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(72) Inventeur/Inventor:
TAGLIAFERRI, FABRIZIO, IT

(73) Propriétaire/Owner:
DULEVO INTERNATIONAL S.P.A., IT

(74) Agent: SHAPIRO COHEN_LLP

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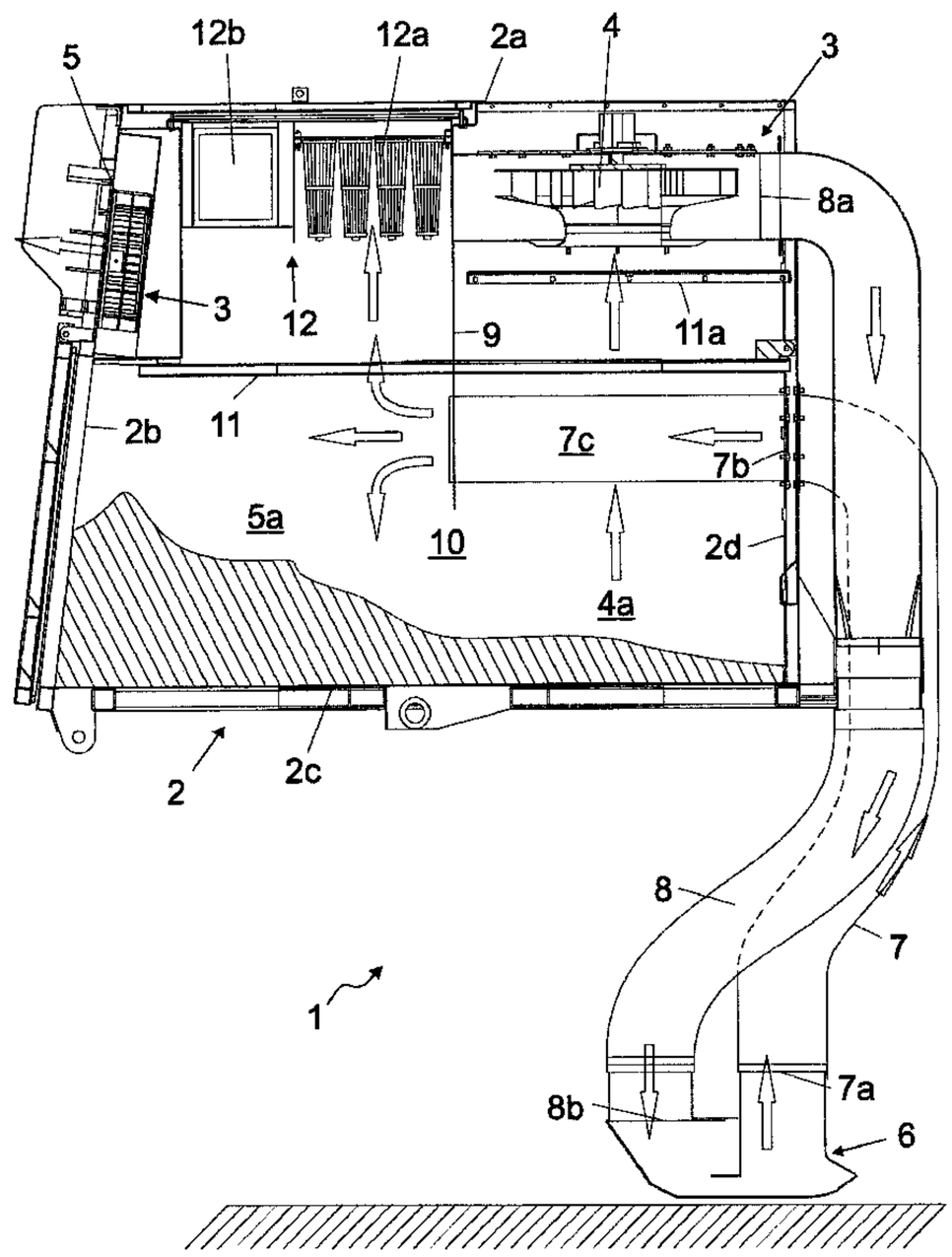

(57) Abrégé/Abstract:
A cleaning unit is provided comprising: a containment chamber defining an accumulation base, a suction apparatus including a suction inlet positioned close to the ground, and a filtering apparatus, the suction apparatus comprising primary suction means and secondary suction means positioned in parallel to one another above the accumulation base, the primary suction means controlling said suction inlet and the secondary suction means being suitable to expel filtered air, and the containment chamber including separating element which separates the turbulent zone, the air inside of which being highly turbulent, and a recirculation zone, the air inside of which having a low turbulence, the recirculation zone being connected to the primary suction means and the turbulent zone being connected to the secondary suction means.

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ABSTRACT OF THE DISCLOSURE

A cleaning unit is provided comprising: a containment chamber defining an accumulation base, a suction apparatus including a suction inlet positioned close to the ground, and a filtering apparatus, the suction apparatus comprising primary suction means and secondary suction means positioned in parallel to one another above the accumulation base, the primary suction means controlling said suction inlet and the secondary suction means being suitable to expel filtered air, and the containment chamber including separating element which separates the turbulent zone, the air inside of which being highly turbulent, and a recirculation zone, the air inside of which having a low turbulence, the recirculation zone being connected to the primary suction means and the turbulent zone being connected to the secondary suction means.

CLEANING UNIT OF ROADS AND THE LIKE

Field of the Invention

The present invention relates to a cleaning unit for roads and the like of the type comprising: a containment chamber defined by a accumulation base, a suction apparatus including a suction inlet positioned close to the ground, and a filtration apparatus, the suction apparatus being suitable to recycle the air between the containment chamber and the suction inlet.

Description of the prior art

As it is known, there are at present on the market different types of road cleaning units and the like, used for the cleaning of roads, squares, large shopping areas and others.

The basic components of these units are: a refuse conveyance apparatus, a separation filter of the refuse and pollutants and a container for the storage of the refuse. These units can operate dry or with water.

They intake air, the refuse and pollutants such as dust and the like, that are subsequently separated, by means of a special filter, and the refuse and pollutants are then stored, thereby cleaning the road surface.

The conveyance of the substances is performed in the mechanical-suction type units by means of special rotating brushes and mechanical conveyors, and in other units especially through the use of a pressurised air flow that skims the ground to create, according to concepts known in fluid dynamics, a surface vacuum that allows the refuse and pollutants that adhere to the ground to be lifted.

The pressurised air can for example come from the recycled air of the suction apparatus, this air already having a notable kinetic energy, and a reduced

energy cost is sufficient to create the flow of pressurised air.

A similar unit is described in the US 4099290 patent, where the intake air is partially filtered and recycled.

Said filtered air is also partially collected and filtered again to be discharged into the environment.

The above mentioned technique presents some important drawbacks.

In fact, the air under pressure, that with its action at ground level causes the refuse to rise, normally presents a large load of dusts and pollutants. Therefore a pollution is caused each time this recycled air is dispersed into the environment.

Despite the fact that the devises that are used are normally designed in such a way to allow an efficient recycling of the air used to lift the substances from the ground with little load loss, the air itself cannot be totally recycled, due to the unevenness of the ground and normal loss of load.

Otherwise, using purified air to lift the pollutants from the ground is not convenient because, during the described operation, the purified air mix again with the pollutants and therefore need to be purified again with notable waste of energy and operating time.

Furthermore, said units require frequent maintenance, cleaning and more.

Build ups of refuse and the like can also occur inside the said units, which could cause possible and hazardous proliferation of bacteria or the like, or simply the deterioration of the functioning conditions.

In addition, frequent cleaning of the filters or their replacement is necessary.

It is also necessary to interrupt the functioning of the unit to perform the cleaning of the filters or of the unit itself.

The cleaning and maintenance of said unit cause a rise in costs and of operating times.

Furthermore, the units at present on the market are not always able to treat pollutants present in the environment, such as fine dust and toxic particles.

Summary of the Invention

In this situation, the technical aim that is the basis of the present invention is that of conceiving a cleaning unit for roads and the like capable of substantially overcoming the drawbacks stated in the prior art.

Within said technical aim is an important aim of the invention to conceive a cleaning unit that allows to remove pollutants and retain them without releasing them into the environment.

Another important aim of the invention is to conceive a cleaning unit that allows a rapid and infrequent maintenance of the unit itself.

Another aim of the invention is that of creating a cleaning unit of roads and the like that allows that the cleaning operation of the filters and the like is performed without having to interrupt the use of the machine itself.

The technical aim and specified objectives are attained by a cleaning unit of roads and the like, comprising: a containment chamber defined by an accumulation base, a suction apparatus including a suction inlet positioned close to the ground, and a filtration apparatus; said suction apparatus being suitable to recycle the air between said containment chamber and said suction inlet and including primary suction means and secondary suction means positioned in parallel to one another and above said accumulation base; said primary suction means controlling said suction inlet and said secondary suction means being suitable to expel filtered air; and said

containment chamber including a separation element that separates a turbulent zone, in which exists air with a high level of turbulence and energy, and a recirculation zone, in which exists air with a low level of turbulence and energy; said recirculation zone being connected to said primary suction means and said turbulent zone being connected to said secondary suction means.

Said cleaning unit allow to recycle air that contains few pollutants and it is simply and economically managed.

Brief Description of the Drawings

Additional characteristics and the advantages of the invention are explained further below by the detailed description of a preferred embodiment of the invention, with reference to the combined drawings, in which:

Fig. 1 illustrates a section of the unit according to the invention;

Fig. 2 illustrates the unit according to the invention placed on a motorised vehicle.

Description of the Preferred Embodiments

With reference to the said Figures, the cleaning unit according to the invention is totally indicated with the number **1**.

This is a type that is transportable on lorries, vans and the like and includes a containment chamber **2** duly and substantially of a parallelepiped form or the like and constructed of sheet metal or the like. Said containment chamber 2 is at least made up in part by: an upper wall **2a**, a rear wall **2b**, that can at least be opened or removed in part, a front wall **2d**, a base wall **2c** and two side walls.

These walls are preferably and substantially flat, without considering

alterations of the wall planarity, any ribs or reinforcing angles on said walls.

The lower section of the chamber 2 is destined to the containment of the refuse and pollutants. Therefore the base 2c and the lower sections of the side walls and front wall 2d and rear wall 2b, create an accumulation base **10** for the storage of the said refuse and pollutants.

Unit 1 also includes a suction apparatus **3**, that sucks air, pollutants, such as dust and the like, and refuse, which are larger in size than the said pollutants, from the ground.

Said suction apparatus includes primary suction means **4** and secondary suction means **5** positioned in parallel.

The primary and secondary suction means 4 and 5 are positioned in the upper section of said containment chamber 2, above the accumulation base 10.

In particular, the primary suction means 4 are preferably made up by a centrifugal fan positioned parallel and close to the upper wall 2a of the containment chamber 2.

The secondary suction means **5** are preferably made up by two parallel operating axial-flow fans. These axial-flow fans 5 are positioned in parallel to the rear wall 2b of the containment chamber 2 and close to both the said rear wall 2b and the upper wall 2a.

Both the primary suction means 4 and the secondary suction means 5, in parallel to each other, work together to create a vacuum in the chamber 2 and at the same time an ample movement of the air. In particular, the primary suction means 4 have a greater capacity than the secondary suction means

5. For example, the primary means 4 have a capacity equal to 60%-70% of the total, while the secondary means 5 have a capacity equal to 30%-40% of the total.

Furthermore, a separation means **9** is also present that essentially separates a recirculation zone **4a**, in which the action of the primary suction means 4 is prevalent, by a turbulent zone **5a**, in which the action of the secondary suction means 5 is prevalent.

The separation element 9 is preferably made up by a section of wall.

The separation element 9 can be variously shaped and dimensioned.

The suction apparatus 3 includes a suction inlet **6**, which sucks said air, pollutants and refuse from the outside, more precisely from the ground.

Said suction inlet 6 is duly positioned below said containment chamber 2.

The suction apparatus 3 also includes a suction duct **7** that channels said air, pollutants and refuse, to transport them from the suction inlet 6 to the accumulation base 10.

This suction duct 7 is essentially made up by tubes or the like positioned inside the said containment chamber 2, that therefore bend from an inlet **7a** in correspondence with the suction inlet 6 to an outlet **7b** positioned in the containment chamber 2.

The outlet 7b is then connected to conveyance means **7c**, preferably made up by a simple extension of the duct 7, or by other elements such as guide bulkheads, that convey the refuse close to the centre of the containment chamber 2, towards the turbulent zone 5a of the chamber itself.

The suction apparatus 3 also includes an air recirculation duct **8,** which channels the air of the chamber 2 to the suction inlet 6.

This recirculation duct 8 is also mainly made up by tubes or the like that expand outside the chamber 2 and it includes an inlet **8a**, positioned close to the primary suction means 4, and an outlet **8b**. The tubing or the like of this outlet 8b narrows so as to create a pressurised air flow that skims the ground that, according to the known Venturi effect, helps the detachment of the pollutants from the ground and their suction.

The unit 1 also includes a filtration element **11** that filters the refuse sucked by both the primary suction means 4 and the secondary suction means 5.

The filtration element 11 is preferably made up by a net or grille, positioned above the said accumulation base 10. This net preferably has a mesh diameter between 8 mm and 10 mm, so as to prevent the refuse exiting from the accumulation base. Due to the simplicity of said filtration element 11 it does not require any cleaning or maintenance operations.

The unit 1 also includes a filtration element **12** that filters the pollutants that are sucked by the secondary suction means 5.

Therefore the filtration element 12 retains the dusts and other particles dispersed in the environment.

This apparatus 12 is essentially made up by at least one cloth filter **12a,** or a cartridge filter, cylindrical or conical, or bags.

Both of these types of filter are based on a filtering cloth that is placed around a conical or cylindrical cartridge, or is positioned following a course with several loops or sacks.

These filters convey the air through the filtering cloth that retains it. These filters are also positioned, in particular in conical cartridge and sack models, in such a manner that the gravitational force pushes the pollutants that

accumulate on the surface towards the accumulation base 10.

Not all pollutants fall immediately in the accumulation base 10, but some of them deposit on the surface of the filtering cloth.

The progressive deposit of pollutants on the filtering cloth makes periodic cleaning of the cloth necessary, which is performed automatically through the shaking of the filtering cloth, or alternatively by means of washing, compressed air, or the like.

Furthermore, a fine filter **12b**, such as an electrostatic type, is preferably positioned in series to the filtering cloth 12a, which sterilizes by means of the ionization of the air, which is created thanks to the presence of a strong electrostatic field. Thereby the pollutants assume an electrical charge and deposit on the walls of the filter. The walls can then be either manually or automatically cleaned.

Alternatively an absolute fine filter 12b, also being of filtering cloth, can be positioned in series to the filtering cloth 12a, but this time with a very fine cloth that filters the finer pollutants.

The fine filter 12b is also positioned above the accumulation base 10 and therefore the pollutants that are discharged from said filter, fall and deposit directly onto the accumulation base 10, after having passed the filtration element 11.

Once the dusts have fallen into the accumulation base 10, they deposit and adhere to the refuse, especially if they are damp as quite often is the case. Therefore they are not sucked up again by the suction apparatus 3.

The fine filter 12b is furthermore positioned next to the secondary suction means 5, so that they convey the filtered air into the environment.

The functioning of the cleaning unit according to the invention, structurally described above, is as follows.

On starting, the suction system 3 is activated, or rather the primary and secondary suction means 4 and 5 are started at the same time in parallel. In this manner a vacuum is created in the chamber 2.

Due to the said vacuum, the suction inlet 6 draws in the air, refuse and pollutants from the ground. These pass through the suction duct 7 and arrive to the containment chamber 2.

The refuse is detained by the filtering device 11 and fall into the accumulation base 10.

The suction means 4 and 5 are such that they are capable of also lifting heavy refuse and of creating a current of air with a flow that arrives to a speed of 60m/s.

The air that exits the outlet 7b and the conveyance attachment 7c is introduced into the turbulent zone 5a.

This turbulent zone 5a is therefore interested by the presence of air being highly turbulent and with a great kinetic energy.

This air is mainly sucked by the nearby secondary suction means 5.

This is then filtered by the filtering apparatus 12, and looses the pollutants that it contains. It is then expelled and put into the environment.

Filtration is performed both by the filtering cloth filter 12a, that removes the larger pollutants, as well as the fine filter 12b that removes the finer pollutants.

The air that arrives to the recirculation zone 4a has passed throughout the entire containment chamber 2. The recirculation zone 4a is therefore

characterised by a reduced turbulence and energy, due also to the loss in load.

Furthermore, only part of the air introduced by the conveyance organs 7c arrives in the recirculation zone 4a, because part of this air is sucked and expelled by the secondary suction means 5.

Therefore this air difficulty transports the pollutants that fall into the accumulation base 10.

Therefore the primary suction means 4 suck air that contains fewer pollutants.

The air is conducted through the recirculation duct 8 and arrives to the outlet 8b close to the suction inlet 6.

Here the air laps the ground at high speed, thereby creating the Venturi effect, which allows the removal of dust and the like. The air subsequently returns, through the suction duct 7, to the chamber 2.

Based on the capacity of the primary and secondary suction means 4 and 5, different amounts of air can be recycled or filtered and then expelled into the environment.

The filtering cloth filter 12a is automatically shaken and cleaned after it has reached its maximum capacity, the pollutants thereby fall into the accumulation base 10.

The absolute or electrostatic fine filter 12b, which is also positioned above the accumulation base 10, requires less maintenance.

The invention permits significant advantages.

One significant advantage is given by the particular and innovative lay-out of the filtering apparatus 12, by the primary suction means 4 and the secondary suction means 5.

These are all in fact positioned in the upper section of a single containment chamber 2, which is preferably a very simple shape, such as a parallelepiped for example. Consequently the unit 1 is simply and economically managed.

The suction 7 and recirculation ducts 8 are largely positioned outside the containment chamber 2.

This lay-out prevents the undesired and hidden accumulation of pollutants and refuse. The unit 1 does not have areas or gaps that would favour this accumulation.

Possible malfunction or load loss or similar of the primary and secondary suction means 4 and 5 cause the pollutants or refuse to fall directly into the accumulation base 10.

An additional advantage of this lay-out of said equipment inside the containment chamber 2 and the ducts positioned mainly outside the chamber, is implied in the fact that the chamber 2 can be easily adapted to a different type of cleaning unit, by simply removing part of the elements contained within. For example the simple removal of the primary suction means 4 and ducts 7 and 8 allows using the containment chamber 2, with its filters and with the secondary suction means 5, to create a mechanical-suction type cleaning unit, where the refuse is also conveyed by mechanical conveyance elements.

The primary suction means 4 and the secondary suction means 5 operate simultaneously in parallel: the power of the suction means is therefore totalled and the suction has a greater efficiency.

Not withstanding the lay-out of said members in a single containment chamber 2, the air used for the recirculation contains low quantities of dust

and pollutants due to the differentiation of the suction zones of said members. Therefore the unit 1 does not release relevant amounts of pollutant into the environment, even when the suction inlet 6 has difficulty in adhering to the ground.

At the same time unit 1 allows a rapid and continual flow of air and does not filter the same air more than once.

The special type of filters and their position above the accumulation base 10, allow them to be automatically cleaned and the settling of the pollutants, freed from the filters, directly in the accumulation base 10.

Therefore frequent maintenance of the filters is not necessary.

The particular lay-out of the filtering cloth and electrostatic or absolute filters that are arranged in series, also allows even very fine particles to be treated (up to 0.01 μm) that are a health hazardous and that cannot be treated with other types of filters. This lay-out and choice of filters is particularly suitable and can be used also in the absence of pneumatic conveyance and recirculation of the airflow.

The invention is subject to variation that fall within the inventive concept.

For example, a second filtering element **11a** can be positioned immediately below the primary suction means 4, between the separation element 9 and the front wall 2c, which is made up by a grille or net.

Furthermore, mechanical conveyance members, such as a conveyor belt and brush, can be integrated to the suction of the refuse and pollutants, inside the suction duct 7.

WE CLAIM

1. Cleaning unit of roads comprising:

- a containment chamber defined by an accumulation base, a suction apparatus including a suction inlet positioned close to the ground, and a filtration apparatus,

- said suction apparatus being constructed and arranged to recycle the air, between said containment chamber and said suction inlet, and including primary suction means and secondary suction means positioned in parallel to one another and above said accumulation base,

- said primary suction means controlling said suction inlet and said secondary suction means being constructed and arranged to expel filtered air,

- and said containment chamber including a separation element that separates a turbulent zone, in which exists air with a high level of turbulence and energy, and a recirculation zone, in which exists air with a low level of turbulence and energy,

- said recirculation zone being connected to said primary suction means and said turbulent zone being connected to said secondary suction means.

2. Unit according to claim 1, in which said suction apparatus includes a suction duct and conveyance members constructed and arranged to channel said air, refuse and pollutants from said inlet to said turbulent zone, and a recirculation duct, constructed and arranged to channel said air from said recirculation zone to said inlet, in a manner to aid the suction of said pollutants.

3. Unit according to claim 2, in which said conveyance members are defined by an extension of said suction duct, and in which said conveyance members pass through said suction element.

4. Unit according to claim 1, in which said suction apparatus includes a suction duct and a recirculation duct, and in which said suction and recirculation ducts are outside said containment chamber.

5. Unit according to claim 1, in which said separation element is made up by a vertical wall section.

6. Unit according to claim 1, having a filtrating device which is extended in said containment chamber in such a manner so as to filter refuse sucked by said primary suction means as well as said secondary suction means, and in which said filtering apparatus is constructed and arranged to filter said refuse and said pollutants sucked by said secondary suction means.

7. Unit according to claim 6, in which said filtering device is made up by a net having a mesh opening between 8 mm and 10 mm.

8. Unit according to claim 1, in which said filtering apparatus includes a filtering cloth filter.

9. Unit according to claim 8, in which said filtering apparatus includes an absolute filter placed in series to said filtering cloth filter.

10. Unit according to claim 8, in which said filtering apparatus includes an electrostatic filter placed in series to said filtering cloth filter.

11. Unit according to claim 1, including a second filtering device positioned between said filtering device and said primary suction means.

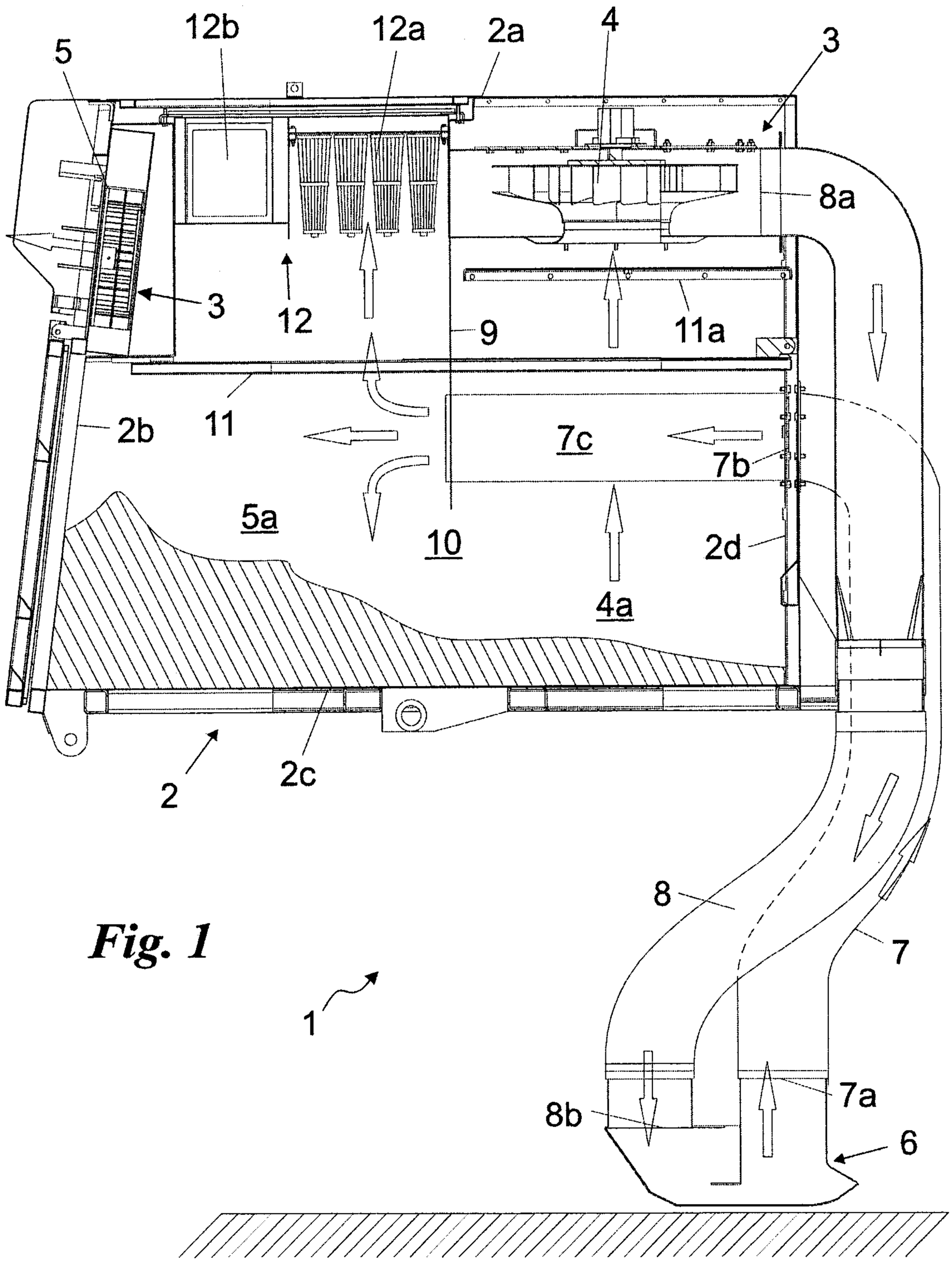


Fig. 1

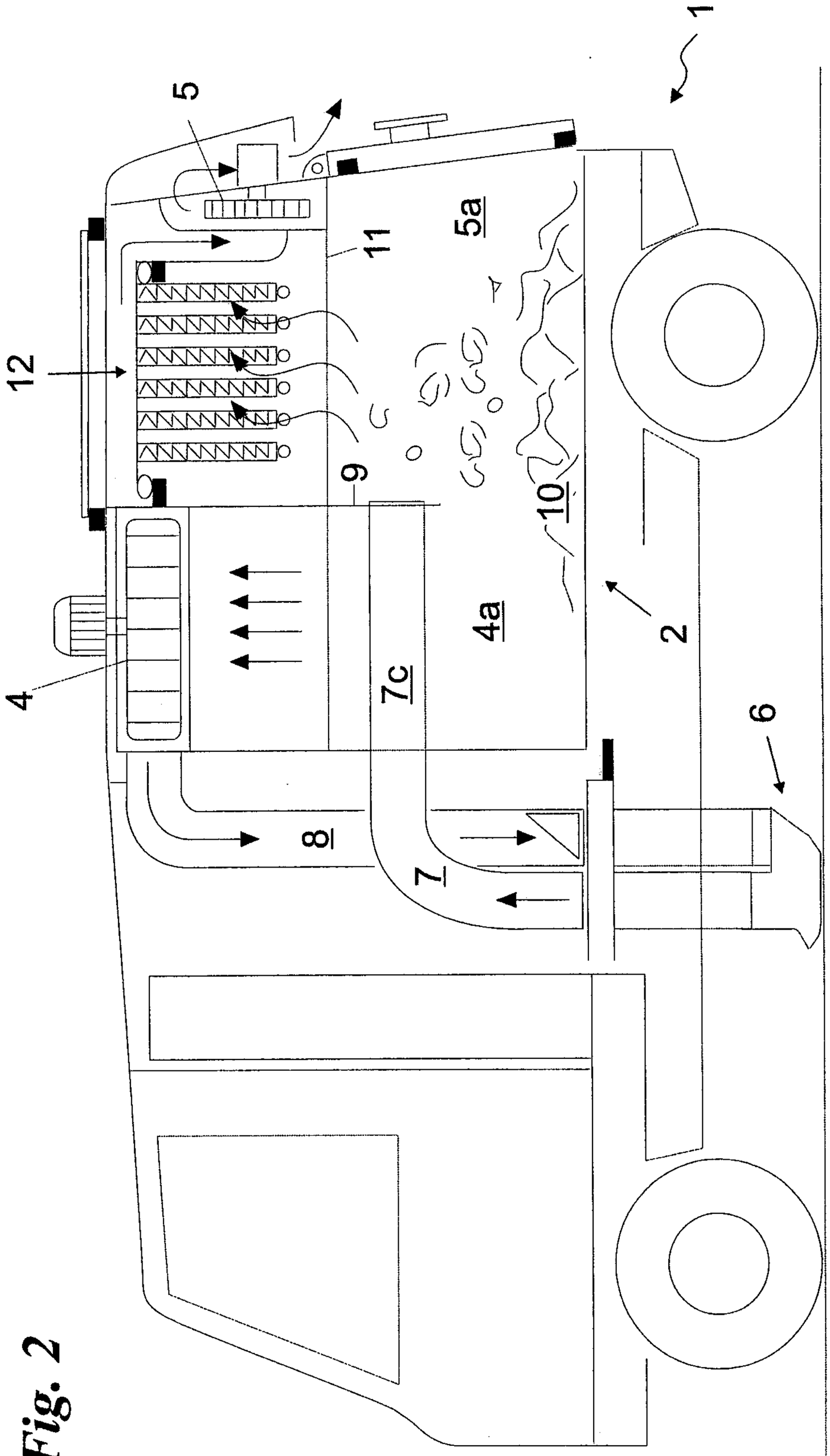
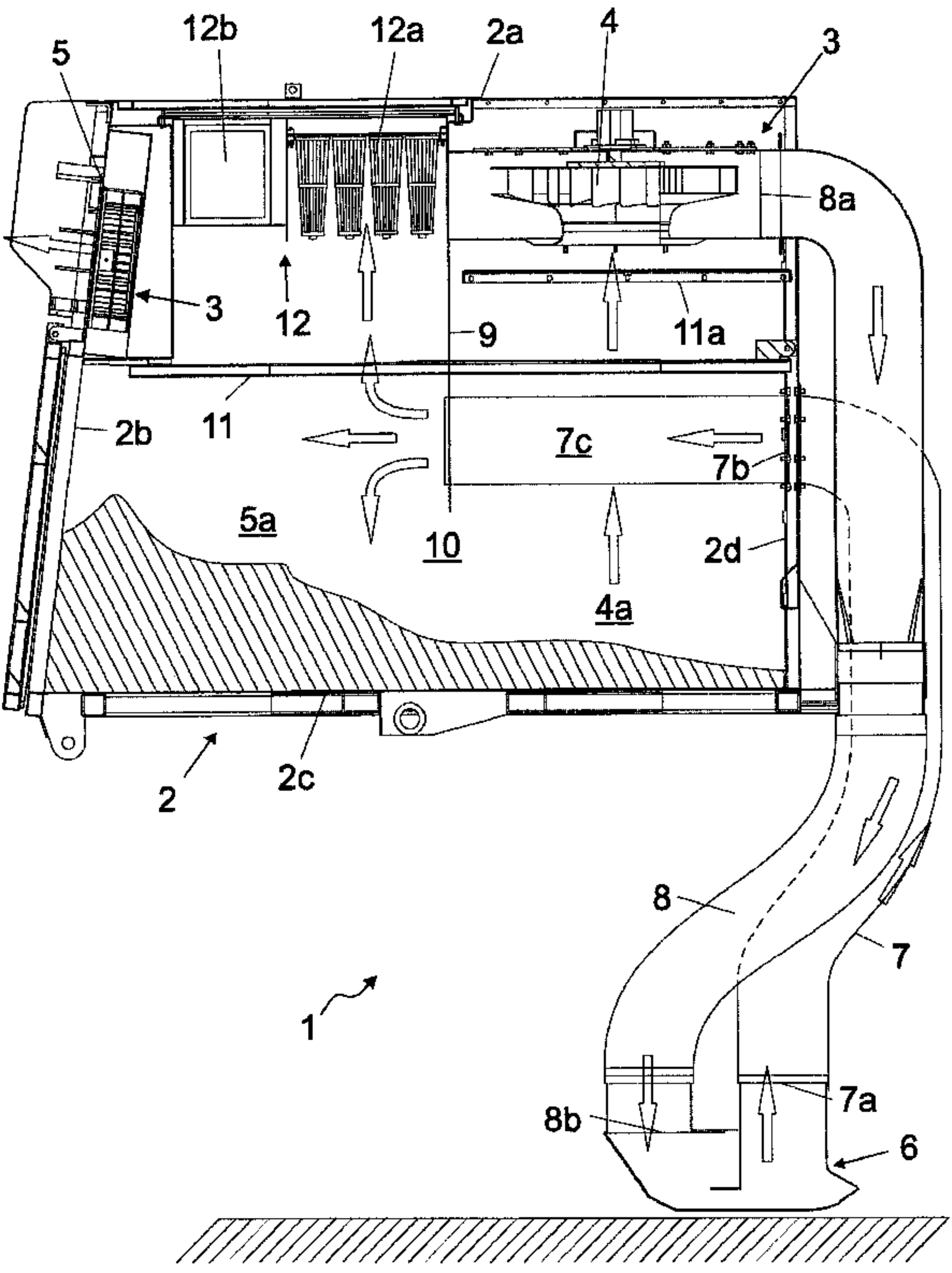


Fig. 2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