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(12) # EUROPEAN PATENT APPLICATION

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(54) **PROTECTIVE CHAMBER**

(57) The invention relates to a chamber (100, 200) for performing tests with chemicals and particles up to a nanometric size, the chamber comprising a flow discharge chamber (4), a flow extraction chamber (5) comprising two flow suction areas (11) and (12), a work area (2) comprising a first flow discharge area which creates inner flows (15), (16), a user protection area (6a) comprising a user protection barrier (6) and a second flow discharge area which creates an outer flow (18), wherein the first and second flow discharge areas create a gradient of discharge speeds which enables a containment barrier to be created in order to prevent particle dispersion.

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Description

Object of the invention

[0001] The present invention relates to a chamber (or enclosure) used as a protective device for performing tests with chemicals and particles up to a nanometric size.

Background of the invention

[0002] In the field of nanomaterials, tests are performed with particle samples requiring a working environment which protects the user from inhaling said nanoparticles. Working with nanoparticles requires specific conditions in the working environment which prevent the agglomeration of said nanoparticles with the resulting modification or loss of properties.

[0003] The turbulent flow solutions usually applied to chemical hazards and/or high-speed laminarised flows usually applied to biological containment increase the risk of dispersion and are therefore inefficient with respect to protecting the user working with nanoparticles. The devices for chemical applications and those corresponding to biological applications limit the actuation thereof to the work area, leaving the area immediately outside the work area, wherein the respiratory area will be located for the user exposed to the influence of the changing outer environment which can influence the behaviour of the device with respect to the protection offered.

[0004] Therefore, a solution is sought which solves the following limitations to working with nanoparticles in light of the devices existing in the market:

- The work area must have negative pressure such that it ensures the protection of the user.
- The work area requires a low-speed air flow which limits the risk of particle dispersion and agglomeration.
- The environment in the work area must be treated.
- The area outside the work opening must be treated in order to ensure the robustness of the containment of the device and therefore the efficiency thereof.

Description of the invention

[0005] The present invention relates to a ventilated protective chamber for performing tests with chemicals with particles up to a nanometric size. The protective chamber is not limited to the use of nanoparticles, but rather it further ensures protection when using fine chemicals and the combination of both.

[0006] The ventilated protective chamber offers high energy efficiency for the confinement of a work area and solves the limitations of the state of the art by means of a series of technical features described in this document.

[0007] The protective chamber comprises a work area in a depression which offers protection for the user and the laboratory environment by limiting the spread of gaseous or particulate contaminants outside of the work area. The work area is limited by side walls, a roof, a rear wall and a front wall comprising an adjustable opening.

[0008] Thus, the work area is accessed through said height-adjustable opening for protection (not tilting), located between the user and the work area. The adjustable work opening enables contaminants to be captured at the emission point. The adjustable opening offers a maximum work opening (for example, 500 mm) and may be limited by a locking device which will need to be unlocked in order to enable a larger opening. The adjustable opening ensures the protection of the user from the closed position to the maximum opening thereof.

[0009] The protective chamber according to the present invention bases the efficiency of the protection and safety of the user on the creation of a controlled laminar flow which extends from the work area, wherein the handling with nanoparticles will be performed until the area outside of the protective chamber wherein the user is located.

[0010] The laminar flow or flow laminarisation inside the chamber enables the necessary environmental conditions to be adjusted for the handling of samples with particles up to a nanometric size. Low-speed flow laminarisation in the front outer area of the protective chamber offers greater robustness of the chamber and therefore greater protection for the user.

[0011] The low-speed vertical laminar flow used in the protective chamber is able to minimise the effects of a possible turbulent flow in the work area. The creation of this low-speed vertical laminar flow prevents a turbulent flow in the work area which would cause the dispersion of the (nano)-particles, with the risk of projecting them outwards and these being able to be inhaled by the user, as well as the protection of the nanoparticle sample, keeping the conditions suitable in order to prevent the agglomeration thereof.

[0012] In order to obtain the laminar flow, the chamber carries out a descending discharge of filtered and/or treated air in order to achieve the necessary temperature and/or moisture conditions which will allow the desired laminar flow to be created in the work area, in order to obtain a laminar curtain of inner and outer air created with said flow and which comprises the same quality conditions as the ones corresponding to the work area inside the protective chamber (or different quality conditions depending on the intended use of the protective chamber).

[0013] Thus, the laminar flow is achieved through said downward discharge and suction at the height of the working plane of the protective chamber which is achieved by means of suction areas. These suction areas will be distributed depending on the dimensions of the work area and will also be able to be located in the very work area and/or in the sides of said work area as seen in Figures 2 and 3. A balanced suction with an air discharge inside and outside the chamber which creates the suitable negative pressure in the work enclosure.

[0014] The chamber is made of construction materials according to the chemical, mechanical or thermal resistance required in the tests to be performed and it additionally comprises a pressure relief device which offers effective discharge means for the shock wave in case of an explosion.

[0015] The chamber additionally comprises an adaptation system integrated in the discharge chamber. The adaptation system includes the conditions required for handling the samples such as environments free from electrostatic charges, moisture and temperature.

[0016] The chamber additionally comprises a regulation and monitoring system which ensures the suitable balance of flows and shows the operating status of the chamber.

[0017] The chamber additionally comprises a system for detecting the concentration of particles in the emission.

[0018] The chamber additionally comprises a visual and acoustic alarm system which warns the user of incorrect operation.

[0019] The chamber additionally comprises a lighting system.

[0020] The chamber additionally comprises an extraction chamber with air purification.

Description of the drawings

[0021] To complement the description provided herein and for the purpose of helping to better understand the features of the invention according to a preferred practical embodiment thereof, said description is accompanied by a set of figures constituting an integral part of the same, wherein the following is depicted with an illustrative and non-limiting character:

Figure 1 shows a side view of the protective chamber according to the present invention.
Figure 2 shows a side view of a first embodiment of the protective chamber according to the present invention.
Figure 3 shows a side view of a second embodiment of the protective chamber according to the present invention.

[0022] Figure 4 shows the suction chamber of the protective chamber.

Preferred embodiment of the invention

[0023] The figures described below enable working safely with nanoparticles in a chamber (or enclosure) with a height-adjustable opening while ensuring the suitable conditions for performing tests with nanoparticles and chemicals.

[0024] Thus, Figure 1 shows a side view of the complete chamber assembly (100) according to the present invention wherein the following parts are distinguished: An adjustable opening (1), a work area (2), a removable worktop (3), a discharge chamber (4), an extraction chamber (5), a user protection area (6a) delimited by a user protection barrier (6) comprising a front opening (8) for accessing the adjustable opening (1).

[0025] The discharge chamber (4) creates a discharge area of a flow towards the work area (2) and a second discharge area of a flow towards the user protection area (6a).

[0026] FIG.2 shows the directionality of the low-speed flow which extends from the work area (2), wherein the handling with nanoparticles will be performed, to the user protection barrier (6) in the user protection area (6a) and the pressure gradient in the assembly of the chamber (100).

[0027] The air enters the chamber (100) through the ceiling (7) and the front opening (8) comprised in the protective barrier (6). The adjustable opening (1) can be adjusted according to the needs of the user from the position "Pos.9" to the position "Pos.10". In a preferred embodiment, the maximum opening of the front opening (8) is 500 mm and is equivalent to the maximum work opening of the adjustable opening (1). The suction of the flow is performed through the area (11) and the area (12), subsequently passing through the extraction chamber (5) wherein two configurations will be provided depending on the type of contaminant being worked with:
In the first configuration, the extraction chamber (5) comprises a duct (13) for expelling the flow outside the chamber (100) as shown in Figure 2. The chamber (100) has different flow discharge areas which enable a gradient of discharge speeds to be created between the inner flows (15), (16) in the work area (2) and the outer flow (18) in the user protection area (6a), the relationship of which with the flow suction areas (11) and (12) and the ducts (13) and (14) enable the protection efficiency of the chamber (100) to be ensured.

[0028] Thus, the chamber (100) generates three areas defined by three speed gradients: v(15), v(16) and v(18). The speed gradient v(15) of the flow (15) enables the sample to be protected in the work area with a low speed. The speed gradient v(16) of the flow (16) enables a containment barrier to be created in order to prevent particle dispersion. The speed gradient v(18) of the flow (18) enables a user protection area to be created which protects the respiratory area and promotes particle deposition if they are dispersed.

[0029] The chamber (100) additionally comprises an adaptation system (22) integrated in the discharge chamber (4). The adaptation system (22) includes the conditions required for handling the samples such as environments free from electrostatic charges, humidity and temperature.

[0030] The chamber (100) additionally comprises a regulation and monitoring system (23) which ensures the suitable balance of flows and shows the operating status of the chamber. The chamber (100) additionally comprises a system for detecting the concentration of particles in the emission (24).

[0031] In a second configuration shown with the chamber (200) of Figure 3, the extraction chamber (5) comprises a duct (14) with a return flow. Thus, Figure 3 shows an alternative operation for the chamber (100) wherein the air is recirculated. The chamber (200) also has different flow discharge areas which enable a gradient of discharge speeds to be created between the inner flows (15), (16) and the outer flow (18) in the user protection area (6a), the relationship of which with the flow suction areas (11) and (12) and the ducts (13) and (14) enable the protection efficiency of the chamber (200) to be ensured.

[0032] The air enters the chamber (200) through the front opening (8) which comprises the same dimensions as the adjustable opening (1) and which provides access to the user protection barrier (6). The adjustable opening (1) can be adjusted according to the needs of the user from the position "Pos.9" to the position "Pos.10" with a maximum opening of 500 mm. The suction of the flow is performed through the area (11) and the area (12), subsequently passing through the extraction chamber (5).

[0033] Figure 2 and Figure 3 show the speed gradient in the extraction chamber (5), for chambers (100) and (200), respectively, wherein:

$$Q(11) + Q(12) > Q(18) + Q(15) + Q(16)$$

and

$$v(15) < v(16) > v(18)$$

[0034] With $Q(11)$ and $Q(12)$ being the volumetric flow rates in the flow suction areas (11) and (12), $Q(15)$,$Q(16)$ and $Q(18)$ being the volumetric flow rates in the inner flow (15), (16) and the outer flow (18) areas, respectively. Wherein $v(15)$,$v(16)$ and $v(18)$ are the speed gradients of the flows (15), (16) and (18), respectively.

[0035] Figure 4 describes the extraction chamber (5). The extraction chamber (5) is made up of flow suction areas (11), (12) comprising grates, collectors (17) and (19), a housing (20) and filters (21).

[0036] The air extracted through the flow suction areas (11) and (12) is filtered with safe change filters such as "Bag-in/Bag-out" filters and chemical filters, when appropriate. The extraction chamber (5) allows for a configuration with 100% air extraction or with air being filtered and returned to the room.

Claims

1. A chamber (100, 200) for performing tests with chemicals and particles up to a nanometric size, the chamber comprising:

   a flow discharge chamber (4);
   a flow extraction chamber (5) comprising two flow suction areas (11) and (12);
   a work area (2) comprising a first flow discharge area which creates inner flows (15), (16);
   a user protection area (6a) comprising a user protection barrier (6) and a second flow discharge area which creates an outer flow (18),
   wherein the first and second flow discharge areas create a gradient of discharge speeds which enables a containment barrier to be created in order to prevent particle dispersion, and wherein said gradients meet:

$$v(15) < v(16) > v(18)$$

   wherein $v(15)$, $v(16)$ *and* $v(18)$ are the speed gradients of the inner flows (15), (16) and outer flow (18), respec-

tively; and
wherein the sum of the volumetric flow rates in the flow suction areas (11) and (12) is greater than the sum of the volumetric flow rates in the inner flow areas (15), (16) and in the outer flow area (18), such that:

$$Q(11) + Q(12) > Q(15) + Q(16) + Q(18)$$

2. The chamber (100, 200) according to claim 1, comprising an adjustable opening (1) between the work area (2) and the user protection area (6a) and wherein said adjustable opening (1) provides access to the work area (2).

3. The chamber (100, 200) according to claim 2, wherein the user protection barrier comprises a front opening (8) with the same dimensions as the adjustable opening (1).

4. The chamber (100, 200) according to any of the preceding claims, which additionally comprises an adaptation system (22) integrated in the discharge chamber (4).

5. The chamber (100, 200) according to any of the preceding claims, which additionally comprises a regulation and monitoring system (23).

6. The chamber (100, 200) according to any of the preceding claims, which additionally comprises a system for detecting the concentration of particles in the emission (24).

7. The chamber (100, 200) according to any of the preceding claims, which additionally comprises a removable worktop (3).

8. The chamber (100) according to any one of claims 1 to 7, wherein the extraction chamber (5) comprises a duct (13) for expelling the flow outside the chamber (100).

9. The chamber (200) according to any one of claims 1 to 7, wherein the extraction chamber (5) comprises a duct (14) with a return flow.

10. The chamber (100, 200) according to any of the preceding claims wherein the flow suction areas (11), (12) comprise grates, and
wherein the extraction chamber (5) further comprises collectors (17) and (19), a housing (20) and filters (21).

11. The chamber (100, 200) according to any of the preceding claims, which additionally comprises a lighting system.

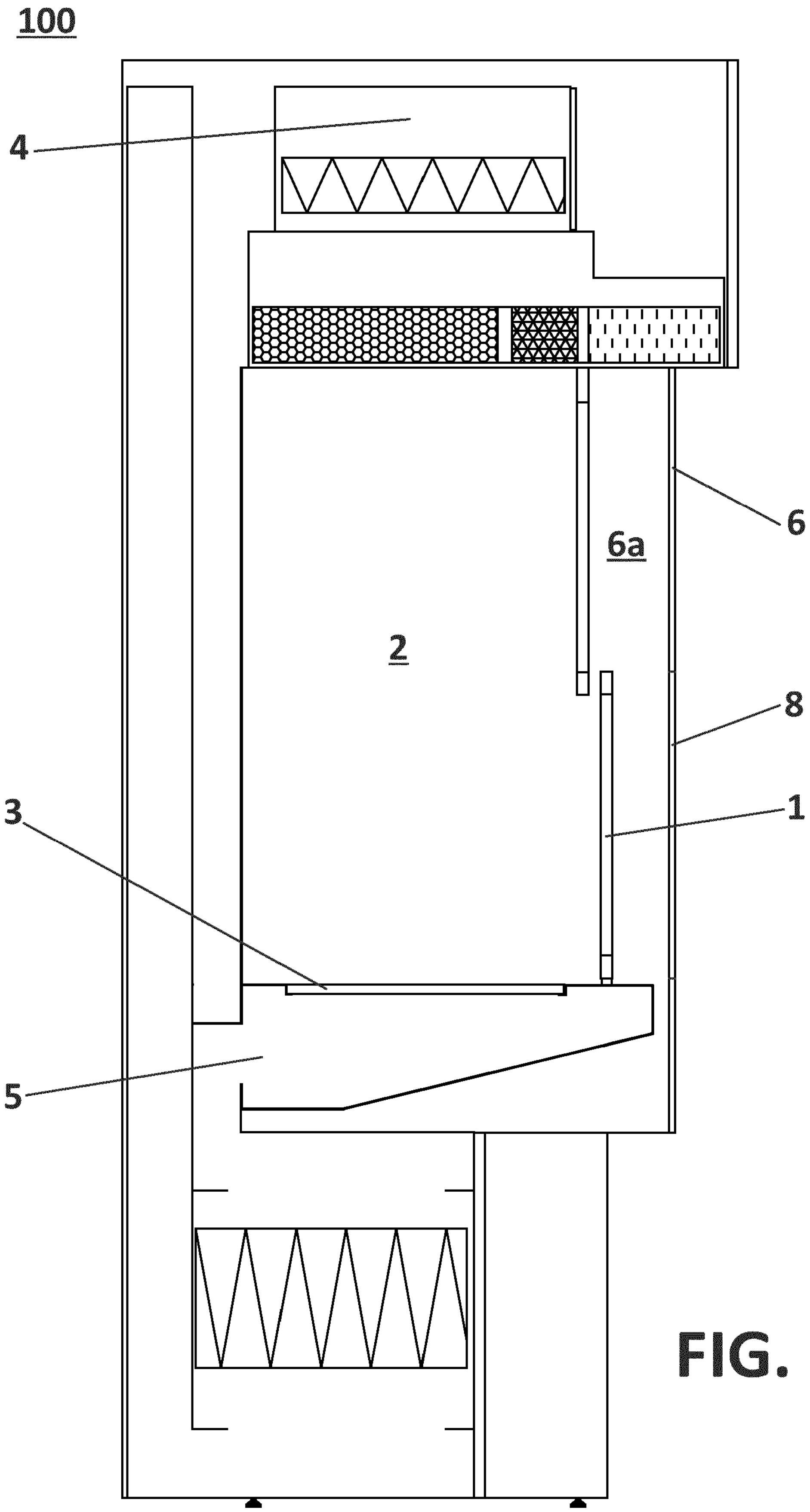

FIG. 1

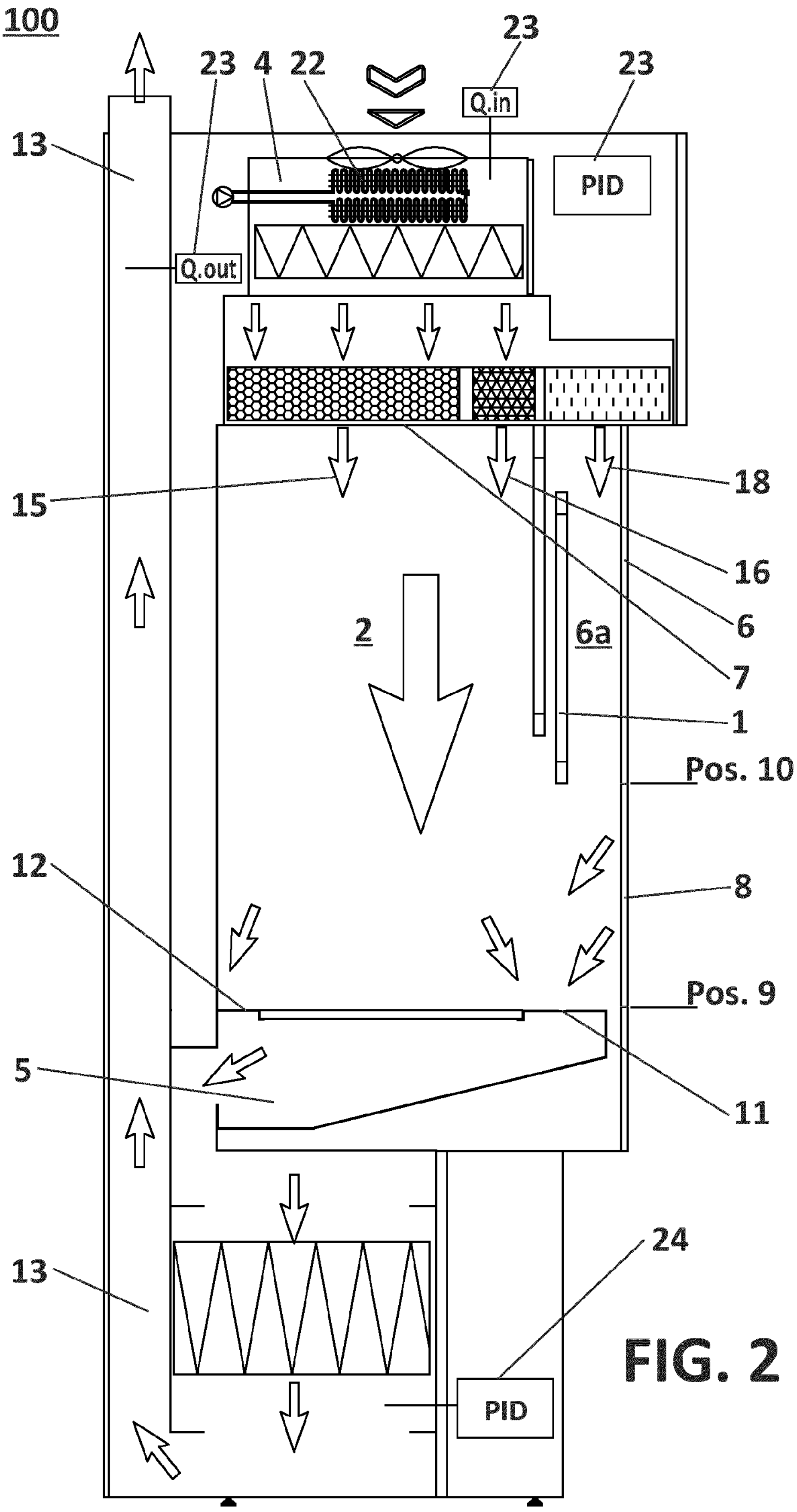
100
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FIG. 2

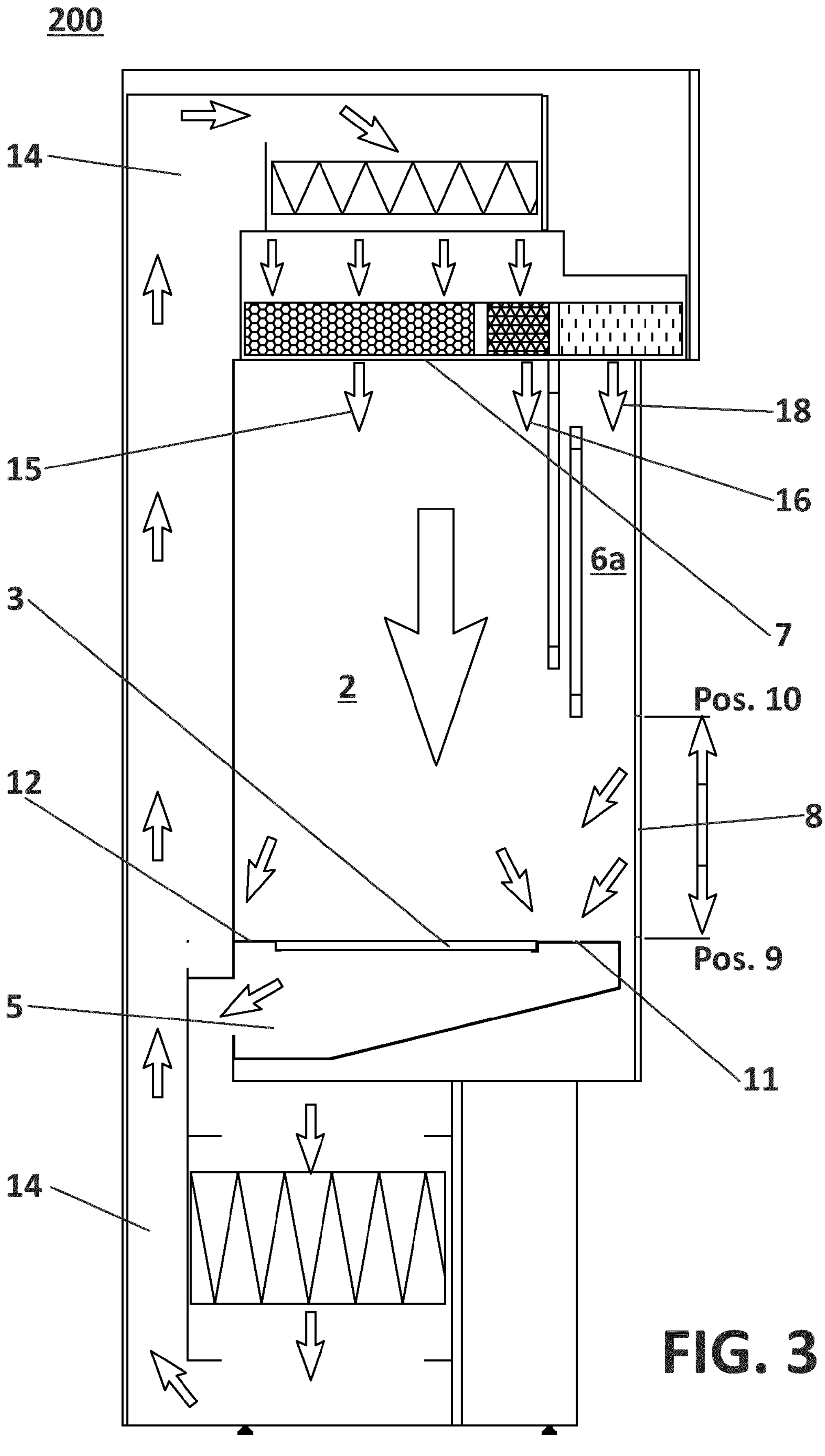

FIG. 3

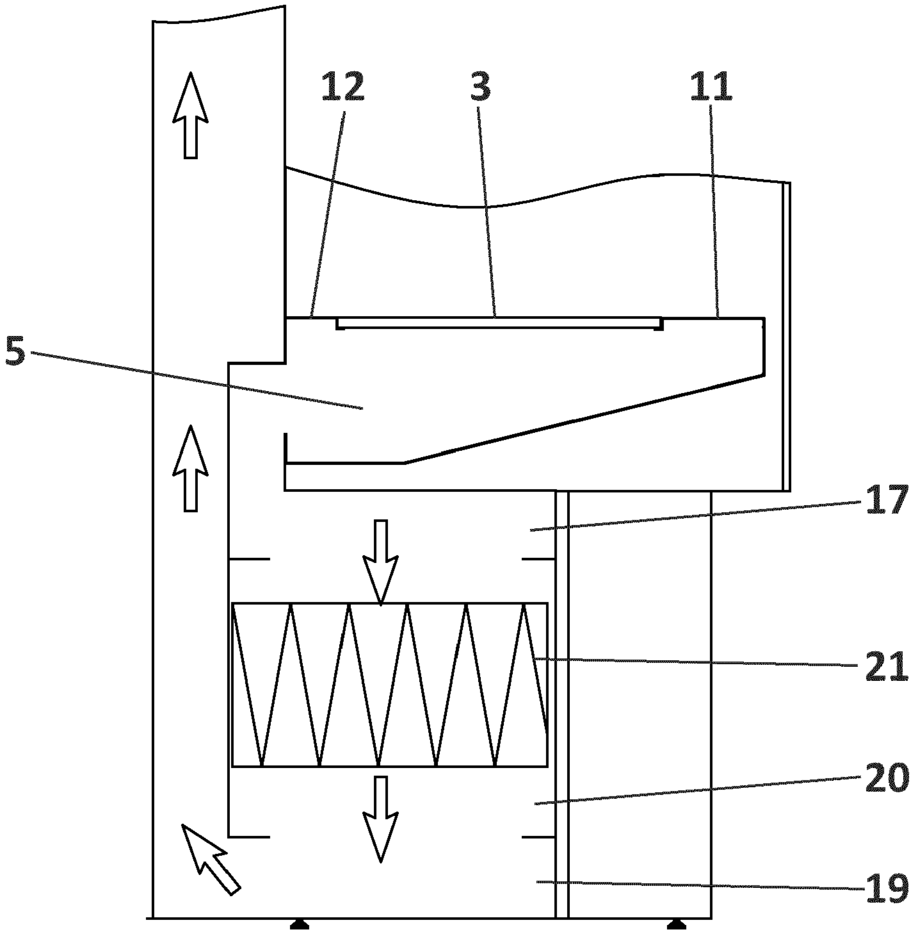

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 19 38 2657

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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	16 December 2019	Bischoff, Laura

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 38 2657

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