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(71) Applicant: **Joint-Stock Company "Tion Smart Microclimate"**  
**Novosibirsk, 630090 (RU)**

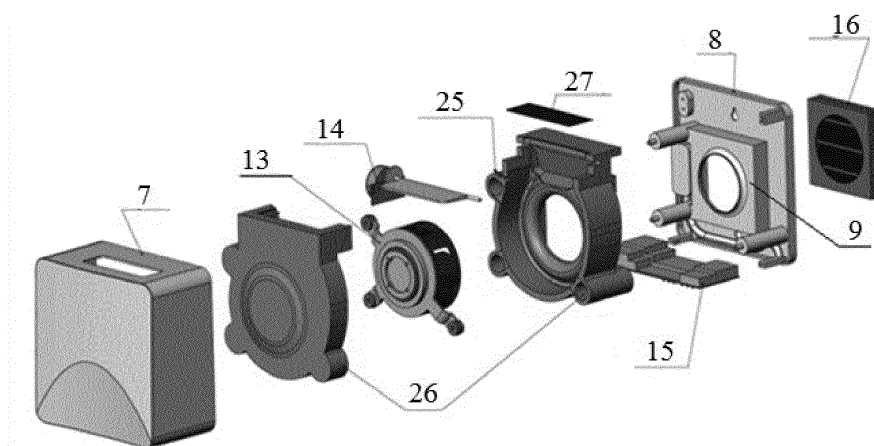
(72) Inventors:  
• **TRUBITSYN, Dmitry Aleksandrovich**  
**Novosibirsk, 630090 (RU)**  
• **SMIRNOV, Roman Nikolaevich**  
**Novosibirsk, 630058 (RU)**  
• **GABRIELIAN, Vladimir Valerevich**  
**Berdsk, 633004 (RU)**

(74) Representative: **Osmans, Voldemars et al**  
**Agency Tria Robit**  
**P.O. Box 22**  
**LV-1010 Riga (LV)**

(54) **COMPACT FORCED VENTILATION SYSTEM**

(57) The invention relates to the field of ventilation, primarily ventilation for living spaces. A compact forced ventilation system, a forced air supply device, and an inlet grate are intended for the forced supply of purified and possibly heated air from outdoors into an indoor space. The problem addressed by the present invention consists in creating a device that efficiently supplies air

wherein providing an appropriate degree of air purification and complying with a set noise level. The technical result consists in more efficiently supplying air. Efficiently supplying air is understood as supplying air into an indoor space in a given mode under any external conditions with minimal internal aerodynamic resistance in a compact forced ventilation system.



**FIG. 2**

## Description

### Field of the invention

**[0001]** The invention relates to the field of ventilation, primarily ventilation for living spaces. It is intended for the forced supply of purified and possibly heated air from outdoors into an indoor space

### Background of the invention

**[0002]** A supply ventilation device is known (the document RU2194222 publ. 10.12.2002), the device comprises a heat-insulating housing, an adjustable air inlet grate, a protective louvre, a porous insulation material located in the housing, thrust strips, a windproof valve having the form of a plate hinged in the upper part of the housing, or having the form of equal-leg angles hinged in the side walls of the housing and configured to move relative to the axis of fastening, or having the form of unequal-leg angles hinged in the side walls of the housing and configured to move relative to the axis of fastening.

**[0003]** The disadvantage of this device is the inability to change the direction of the air flow entering an indoor space and, as a result, ineffective air supply into the indoor space.

**[0004]** A supply ventilation device, which is configured to be built into the outer walls of buildings (the document RU130050 publ. 10.07.2013) is known. The device comprises a housing, the upper and lower surfaces of which are made of an airtight material, an adjustable air inlet grate, a protective louvre, and a porous insulation. At an angle to the upper and lower surfaces of the housing, respectively, at least two lamellar partitions made of airtight material are rigidly fixed, being installed parallel and opposite to each other with the formation of a duct between them for the passage of air.

**[0005]** The disadvantage of this device is insufficient filtration (purification from aerosols) of the air coming from outdoors by the porous insulation.

**[0006]** Air supply and purification unit (the document RU 176378 U1 publ. 17.01.2018) is known, which unit comprises a fan assembly, filters, an inflow valve, a control unit electrically connected to the inflow valve, all of which are located in the housing, a hole is made in the housing to connect the housing to an air duct and air outlet grate for the air flow output, the fan assembly is equipped with a fan, wherein an air inlet grate is additionally made in the housing, and a carbon dioxide sensor is located in the housing, wherein the hole for connecting the housing to the air duct and the air inlet grate are made in different planes, the control unit is electrically connected to the fan and comprises a control board connected to the carbon dioxide sensor.

**[0007]** The disadvantage of this device is the formation of condensation on the air outlet grate, and therefore, a decrease in the efficiency of purified air supply into an indoor space.

**[0008]** The patent RU 80923 U1 publ. 27.02.2009 is known, which discloses a forced ventilation device (prototype), comprising a fresh air supply plenum located in the wall, an electric air heater with overheating protection elements, an internal heat-insulated housing that forms a re-circulation duct for room air with a filter, a fan and a valve installed therein. The device is additionally equipped with an air temperature sensor at the outlet into the indoor space and an automatic control system with an electric drive that controls the valve position according to the current temperature value of the air supplied into an indoor space.

**[0009]** The disadvantage of this device is the ineffective air supply, due to the location of the electric air heater and the noise damper inside the ventilation duct, which in turn increases the aerodynamic resistance and makes it difficult to supply air through the ventilation duct. In this case, the direct air entry from the ventilation duct through the central opening in the housing causes various turbulences and non-laminar flows inside the housing of the device, which negatively affects the efficiency of air supply. And also the location of the fan in the upper part of the housing, if there are holes in the housing from the top and bottom connecting the interior of the housing of the device and the interior of the indoor space, negatively affects the efficiency of air supply into the indoor space, since the fan draws air as from the ventilation duct and from the indoor space through the bottom hole in the housing.

### Summary of the invention

**[0010]** The objective of this invention is to provide a device that ensures efficient air supply, ensuring the proper degree of air purification and maintaining a predetermined noise level.

**[0011]** The technical result consists in increasing the efficiency of air supply. The efficiency of air supply refers to the air supply into an indoor space in a given mode under any external conditions with minimal internal aerodynamic resistance in a compact forced ventilation system.

**[0012]** The technical result is achieved in the invention according to claim 1 through the use of a compact forced ventilation system, comprising an inlet grate, a ventilation duct, a forced air supply device, wherein a pleated conical filter is installed inside the ventilation duct using elastic and centering rings.

**[0013]** It is possible to design the compact forced ventilation system with a step of pleating the filter material of the conical filter, which is 3-8 mm.

**[0014]** In this case, it is possible to design the compact forced ventilation system so that the forced supply ventilation device is installed with the possibility of rotation relative to the axis of the ventilation duct.

**[0015]** The technical result is achieved in the invention according to independent claim 4 through the use of a forced air supply device comprising a housing made of

a decorative panel and a load-carrying panel with a seat, a scroll comprising a main body adjacent to the housing seat and a cover, a radial fan fixed inside the scroll, a shutter, and an electronics unit, wherein a channel is made inside the main body and the cover of the scroll, with the channel depth and channel section width gradually increasing along the direction of air movement with the formation of an asymmetric diffuser.

**[0016]** It is possible to design the forced air supply device, in which central holes coaxial to each other are made in the housing seat and in the main body of the scroll.

**[0017]** In this case, it is possible to design the forced air supply device, in which a heat-insulating material is applied to the shutter.

**[0018]** In the forced air supply device, a temperature sensor can be installed at the outlet of the scroll.

**[0019]** It is possible to design the forced air supply device with a heater installed in the seat of the load-carrying panel.

**[0020]** It is possible to design the forced air supply device with an adapter insert installed in the seat of the load-carrying panel.

**[0021]** It is possible to design the forced air supply device in which the opening angle of the asymmetrical diffuser is 30-60 degrees.

**[0022]** The technical result is achieved in the invention according to independent claim 11 through the use of a compact forced ventilation system comprising an inlet grate, a ventilation duct, a forced air supply device consisting of a housing made of a decorative panel and a load-carrying panel with a seat, a scroll comprising a main body adjacent to the housing seat and a cover, a radial fan fixed inside the scroll, a shutter, and an electronics unit, wherein a channel is made inside the main body and the cover of the scroll, with the channel depth and channel section width gradually increasing along the direction of air movement with the formation of an asymmetric diffuser, wherein a pleated conical filter is installed inside the ventilation duct of the compact forced ventilation system using elastic and centering rings.

**[0023]** The technical result is achieved in the invention according to claim 12 through the use of an inlet grate of the compact forced ventilation system, which grate comprises a body having the form of a hollow cylinder, inclined lamellae located inside the body from the outer edge, wherein at least two inclined lamellae in the lower part of the body having the form of a hollow cylinder are made with elongation.

**[0024]** It is possible to design the inlet grate of the compact forced ventilation system with the first inclined lamella, which is located in the lower part of the body having the form of a hollow cylinder, made with a smaller elongation.

**[0025]** It is possible to design the inlet grate of the compact forced ventilation system with the inclined lamellae of the diffuser having the form of a vertical plate located centrally within the body.

**[0026]** It is possible to design the inlet grate of the compact forced ventilation system with fastener seats located inside the body in the center of the first from the bottom and from the top inclined lamellae.

**[0027]** The technical result is achieved due to the specified design features by reducing the aerodynamic resistance inside the ventilation duct and ensuring smooth, without significant turbulences, air flow from outdoors through the inlet grate and through the ventilation duct into the scroll of the forced air supply device and further along a channel having the channel depth and channel section width gradually increasing along the direction of air movement with the formation of the asymmetrical diffuser into the indoor space.

#### Description of the Drawings

**[0028]** The claimed device is illustrated by the following figures.

FIG. 1 shows a general view of a compact forced ventilation system.

FIG. 2 shows a forced air supply device.

FIG. 3 shows the dependence of the pressure drop across filter elements on the diameter of the central element of the guide, where the solid line is the pressure drop across the central element of the guide, and the dotted line is the pressure drop across the filter element.

FIG. 4, 5 shows an inlet grate.

FIG. 6 shows the distribution of air flows in a wall duct when installing a standard inlet grate, without elongated inclined lamellae, with the formation of a lower zone of turbulence of the air flow.

FIG. 7 shows the distribution of air flows in a wall duct when installing the inlet grate with elongated inclined lamellae.

FIG. 8 shows a pleated conical filter.

FIG. 9 shows a cross-section of the scroll.

Position 1 is the inlet grate;  
Position 2 is a ventilation duct;  
Position 3 is an elastic ring;  
Position 4 is a centering ring;  
Position 5 is a pleated conical filter;  
Position 6 is the forced air supply device;  
Position 7 is a decorative panel;  
Position 8 is a load-carrying panel;  
Position 9 is a seat on the load-carrying panel;  
Position 10 is a main body;  
Position 11 is a cover;  
Position 12 is the channel section width with the formation of an asymmetrical diffuser;  
Position 13 is a radial fan;  
Position 14 is a shutter;  
Position 15 is an electronics unit;  
Position 16 is a heater;  
Position 17 is an adapter insert;

Position 18 is a wall;  
 Position 19 is a body having the form of a hollow cylinder;  
 Position 20 is an edging ring;  
 Position 21 is an inclined lamella;  
 Position 22 is the inclined lamella with elongation;  
 Position 23 is the first inclined lamella with a smaller elongation in the lower part of the body having the form of a hollow cylinder;  
 Position 24 is a splitter;  
 Position 25 is a temperature sensor;  
 Position 26 is a scroll;  
 Position 27 is an outlet grate;  
 Position 28 are fastener seats in the inlet grate;  
 Position 29 is the lower zone of turbulence and curvature of the air flow in the ventilation duct;  
 Position 30 is a pleating step;  
 Position 31 is the channel depth;  
 $\alpha$  is an opening angle.

#### Detailed description of the invention

**[0029]** An inlet grate 1 consists of a body 19 having the form of a hollow cylinder with an edging ring 20 made on the outer edge of the body, inclined lamellae 21 located inside the body from the outer edge, wherein at least two inclined lamellae 22 in the lower part of the body having the form of a hollow cylinder are made with elongation, the first inclined lamella 23 from the bottom is made with a smaller elongation, a splitter 24 having the form of a vertical plate is made inside the body 19 in the center of the inclined lamellae 21, fastener seats 28 are made inside the body 19 in the center of the first from the bottom and from the top inclined lamella 21. The diameter of the intake opening of the standard inlet grate 1 is 96 mm, while a large number of inclined lamellae 21 (9 pieces) additionally reduces the usable area of the intake opening. At the same time, the number of inclined lamellae 21 for the diameter of the intake opening 126 mm is 7 pcs., while the recommended number of inclined lamellae 22 with elongation is 4, including the first lamella 23 with a smaller elongation made in the lower part of the body 19 having the form of a hollow cylinder. The inlet grate 1 can be made of composite materials, metal, plastic material.

**[0030]** The design of the body 19 having the form of a hollow cylinder of the inlet grate with the edging ring 20 from the outer edge ensures the preservation of the shape of the body 19 of the inlet grate 1, which makes it possible to install said body 19 into the ventilation duct 2 tightly and sealingly, as well as the shape retention of the body 19 of the inlet grate ensures stable cross-sectional area, which provides air supply from outdoors into the body 19 of the inlet grate and ventilation duct 2 in wind and bad weather conditions, since there are no distortions and bends (flanged edges) of the body 19.

**[0031]** The design of the inclined lamellae 21 inside

the body from the outer edge and the design of at least two inclined lamellae 22 with elongation in the lower part of the body having the form of a hollow cylinder makes it possible to ensure a uniform laminar air flow immediately after entering the body 19 of the inlet grate, and also eliminates the lower zone of turbulence and curvature of the air flow, which positively affects the efficiency of the air supply.

**[0032]** The design of the first inclined lamella 23, which is located in the lower part of the body 19 having the form of a hollow cylinder in the inlet grate 1, with a smaller elongation is necessary for a tight connection of the body 19 of the inlet grate and the casing of the ventilation duct 2. Also, said inclined lamella 23 functions as a stopper, which has a positive effect on fastening reliability and, therefore, on the efficiency of air supply in bad weather and strong wind conditions.

**[0033]** The design of the fastener seats 28 in the center of the first from below and from the top inclined lamella 21 inside the body 19 of the inlet grate 1 makes it possible to fasten the body 19 of the inlet grate to the casing of the ventilation duct 2 more reliably using fasteners, which favorably affects the efficiency of air supply in bad weather and strong wind conditions, as well as on the ease of installation.

**[0034]** The design of the splitter 24 having the form of a vertical plate in the center of the inclined lamellae 21 inside the body 19 in the inlet grate 1 is necessary for the bodies 19 of the inlet grate of large diameter and makes it possible to provide the specified flow sections between the inclined lamellae 21 in case of bad weather and strong wind conditions, which in turn favorably affects the efficiency of air supply.

**[0035]** The forced air supply device 6 consists of: a housing made of a decorative panel 7 and a load-carrying panel 8 with a seat 9, a scroll 26 comprising a main body 10 adjacent to the body seat 9, and a cover 11, wherein a channel is made inside the main body 10 and the cover 11 of the scroll, with the channel depth 31 and channel section width 12 gradually increasing along the direction of air movement with the formation of an asymmetric diffuser, wherein the channel of the scroll is made gradually expanding for smooth spreading of the air flow, forming the diffuser with an opening angle  $\alpha$ , wherein the range of angle  $\alpha$  varies from 30 to 60 degrees, in this case, the most optimal angle  $\alpha$  equal to 45 degrees is chosen, and in order to avoid the formation of turbulences, all corners on the surface of the scroll are rounded. A radial fan 13, fixed inside the scroll 26, a shutter 14 and an electronics unit 15, wherein central holes coaxial to each other are made in the seat 9 of the housing and the main body 10 of the scroll.

**[0036]** In one embodiment, the forced air supply device 6 may have overall dimensions 260x260x130 mm, wherein individual adjustment of the overall dimensions beyond the specified ones is possible. The weight of the forced air supply device 6 with the specified dimensions must not exceed 5 kg.

**[0037]** The design of the coaxial central holes in the seat 9 of the housing (load-carrying panel 8) and the main body 10 of the scroll 26 ensures smooth air flow from the ventilation duct 2 into the inner space of the scroll 26, namely into the channel having the channel depth 31 and channel section width 12 gradually increasing along the direction of air movement with the formation of an asymmetric diffuser, without the occurrence of turbulences, which ensures the minimal aerodynamic resistance, as a result of which the efficiency of air supply increases.

**[0038]** Placement of the radial fan 13 inside the scroll 26 and the design of the channel inside the main body 10 and the cover 11 of the scroll, with the channel depth 31 and channel section width 12 gradually increasing along the direction of air movement with the formation of an asymmetric diffuser, provides a smooth circular flow of air inside the scroll 26, namely in the channel having the channel depth 31 and channel section width 12 gradually increasing along the direction of air movement with the formation of the asymmetric diffuser, which in turn gives a turbulence-free flow of air from the ventilation duct 2 through the scroll 26 into the indoor space, which increases the efficiency of air supply. And since the air from the central opening of the main body of the scroll flows through the channel having the channel depth 31 and channel section width 12 gradually increasing along the direction of air movement with the formation of the asymmetrical diffuser and configured to provide circular flow inside the scroll 26, the effect of the air flow acceleration is provided, since part of the air from the scroll 26 goes into the indoor space, and the rest of the air flows in a circle again through the channel having the channel depth 31 and channel section width 12 gradually increasing along the direction of air movement with the formation of the asymmetrical diffuser, which generates a directed air flow, which gradually picks up air from the ventilation duct 2, as a result of which a directed circular air flow is formed inside the scroll 26, while the characteristic of this flow tends to the characteristics of a laminar flow, which ensures a fast and orderly air flow, which in turn increases the efficiency of air supply. At the same time, the circular air flow also favorably affects the efficiency of air supply when the shutter 14 is partially open, since no turbulences and stagnant zones that could adversely affect the air flow rate are formed in the area of the shutter 14.

**[0039]** The design of the scroll 26 makes it possible to avoid the formation of turbulences and unsteadiness of the flow and at the same time ensures the uniformity of the air flow rate along the entire length of the air channel formed by the walls of the scroll 26 and the impeller of the radial fan 13 through to use of the channel of the scroll 26, with the channel depth 31 and channel section width 12 gradually increasing in the direction of air movement with the formation of the asymmetrical diffuser, i.e. by adding fillets and smoothing the inner surfaces of the scroll 26.

**[0040]** The application of heat-insulating material to the shutter 14 makes it possible to increase the efficiency

of air supply into the indoor space by preventing the formation of condensation on the surface of the shutter 14, which allows to increase the reliability of the operation of the given device and makes it possible, especially in conditions of low outside temperatures, to reduce wear and damage to the device from temperature drops on the surface of the shutter 14.

**[0041]** The installation of a temperature sensor 25 at the outlet of the scroll 26 of the forced air supply device 6 makes it possible to increase the efficiency of air supply due to the optimal adjustment of the air supply from outdoors into the indoor space, since data from the sensor 25 enter the electronics unit 15 in real time mode and commands to the radial fan 13 and the shutter 14 are also provided by the electronics unit 15 in real time mode, which allows to maintain the temperature regime of air conditioning and air supply set by the user.

**[0042]** Installing a heater 16 in the seat 9 of the load-carrying panel 8 makes it possible to ensure the specified temperature regime and keep the minimal possible aerodynamic resistance in the ducts of the compact forced ventilation system, since the configuration and location of the seat 9 is calculated from the conditions of minimal aerodynamic resistance in the ducts of the system, which in turn increases the efficiency of air supply. At the same time, compliance with the temperature regime of the incoming air makes it possible to know the characteristics of the air flow, therefore, according to the programs prestored in the electronics unit, the operating mode of the radial fan 13 and shutter 14 is controlled taking into account the characteristics of the air flow.

**[0043]** The design of the forced air supply device 6 with an adapter-insert 17 installed in the seat 9 of the load-carrying panel 8 makes it possible, in some embodiments of the forced air supply device 6, to maintain the required configuration of the duct at the inlet of the scroll 26. This, in turn, ensures the minimal possible aerodynamic resistance and therefore improves the efficiency of the air supply.

**[0044]** The design of the forced air supply device with an opening angle  $\alpha$  of the asymmetric diffuser of 30-60 degrees ensures a smooth overflow of air flow from the ventilation duct 2 to the channel having the channel depth 31 and channel section width 12 gradually increasing along the direction of air movement with the formation of an asymmetric diffuser, which ensures a vortex-free air movement and, consequently, increases the efficiency of air supply by reducing the aerodynamic resistance in the ducts through which the air flow passes.

**[0045]** In one embodiment, a compact forced ventilation system consisting of an inlet grate 1 comprising a body 19 having the form of a hollow cylinder, from the outer edge of which an edging ring 20 is made, inclined lamellae 21 located inside the body from the outer edge, with at least two inclined lamellae 22 in the lower part of the body having the form of a hollow cylinder made with elongation, a ventilation duct 2, a forced air supply device 6, wherein a pleated conical filter 5 is installed inside the

ventilation duct 2 using elastic 3 and centering 4 rings.

**[0046]** In another embodiment, a compact forced ventilation system, consisting of an inlet grate 1, a ventilation duct 2, a forced air supply device 6 comprising a housing made of a decorative panel 7 and a load-carrying panel 8 with a seat 9, a scroll 26 comprising a main body 10 adjacent to the housing seat 9, and a cover 11, wherein a channel is made inside the main body 10 and the cover 11 of the scroll, with the channel depth 31 and channel section width 12 gradually increasing along the direction of air movement with the formation of an asymmetrical diffuser, wherein a pleated conical filter 5 is installed inside the ventilation duct 2 using elastic 3 and centering 4 rings.

**[0047]** The pleated conical filter 5 is made with a pleating step 30 (FIG. 8) of the filter material from 3 to 8 mm. The outer diameter of the filter 5 is 67 mm. With an increase in the diameter of the filter 5, the cross-sectional area of the duct decreases, and the pressure drop across this element increases (solid line in FIG. 3). At the same time, the pleating step 30 of the filter material decreases when approaching the centering ring 4 (dashed line in FIG. 3). The centering ring 4 and elastic ring 3 are made of plastic material.

**[0048]** The diameter of the centering ring 4, which is equal to 67 mm, gives minimal pressure drop across the filter 5.

**[0049]** The compact forced ventilation system operates as follows. The air from outdoors is sucked in the process of operation of the radial fan 13 and enters the ventilation duct 2 passing through the inlet grate 1, which prevents the penetration of foreign objects into the device and into the ventilation duct 2. At the same time, the air flow passing the inlet grate 1 is leveled on inclined lamellae 21 forming an ordered air flow. Further, the ordered air flow passes through the ventilation duct 2, where it at first floats onto the end with the smaller diameter of the pleated conical filter 5 fixed in the centering ring 4. After that, the ordered air flow gradually penetrates through the filter material of the pleated conical filter 5, where it is purified. Due to the conical shape of the pleated conical filter 5, the purification process occurs evenly, without turbulence, and also unpurified air cannot penetrate beyond the pleated conical filter 5 through the use of the elastic ring 3, which separates and seals the areas of purified air and polluted air. After that, the purified air flow reaches the end of the ventilation duct 2 and flows into the area of the seat 9 on the load-carrying plate 8 of the forced air supply device 6. In the seat 9 on the carrier plate 8, either the heater 16 or the adapter-insert 17 is installed, on which the purified air flow is leveled. After passing through them, the purified air flow enters the scroll 26, namely, on the blades of the radial fan 13 and into the channel having the channel depth 31 and channel section width 12 gradually increasing along the direction of air movement with the formation of the asymmetric diffuser. Further, the air flow passes through the channel of the scroll, and finally it passes through the outlet grate

27. After passing the outlet grate 27, the air is suspended and due to the possibility of rotation of the forced air supply device 6, it is possible for the air flow to freely exit and pour into the existing air circulation in the indoor space.

**[0050]** The design of the pleated conical filter 5 with the pleating step 30 of the filter material from 3 to 8 mm makes it possible to ensure the optimal throughput of the wall of the pleated conical filter 5 with minimal aerodynamic resistance, taking into account the compliance with the specified filtration requirements on its surface, which favorably affects the efficiency of air supply.

**[0051]** Placement of the pleated conical filter 5 inside the ventilation duct 2 ensures minimal aerodynamic resistance on the surface of the filter 5 and, therefore, inside the ventilation duct 2. While conventional mesh or bag filters block the ventilation duct 2 and have high aerodynamic resistance, the pleated conical filter 5 prevents air flow to a far lesser extent, this is due to the fact that the conical pleated filter does not overlap the cavity of the ventilation duct 2 at a single location, but it has a limited area of overlapping the cavity of the ventilation duct 2 at a single location (in section), that is, the pleated conical filter 5 gradually overlaps the cavity of the ventilation duct 2 for due to its length, and since the air is filtered in the corrugations of the filter 5 penetrating through them, the air flow passing through the ventilation duct 2 is filtered through the pleated conical filter 5 gradually, smoothly and without turbulences, and then flows into the internal cavity of the scroll 26 of the forced air supply device 6, which in turn provides an efficient air supply. In this case, the pleated form of the filter 5 provides an increase in the area of the filtering surface.

**[0052]** The design of the compact forced ventilation system with the installation of the forced air supply device 6, which is configured to rotate relative to the axis of the ventilation duct makes it possible to direct the output air flow in any direction, which allows to increase the efficiency of air supply into the indoor space in the case of indoor spaces of complex geometry or complex air circulation, due to optimal air circulation taking into account the existing air flows in the indoor space.

**[0053]** Therefore, the claimed technical solutions increase the efficiency of air supply by reducing the aerodynamic resistance inside the ventilation duct and ensuring smooth air flow, without significant turbulences, from outdoors through the inlet grate and through the ventilation duct into the scroll of the forced air supply device and further along the channel having the channel depth and channel section width gradually increasing along the direction of air movement with the formation of the asymmetric diffuser into the indoor space.

## Claims

1. A compact forced ventilation system comprising an inlet grate, a ventilation duct, a forced air supply de-

vice, wherein a pleated conical filter is installed inside the ventilation duct using elastic and centering rings.

2. The compact forced ventilation system according to claim 1, wherein a pleating step of the filter material of the conical filter is 3-8 mm. 5

3. The compact forced ventilation system according to claim 1, wherein the forced air supply device is installed with the possibility of rotation relative to the axis of the ventilation duct. 10

4. A forced air supply device, comprising:

- a housing made of a decorative panel and a load-carrying panel with a seat, 15
- a scroll comprising a main body adjacent to the housing seat and a cover, a radial fan fixed inside the scroll,
- a shutter, 20
- an electronics unit,

wherein a channel is made inside the main body and the cover of the scroll, with the channel depth and channel section width gradually increasing along the direction of air movement with the formation of an asymmetric diffuser. 25

5. The forced air supply device according to claim 4, wherein the housing seat and the main body of the scroll are made with central holes coaxial to each other. 30

6. The forced air supply device according to claim 4, wherein a heat-insulating material is applied to the shutter. 35

7. The forced air supply device according to claim 4, wherein a temperature sensor is installed at the outlet of the scroll. 40

8. The forced air supply device according to claim 4, wherein the device comprises a heater installed in the seat of the load-carrying panel. 45

9. The forced air supply device according to claim 4, wherein the device further comprises an adapter-insert installed in the seat of the load-carrying panel.

10. The forced air supply device according to claim 4, wherein an opening angle of the asymmetrical diffuser is 30-60 degrees. 50

11. A compact forced ventilation system, consisting of an inlet grate, a ventilation duct, a forced air supply device, which device comprises: 55

- a housing made of a decorative panel and a

load-carrying panel with a seat,

- a scroll comprising a main body adjacent to the housing seat and a cover, a radial fan fixed inside the scroll,
- a shutter,
- an electronics unit,

wherein a channel is made inside the main body and the cover of the scroll, with the channel depth and channel section width gradually increasing along the direction of air movement with the formation of an asymmetric diffuser, wherein a pleated conical filter is installed inside the ventilation duct of the compact forced ventilation system using elastic and centering rings.

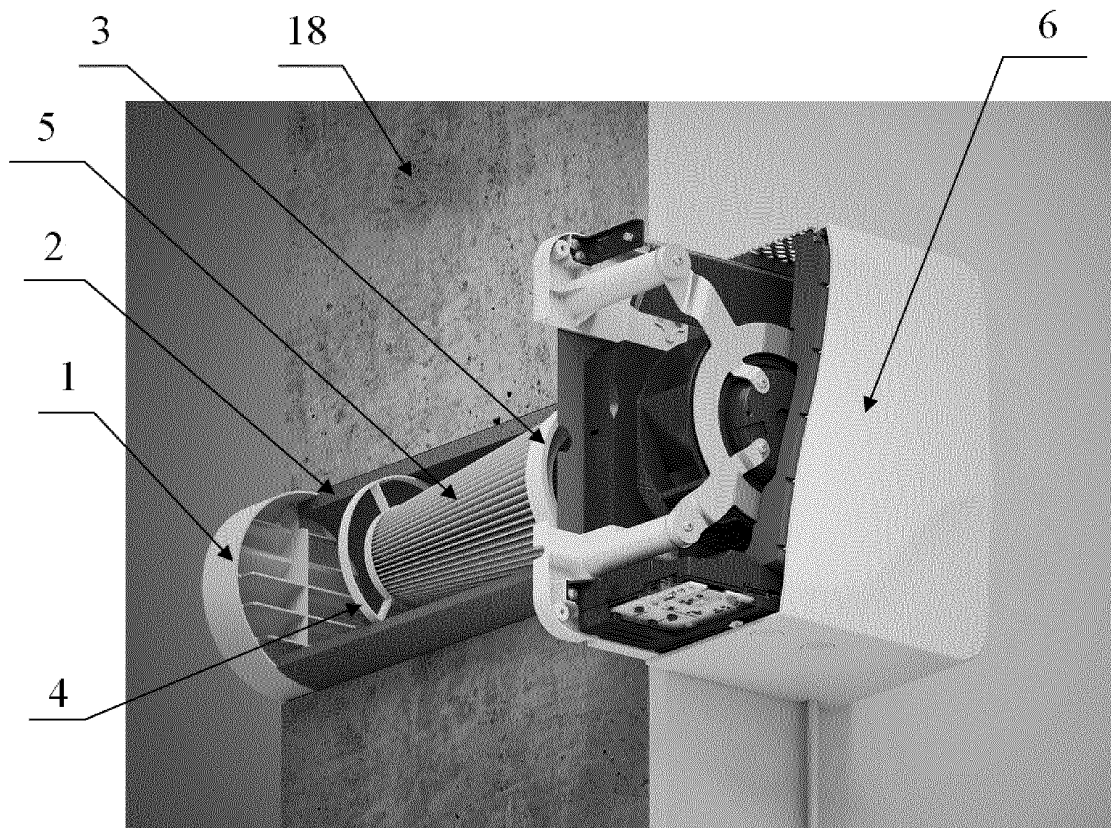
12. An inlet grate of the compact forced ventilation system, which grate comprises:

- a body having the form of a hollow cylinder,
- inclined lamellae located inside the body from the outer edge, wherein at least two inclined lamellae in the lower part of the body are made with elongation.

13. The inlet grate of the compact forced ventilation system according to claim 12, wherein the first inclined lamella in the lower part of the body having the form of a hollow cylinder is made with a smaller elongation.

14. The inlet grate of the compact forced ventilation system according to claim 12, wherein a splitter having the form of a vertical plate is made inside the body in the center of the inclined lamellae.

15. The inlet grate of the compact forced ventilation system according to claim 12, wherein fastener seats are made inside the body, in the center of the first from the bottom and from the top inclined lamella.



**FIG. 1**

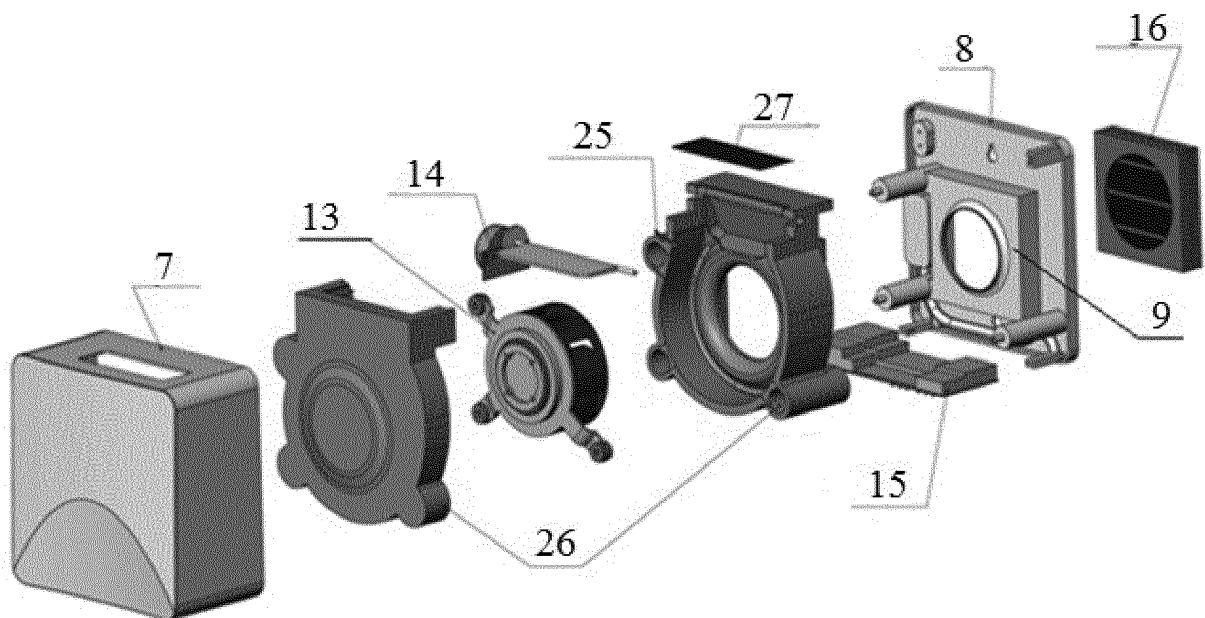


FIG. 2

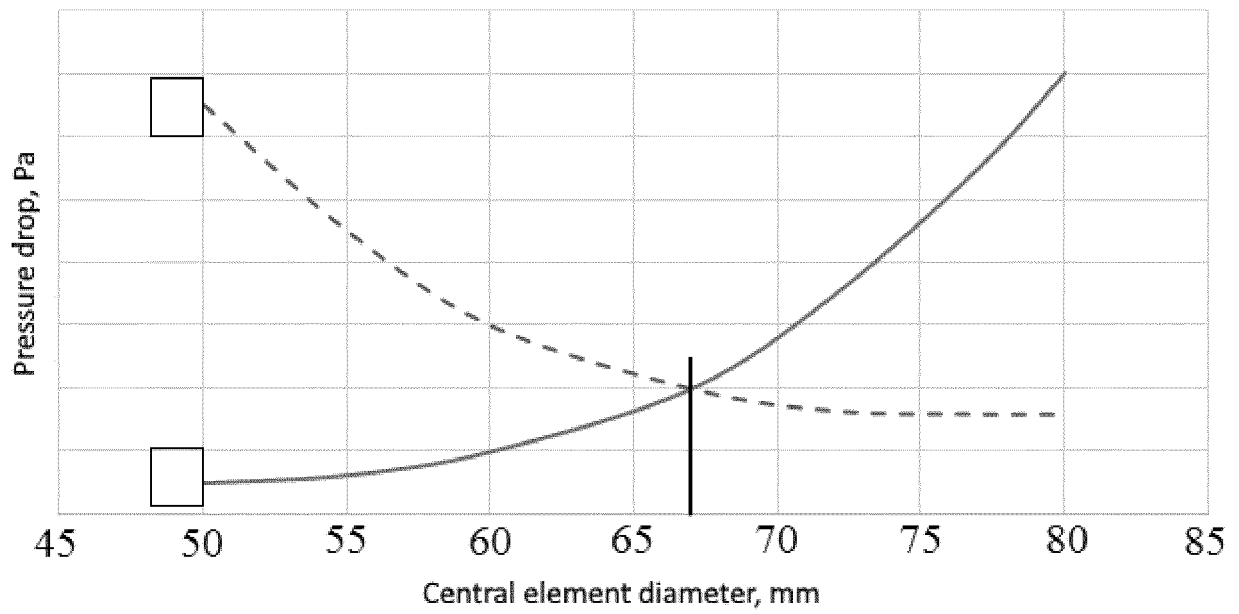


FIG. 3

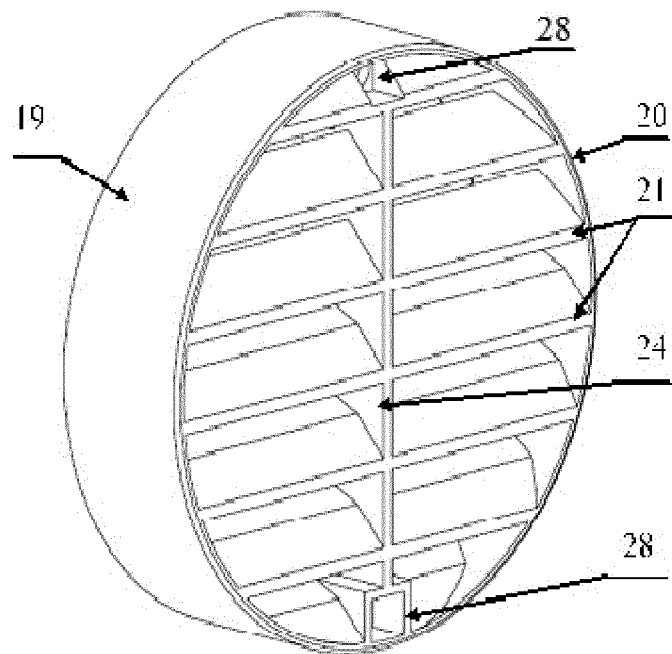


FIG. 4

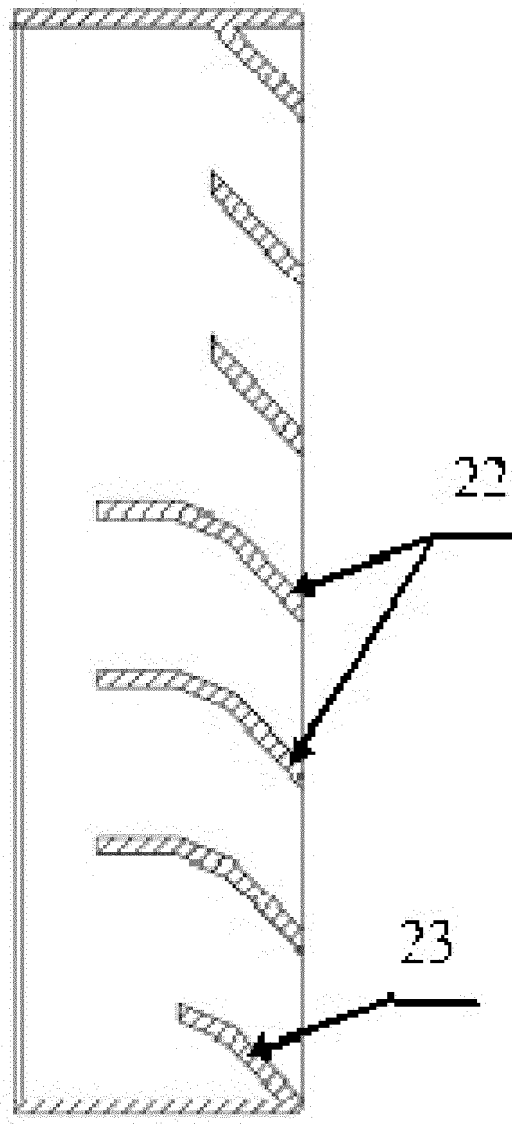


FIG. 5

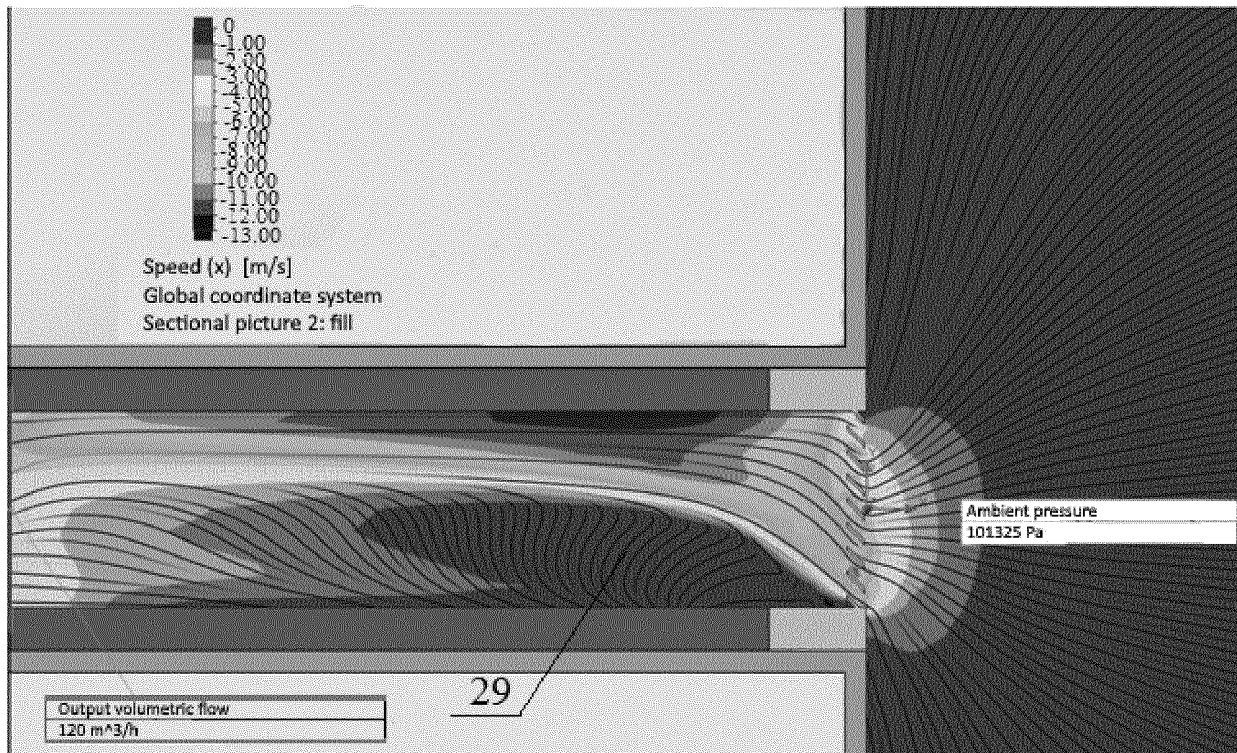


FIG. 6

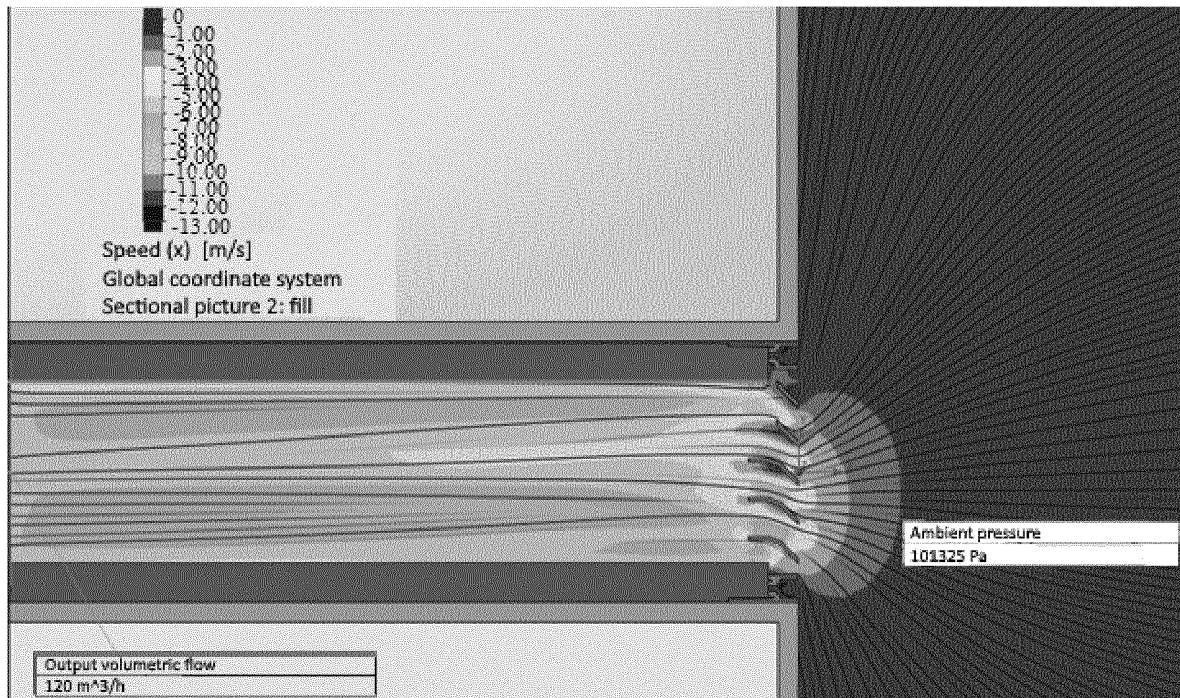


FIG. 7

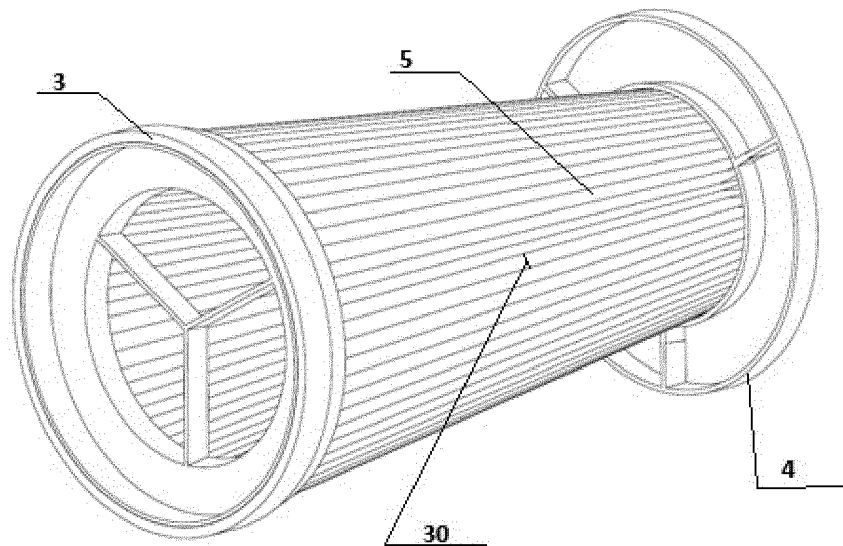


FIG. 8

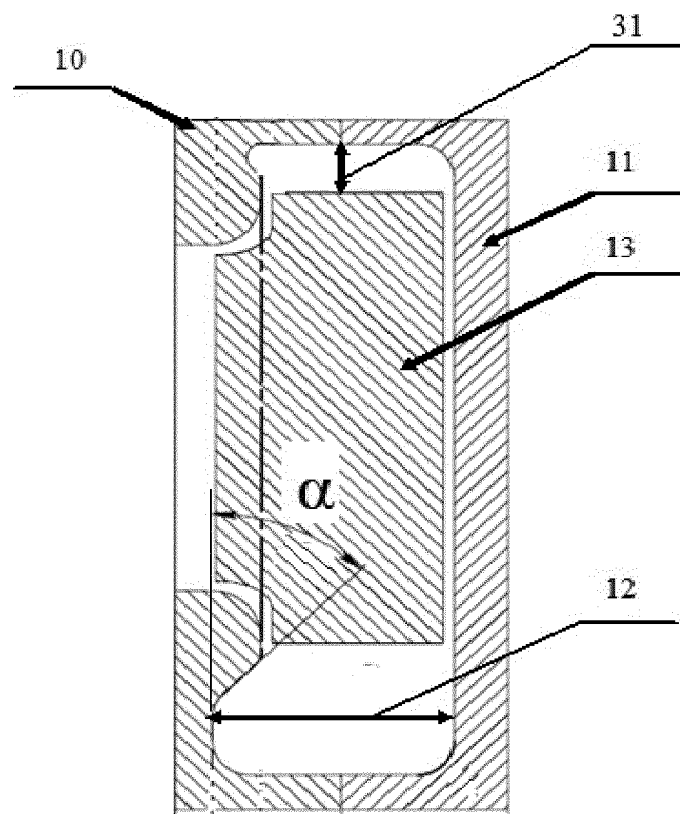


FIG. 9

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/RU 2019/050220

## A. CLASSIFICATION OF SUBJECT MATTER

F24F 13/00 (2006.01); F24F 7/007 (2006.01); F24F 13/28 (2006.01); F24H 3/04 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24F 13/00, 7/00, 7/007, 12/00, 13/28, F24H 3/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatSearch (RUPTO Internal), USPTO, PAJ, Espacenet, Information Retrieval System of FIPS

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category*   | Citation of document, with indication, where appropriate, of the relevant passages               | Relevant to claim No.       |
|-------------|--------------------------------------------------------------------------------------------------|-----------------------------|
| X<br>Y<br>A | CN 105157151 A (NINGBO DONGDA AIR-CONDITIONING EQUIPMENT CO., LTD.) 16.12.2015, figures          | 12, 13<br>1-3, 14, 15<br>11 |
| Y           | RU 154005 U1 (SAFONOV DMITRY IGOREVICH et al.) 10.08.2015, fig., p. 3, line 37 - p. 4, line 9    | 1-3                         |
| Y           | RU 84935 U1 (ZAKRYTOE AKTSIONERNOE OBSHCHESTVO "VENTILIATSIONNYE SISTEMY") 20.07.2009, fig. 1, 3 | 14                          |
| Y           | WO 2000/055547 A1 (EUROPLAST S.P.A.) 21.09.2000, fig. 8, 11, 12                                  | 15                          |
| A           | US 4476773 A (SUEDDEUTSCHE KUEHLER BEHR) 16.10.1984                                              | 4-10                        |

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

23 January 2020 (23.01.2020)

Date of mailing of the international search report

20 February 2020 (20.02.2020)

Name and mailing address of the ISA/  
RU

Authorized officer

Facsimile No.

Telephone No.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/RU 2019/050220

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

10

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------|-----------------------|
| A         | CN 204943769 U (NINGBO DONGDA AIR-CONDITIONING EQUIPMENT CO LTD) 06.01.2016        | 1-15                  |
| A         | SU 1596182 A1 (LENINGRADSKY INZHENERNO-STROITELNY INSTITUT) 30.09.1990             | 12-15                 |

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Form PCT/ISA/210 (continuation of second sheet) (April 2005)

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/RU 2019/050220

**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

See supplemental sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

## Box III

Pursuant to PCT Rule 13.1, the international application shall relate to one invention only or to a group of inventions so linked as to form a single general inventive concept ("requirement of unity of invention").

Where a group of inventions is claimed in one and the same international application, the requirement of unity of invention shall be fulfilled only when there is a technical relationship among those inventions involving one or more of the same or corresponding special technical features. The expression "special technical features" shall mean those technical features that define a contribution which each of the claimed inventions, considered as a whole, makes over the prior art (PCT Rule 13.2).

When the present claims are divided up according to their special technical features, the following groups can be identified.

Group 1: claims 1 and 11, containing the features: a pleated conical filter is mounted inside an air conduit with the aid of a resilient ring and a centring ring.

Group 2: claims 4 and 11, containing the features of a forced-air supply device that consists of: a housing configured from a decorative panel and a load-bearing panel with a seat; a scroll case comprising a main housing which abuts the seat of the aforementioned housing, and a cover; a radial fan fastened inside said scroll case; a damper; and an electronics module, wherein inside the main housing and the cover of the scroll case a conduit is configured such as to gradually increase in depth and cross-sectional width in the direction of travel of the air, thus forming an asymmetrical divergent portion.

Group 3: claim 12, containing the features: an inlet grille of a compact forced-air ventilation system, said grille consisting of a housing in the form of a hollow cylinder, and inclined fins arranged inside said housing at the outer end thereof, at least two of said inclined fins in the lower part of the housing having an elongate portion.

Therefore, the above groups do not contain the same or corresponding special technical features.

Consequently, the requirement of unity of invention is not met.

**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- RU 2194222 [0002]
- RU 130050 [0004]
- RU 176378 U1 [0006]
- RU 80923 U1 [0008]