(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 826 409 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.01.2015 Bulletin 2015/04

(51) Int Cl.:
A47K 10/48 *(2006.01)* ***B61D 35/00*** *(2006.01)*

(21) Application number: **14177890.2**

(22) Date of filing: **21.07.2014**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **19.07.2013 IT FI20130033 U**

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(54) **A hand dryer device**

(57) The present invention refers to the field of hygienic systems, and more precisely it refers to a device for drying hands, more in particular for drying hands in the washrooms of train carriages.

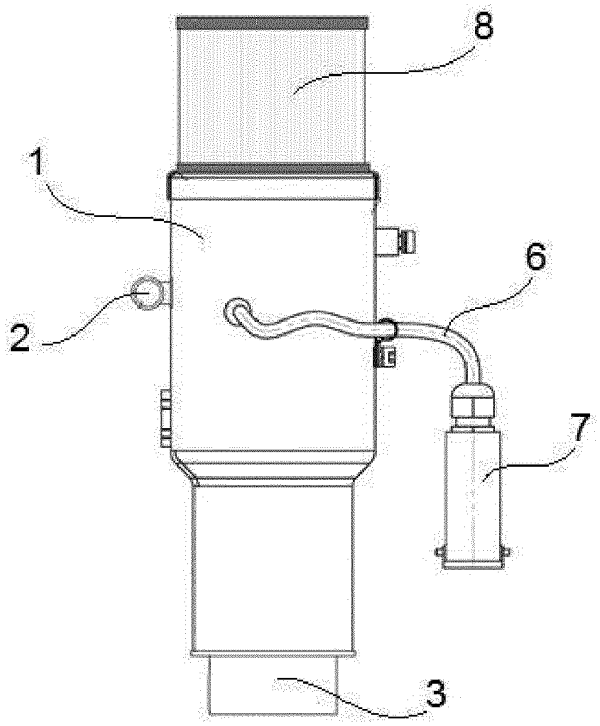

Fig. 1

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Description

[0001] The present invention refers to the hygienic systems industry and more precisely it refers to a device for drying hands, particularly adapted to be positioned in washrooms of train carriages.

[0002] Timed air jet hand dryers are devices widely used in public washrooms, including most modern train washrooms. In these plants the air jet is generated by an electrical motoventilator with maximum 150 W power and heated by a resistance of 1500 W maximum power, controlled separately by an electronic exchange unit and supplied at 230 Vac (Volt alternating current). Due to the early wear of the brushes of the electrical motor, these devices require a very frequent maintenance which, in case of trains, it cannot be carried out when the device is in use given that the hand dryer is positioned in the wall of the washroom; thus, in this case, there arises the need of entirely replacing the device to be subjected to maintenance with a new one, and check and possibly repair on the bench. Thus, this is a long and expensive operation.

[0003] In addition, in the devices currently in use, the air which is blown on the hands to dry them is directly suctioned from the internal of the washroom and, it is not disinfected, it may therefore contain bacteria and various impurities. A further disadvantage of the hand dryer device currently in use is the high degree of noise generated during the operation of the electrical motor, which cannot be reduced or eliminated by soundproofing. This drawback is particularly felt in the washrooms of train carriages, which are narrow environments with extremely limited exchange of air, in which the isolating walls of the washroom make the noise of the hand dryer device even more disturbing.

[0004] On the other hand, this type of device guarantees anyway a greater hygiene with respect to the conventional hand dryer systems, especially the fabric or tissue hand dryers, and it also is simple and practical to use and thus it is appreciated by the users. Thus, there is to be expected a greater utilisation of air jet hand washers and thus it would be particularly useful to have a new device capable of overcoming the problems outlined above regarding the hand dryers currently in use.

[0005] Thus, in the light of the above, a subject of the present invention is to provide an air jet hand dryer device that does not require maintenance, i.e. it requires less frequent and complex maintenance operations, with respect to what is required of the air jet hand washers currently in use.

[0006] A further subject of the present invention is to provide an air jet hand dryer capable of guaranteeing the quality of the air blown out and used for drying, and in particular it guarantees the absence of bacterial load or other potentially harmful pollutants.

[0007] Still a further subject of the present invention is to provide a device that does not generate noise during the operation, or at least it produces a degree of noise lower than that of the known devices.

[0008] These and other subjects are attained by a device having the essential characteristics according to the first of the attached claims.

[0009] The invention shall now be illustrated with the description that follows of an embodiment thereof, provided solely by way of non-limiting example, with reference to the attached drawings, wherein:

- figure 1 shows a body of the hand dryer device according to the present invention;
- figure 2 represents a longitudinal sectional view of the device of figure 1;
- figure 3 shows a bottom view of the device of figure 1;
- figures 4a and 4b show a detail of the device of figure 1, representing a component thereof described hereinafter, a flow rate amplifier, and the operating mode thereof;
- figure 5 shows a particular embodiment of the present device, comprising an integrated circuit of the pneumatic type described hereinafter.

[0010] With reference to the aforementioned figures the hand dryer device according to the invention comprises a tubular body 1 provided with an inlet 2 for the compressed air coming from a source of compressed air, for instance a compressed air line or a compressor, and a dispenser opening 3 of the air flow which is conveyed in said opening through a flow rate pneumatic amplifier 4, which can be controlled by a cut-out solenoid valve.

[0011] The body 1 of the present device may be entirely made of aluminium and with a design suitable for use, so as to obtain a compact, light and robust device.

[0012] The dispenser opening 3 may have a shape such to facilitate the hand dryer function of the present device, in particular it may have a shape which confers further force to the exiting air jet to facilitate the moving away of water from the hands of the user.

[0013] According to a preferred embodiment of the present invention the air exiting from the amplifier 4 is made to pass through a heating means, preferably an electrical resistance 5 of suitable power, to be heated. An electronic control unit, like the one presents in the conventional air jet hand dryer devices, manages and controls the power of the device. Control unit and device are connected, for instance, through cables 6 and pin connector 7 for multiple resistance connection, solenoid valve and thermostat. Of these and other components present in the device of the invention mentioned hereinafter, a detailed description is not provided given that these components are known to those skilled in the art.

[0014] The presence of the flow rate amplifier in the present device allows avoiding the use of an electrical motor, instead present in conventional air jet hand dryer devices. The present flow rate pneumatic amplifier substantially has the purpose of creating a high volume and high speed airflow, with an amplification ratio between agitated air and compressed air for example equal to

about 8 to 1. Figure 4a illustrates an embodiment of a flow rate amplifier for use in the present device, comprising an annular chamber 41 in which the compressed air enters through an inlet 42, which can be a threaded coupling and it is connected to the aforementioned inlet 2. In the chamber 41 the air is vented through a thin nozzle 43, thus creating a primary airflow 44 illustrated in figure 4b that, adhering at high speed to the inner walls of the amplifier, follows their profile due to the Coandă effect, moving towards the outlet 45. Thus, this creates a considerable vacuum in the inlet pipe 46 which, combining with the primary airflow 44, drags a large amount of air present in the surrounding environment therewith, creating a high flow-rate and high speed flow 47, which continues to move towards the outside, traversing the possible heating means arranged downstream of the amplifier.

[0015] The flow rate amplifier 4 in the present device is a metal component, preferably entirely made of aluminium, compact, robust and without any mobile part, thus silent; operation and stop are furthermore instantaneous and no maintenance is required. Thus, it overcomes the problem of the generated noise and the need of continuous maintenance of the known devices, related to the presence of an electrical motor therein, and it also has a much higher air flow rate.

[0016] In the present device this actually allows obtaining an air flow with much higher volume with respect to the conventional air jet hand dryers, so that the times of dispensing and resistance power can be halved obtaining the same results in terms of drying, with considerable saving in terms of management of the system as well as of maintenance.

[0017] Preferably, the present hand dryer device has dimensions such to be positioned in a housing for hand dryers as the ones previously in use in the washrooms of train carriages. This not only allows installing the device in newly designed carriages but also the replacement of obsolete devices in carriages already provided with air jet hand dryers of the traditional type.

[0018] According to a preferred embodiment of the invention, the device also comprises a filter for filtering the impurities possibly present in the compressed air line, for instance a 5 μm, air filter and/or a filter 8 for filtering the air which enters into the device coming from the surrounding environment, which is preferably a filter of the "HEPA" (High Efficiency Particulate Air) type, or an analogous high efficiency filter such as for example a filter of the type with sintered bronze cartridge, or analogous high efficiency filter. Thus, the present device guarantees a high quality and hygiene of the air which is blown on the hands of the user.

[0019] By way of example, when supplied with a flow of compressed air at a 4 bar pressure for an air supply time of 30 seconds, conditions according to a preferred embodiment of the present invention, the performance of the present device is as follows:

air consumption: 105 Nlitres;
suctioned flow rate: 846 Nlitres; and
supplied flow rate: 948 Nlitres.

[0020] The pneumatic supply of the pneumatic amplifier 4 is advantageously controlled by a solenoid valve, preferably of 2/2 type at 230 Vac, through the electronic control unit. Such solenoid valve may be provided with a pressure switch for checking the presence of a minimum operating pressure of 2 bars.

[0021] According to a further embodiment of the present invention the supply of the pneumatic amplifier 4 with incoming air is controlled and regulated by a pneumatic circuit integrated in the body 1 of the device; in particular, such circuit is capable of controlling the pressure of the air entering the amplifier to determine the flow rate thereof and adjust it to the desired value, the same applies to the time of the drying cycle, typically comprised between 5 and 60 seconds. Also in this case, the integrated circuit may be provided with a pressure switch which controls the presence of a minimum operating pressure of 2 bars.

[0022] With particular reference to figure 5 there is schematically illustrated a pneumatic logic integrated circuit, in its positioning in the body 1 of the present device, to show the connection to the various parts which determine the functionalities of the device itself. In such embodiment, an air reservoir 9 serves as a timer element adjusting the operating cycle of the device thanks to the variation of the pressure of air contained therein, as better detailed hereinafter.

[0023] Still with particular reference to figure 5, an inlet fitting of the compressed air coming from the line inside the device is indicated with 101, while the discharge of the air, for example constituted by a pin discharge regulator, is indicated with 102. A series of valves connected to each other and to other elements in the device, guide the airflow inside the device: the compressed air entering the fitting 101 supplies the valve 103 which controls the valve 104 in closure and, after traversing the unidirectional valve 105, it pressurises the reservoir 9. The valve 106 is instead controlled by an external push-button, or by a photocell, actuatable by the user when intending to start a drying cycle.

[0024] When the present device is connected to the compressed air line there is no supply, the timing reservoir 9 is loaded and ready to start a drying cycle through the operation of the device. Through an external button a pneumatic signal is sent to the valve 106 which changes position and, thus, opens the valve 104 which starts to release the air of the reservoir 9 through the micrometric regulator 102; at the same time, from the valve 106 the pneumatic signal, after traversing a unidirectional valve 107 takes the valve 103 to the pressure of the air in the reservoir 9 and it is discharged through the discharge regulator 102. A constriction 108 is preferably introduced between the valve 103 and the regulator 102. The switching of the valve 103 takes the pneumatic signal to a re-

duction gear 109 which has the function of stabilising the signal at a predetermined value, typically about 4 bar, thus actuating the flow rate amplifier 4 which, suctioning air from the environment through the filter 8, dispenses it outside through the opening 3. The timing of the drying cycle in this particular embodiment, occurs through the adjustment of the discharge of the pressure contained in the reservoir 9, calibrated for example from a minimum value of 5 to a maximum value of 60 seconds, acting on the discharge adjustment screw 102: when the pressure of the reservoir drops below 1 bar there lacks the control on the valve 103 which, being repositioned, removes pressure from the amplifier 4 and at the same time also valves 104 and 106 are repositioned: the reservoir 9 is then pressurised once again awaiting a new cycle. The regulation of the flow rate through the reduction gear 109 and the timing of the cycle through the discharge regulator 102 are carried out only the first time during installation, or when it is intended to change parameters.

[0025] The resistance 5 comprised in the present device may be provided with at least one protection thermostat for limiting or interrupting the supply to the resistance when the internal temperature reaches a predetermined value beyond which the device could be damaged or the exiting air could harm the user. According to a particular embodiment of the present invention, the electrical resistance 5 is provided with two protection thermostats, typically a first thermostat intervenes when the temperature of the resistance reaches 70°C, generating a pre-alarm signal for the control exchange unit for limiting the power of the resistance; while a second thermostat, mounted in series on the resistance, intervenes when the temperature reaches 90°C thus directly interrupting the supply to the resistance. In general, the heat conditions obtained with the present device may be modulated according to the specific conditions due to the environment and use the device is intended for, thus acting on the control unit to suitably vary the supplied power.

[0026] The activation of the hot airflow may be obtained through any of the known systems in the conventional hand dryer devices, for example with a button actuatable by the user, preferably a pneumatic control button, or with a photocell which shall activate the flow of hot air only when the hands of the user end up positioned at the photocell. A timer shall instead allow the switching off of the hot air jet after a preset time of duration of operation, for example comprised between 5 and 60 seconds. According to a preferred embodiment of the present device, in the switching off step, after cutting out supply to the resistance, the unheated air jet is dispensed for another few seconds with the aim of dissipating the accumulated heat.

[0027] According to a further embodiment of the present invention, the hand dryer device may be designed for operating with cold air, thus without having the electrical resistance 5 described above therein, and the related protection thermostat, or another heating means. The body 1 of such device may however be connected, through the dispenser opening 3, to an external heating module, comprising for instance an electrical resistance as a heating means, said external module preferably provided with protection thermostat which intervenes cutting out the supply to the resistance when the temperature reaches a limit value, for example 70°C, so as to avoid damages to the user and/or to the device itself.

[0028] With reference to the attached figure 5, in such particular embodiment of the device of the invention, the integrated pneumatic circuit may be connected to the external heating module through an automatic socket 110 which moves the pneumatic signal to a pressure switch comprised in the module, calibrated to a determined pressure, typically at 2 bars; when the pressure in the reservoir 9 exceeds such value, the contact of the pressure switch is closed and the heating module heats the air while it is dispensed from the opening; on the other hand, when the pressure drops below this value, the contact of the pressure switch opens cutting out the heating module, which is impacted by cold air until the pressure in the reservoir 9 drops below a predetermined value, typically 1 bar.

[0029] This embodiment of the present device does not require an electronic control unit, as described above, to manage the amplifier and possible resistances, but it comprises an integrated pneumatic circuit instead, in particular the circuit described above and illustrated in figure 5. The dispensing of cold air from such embodiment of the device is possible without using any electric or electronic device for the control and operation of the device, managed solely with the pneumatic means. The only use of the electric circuit occurs when the aforementioned device is required to dispense hot air. In this case, the aforementioned heating module shall be connected to the electrical network through a suitable electrical cable with plug.

[0030] The present device can be wall-mounted in any space where the presence thereof is required, in a position adapted to perform the hand dryer function thereof, as it is or recessed in suitable containers from which the dispenser opening alone emerges.

[0031] Thus, device according to the invention attains the air jet hand dryer in a more economic, hygienic and practical manner with respect to the conventional devices.

[0032] An advantage of the present device lies in the capacity of maintaining the efficiency and initial operation capacity over time, without requiring any maintenance operation.

[0033] A further advantage lies in the lesser acoustic impact with respect to the air jet devices currently in use, which are extremely noisy and unsuitable for closed and narrow environments, such as washrooms of train carriages in particular.

[0034] Still, another advantage lies in the guarantee of the hygiene of the air that is blown on the hands of the users, due to the passage of the jet through filters adapted to remove possible impurities.

[0035] The invention is not generally limited to the aforementioned described and illustrated embodiment, but it comprises any further variants thereof.

Claims

1. A hand dryer device comprising a tubular body (1) comprising an inlet (2) for the air coming from a source of compressed air, and a dispenser opening (3) for the exit thereof, said body (1) comprising a flow rate pneumatic amplifier (4) fed by the compressed air coming from said inlet (2), said pneumatic amplifier (4) creating an agitated air flow (47) having a high volume and high speed, which is directed towards said dispenser opening (3) positioned downstream of said amplifier (4).

2. The device according to claim 1, wherein said flow rate pneumatic amplifier (4) is made of aluminium.

3. The device according to claim 1, further comprising, downstream of said flow rate amplifier (4), an electrical resistance (5) for heating the air jet exiting from the device.

4. The device according to claim 3, wherein said electrical resistance (5) is included in an external heating module, connected to the body (1) of the device through the dispenser opening (3).

5. The device according to claim 3, wherein said electrical resistance (5) is provided with at least one protection thermostat for limiting or interrupting the supply to said electrical resistance (5) when the internal temperature reaches a predetermined value beyond which the device could be damaged or the exiting air could harm the user.

6. The device according to any one of the preceding claims, further comprising a filter for filtering possible impurities present in the flow of compressed air entering the device coming from said source of compressed air.

7. The device according to any one of the preceding claims, further comprising a HEPA filter or a sintered bronze filter for filtering possible impurities in the air entering the device coming from the surrounding environment.

8. The device according to claim 1, wherein said pneumatic amplifier (4) has an amplification ratio between the agitated air and the consumed compressed air equal to about 8 to 1.

9. The device according to any one of the preceding claims, further comprising a button actuatable by the user or a photocell which activates the flow of hot air only in the moment wherein the hands of the user are positioned at the photocell.

10. The device according to any one of the preceding claims, further comprising a timer for stopping the airflow after a preset time of duration of the exit of the flow.

11. The device according to claim 3, wherein in the switching off step there is cut out the supply to said electrical resistance (5), continuing to dispense unheated air for a few seconds with the aim of dissipating the accumulated heat.

12. The device according to any one of the preceding claims, further comprising an electronic control unit which manages and controls the power of said amplifier (4) and possible resistances (5), and related thermostats.

13. The device according to any one of claims 1-11, further comprising a pneumatic circuit for the management and control of the power of said amplifier (4) and possible resistances (5) and related thermostats.

14. The device according to claim 13, wherein said pneumatic circuit comprises a fitting (101) for the inlet of the compressed air, a first valve (103) supplied by said fitting, a second valve (104) guided in closure by said first valve, a reservoir for the air (9), a third valve (106) controlled by an external actuation button or by a photocell, a reduction gear (109) and a discharge (102) for the exiting air, said third valve (106) being actuated through a pneumatic signal generated by the actuation of said external button or photocell, in turn opening said second valve (104) which discharges the air from said reservoir (9) through said discharge (102) and, simultaneously, moving said first valve (103) to the pressure in said reservoir (9) and moving the pneumatic signal to said reduction gear (109) where, when the signal reaches a predetermined value, actuates said flow rate amplifier (4) which suctions air from the environment and dispenses it to the outside through said dispenser opening (3).

15. The device according to any one of the preceding claims, for the use in the washrooms of train carriages, possibly after arranging in a special housing recessed in the walls or in a suitable container from which said dispenser opening (3) emerges.

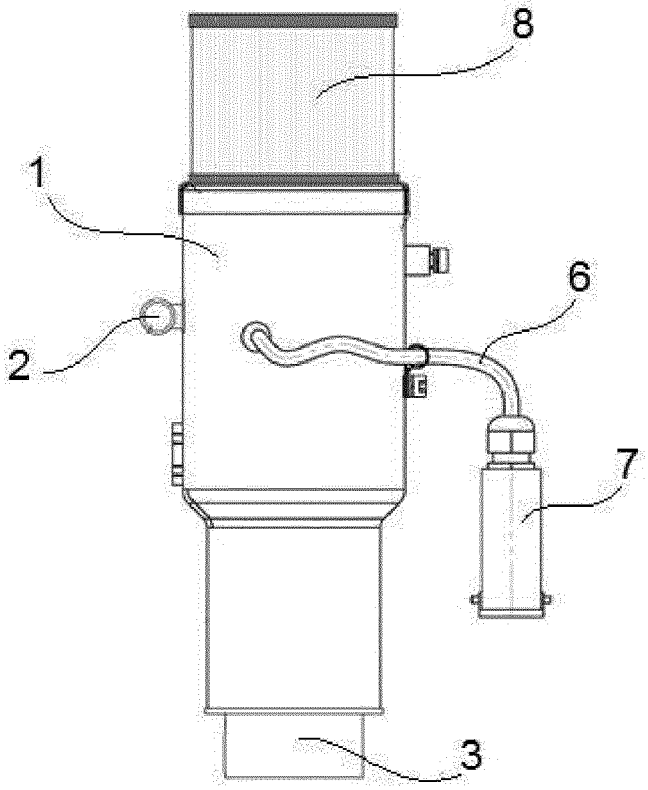

Fig. 1

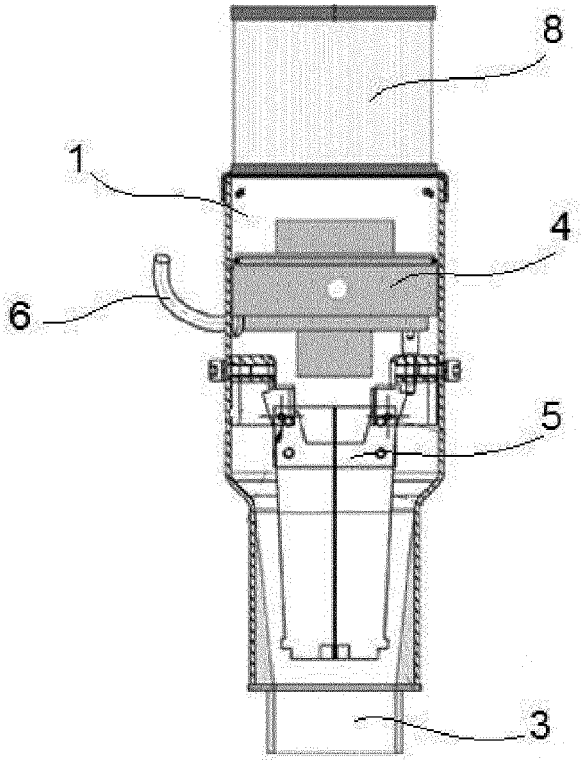

Fig. 2

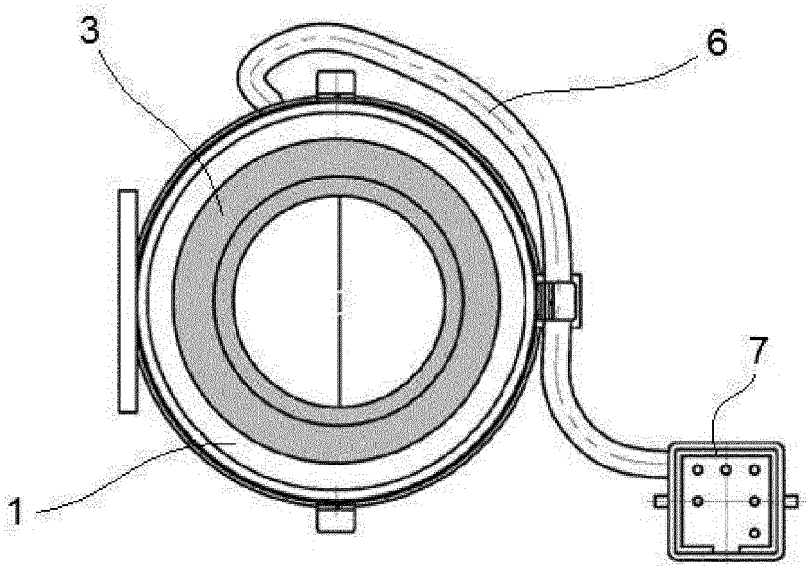

Fig. 3

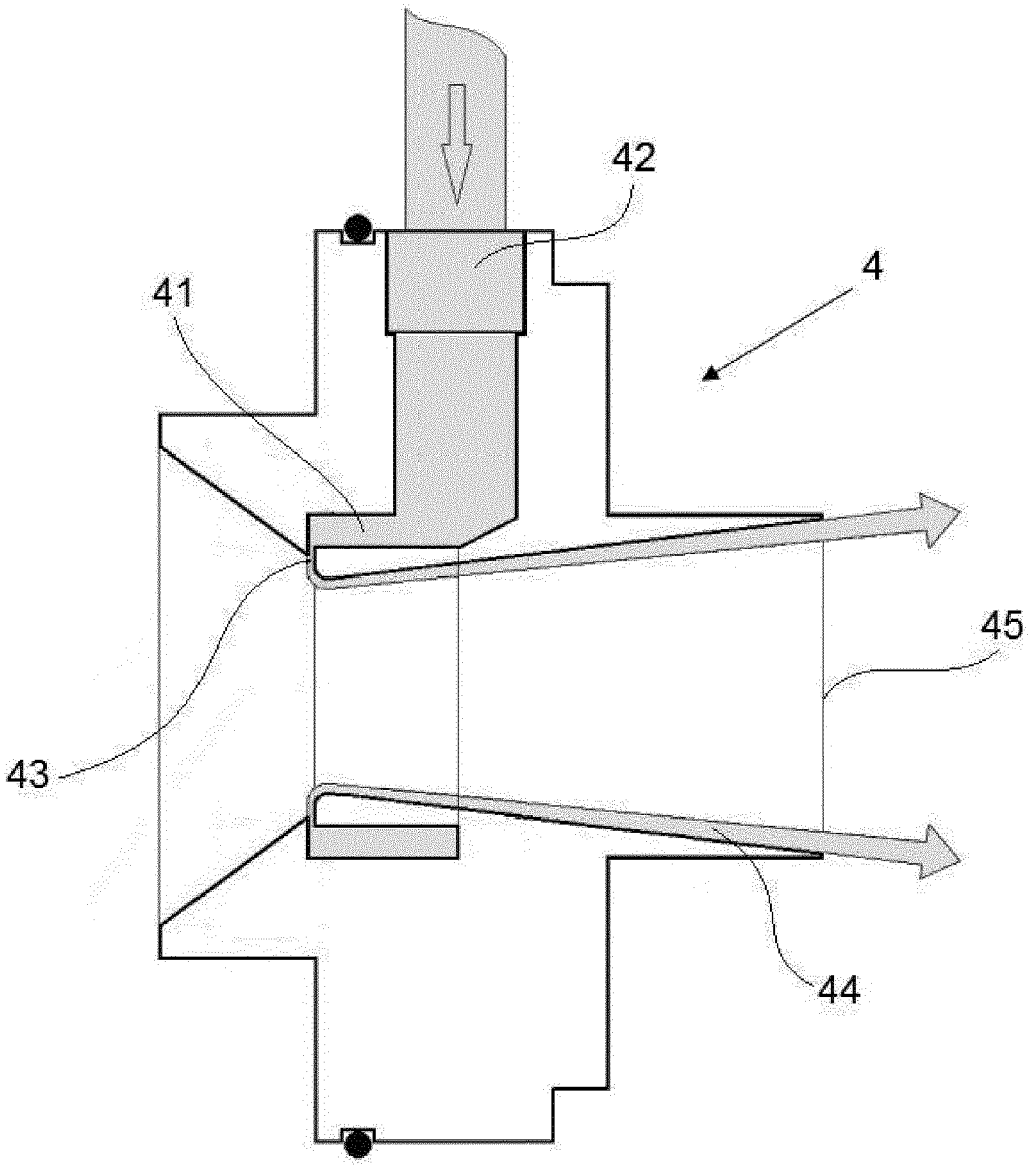

Fig. 4a

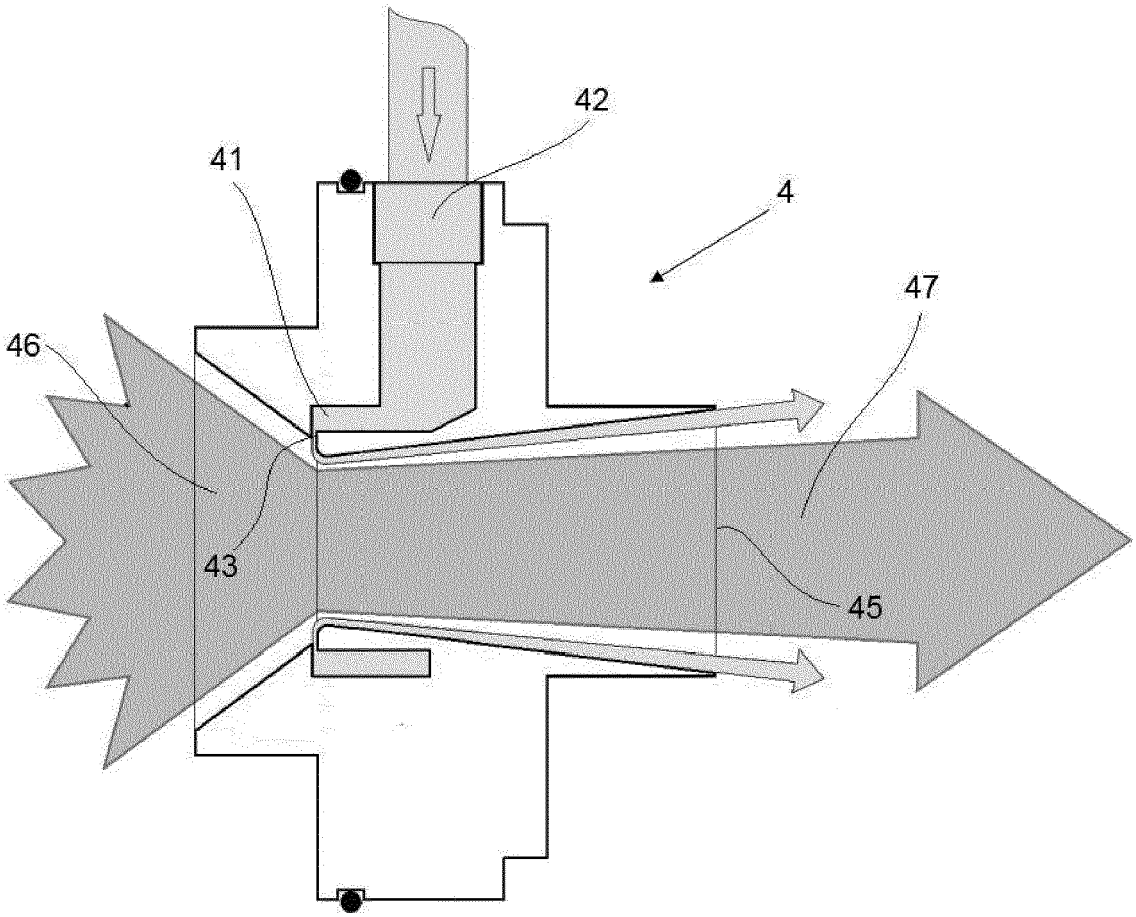

Fig. 4b

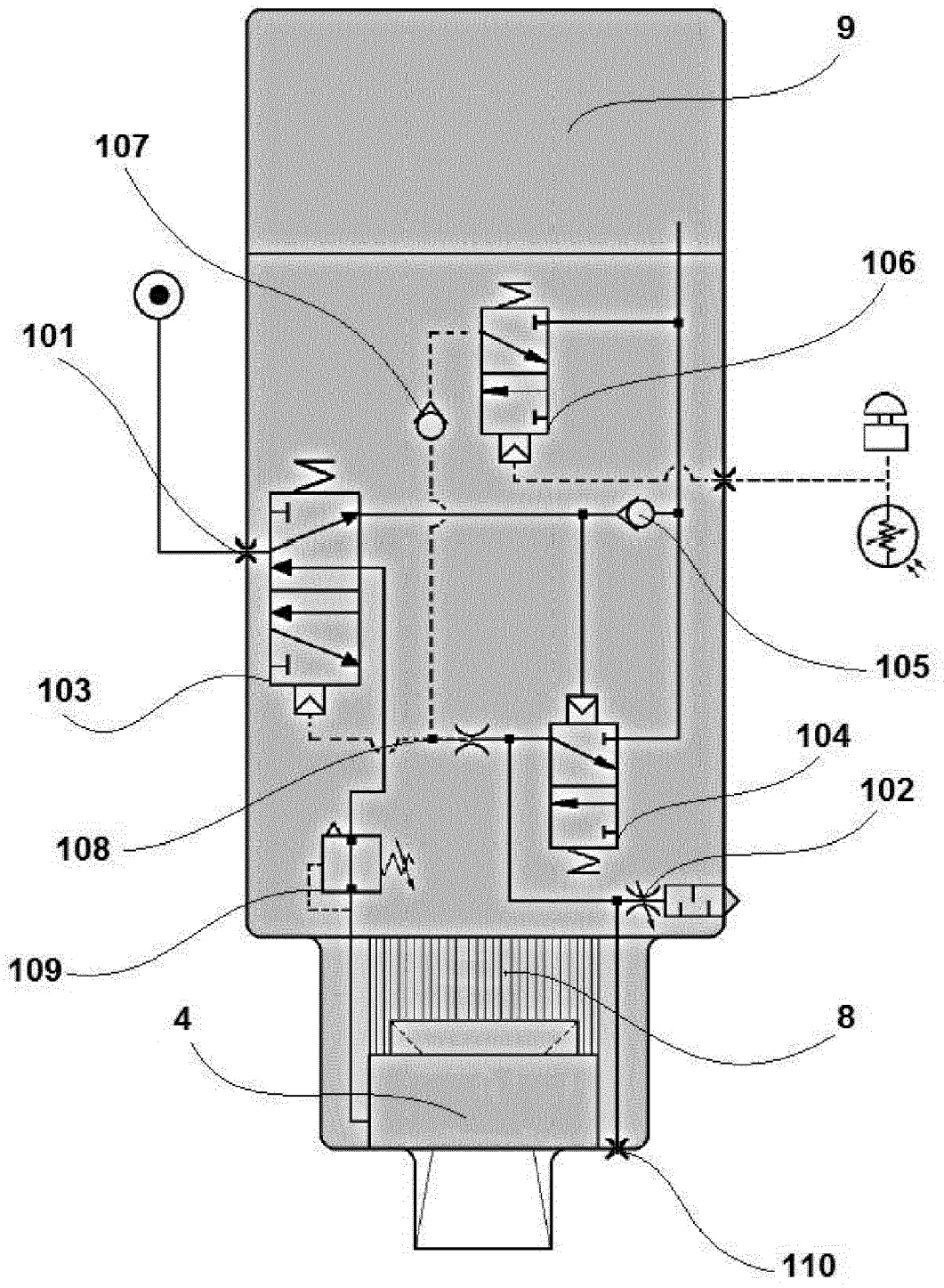

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 14 17 7890

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	13 November 2014	Fordham, Alan

CATEGORY OF CITED DOCUMENTS

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