

Air Cleaning Device

The invention concerns an air cleaning device with means for introduction, cleaning and distribution of external air into
5 at least one closed room, in particular secure and/or protected rooms. The invention also refers to a process for operation of the air cleaning device.

A device of this type is known for example from DE,A1
10 4215773. The device described there consists of a substantially cylindrical element which can hold a filter or a filter unit, and two end closing covers of the cylindrical element, each of which contains an adapter for connection of the device to the air inlet and outlet side. In addition, a
15 cyclone filter is permanently mounted in the closing lid on the air inlet side to filter out coarse dust.

A filter unit which can be used in the device described above is known from DE,A1 3841895. The filter unit is
20 preferably cylindrical and consists of individual filters inserted inside each other which together guarantee protection against atomic, biological and chemical (ABC) substances. In order to operate the device, a fan is used which is flanged onto the outside. To construct a
25 ventilation system for protected rooms from the components stated above, it must be ensured in a complex manner that all components are matched to each other both constructionally and with regard to their functional parameters.

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Trial runs of a ventilation system, which must be performed regularly, test the function of all components concerned and the adequate seal of the rooms. Proof must be supplied that the prescribed room pressure is achieved. The active
35 charcoal filter must be stored outside the system so that it is not moistened prematurely and the ageing process triggered.

DE,C1 3521536 discloses a room filter unit in which the filter and a pipe piece are connected together in a "piggyback" arrangement so that on trial runs of the ventilation system the pipe piece serves as a bypass for the
5 filter, but when required the filter is always stored in the vicinity of its area of use. The disadvantage of this arrangement is that in case of need, both filter and bypass must be moved for adaptation and that the connection points for the air inlet and outlet must be opened and resealed,
10 which often leads to leakage.

The task of the invention is to create an air cleaning device of the type described initially, and a process for its operation, without having to match a multiplicity of
15 individual components to each other before commissioning, and also to reduce greatly the risk of leakages in the machine caused by the multiplicity of adapters and seals. The unprotected penetration of external air should not be possible even with rooms which are not sealed and/or in
20 windy weather. The filter unit must also be protected against ageing and mechanical damage while stored in the vicinity of the area of use so that in case of need, even after many years of storage, it is ready for use immediately on the machine without conversion.

25 With reference to the device, the task is solved in that an air cleaning device formed as an autonomous installation unit with an airtight housing, an air inlet connector for the air to be cleaned and an outlet connector, contains a
30 fan, at least one unused and airtight-packed air filter unit and an integral bypass for the filter unit(s). Special and further design forms of the air cleaning device are the subject of the dependent claims.

35 The omission of the adapter and connector pieces between the components in the air cleaning device greatly reduces the risk of leakages.

The filter unit preferably consists of a coarse dust filter, a high efficiency submicron particulate filter and one or more active charcoal filters which are arranged in succession in this order and through which in this order
5 flows the air to be cleaned. The active charcoal filter can be filled with impregnated active charcoal which gives specific protection against weapons, or with active charcoal which adsorbs the radionuclide mixture contained in the air in the event of a nuclear accident. Together they guarantee
10 protection against ABC substances or nuclear power station accidents.

The filter unit according to the invention is stored in the housing of the air cleaning device with the active charcoal
15 filter and thus protected by the housing wall against mechanical damage and the effects of light. An airtight packing for the filter unit, preferably achieved by welding into a multilayer foil, ensures that the filter unit will remain fully functional even after many years of storage. In
20 particular an active charcoal filter would without such packing age prematurely just by storage. The advantage of this type of packing is the omission of any additional mechanical protection as the wall of the air cleaning device itself gives protection, and in case of need mere removal
25 from the foil is required, without removing and thus constituting a risk of damage to any screw or plug connections together with the sealing material.

The packed filter unit is suitably stored in the air
30 cleaning device so that on trial runs, the incoming air first flows through a chamber in the air cleaning device, the functional bypass, then meets the packed filter unit and flows around this and finally enters the fan.

35 In case of need, the unpacked filter unit is placed directly under the inlet connector in the said hollow chamber and pressed against a seal such that the incoming air must flow

through the filter unit. This concept avoids complex measures for exchange of filter and bypass.

5 The gas-tight housing of the air cleaning device is preferably formed in two parts. By opening quick closures, the packed filter unit and hollow chamber are easily accessible. This allows rapid use of the filter unit when required.

10 In a variant according to the invention, the said chamber in the air cleaning device is designed sufficiently large that a further filter unit can be inserted there in addition to the filter unit stored in the air cleaning device. The
15 filter is preferably a dust and/or submicron particulate filter, e.g. a pollen filter. In this configuration, the air cleaning device can in normal operation blow fresh air free from dust, submicron particulates and also pollen into the room where allergic persons can remain without problems. The air cleaning device is not affected by this in its function
20 as an installation unit of a ventilation system for protected areas in extraordinary conditions. The two-part formation of the housing fitted with quick closures allows easy access to both filter units which can be exchanged at any time. As a variant in case of need, the additional
25 filter unit can also be removed fully and a required filter unit inserted in the chamber.

Preferably, immediately after the motorized and/or manual fan, still in the air cleaning device, is mounted a sound
30 insulator which reduces the fan noise of the air cleaning device. The insulation material is preferably glass or mineral wool but also sound-insulating foam. A sound damper substantially increases the comfort level in the room ventilated by the air cleaning device. This aspect is
35 particularly important on operation of the air cleaning device with a dust and/or high efficiency submicron particulate filter.

Application variants of a device according to the invention include the ventilation of several different rooms with the same air cleaning device. Here it is a great advantage that the air cleaning device can be connected to existing air conditioning assemblies simply via the inlet and outlet connectors and there is no need for adapter pieces or seals between individual integrated components in the air cleaning device. A very versatile use of the air cleaning device is thus possible.

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In a preferred design form of the air cleaning device, all integral components and the entire installation unit have an essentially axially symmetrical geometry.

- 15 In relation to the process for operation of the air cleaning device, the task is solved by the invention in that the cleaned air is constantly blown into the secure and/or protected room where, on generation of a constant slight excess pressure, it escapes through leaks in the secure rooms and/or a pressure relief valve in the protected rooms.

Secure rooms arranged above ground always have leaks. Therefore a constant slight excess pressure is of the same importance as in protected rooms of a higher constructional standard, where no external air may penetrate. This is achieved even with an excess pressure of a few Pascal (Pa), for example 20 to 200 Pa. Even wind gusts cannot penetrate this.

- 30 The invention is explained in more detail using the design examples shown in the drawings which are the subject of dependent claims. Here:

Fig. 1 shows a longitudinal section through a substantially cylindrical air cleaning device with a tightly closed filter unit,

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Fig. 2 shows a variant of Fig. 1 with an additional tightly closed filter unit, and

Fig. 3 shows a section A-A in Fig. 1.

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An air cleaning device 10 shown in Fig. 1 is formed substantially cylindrical and has a two-part housing 12. A substantially cup-shaped lid 14 can be attached below the housing by a quick closure 16. The air flowing through the
10 air cleaning device 10 is indicated by arrows U.

The air cleaning device is equipped, in the area of the air inlet opening 18, also known as the inlet connector, with a sealing cap 20 and a quick closing coupling 21. The sealing
15 cap 20 can be lead-sealed. A corresponding system can also be provided at the air outlet. Evidently the sealing cap 20 must be removed before commissioning otherwise the air cannot flow through, as shown in Fig. 1.

20 In a cylindrical peripheral recess 22 is inserted a seal 24, in the present case an O-ring.

Coaxial to the longitudinal axis L of the housing 12 is arranged a two-part first filter unit 26 in the direction of
25 air flow. This filter unit 26 essentially comprises an internal cup-shaped coarse dust filter 28 and an external cylinder-casing shaped high efficiency submicron particulate filter 30, e.g. a dust and/or pollen filter. The filter parts 28, 30 are retained by an upper and a lower plate 32,
30 34. The lower plate 34 is supported on a plate 36 or at least three radial braces which are suspended via a clamping device 38 and bracket 40 on lid 14 of housing 12. The upper plate 32 is pressed against seal 24 in the area of the coarse dust filter 28.

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In the centre part of the housing 12 is arranged a second filter unit 42 formed in three parts. In addition to the coarse dust filter 28 and submicron particulate filter 30 it

contains a peripheral active charcoal filter 44, also coaxial to the longitudinal axis L and also retained by upper and lower plates 32, 34.

- 5 The entire second filter unit, visible in Fig. 1 only in the area of the inlet opening of the coarse dust filter 28, is packed airtight with a foil 48. In the present case, this foil 48 is shrunk on and therefore follows the outer contours of the three-part filter unit 42.

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In the lowest area of the housing 12 of the air cleaning device 10 is shown a fan unit 50 which is attached via a supporting plate 52 to housing 12. The filter chamber of the housing is closed underneath by a disc-like guide plate 54
15 which has an inlet nozzle 56 running axially with a fan impeller 58 connected to this. This is driven by an electric motor 60.

The sound damper 62 indicated on the left side with a
20 peripheral air duct 64 is explained in more detail in Fig. 3.

When the fan wheel 58 is running, dirty and/or contaminated air from the outside is drawn into the air inlet connector
25 18 as shown by arrows U. The upper plate 32 lying on the seal 24 forces the incoming air firstly through the coarse dust filter 28 and then, with the help of the lower plate 34, also through the high efficiency submicron particulate filter 30 of the first filter unit 26. Depending on the
30 structure of the plate 36, the air cleaned of its mechanical particulates flows about or through this to the second filter unit 42 with an airtight packing. Here it flows through an annular bypass 66 which is not a construction element. Finally the air flows through the inlet nozzle 56
35 to the fan impeller 58 which transports the air to the outside via the peripheral air duct 64.

If the air is not cleaned by the first filter unit 26, the clamping devices 38 are released so that a further bypass is created in the area of the seals 24.

5 A variant of the air cleaning device 10 in Fig. 2 corresponds to that shown in Fig. 1 with the following changes:

- 10 - there is no two-part first filter unit 26. Instead there is an airtight-packed second filter unit 42 with an active charcoal filter 44 for use against chemical weapons.
- 15 - a further second filter unit 42' arranged in the direction of flow has an active charcoal filter 44' against any nuclear accident. The coarse dust filter 28 and the submicron particulate filter 30 are formed in the same way in both second filter units 42 and 42'.
- 20 - the fan impeller 58 can be operated electrically or optionally by a hand crank 68 via a gear 70. Thus the air cleaning device 10 remains functioning even in the event of a power failure, the necessary pressure in the room can be generated manually. Thus the penetration of
- 25 contaminants into the occupied room can be prevented independently of a power supply.

As in Fig. 1, the air to be cleaned is drawn in via the air inlet connector. Because of the two second filter units 42, 30 42' packed airtight with a foil 48, the air drawn in is deflected between the seal 24 and the upper plate 32 in the peripheral area and there forms a functional bypass along the filter unit. It must be noted that in this variant, the air penetrates uncleaned. In a corresponding extension to 35 the housing, a lid 14 as in Fig. 1 can be used, fitted with a two-part first filter unit 26 with a coarse dust filter 28 and a submicron particulate filter 30 through which the air flows.

Depending on the incident, according to the design form in Fig. 2 the one and/or the other second filter unit 42, 42' can be removed from the protective foil 48 and actively used. Evidently the top plate 32 must be pressed against the seal 22 on the upper filter.

Fig. 1 and 2 show an essential advantage of the invention. The second filter unit 42, 42' used in serious cases need merely be removed from the protective foil 48 and is ready to use with safety. Storage outside the air cleaning device is not necessary. The filter units are therefore accessible immediately and fully functioning.

Fig. 3 shows a radial section at the height of the fan impeller 58. The ejected air flow U is guided via the peripheral air duct 64 to a side outlet connector 72 for the cleaned air. This duct 64 is bordered on the outside by the housing wall 12 and on the inside by the essentially tongue-shaped sound damper 62. At the inlet to the air duct 64 is fitted an air quantity control valve 74. After the air quantity control valve 74 in the direction of the air flow U is fitted an air quantity meter 76. In this area the air flow U is practically laminar and can be adjusted manually or by process control by activation of valve 74. The arrangement in Fig. 3 has the advantage that the noise from the air quantity control valve 74 and air quantity meter 76 is reduced in the subsequent sound damper 62.

The sound damper tongue 62 is bordered against the air duct 64 by a perforated sheet or net 78 which retains the insulation material of the sound damper 62. The sound damper tongue 62 can be made of sound-absorption material or fibre-free foam.

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The unit is connected to existing air conditioning assemblies via the side outlet connector 72, where this

outlet connector can form the opening through which a room is ventilated.

It has already been stated and is emphasised again that the
5 air cleaning device 10 according to the invention (Fig. 1, 2) has a fixed integral air inlet connector 18 (Figs. 1, 2) for the external air and a side outlet connector 72 for the cleaned air. Otherwise no adapters or seals are required, which constitutes an inestimable advantage for the air
10 cleaning device according to the invention.



CLAIMS

1. Air cleaning device (10) with means for the introduction, cleaning and distribution of external air into at least one closed room, in particular secure and/or protected rooms, characterized in that
an air cleaning device (10) formed as an autonomous installation unit with an airtight housing (12), an air inlet connector (18) for the air to be cleaned and an outlet connector (72), contains a fan (58), at least one unused and airtight-packed filter unit (42, 42') and an integral bypass (46) for the filter unit(s) (42, 42').
2. Air cleaning device (10) according to claim 1, characterized in that in that the second filter unit (42, 42') is formed as a multistage compact ABC filter which preferably comprises a coarse dust filter (28), a high efficiency submicron particulate filter (30) and at least one active charcoal filter (44, 44').
3. Air cleaning device (10) according to claim 2, characterized in that the individual filters (28, 30, 44, 44') are inserted inside each other cylindrically in the compact filter and preferably arranged with the coarse dust filter (28) on the inside, the submicron particulate filter (30) in the centre and the active charcoal filter(s) (44, 44') on the outside.
4. Air cleaning device (10) according to any of claims 1 to 3, characterized in that unused second filter units (42, 42') stored in the device are welded into a foil (48), preferably a multilayer foil (48).
5. Air cleaning device (10) according to any of claims 1 to 4, characterized in that installed in the device ready for operation is a second filter unit (26),



preferably a high efficiency submicron particulate filter (30) selected according to the personal requirements of the user, where at least one second filter unit (42) remains stored in the air cleaning device (10), packed airtight in foil (48).

6. Air cleaning device (10) according to any of claims 1 to 5, characterized in that the housing (12) is formed in two parts, where the lid (14) with a first filter unit (26) or a second filter unit (42) can be raised after releasing the quick closures (16).
7. Air cleaning device (10) according to any of claims 1 to 6, characterized in that connected after the integral fan impeller (58) is a similarly integral sound damper (62).
8. Air cleaning device (10) according to claim 7, characterized in that the sound damper (62) is formed as a tongue and forms a peripheral air duct (64) which leads to a side outlet connector (72).
9. Air cleaning device (10) according to claim 8, characterized in that installed in the peripheral air duct (64) is an air quantity control valve (74) and/or an air quantity meter (76) arranged at a distance from this in the direction of the air flow.
10. Process for operation of an air cleaning device (10) according to any of claims 1 to 9, characterized in that the cleaned air is constantly blown into the secure and/or protected room where, under generation of a constant slight excess pressure, it escapes through leaks in the secure rooms and/or a pressure relief valve in the protected rooms.