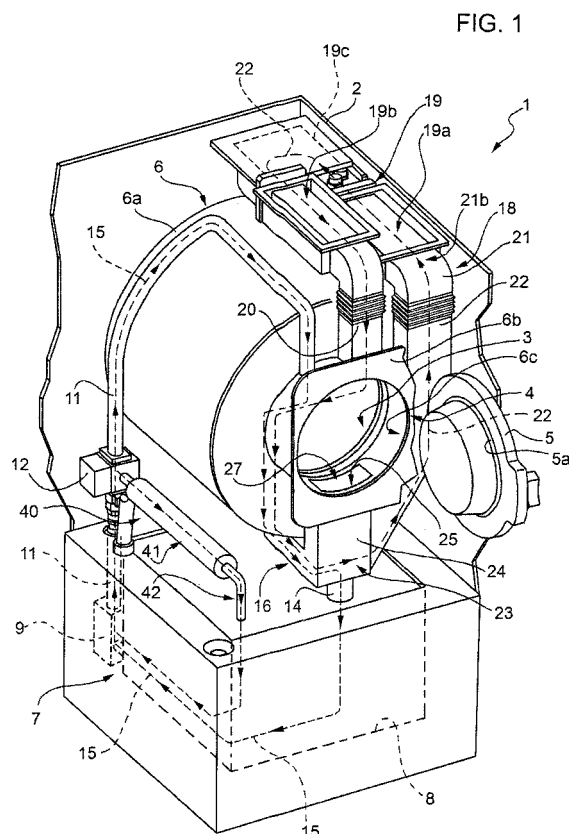
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(54) **Dry-washing machine employing a wash fluid and equipped with a combination filter assembly**

(57) A dry-washing machine (1) having a wash assembly (7) for circulating a solvent along a predetermined wash path (15) extending through a laundry drum (3); a drying assembly (18) for circulating hot air along a predetermined drying path (22) extending through the drum (3); and a filter assembly (23) which, during a wash cycle, removes fibres, lint, and fluff from the solvent circulating along the wash path (15), and, during a drying cycle, removes fibres, lint, and fluff from the hot air circulating along the drying path (22); the filter assembly (23) being designed to accumulate the fibres, lint, and fluff from the solvent at a predetermined location along the drying path (22), so that hot air flows over the accumulated fibres, lint, and fluff during the drying cycle.



Description

[0001] The present invention relates to a dry-washing machine employing a wash fluid and equipped with a combination filter assembly.

[0002] More specifically, the present invention relates to a dry-washing machine for home use designed to perform wash cycles employing a wash fluid comprising a preferably, though not necessarily, water or silicone solvent, to which the following description refers purely by way of example.

[0003] As is known, some last-generation dry-washing machines are equipped with a wash assembly which, during the wash cycles, circulates inside the laundry drum a wash fluid comprising a silicone solvent, such as siloxane, mixed with various washing agents to repeatedly sprinkle the laundry; and a drying assembly which, when washing is completed, feeds hot air into the laundry drum and, at the same time, draws the hot, moisture-laden air out of the laundry drum to dry the laundry.

[0004] Dry-washing machines of the type described above normally also comprise two independent, physically separate filters, a first of which is housed removably inside a seat along a silicone solvent recovery conduit of the wash assembly to remove fibres, lint, and fluff left in the solvent by the laundry during the wash cycle, and so prevent clogging of the wash assembly pumps and/or valves.

[0005] The second filter is normally housed removably inside a seat along an intake conduit of the drying assembly to remove, during the drying cycle, fibres, lint, and fluff left in the air by the laundry in the drum, and so prevent clogging of the various drying assembly devices.

[0006] At the end of each wash-dry cycle, both filters must be removed by the user from their respective seats, and the accumulated fibres, lint, and fluff removed to ensure correct performance of the next wash-dry cycle.

[0007] One drawback of dry-washing machines of the above type lies in the user, when cleaning the first filter, coming into contact with the fibres, lint, and fluff, which, being soaked with the wash solvent, therefore bring the user into contact with the solvent, which constitutes a potential health hazard.

[0008] It is an object of the present invention to provide a dry-washing machine equipped with a combination filter assembly designed to prevent the user from coming into contact with the wash solvent when cleaning the combination filter assembly.

[0009] According to the present invention, there is provided a dry-washing machine equipped with a combination filter assembly, as claimed in Claim 1 and preferably, though not necessarily, in any one of the Claims depending directly or indirectly on Claim 1.

[0010] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a schematic view in perspective, with

parts removed for clarity, of a dry-washing machine in accordance with the teachings of the present invention;

Figure 2 shows a cross section, with parts removed for clarity, of the Figure 1 dry-washing machine;

Figure 3 shows a larger-scale front view in perspective, with parts removed for clarity, of part of the Figure 1 dry-washing machine;

Figure 4 shows a larger-scale front view in perspective, with parts removed for clarity, of part of the Figure 1 dry-washing machine, in which the filter is partly extracted from its seat;

Figure 5 shows a larger-scale front view in perspective of the filter of the Figure 1 dry-washing machine; and

Figure 6 shows a larger-scale cross section of the filter of the Figure 1 dry-washing machine.

[0011] With reference to Figures 1 and 2, number 1 indicates as a whole a home dry-washing machine substantially comprising a preferably, though not necessarily, parallelepiped-shaped casing 2; a laundry drum 3 for housing the laundry to be washed and dried, which is housed in axially rotating manner and preferably, though not necessarily, horizontally inside a wash tub 6 inside casing 2, directly facing a laundry loading-unloading opening 4 in a lateral wall of wash tub 6.

[0012] Home dry-washing machine 1 also comprises a door 5 hinged preferably, though not necessarily to the wall of the wash tub 6 to rotate to and from a work position closing opening 4 in the wall to hermetically seal wash tub 6; and an electric motor or similar (not shown) for rotating laundry drum 3 about its longitudinal axis L inside the wash tub 6.

[0013] More specifically, wash tub 6 comprises a cylindrical main body 6a; and a substantially rectangular lateral supporting plate 6b fitted rigidly and parallel to the front wall of cylindrical main body 6a by an annular collar 6c connecting loading-unloading opening 4 to a circular opening formed in the front wall of wash tub 6.

[0014] The inner edge of door 5 is fitted with an annular seal 5a made of rubber material and shaped to rest on the annular edge of loading-unloading opening 4, when door 5 is closed, to seal wash tub 6.

[0015] Dry-washing machine 1 also comprises a wash assembly 7 for circulating a wash fluid along a predetermined wash path 15, which extends through drum 3 and is designed to recover the wash fluid during the wash cycle. In the example shown, the wash fluid employed by wash assembly 7 comprises a preferably, though not necessarily, silicone-base solvent, such as siloxane or decamethylcyclopentasiloxane, commonly known as D5, or any other similar solvent.

[0016] In an alternative embodiment (not shown), the wash fluid employed by wash assembly 7 comprises water.

[0017] With reference to Figures 1 and 2, wash assembly 7 substantially comprises a tank 8; a pump 9 con-

nected to tank 8 by an intake conduit 10, and to wash tub 6 by a conduit 11 to feed a given quantity of fluid into wash tub 6 and, hence, drum 3; a detergent dispenser (not shown) located along intake conduit 10 to add a given amount of detergent/s to the solvent; and a valve 12 located along conduit 11 to control solvent feed into wash tub 6.

[0018] More specifically, valve 12 is preferably, though not necessarily, a two-way valve, which has an inlet connected to the outlet of pump 9; a first outlet connected to wash tub 6 by an end portion of conduit 11, which end portion is preferably, though not necessarily, made of flexible material; and a second outlet connected to a solvent filtering circuit 40.

[0019] More specifically, in the Figure 1 example, valve 12, on command, selectively cuts off supply of the fluid, mixed with detergent/s, into wash tub 6, and activates fluid supply to filtering circuit 40 to clean the solvent.

[0020] In the example shown, solvent filtering circuit 40 substantially comprises an active-carbon filter 41 interposed between the second outlet of two-way valve 12 and an inlet conduit 42 of tank 8 to clean the solvent.

[0021] Wash assembly 7 also comprises a recovery conduit 14 connecting wash tub 6 to tank 8, and along which the fluid in tub 6 flows gradually back into tank 8.

[0022] More specifically, in the Figure 1 example, recovery conduit 14 has one end connected by a connecting conduit 16 to a bottom portion of wash tub 6 to receive the used solvent from wash tub 6; and an opposite end connected to a preferably top portion of tank 8 to feed the solvent by gravity back into tank 8. In the example shown, the solvent is preferably fed continuously back into tank 8 by connecting conduit 16 and recovery conduit 14 during the wash cycle.

[0023] In connection with the above, it should be pointed out that wash assembly 7 circulates the fluid along wash path 15, so that it flows along conduits 10 and 11, through wash tub 6 and drum 3, and along connecting conduit 16 and recovery conduit 14.

[0024] With reference to Figure 1, dry-washing machine 1 also comprises a drying assembly 18, which circulates hot air along a predetermined drying path 22 extending through drum 3.

[0025] More specifically, drying assembly 18 feeds hot air into drum 3 through wash/drying tub 6, and draws the moisture-laden air out of drum 3. In other words, drying assembly 18 continually heats the air, and feed it into wash tub 6 and, hence, drum 3, to rapidly dry the laundry inside drum 3.

[0026] More specifically, in the Figure 1 example, drying assembly 18 comprises a heat pump device 19; a feed manifold 20 connecting the outlet of heat pump device 19 to wash tub 6 to supply tub 6 with hot air; and an intake manifold 21 connecting wash tub 6 to heat pump device 19 to feed the moisture-laden air from wash tub 6 to heat pump device 19.

[0027] In the example shown, heat pump device 19 substantially comprises a cooling stage 19a connected

to intake manifold 21 to condense the air from wash tub 6 and separate the solvent and/or moisture from the air; a heating stage 19b connected to feed manifold 20 to heat the air supply to wash tub 6; and at least one ventilator 19c interposed between cooling stage 19a and heating stage 19b to force-circulate the air into drying assembly 18.

[0028] With reference to Figures 1 and 3, intake manifold 21 has one end 21a connected by connecting conduit 16 to wash tub 6; and an opposite end 21b connected to the inlet of cooling stage 19a.

[0029] In connection with the above, it should be pointed out that drying assembly 18 circulates air along drying path 22, which extends through heating stage 19b, feed manifold 20, wash tub 6 and drum 3, along connecting conduit 16, and through intake manifold 21, cooling stage 19a and ventilator 19c.

[0030] Dry-washing machine 1 also comprises a combination filter assembly 23, which, during the wash cycle, removes fibres, lint, and fluff from the solvent circulating along wash path 15, and, during the drying cycle, removes fibres, lint, and fluff from the air circulating along drying path 22.

[0031] Combination filter assembly 23 is designed to accumulate the fibres, lint, and fluff from the fluid at a predetermined location along drying path 22, so that air flows over the accumulated fibres, lint, and fluff during the drying cycle.

[0032] In other words, combination filter assembly 23 is so located in dry-washing machine 1 as to intercept and filter the solvent flowing along wash path 15, and, at the same time, the moisture-laden air flowing along drying path 22, and is designed so that the hot air flowing along drying path 22 flows through, and so removes accumulated solvent from, the fibres, lint, and fluff accumulated by combination filter assembly 23 during the wash cycle and the drying cycle.

[0033] In connection with the above, it should be pointed out that, at the start of the drying cycle, combination filter assembly 23 accumulates further fibres, lint, and fluff partly impregnated with solvent and with a small amount of moisture. At this stage, in fact, the air supply to wash tub 6 draws out of drum 3 a certain amount of fibres, lint, and fluff, which gradually accumulate in combination filter assembly 23, so that the air emitted during the drying cycle removes not only the solvent impregnating the fibres, lint, and fluff accumulated during the wash cycle, but also the solvent in the fibres, lint, and fluff accumulated by combination filter assembly 23 during the drying cycle itself.

[0034] Combination filter assembly 23 comprises a substantially parallelepiped-shaped housing 24 fitted to annular collar 6c, and which has a top opening 25 formed in annular collar 6c, and a substantially parallelepiped-shaped inner compartment 26; and an easily removable filter 27 housed firmly inside compartment 26 of housing 24.

[0035] With reference to Figure 2, housing 24 has an

inlet 28 connected by conduit 16 to wash tub 6 to receive both the solvent - before it is fed back into tank 8 - and the moisture-laden air from wash tub 6; at least a first outlet 29 connected to intake manifold 21; and a second outlet 30 connected to tank 8 by recovery conduit 14.

[0036] In the Figure 2 example, housing 24 extends downwards from annular collar 6c along an axis D, and comprises a rear wall facing the front wall of wash tub 6; a lateral wall facing the inlet 21a of intake manifold 21; and a bottom wall facing the inlet 14a of recovery conduit 14.

[0037] More specifically, inlet 28 comprises a preferably rectangular opening formed in the rear wall of housing 24 to connect compartment 26 to conduit 16; first outlet 29 comprises a rectangular opening formed in the lateral wall of housing 24 to connect compartment 26 to inlet 21a of intake manifold 21; and second outlet 30 comprises a rectangular opening formed in the bottom wall of housing 24 to connect compartment 26 to inlet 14a of recovery conduit 14.

[0038] Filter 27 is fitted inside compartment 26 through top opening 25 (Figure 4), provides for intercepting the fibres, lint, and fluff in both the solvent and the air intake immediately downstream from connecting conduit 16, and is designed to accumulate the fibres, lint, and fluff in a predetermined location enabling solvent removal by hot air flowing over the solvent.

[0039] With reference to Figures 3, 5 and 6, filter 27 has at least one perforated wall, which intersects drying path 22 to remove fibres, lint, and fluff from the hot air.

[0040] More specifically, in the Figure 3-5 example, filter 27 is substantially parallelepiped-shaped, and comprises a perforated front major wall 27a parallel to the longitudinal axis D, when filter 27 is fitted inside housing 24; two parallel, opposite, perforated minor lateral walls 27b on opposite sides of front major wall 27a; and a top wall 27c crosswise to major wall 27a.

[0041] More specifically, filter 27 is open on two sides, i.e. has a substantially rectangular opening 27d formed in a rear major wall 27e opposite front major wall 27a; and a bottom opening 27f formed in the bottom lateral wall opposite top wall 27c.

[0042] More specifically, in Figure 3-5 example, filter 27 is fitted inside compartment 26 of housing 24 so that opening 27d at least partly faces inlet 28 of housing 24, one of perforated minor lateral walls 27b faces end 21a of the intake manifold, and opening 27f faces second outlet 30 of housing 24.

[0043] More specifically, the holes in major wall 27a and lateral walls 27b are sized to remove the fibres, lint, and fluff from the air intake, while at the same time allowing the air intake through to intake manifold 21.

[0044] Filter 27 also comprises at least one perforated partition 31, which intersects wash path 15 to remove and accumulate fibres, lint, and fluff in the predetermined location, and is positioned inside filter 27 to intersect drying path 22, so that hot air flows over the accumulated fibres, lint, and fluff.

[0045] More specifically, perforated partition 31 extends substantially crosswise to front major wall 27a, faces opening 27e, and intercepts the fibres, lint, and fluff in the solvent.

[0046] More specifically, in the Figure 2 example, the filter 27 comprises a number of parallel perforated partitions 31 spaced apart along longitudinal axis D and tilted downwards at a given angle to major wall 27a.

[0047] In the example shown in the Figure 2, perforated partitions 31 are located inside filter 27 at bottom opening 27f, i.e. in a bottom portion of filter 27, and are interposed between inlet 28 and second outlet 30 of housing 24 when filter 27 is fitted inside compartment 26 of housing 24.

[0048] The holes in each partition 31 are sized to remove the fibres, lint, and fluff from the solvent, while at the same time allowing the solvent through to recovery conduit 14.

[0049] Top wall 27c is substantially arc-shaped, so as to be flush with annular collar 6c, when filter 27 is fitted inside compartment 26 of housing 24, and so allow door 5 to close. In the example shown, top wall 27c is substantially semicircular, and is designed to close the top opening 25 of housing 24 and define, when filter 27 is fitted inside compartment 26, a portion of annular collar 6c against which door 5 closes.

[0050] In actual use, filter 27 is inserted inside compartment 26 of housing 24 through top opening 25. During the wash cycles, the fluid, namely the solvent, accumulated in wash tub 6 flows gradually along connecting conduit 16 to inlet 28 of housing 24 and through perforated partition/s 31, which is/are positioned to intercept the fibres, lint, and fluff in the solvent before it is fed back into tank 8 by recovery conduit 14.

[0051] When washing is completed, the drying cycle is activated to feed hot air into drum 3 via feed manifold 20 and wash tub 6. The moisture-laden air in drum 3 is drawn out by intake manifold 21 along connecting conduit 16 and into compartment 26; in the course of which, the hot air flows successively through perforated partitions 31 and then through walls 27a and 27b of the filter 27. As the hot drying air flows through perforated partitions 31, solvent is advantageously evaporated from the fibres, lint, and fluff accumulated on perforated partitions 31, and the fibres, lint, and fluff in the air accumulate in perforated walls 27a and 27b of filter 27.

[0052] In connection with the above, it should be pointed out that, when the wash cycle is completed, and therefore during the drying cycle, dry-washing machine 1 preferably, though not necessarily, filters the solvent by means of filtering circuit 40. More specifically, the solvent is filtered by activating two-way valve 12 to connect filtering circuit 40 to tank 8, and by activating pump 9 to circulate the solvent in tank 8 through filter 41.

[0053] The dry-washing machine 1 as described above has the major advantage of eliminating any contact with the fluid, namely the solvent by the user when cleaning filter 27.

[0054] Moreover, locating filter 27 inside housing 24 prevents the user accidentally coming into contact with the solvent. That is, user access to filter 27 is only possible by opening door 5, which, in dry-washing machine 1, can only be done after filter 27 is dried and, therefore, only after all traces of solvent have been removed from filter 27.

[0055] Moreover, the design of filter 27 makes removal of the accumulated fibres, lint, and fluff faster and easier, in that the user only has to remove, clean, and replace one filter instead of two.

[0056] Clearly, changes may be made to dry-washing machine 1 as described herein without, however, departing from the scope of the present invention as defined in the accompanying Claims.

Claims

1. A dry-washing machine (1) comprising a casing (2); a wash tub (6) mounted inside said casing (2); a laundry drum (3) mounted for rotation inside said wash tub (6); wash means (7) for circulating a fluid along a predetermined wash path (15) extending through said drum (3); and drying means (18) for circulating hot air along a predetermined drying path (22) extending through said drum (3); said dry-washing machine (1) being
characterized by comprising a filter assembly (23) which, during a wash cycle, removes fibres, lint, and fluff from the fluid circulating along said wash path (15), and, during a drying cycle, removes fibres, lint, and fluff from the hot air circulating along said drying path (22); said filter assembly (23) being designed to accumulate said fibres, lint, and fluff from said fluid and said air at a predetermined location along said drying path (22), so that said hot air flows over the accumulated said fibres, lint, and fluff during said drying cycle.
2. A dry-washing machine as claimed in Claim 1, and comprising a filter (27), which comprises at least one perforated wall (27a; 27b) intersecting said drying path (22) to remove fibres, lint, and fluff from the hot air; said filter (27) comprising at least one perforated partition (31) intersecting said wash path (15) to remove and accumulate said fibres, lint, and fluff at said predetermined location; said perforated partition (31) being so located in said filter (27) as to intersect said drying path (22), so that hot air flows over the accumulated fibres, lint, and fluff.
3. A dry-washing machine as claimed in Claim 2, wherein said filter assembly (23) comprises a housing (24) having an inner compartment (26) for housing said filter (27); said housing (24) comprising an inlet (28) alternately receiving said fluid and said hot air; said at least one perforated partition (31) being located in said filter (27) so as to directly face the inlet (28) of the housing (24) when said filter (27) is fitted inside the compartment (26).
4. A dry-washing machine as claimed in Claim 3, wherein said housing (24) has a first outlet (29) through which hot air flows; and a second outlet (30) through which said fluid flows.
5. A dry-washing machine as claimed in Claim 3 or 4, wherein the inlet (28) of the housing (24) is connected to said wash tub (6) by a connecting conduit (16), which supplies said housing (24) with said fluid during a wash cycle, and with said hot air during a drying cycle.
6. A dry-washing machine as claimed in any one of Claims 2 to 5, wherein said filter (27) is substantially parallelepiped-shaped, and comprises a perforated front major wall (27a) parallel to the longitudinal axis (D) of said housing (24); and at least two parallel, opposite, perforated minor lateral walls (27b) on opposite sides of the front major wall (27a).
7. A dry-washing machine as claimed in Claim 6, wherein said filter (27) has a first opening (27d) formed in a rear major wall (27e) facing said front major wall (27a); and a second opening (27f) formed in a bottom lateral wall.
8. A dry-washing machine as claimed in Claim 7, wherein said filter (27) is housed firmly but easily removably inside said compartment (26) of the housing (24), so that, when it is fitted inside the compartment (26), said first opening (27d) and said at least one perforated partition (31) face the inlet (28) of the housing (24).
9. A dry-washing machine as claimed in Claim 8, wherein said drying means (18) comprise at least a hot-air intake manifold (21), said first outlet (29) of said housing (24) being connected to said hot-air intake manifold (21); and wherein said wash means (7) comprise
at least a tank (8) containing said fluid, and a recovery conduit (14) connected to said tank (8); said second outlet (30) of said housing (24) being connected to said recovery conduit (14).
10. A dry-washing machine as claimed in any one of Claims 2 to 9, and comprising a laundry loading-unloading opening (4) formed in a lateral wall (6b) of said wash tub (6); and a door (5) hinged to said wall of said wash tub (6) to rotate to and from a work position closing said loading-unloading opening; the wash tub (6) comprising a cylindrical main body (6a), and a lateral supporting plate (6b) which is connected rigidly to the front wall of said cylindrical main

body (6a) by an annular collar (6c) connecting the loading-unloading opening (4) to the wash tub (6); and said housing (24) being fitted to said annular collar (6c), and having a top opening (25) formed in the annular collar (6c).

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11. A dry-washing machine as claimed in any one of Claims 1 to 10 wherein said fluid comprises a solvent.

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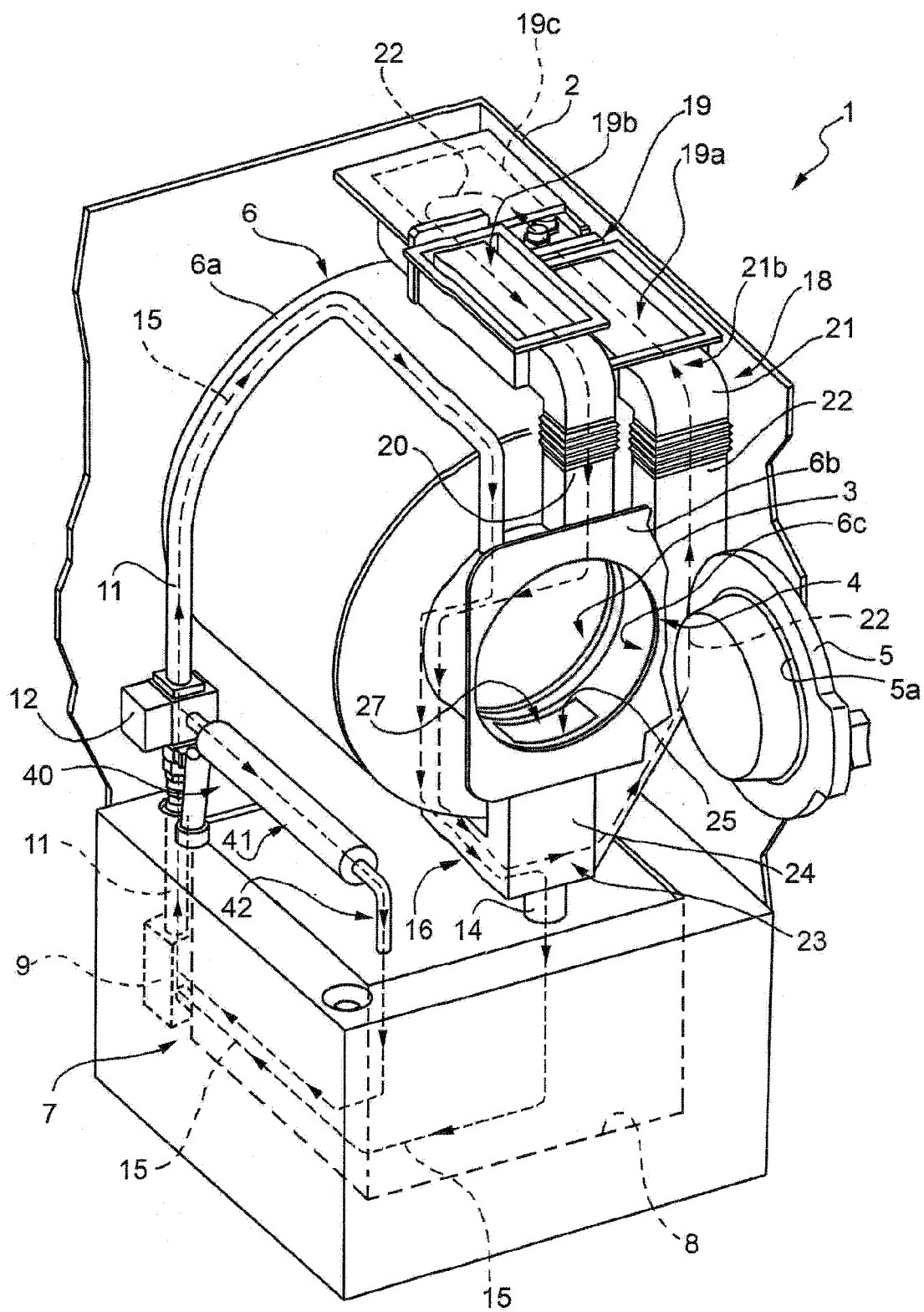
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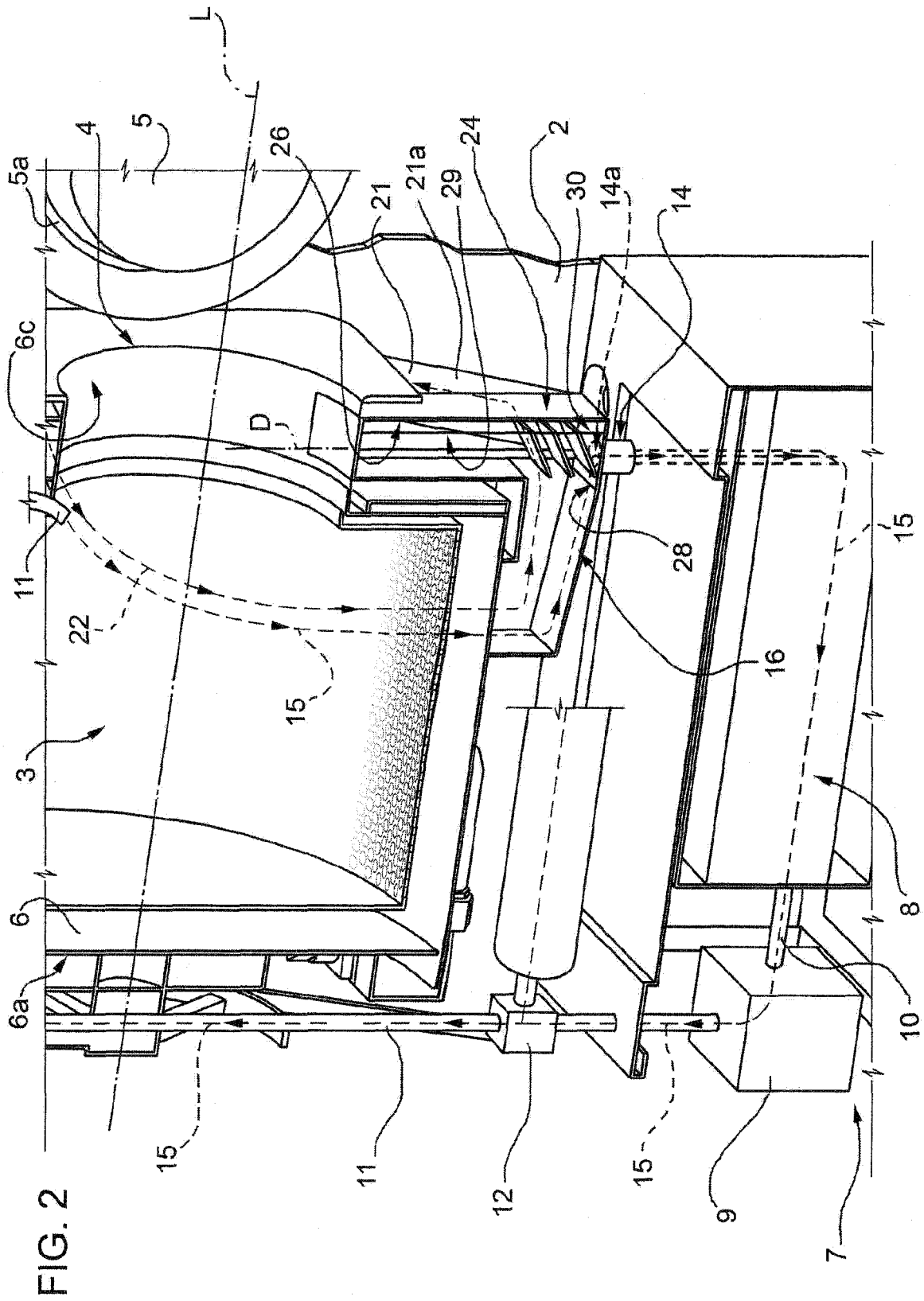
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FIG. 1





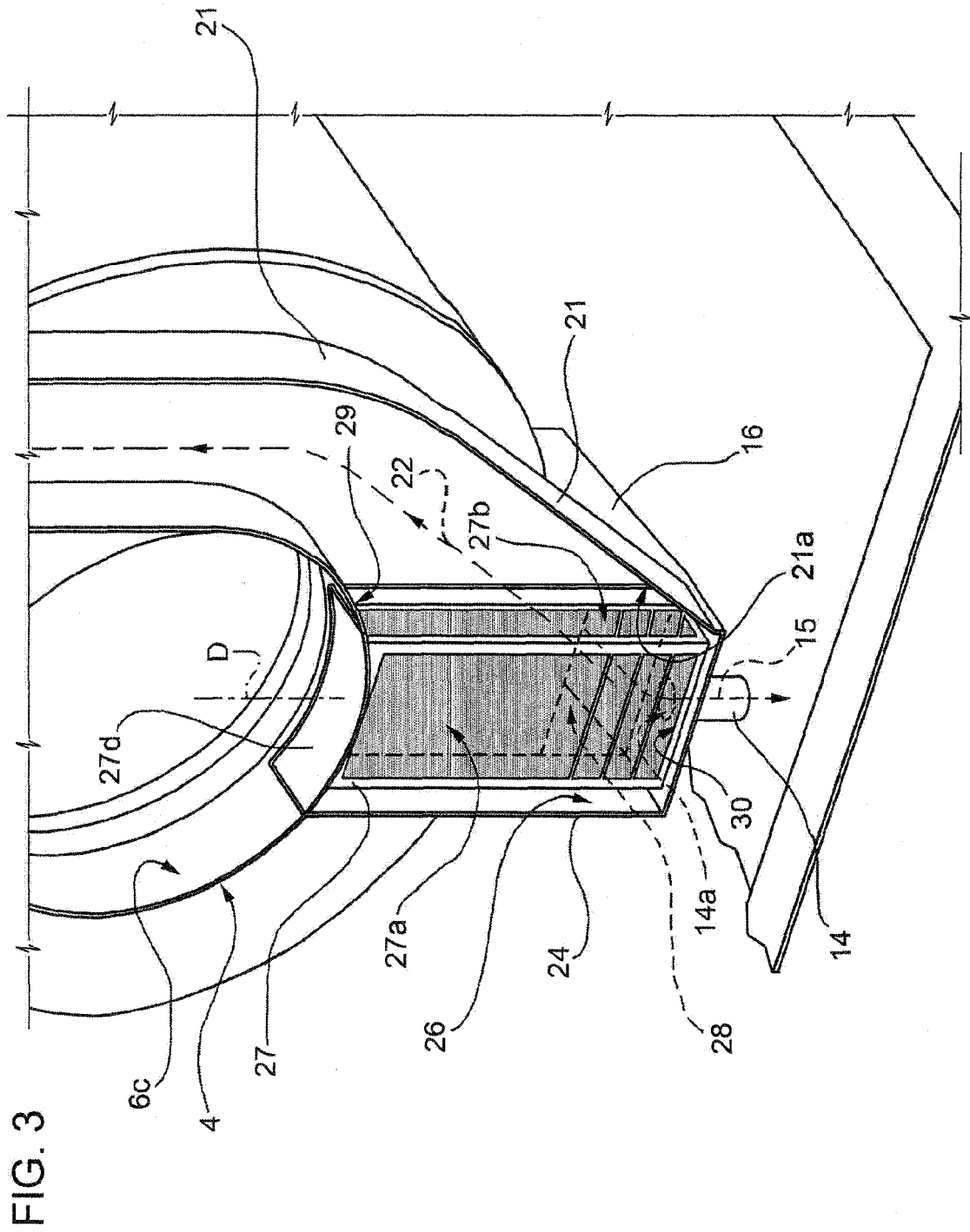


FIG. 4

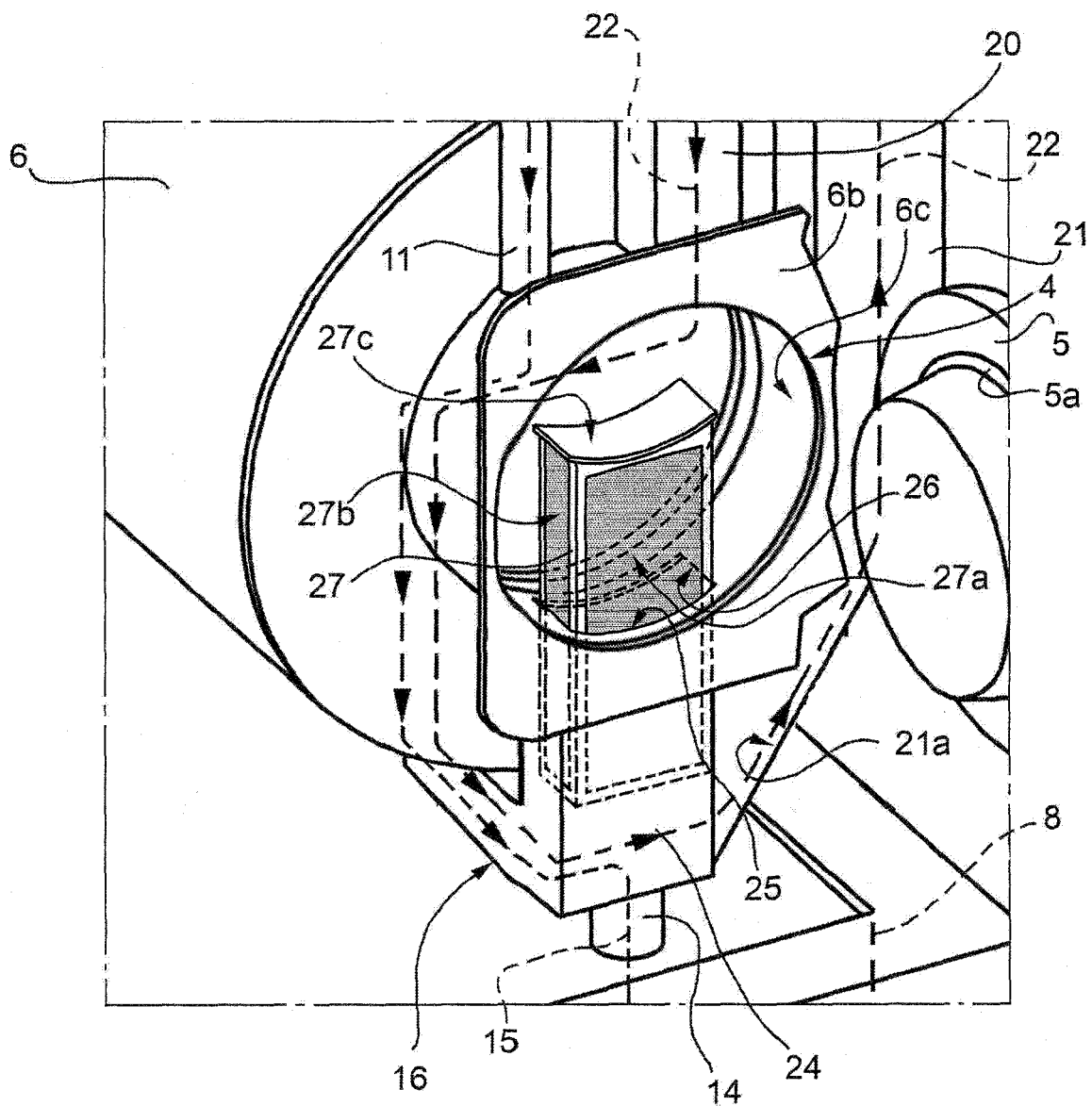


FIG. 5

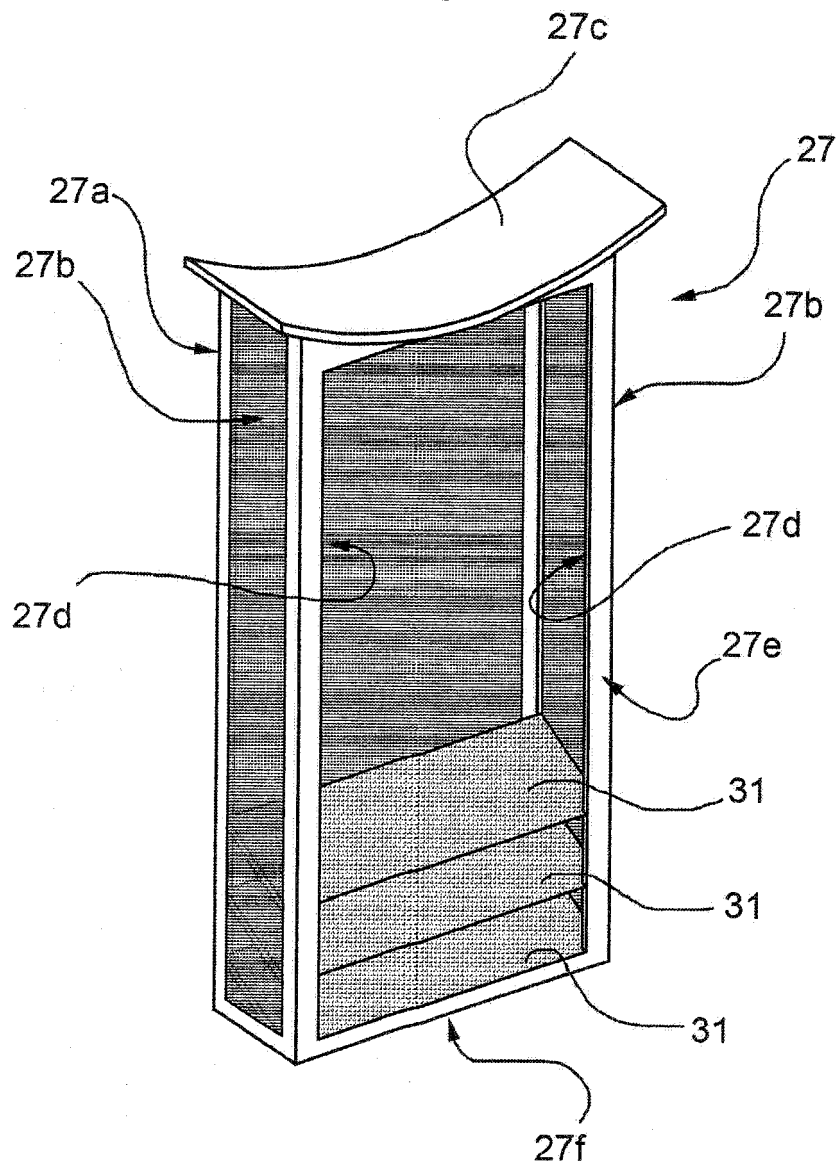
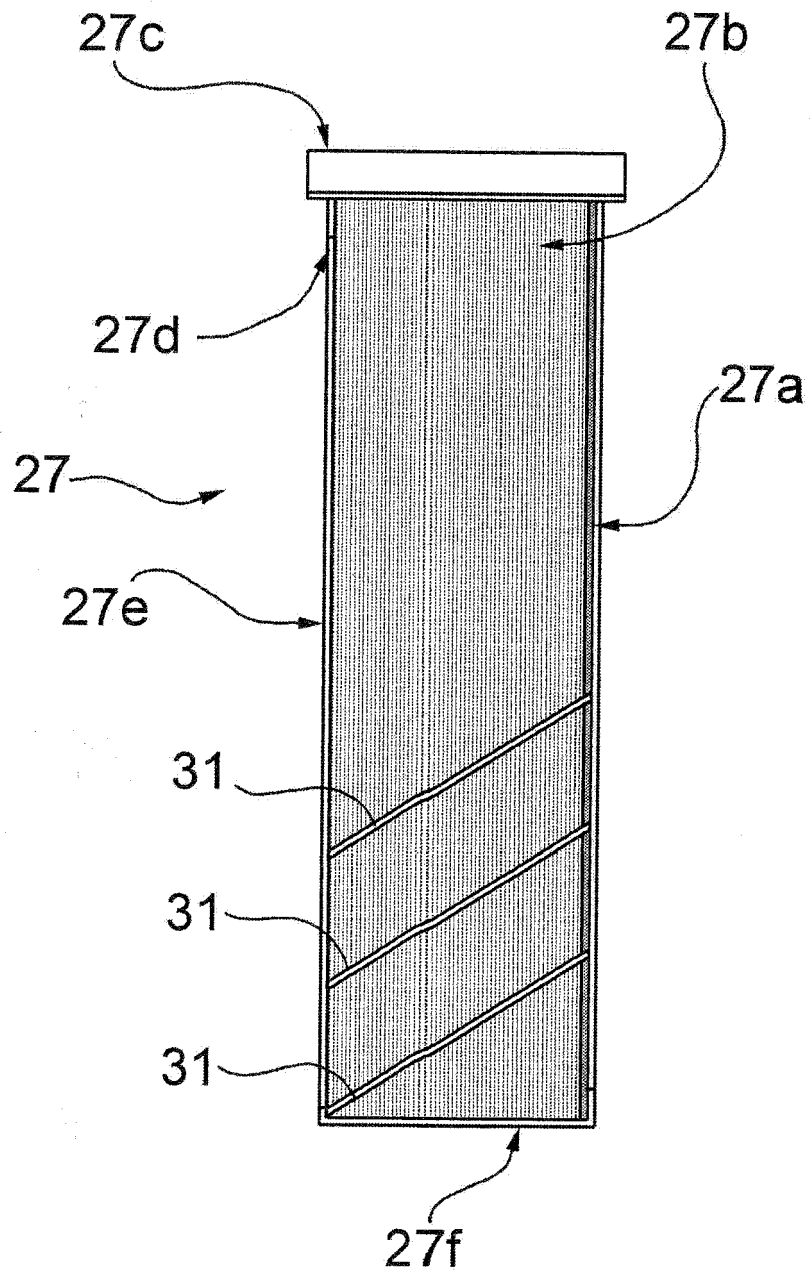


FIG. 6





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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 27 March 2008	Examiner Fachin, Fabiano
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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EP 07 11 8829

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
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