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(54) Improved domestic vacuum cleaner

(57) The present invention relates to a vacuum cleaner for domestic cleaning of the type comprising a body (2) adapted to comprise suction means (5) in fluid communication with an air intake opening (8), filtering means (6A, 11) to filter the particles contained in the suctioned air, these filtering means (6A, 11) being interposed between the intake (8) and the suction means (5), an air discharge path adapted to convey a flow of air suctioned by the suction means (5) to an outlet opening (23) and a tank (3, 3A) for a fluid (17) associated with the body (2) in order to be interposed in fluid communication between the suction means (5) and the outlet (23). The vacuum cleaner has the-characteristic feature that the flow of air suctioned by the suction means (5) enters the tank (3, 3A) so as to impact the free surface (L) of the fluid (17) contained in the tank (3, 3A) and comprises means (19, 20, 23) for atomising and mixing the flow of air suctioned by the suction means (5) before this flow impacts the free surface (L) of the fluid (17) so as to extract the particles contained in the suctioned air.

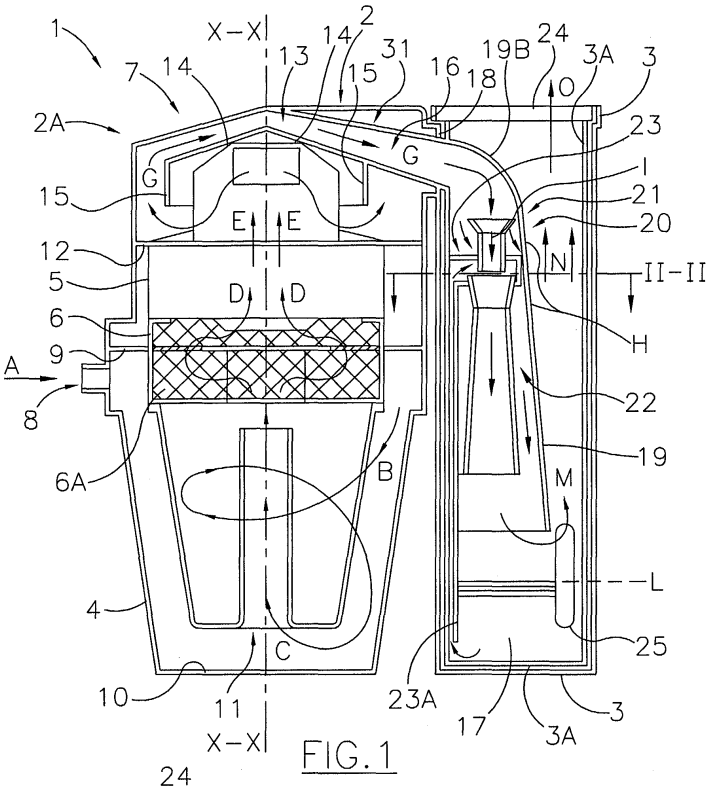

FIG. 1

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Description

[0001] The present invention relates to an improved domestic vacuum cleaner.

[0002] Vacuum cleaners comprising a box-shaped body associated with a tank containing a fluid are known. The vacuum cleaner comprises, within the box-shaped body, a fan coupled to an electric suction motor connected to an intake duct for air containing dust and dirt. For domestic cleaning, therefore, a vacuum cleaner may be used in which the flow of air containing dust, brought about by the motor/suction unit, passes firstly through a filter, for instance a diaphragm filter (normally in the form of a bag) able to retain and separate the solid particles contained in the suctioned flow of air, then flows along a discharge path into a tank containing a fluid, generally water, so that the dust contained in the suctioned flow of air can be extracted.

[0003] Although vacuum cleaners of the above-mentioned type are satisfactory from a practical point of view, they have the serious drawback that the air purification fluid may flow into the suction path downstream of the tank and/or be conveyed into this path by the purified air.

[0004] Use therefore has to be made of leak-tight electric motors, whose cost has a substantial impact, however, on the final price of the vacuum cleaner.

[0005] In addition, the purification fluid may disadvantageously clog the filters for the removal of the residual dust to an extent that compromises their operating efficiency.

[0006] These filters, conventionally of the "HEPA" type, are in practice disposed along the intake path upstream of the tank, generally in the vicinity of the air outlet slots provided in the body of the vacuum cleaner.

[0007] Known vacuum cleaners, in order to obtain an adequate filtration action, also need to use a substantial quantity of fluid, making the use of the vacuum cleaner difficult as a result of its weight and the volume needed to contain the fluid.

[0008] In view of the prior art described above, the object of the present invention is to provide a vacuum cleaner having structural and operational features able to obviate the drawbacks described above with reference to vacuum cleaners of the prior art.

[0009] A further object of the present invention is to provide a vacuum cleaner in which the tank for the fluid responsible for extracting the dirt is separate from the motor/suction unit and which is therefore easier and more practical for the user to handle.

[0010] A further object of the present invention is to provide a vacuum cleaner which is economical and functional, which enables efficient filtration of the suctioned air, separating it from dust and dirt particles and from droplets of fluid prior to its discharge, and which uses a smaller quantity of fluid for that purpose.

[0011] This object is achieved, in accordance with the present invention, by a vacuum cleaner as claimed in claim 1.

[0012] As a result of the present invention, it is therefore possible to provide a highly efficient domestic vacuum cleaner with a minimum absorbed power and a high particle accumulation capacity.

[0013] As a result of the present invention, moreover, it is possible to provide a vacuum cleaner of compact dimensions with respect to known vacuum cleaners since a smaller quantity of fluid is required to carry out filtration.

[0014] The characteristic features and advantages of the present invention are set out in the following detailed description of a practical embodiment thereof, shown by way of non-limiting example in the accompanying drawings, in which:

Fig. 1 is a diagrammatic view, in section, of an embodiment of the vacuum cleaner of the present invention;
Fig. 2 is a cross-section along the line II-II of a detail of the vacuum cleaner of Fig. 1;
Fig. 3 is a top view of the detail of Fig. 1;
Fig. 4 is a diagrammatic side view of a detail of the vacuum cleaner of the present invention.

[0015] In the accompanying drawings, a device, for domestic use, for cleaning by suction of dust, or a vacuum cleaner, is shown overall by 1.

[0016] The vacuum cleaner 1 comprises a body 2 with which a tank 3 is associated.

[0017] The body 2 of the vacuum cleaner 1 comprises a filtration suction unit 2A comprising a container 4 which may be removed by extraction from the body 2, a motor/suction unit 5, a filter-holder 6 disposed downstream of the motor/suction unit 5 and an air discharge path 7 disposed upstream of the motor/suction unit 5.

[0018] In the following description, in order to ensure an improved and constant dust capture efficiency and ability, even of very fine dust, which is very often the cause of allergies, the embodiment provided with an axial cyclone or volute is proposed as the best embodiment of the filtration suction unit 2A.

[0019] Alternatively, it is possible to use any other type of known filtration suction unit.

[0020] The container 4 takes the form, in a preferred embodiment, such as the embodiment of Fig. 1, of a body with a section of frustoconical type: it is provided laterally with an inlet opening 8 to which dirt and dust collection tools (tubes, brushes, crevice tools, etc.), of known type and not shown in the drawings, are adapted to be connected, comprises a top 9 adapted to divide the container 4 from the motor/suction unit 5 and also comprises, at the bottom, a base 10 adapted to collect the dust residues.

[0021] A generically cylindrical duct 11 (which is in practice slightly conical to facilitate moulding operations) which is connected in a known manner with the filter-holder 6 extends coaxially to and within the container 4.

[0022] The motor/suction unit 5, of substantially known type, comprises an electric motor adapted to cause the

rotation of a fan adapted to generate the vacuum within the container 4 which gives concrete shape to the operation of the vacuum cleaner 1. The motor/suction unit 5 is supported by a base 12 which acts as a dividing wall between this motor/suction unit 5 and the discharge path 7.

[0023] The filter-holder 6 internally comprises a filter 6A which, in a preferred embodiment, takes the form of a filtration member of star-shaped type. This filter 6A may be readily removed by extraction from the filter-holder 6 so as to enable periodic cleaning operations.

[0024] A person skilled in the art may of course substitute other filters equivalent in structural and/or operational terms for this star-shaped filter 6A.

[0025] The air suctioned by the motor/suction unit 5 therefore enters the container 4 in a tangential direction (arrow A) via the inlet opening 8 and descends with a swirling movement (arrow B) into the frustoconical body of the container 4. In this way, the coarser particles contained in the suctioned air are deposited on the base 10 of the container 4 and the partially purified air rises back towards the centre (arrow C) of the frustoconical body in order to flow into the central duct 11.

[0026] A volute or cyclone (not shown), which provides the essentially axial flow of air in the duct 11 with a swirling movement, is rigidly housed in the central duct 11 and secured, for instance, by plastic thermowelding, adhesion or simply by pressure.

[0027] As a result of this swirling movement, the residual dust contained in the flow of air suctioned by the motor/suction unit 5 is centrifuged outwardly in a peripheral ring.

[0028] The separation of the peripheral portion of the flow of air from the central portion takes place within the duct 11, more particularly downstream of the cyclone, this central portion thus being able to flow freely through the star-shaped filter 6A. The dust contained in the peripheral portion of the flow of air gradually accumulates on the walls of the cyclone and tends to collect, under the effect of gravity, towards the bottom of the cyclone, and is deposited on the base 10 of the container 4, so that the accumulation of dust in the star-shaped filter 6A is substantially reduced. It will be appreciated that this container 4 has to be emptied periodically by the user.

[0029] The flow of air output from the apex of the cyclone 11 and which passes through the filter 6A is thus conveyed (arrows D) towards the motor/suction unit 5.

[0030] The air output from the motor/suction unit 5 (arrows E) is then deflected by a deflector 13 contained in the air discharge chamber 7. The purpose of the deflector 13 is to deflect the air discharged from the motor/suction unit 5 downwards. In substance, the deflector 13 conveys the air discharged from the motor/suction unit 5 towards the base 12.

[0031] In the embodiment shown in Fig. 1, the deflector 13 is symmetrical with respect to the vertical axis X-X of the motor/suction unit 5 and, in particular, the deflector 13 comprises a first portion 14 which extends externally of the motor/suction unit 5 and a second portion 15 which extends parallel to the vertical axis X-X of the motor/suction unit 5.

[0032] The body 2 of the vacuum cleaner 1 further comprises an outlet opening 16 adapted to bring the motor/suction unit 5 into fluid communication with the tank 3 via the discharge path 7.

[0033] The tank 3 internally contains a container 3A which may be removed by extraction from the tank 3. The container 3A is adapted to collect the residual dust contained in the flow of air discharged by the motor/suction unit 5.

[0034] The container 3A is adapted to be filled to a predetermined level L with a fluid 17, for instance water, possibly mixed with deodorant, sanitising or like products.

[0035] A sealing gasket 18, for instance of rubber, is advantageously mounted on the peripheral edge of the outlet opening 15 of the body 2 and is adapted to prevent the fluid from gaining access to the motor/suction unit 5 and/or escaping from the container 3A.

[0036] The container 3A, which is partially filled with the fluid 17 as described above, is in direct fluid communication with the motor/suction unit 5 via the discharge path 7 by means of atomising and mixing means 19 and 20.

[0037] The atomising and mixing means 19 and 20 are disposed before the flow of air suctioned by the motor/suction unit 5 impacts on the free surface L of the fluid 17.

[0038] The atomising and mixing means take the form, in a preferred embodiment, of a diffusing or diverging duct 19, i.e. a duct which has a smaller air inlet portion and an outlet portion diverging in the direction of travel of the flow of air, within which an ejector 20 is disposed.

[0039] The duct 19 in particular comprises an end portion 19A disposed above the free surface of the fluid 17 while the portion in fluid communication with the motor/suction unit 5 has a portion 19B folded as an elbow.

[0040] The ejector 20, as described above, is disposed within the duct 19 and comprises a conveyor 21 in fluid connection with a Venturi tube 22. The conveyor 21 and the Venturi tube 22 are in particular mutually connected one after the other.

[0041] The conveyor 21 comprises a body having a converging inlet section for the air discharged by the motor/suction unit 5 and an outlet portion of constant section. The outlet section of the conveyor 21 is in fluid communication with the converging inlet section of the Venturi tube 22 and the latter in turn has its diverging outlet disposed above the free surface L of the fluid 17.

[0042] The atomisation of the fluid 17 and the mixing of this fluid with the air discharged by the motor/suction unit 5 takes place in a mixing and atomisation chamber 23.

[0043] The mixing and atomisation chamber 23 is supplied by a supply duct 23A adapted to bring the fluid 17 contained in the container 3A into this chamber, i.e. it is

possible to obtain an environment saturated with atomised fluid in this chamber 23. For this purpose, the duct 23A has its free end portion disposed below the free surface L of the fluid 17 in the tank 3.

[0044] For the fluid communication between the mixing and atomisation chamber 23 and the conveyor 21, in a preferred embodiment, a section of the outlet portion of constant section of the conveyor 21 is inserted in this chamber, while for the fluid communication between the mixing chamber 23 and the Venturi tube 22 a section of the converging inlet section is inserted in the chamber 23.

[0045] A person skilled in the art could obviously substitute other structurally and operationally equivalent configurations for the above-described configuration of the conveyor 21 with respect to the mixing chamber 23 and of the Venturi tube 22 with respect to the mixing chamber 23.

[0046] The particular configuration of the diverging duct 19 means that the air suctioned by the motor/suction unit 5 is subject to a reduction of its speed. A minority portion of the flow of air flowing in the duct 19 flows out laterally to the ejector 20 (arrows H) while the remaining portion, i.e. a majority portion of the flow of air flowing in the duct 19, enters the converging inlet section of the conveyor 21 (arrow I). The flow of air within the conveyor 21 acquires a speed which remains substantially stable up to the outlet section of the conveyor. In the section of converging section, the Venturi tube 22 accelerates the flow of air output from the conveyor 21, causing an air vacuum within the mixing and atomisation chamber 23. This vacuum makes it possible to suction a certain quantity of fluid 17 from the container 3A via the supply duct 23A.

[0047] The vacuum created by the Venturi tube 22 in the chamber 23 therefore causes the fluid 17 suctioned from the container 3A to enter this chamber.

[0048] The chamber 23 becomes the location in which the fluid 17 and the flow of air output from the outlet section of the conveyor 21 are mixed.

[0049] The flow of air mixed with fluid, emerging from the diverging portion of the Venturi tube 22, like the flow of air flowing laterally to the ejector system 20, impacts on the free surface of the fluid 17 giving rise to swirling and turbulent movements of moderate size (arrows M). The dust trapped in the droplets generated by the ejector system 20 are precipitated into the fluid 17 and deposited on the base of the container 3A.

[0050] In practice, after mixing has taken place in the chamber 23, all-the particles tend to fall, under the effect of gravity, towards the base of the container 3A within the fluid 17.

[0051] Lastly, the air mixed with fluid is discharged (arrows N) to the outlet 24 (arrows O) of the tank 3.

[0052] The dust residues contained in the air are thus extracted in a more efficient way than in traditional filter systems, advantageously using a smaller quantity of fluid. This consequently increases the efficiency of extraction of the dust and at the same time reduces the quantity of fluid in the container 3A.

[0053] This has the advantage that a container 3A with a lower volumetric capacity than conventional vacuum cleaners provided with fluid containers can be used and avoids the use of subsequent filters disposed in the vicinity of the outlet opening of the container 3.

[0054] In practice, in vacuum cleaners of the prior art, use is made of costly filters of the type commonly known as "HEPA" filters.

[0055] Advantageously, the vacuum cleaner 1, in accordance with the present invention, does not require such "HEPA" filters as the residual solid particles discharged by the motor/suction unit 5 are retained by the fluid 17.

[0056] It should be noted that the air discharge path 7 comprises valve means adapted to enable the one-way passage of the air discharged by the motor/suction unit 5.

[0057] The description of the valve means cited above is set out in European Patent Application No. 04425538.8 filed on 20 July 2004 in the name of the Applicants. The description of these valve means is understood to be included here for reference.

[0058] It should also be noted that a sensor of the level of fluid present is provided within the container 3A, which sensor may be connected to a stop device, so as to discontinue the operation of the motor/suction unit 5 when the level L of fluid 17 in the container 3A exceeds or drops below a predetermined threshold.

[0059] The description of the sensor cited above is set out in European Patent Application No. 04425538.8 filed on 20 July 2004 in the name of the Applicants. The description of this sensor is understood to be included here for reference.

[0060] In operation, once the user has filled the container 3A with fluid 17 up to a desired level L which can be checked by means of an appropriate graduated window 25, he or she may insert the container 3A in the tank 3. It is then possible to start the motor/suction unit 5 so as to suction air towards the container 4 via the inlet opening 8. The suctioned flow of air containing dust and solid particles passes firstly into the axial cyclone 11 where a first purification stage takes place and then flows through the star-shaped filter 6A where it is subject to a second filtration action. Lastly, the flow of air flows through the atomisation and mixing means 19 and 20 into the container 3A (arrow G).

[0061] As described above, the particular configuration of the diverging duct 19 in combination with the ejector 20 enables a substantial purification of dust residues from the air. This therefore provides a filtration of the solid particles using a post-motor filtering design.

[0062] The vacuum cleaner of the present invention is therefore particularly efficient since it does not require the use of filters entailing substantial losses of load in the suction circuit and thereby reducing the suction vacuum in the take-up section of the external duct.

[0063] A person skilled in the art could obviously, in order to satisfy contingent and specific requirements,

make many modifications and variations to the embodiments described above, without thereby departing from the scope of protection of the invention as set out in the following claims.

Claims

1. A vacuum cleaner for domestic cleaning of the type comprising:

   - a body (2) adapted to comprise suction means (5) in fluid communication with an air intake opening (8);
   - filtering means (6A, 11) to filter the particles contained in the suctioned air, these filtering means (6A, 11) being interposed between the intake (8) and the suction means (5);
   - an air discharge path adapted to convey a flow of air suctioned by the suction means (5) to an outlet opening (24);
   - a tank (3, 3A) for a fluid (17) associated with the body (2) in order to be interposed in fluid communication between the suction means and the outlet (24);

   characterised in that the flow of air suctioned by the suction means (5) enters the tank (3, 3A) in such a way as to impact the free surface (L) of the fluid (17) contained in the tank (3, 3A) and **in that** it comprises means (19, 20, 23) for atomising and mixing this flow of air suctioned by the suction means (5) with the fluid (17) before this flow impacts the free surface (L) of the fluid (17) in order to extract the particles contained in the suctioned air.

2. A vacuum cleaner for domestic cleaning as claimed in claim 1, **characterised in that** the means (19, 20, 23) for atomising and mixing the flow of air suctioned by the suction means (5) comprise a duct (19) diverging in the direction of travel of the flow of air, this first diverging duct (19) being disposed above the free surface (L) of the fluid (17) contained in the tank (3) and an ejector (20) in fluid communication with the duct (19).

3. A vacuum cleaner for domestic cleaning as claimed in claim 1 or 2, **characterised in that** the means (19, 20, 23) for atomising and mixing the flow of air suctioned by the suction means (5) comprise a mixing and atomisation chamber (23) within which it is possible to generate an environment saturated with atomised fluid.

4. A vacuum cleaner for domestic cleaning as claimed in any one of the preceding claims, **characterised in that** the ejector (20) is disposed within the duct (19).

5. A vacuum cleaner for domestic cleaning as claimed in claim 4, **characterised in that** the ejector (20) comprises a conveyor (21) in fluid communication with a Venturi tube (22), this conveyor (21) being disposed to follow on from the Venturi tube (22).

6. A vacuum cleaner for domestic cleaning as claimed in any one of the preceding claims, **characterised in that** the mixing and atomisation chamber (23) is supplied via a supply duct (23A) adapted to bring the fluid (17) contained in the tank (3, 3A) to this chamber (23).

7. A vacuum cleaner for domestic cleaning as claimed in claim 6, **characterised in that** a section of the outlet section of the conveyor (21) is inserted into the mixing chamber (23) and a section of the inlet section of the Venturi tube (22) is inserted into this mixing chamber (23).

8. A vacuum cleaner for domestic cleaning as claimed in any one of the preceding claims, **characterised in that** the filter means (6A, 11) for retaining solid particles comprise a star-shaped filter member (6A) and an axial cyclone (11).

9. A vacuum cleaner for domestic cleaning as claimed in claim 2, **characterised in that** the duct (19) has its diverging outlet section substantially perpendicular to the free surface (L) of the fluid 17.

10. A vacuum cleaner for domestic cleaning as claimed in claim 5, **characterised in that** the Venturi tube (22) has its diverging outlet section substantially perpendicular to the free surface (L) of the fluid (17) .

11. A vacuum cleaner for domestic cleaning as claimed in any one of the preceding claims, **characterised in that** the tank (3, 3A) comprises a container (3A) which may be removed by extraction from the tank (3).

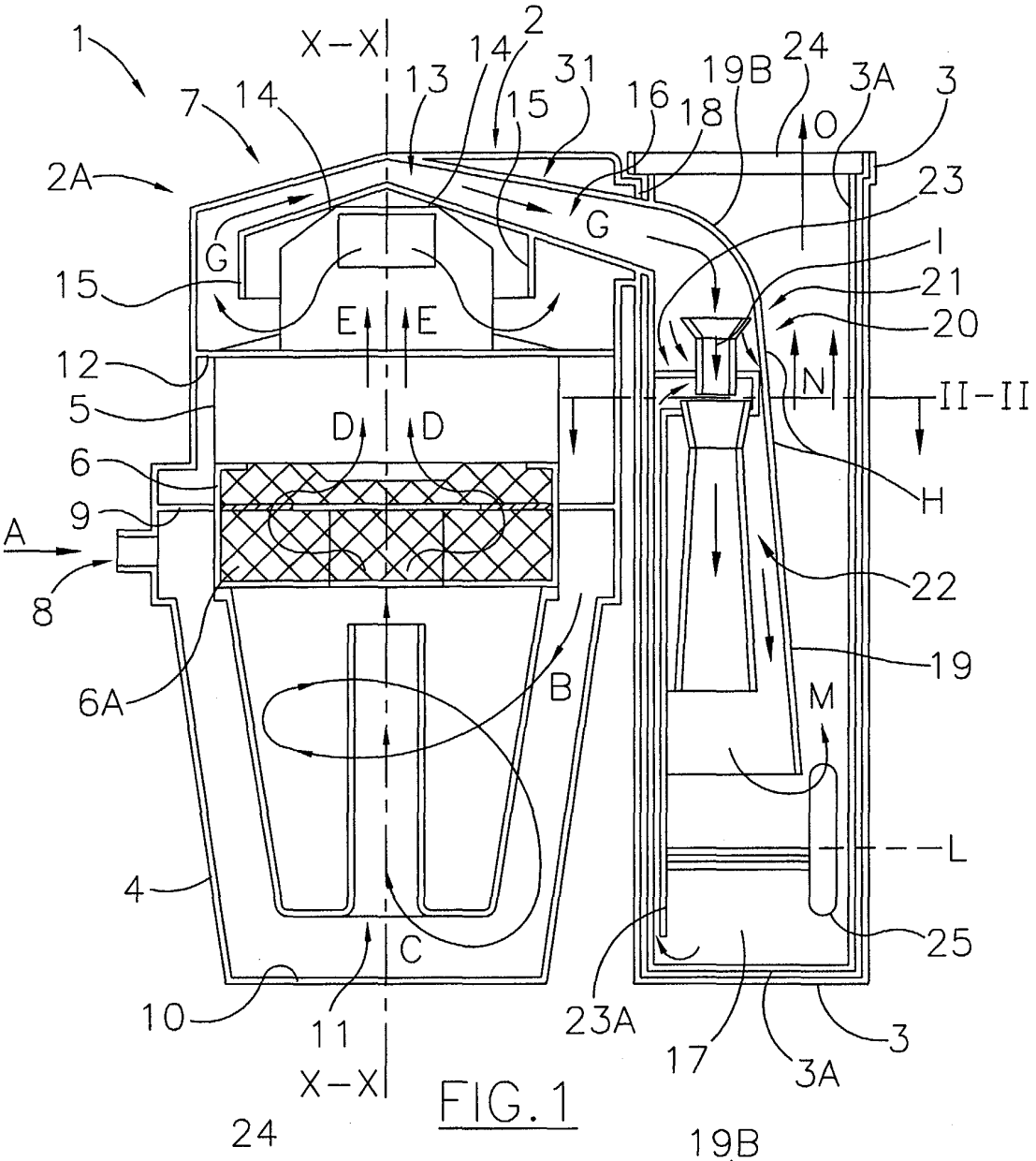

FIG.1

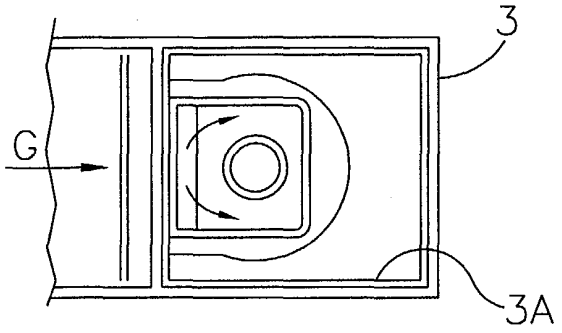

FIG.2

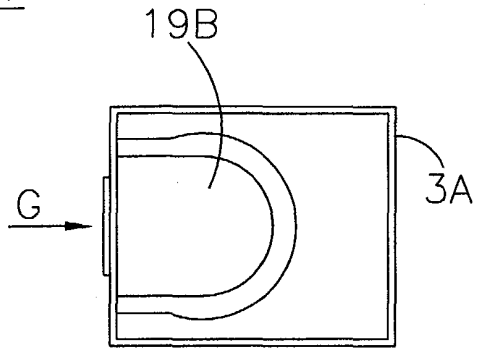

FIG.3

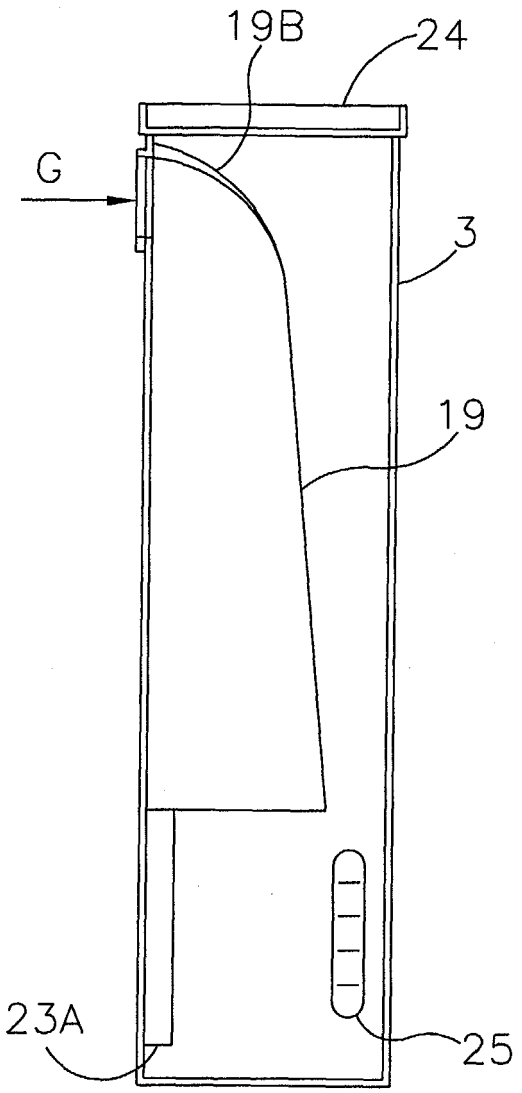

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 04 42 5562

DOCUMENTS CONSIDERED TO BE RELEVANT

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			TECHNICAL FIELDS SEARCHED (Int.Cl.7) A47L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 December 2004	Redelsperger, C

CATEGORY OF CITED DOCUMENTS

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