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(54) **VENTILATION CONTROL SYSTEM**

(57) A ventilation system and a ventilation control system, comprising a central unit (1) configured to transmit signals to and receive signals from a ventilation device (3), a user interface unit (2) communicatively connected to the central unit (1), wherein the central unit (1) is configured to cause i) the ventilation device (3) to initiate ventilation in response to receiving a first user input via the user interface unit (2), ii) the ventilation device (3) to initiate smoke removal after a predetermined time from initiating the ventilation in response to receiving said first user input if the ventilation is functional, and iii) the ventilation device (3) to initiate smoke removal in response to receiving a second user input via the user interface unit (2) if the ventilation is dysfunctional.

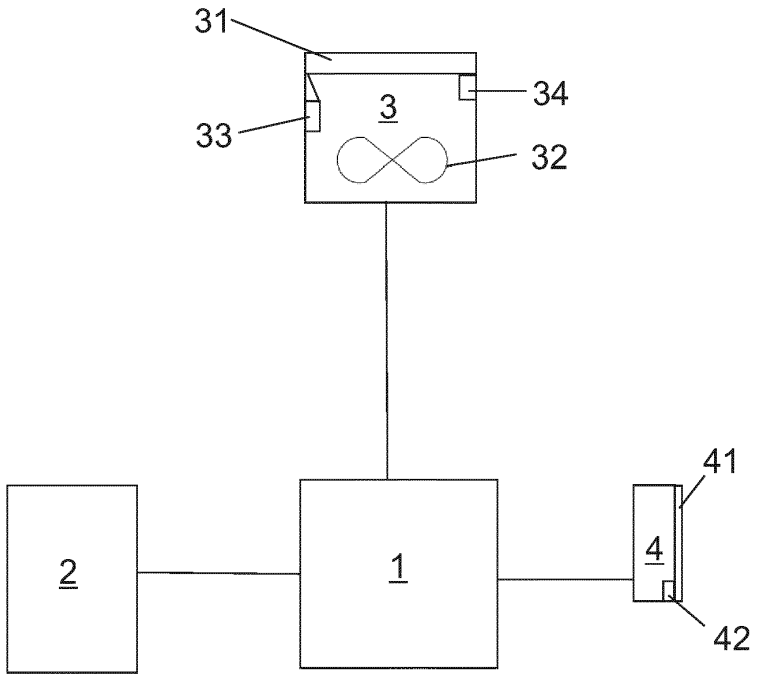

Figure 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to a ventilation control system and a ventilation system, and more particularly to systems for ventilation and extracting smoke in a building.

BACKGROUND

[0002] Ventilation and smoke removal devices have become a part of mandatory installations in residential, commercial and industrial buildings. They alert occupants, provide additional evacuation time, prevent smoke inhalation, and permit firefighters to find trapped individuals more easily and safely.

[0003] The ventilation and smoke removal are typically executed in two separate phases: first initiating the ventilation by opening the air channel or exhaust vent from the building to outside, and second initiating the smoke removal by turning on fans connected to the air channel.

[0004] In case a real fire occurs, periodic tests must be performed to the systems in order to ensure they are functional. Prior ventilation systems provide a manual switch which can initiate the ventilation and smoke removal process. However, these systems only indicate if the smoke removal is active but does not monitor the state of ventilation.

[0005] If the ventilation is disabled or not functioning properly, the system does not initiate smoke removal. If this happens during a real fire, the firefighters have no other means to turn on the smoke removal which could be a critical disadvantage.

BRIEF DESCRIPTION

[0006] An object of the present invention is to provide a solution for detecting dysfunctions of the system and to force smoke removal initiation to alleviate the above problems.

[0007] This is achieved with a ventilation control system comprising a user interface unit communicatively connected to a central unit, wherein the central unit is configured to cause the ventilation device to initiate smoke removal even if the exhaust vent is disabled i.e., the ventilation is not active.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] In the following the invention will be described in greater detail by means of preferred embodiments with reference to the attached drawings, in which

Figure 1 shows a schematic diagram of a ventilation system,

Figure 2 shows schematic view of a user interface unit according to an embodiment.

DETAILED DESCRIPTION

[0009] The present invention pertains to a ventilation control system and a ventilation system comprising said ventilation control system. Figure 1 shows a schematic diagram of a ventilation system, and Figure 2 shows a schematic view of a user interface unit according to an embodiment.

[0010] The ventilation control system comprises a central unit 1 and a user interface unit 2 communicatively connected to the central unit 1, for instance with a wire or wirelessly. The central unit 1 is configured to transmit signals to and receive signals from at least one ventilation device 3. The central unit 1 may be further configured to transmit to and receive signals from at least one exchange air provider 4. The exchange air provider 4 is arranged to provide replacement air from outside into a building.

[0011] The user interface unit 2 is a device which allows the user to interact with the system, including by receiving visual information, obtaining visual information and introducing control commands.

[0012] The central unit 1 may be located together with the user interface unit 2 or separated from the user interface unit 2. The central unit 1 is connected to a power supply and comprises a memory and a controller.

[0013] The memory may be implemented using any suitable data storage technology, such as semiconductor-based memory devices, flash memory, magnetic memory devices and systems, optical memory devices and systems, fixed memory, and removable memory.

[0014] The controller controls operation of the system. All configuration regarding the user interface unit and the ventilation device may be configured in the controller. The controller may comprise one or more communication circuitry, such as at least one processor, including one or more algorithms, such as a computer program code where the memory and the computer program code are configured, with the at least one processor, to cause the controller to carry out any one of the exemplified functionalities described hereinafter.

[0015] The central unit 1 is configured to cause the ventilation device 3 to initiate ventilation in response to receiving a first user input via the user interface unit 2. The first user input refers to the user giving a first command to turn on the ventilation device 3 by initiating the ventilation. The term "ventilation" in this context refers to opening an air channel, exhaust vent or outlet 31, which may locate for instance on a roof of a building or inside the building. In an embodiment, the central unit 1 is further configured to cause the exchange air provider 4 to initiate replacement air intake, for example by opening the inlet vent 41, in response to receiving the first user input via the user interface unit 2.

[0016] The central unit 1 is configured to cause the ventilation device 3 to initiate smoke removal after a predetermined time from initiating the ventilation in response to receiving said first user input if the ventilation is func-

tional. The predetermined time can be for instance 30 seconds. The term "smoke removal" in this context refers to extraction of heat and smoke from a burning building by an extractor 32, for instance by mechanical means such as a fan. The extractor 32 may locate close to the outlet 31 or inside the building's air channel. In an embodiment, the central unit 1 is configured to hold the initiation of the smoke removal until an exchange air threshold is reached.

[0017] The central unit 1 is further configured to cause the ventilation device 3 to initiate smoke removal in response to receiving a second user input via the user interface unit 2 if the ventilation is dysfunctional. The second user input refers to the user giving a second command to bypass the first command and to activate the smoke removal even if the ventilation is disabled.

[0018] The central unit 1 can be further configured to cause smoke removal in response to receiving a third user input via the user interface unit 2 if the exchange air threshold is not reached. The third user input refers to the user giving a third command to initiate smoke removal even if the exchange air threshold's status is not available or below the threshold. The threshold may refer to a flow rate of the replacement air or an opened or closed status of an inlet vent 41, for example.

[0019] Additionally, the central unit 1 may be configured to cause the user interface unit 2 to indicate activation of the ventilation via an activation indicator 23-1, and to cause the user interface unit to indicate smoke removal via a smoke removal indicator 23-2. The activation indicator 23-1 can be a light source, such as a lamp or a light-emitting diode (LED). The activation indicator 23-1 can be for instance a light source emitting discontinuous, such as blinking, green light. The smoke removal indicator 23-2 can be for instance a light source, such as a lamp or a LED, which can be same or different light source as utilized in the activation indicator 23-1. The smoke removal indicator 23-2 can be for instance a light source emitting continuous green light.

[0020] In an embodiment, the smoke removal indicator 23-2 and the activation indicator 23-1 may utilize a same first light source. When the first user input is received and the activation indicator 23-1 turned on, the activation indicator 23-1 changes to the smoke removal indicator 23-2 after the predetermined time is passed, which is from discontinuous light to continuous light. In yet another embodiment, the smoke removal indicator 23-2 and the activation indicator 23-1 may utilize different light sources and/or having different colours.

[0021] However, other activation indicators and smoke removal indicators may be implemented such as a sound source and/or a text or sign displayed on a screen of the user interface unit 2.

[0022] The central unit 1 may be further configured to cause the user interface unit 2 to indicate initiation of ventilation via a ventilation activation indicator 24-1, and to cause the user interface unit 2 to indicate successful ventilation via a ventilation indicator 24-2. The initiation of ventilation refers to opening the outlet 31. The successful ventilation refers to completely open outlet 31 of the ventilation device 3.

[0023] The ventilation activation indicator 24-1 can be a light source, different from the one in activation indicator 23-1 and/or smoke removal indicator 23-2, such as a lamp or LED. The ventilation activation indicator 24-1 can be for instance a light source emitting discontinuous white light. The ventilation indicator 24-2 can be for instance a light source, such as a lamp or LED, which can be same or different light source as utilized in the ventilation activation indicator 24-1. The ventilation indicator 24-2 can be for instance a light source emitting continuous white light.

[0024] In an embodiment, the ventilation indicator 24-2 and the ventilation activation indicator 24-1 may utilize a same second light source. When the first user input is received, the ventilation activation indicator 24-1 is turned on and emitting discontinuous light. After the outlet 31 is completely open, the ventilation activation indicator 24-1 changes to the ventilation indicator 24-2 which is from the discontinuous light to the continuous light. In yet another embodiment, the ventilation indicator 24-2 and the ventilation activation indicator 24-1 may utilize different light sources and/or having different colours. However, other ventilation activation indicators and ventilation indicators may be implemented such as a sound source and/or a text or sign displayed on a screen of the user interface unit 2.

[0025] In an embodiment, the first user input can be caused by activating a switch 21. The switch 21 can refer to a mechanical switch, such as a toggle switch, a rotary switch, or a push button, to turn ON and OFF the ventilation control system. However, in some implementations, the switch 21 can also refer to an electrical switch or an icon on a touch screen.

[0026] In an embodiment, the second user input can be caused by activating a bypass activator 22. The bypass activator 22 can refer to a mechanical switch, such as a toggle switch, a rotary switch, or a push button, to turn ON and OFF the smoke removal. However, in some implementations, the bypass activator 22 can also refer to an electrical switch or an icon on a touch screen.

[0027] In an embodiment, the third user input can be caused by activating an exchange air status acceptor 27. The exchange air status acceptor 27 can refer to a mechanical switch, such as a toggle switch, a rotary switch, or a push button, to acknowledge and accept the state of the exchange air provider 4. However, in some implementations, the exchange air status acceptor 27 can also refer to an electrical switch or an icon on a touch screen.

[0028] In yet another embodiment, the first user input and the second user input can be caused by other means such as voice commands, or remotely received signals sent from a transmitter, or sensors, for instance.

[0029] The central unit 1 may be further configured to cause the user interface unit 2 to indicate ventilation dysfunction via a ventilation dysfunction indicator 25-1. The

ventilation dysfunction may occur, for instance, when an opening of the ventilation device 3 is unable to open or blocked. The ventilation dysfunction indicator 25-1 can be a light source, different from the one in activation indicator 23-1 and/or smoke removal indicator 23-2 and/or ventilation activation indicator 24-1 and/or ventilation indicator 24-2, such as a lamp or LED. The ventilation dysfunction indicator 25-1 can be for instance a light source emitting discontinuous red light.

[0030] In an embodiment, the second user input is configured to initiate bypass activation, and the central unit 1 is further configured to cause the user interface unit 2 to indicate the bypass activation via a bypass activation indicator 25-2. The bypass activation indicator 25-2 can be for instance a light source, such as a lamp or LED, which can be same or different light source as utilized in the ventilation dysfunction indicator 25-1. The bypass activation indicator 25-2 can be for instance a light source emitting continuous red light.

[0031] In an embodiment, the ventilation dysfunction indicator 25-1 and the bypass activation indicator 25-2 may utilize a same third light source. When the first user input is received, and the ventilation is unable to turn on, after a predetermined time, such as 0 to 60 seconds, for instance 30 seconds, the ventilation dysfunction indicator turns on. The user may then give a command to the second user input, wherein the ventilation dysfunction indicator 25-1 changes to the bypass activation indicator 25-2 which is from the discontinuous light to the continuous light. In yet another embodiment, the ventilation dysfunction indicator 25-1 and the bypass activation indicator 25-2 may utilize different light sources and/or having different colours.

[0032] However, other ventilation dysfunction indicators and bypass activation indicators may be implemented such as a sound source and/or a text or sign displayed on a screen of the user interface unit 2.

[0033] The central unit 1 may be further configured to cause the user interface unit 2 to indicate state of exchange air provider 4 via an exchange air indicator 28-1. The exchange air indicator 28-1 can be a light source, different from the ones mentioned above, such as a lamp or LED. The exchange air indicator 28-1 can be for instance a light source emitting discontinuous white light.

[0034] The central unit 1 may be further configured to cause the user interface unit 2 to indicate reaching exchange air threshold via an exchange air threshold indicator 28-2. The exchange air threshold can refer to a predetermined limit or value which can be for example half-open or completely open inlet vent 41 of the exchange air provider 4. The limit or value can be detected using a radar, for example. The exchange air threshold indicator 28-2 can be for instance a light source, such as a lamp or LED, which can be same or different light source as utilized in the exchange air indicator 28-1. The exchange air threshold indicator 28-2 can be for instance a light source emitting continuous white light.

[0035] In an embodiment, a third user input is configured to acknowledge and accept the exchange air status, and the central unit 1 is further configured to cause the user interface unit 2 to indicate the acknowledgement via the exchange air threshold indicator 28-2. When the third user input is received, the central unit 1 can be further configured to initiate smoke removal of the ventilation device 3. If the third user input is not received, the smoke removal is not initiated unless the second user input is received which activates the bypass process.

[0036] In an embodiment, the exchange air indicator 28-1 and the exchange air threshold indicator 28-2 may utilize a same fourth light source. When the first user input is received, and the exchange air threshold is not reached or unavailable after a predetermined time, for instance 30 seconds, the exchange air indicator 28-1 turns on. The user may check the physical status of the exchange air provider 4 and then give a command to the third user input, wherein the exchange air indicator 28-1 changes to the exchange air threshold indicator 28-2 which is from the discontinuous white light to the continuous white light. In yet another embodiment, the exchange air indicator 28-1 and the exchange air threshold indicator 28-2 may utilize different light sources and/or having different colours.

[0037] However, other exchange air indicators and exchange air threshold indicators may be implemented such as a sound source and/or a text or sign displayed on a screen of the user interface unit 2.

[0038] The central unit 1 may be further configured to cause the user interface unit 2 to indicate disturbance in the system via a disruption indicator 26. A disruption may occur when there is overcurrent in the system or fuse discharge or if the outlet 31 is stuck between the closed and completely open state. The overcurrent may be caused when a larger than intended electric current exists through a conductor, which leads to excessive generation of heat and increased risk of fire or damage to the system equipment. The fuse provides overcurrent protection The disruption indicator 26 may also indicate if any of the safety switches is in wrong position. The disruption indicator 26 may also indicate if the smoke removal is dysfunctional. The disruption indicator 26 is preferably a fifth light source emitting discontinuous red light.

[0039] However, other disruption indicators may be implemented such as a sound source and/or a text or sign displayed on a screen of the user interface unit 2.

[0040] As seen in Figure 1, the ventilation system comprises a ventilation control system and at least one ventilation device 3 for ventilation and smoke removal, and at least one exchange air provider 4.

[0041] The ventilation device 3 may comprise an openable and closable exhaust vent or outlet 31, such as a hatch, for enabling the ventilation and the extractor 32, such as a fan powered by an electric motor, for creating a flow of air to remove the smoke. The outlet 31 can be opened by an actuator 33, such as a powered hatch opener with a spindle motor for enabling the outlet 31 to

open even if there is snow on top. The ventilation device 3 may also comprise a mechanical opening mechanism for the maintenance worker to open the outlet 31 for inspection or maintenance.

[0042] The outlet 31 is preferably located outside a building at an end of an air or ventilation channel and the extractor 32 is preferably located inside the air channel next to the outlet 31 or inside the building connected to the air channel. The ventilation device 3 can be comprised of two separate parts, the outlet 31 and the extractor 32, or the ventilation device can be one integrated body comprising both the outlet 31 and the extractor 32.

[0043] The ventilation device 3 may comprise a sensor 34, for instance a radar sensor, configured to detect if the outlet 31 is in an open state or in a closed state. The ventilation device 3 may be configured to transmit a signal to the user interface unit 2 via the central unit 1 to indicate if the outlet 31 is in the open state or if the outlet 31 is in the closed state. In some embodiments, the ventilation device 3 may be configured to transmit a first signal to the user interface unit 2 to indicate the outlet 31 is opening or no longer closed, and to transmit a second signal to the user interface unit 2 to indicate the outlet 31 is completely open.

[0044] The exchange air provider 4 is typically a hatch or channel mounted on a wall or roof of the building and through which outside replacement air can flow inside the building. The exchange air provider 4 can comprise an openable and closable inlet vent 41 and an exchange air sensor 42, such as a roller limit switch or a magnetic switch configured to detect the state of the exchange air or the inlet vent 41. The exchange air sensor 42 may also be a signal received from an opening device of the inlet vent 41. The exchange air sensor 42 may also be configured to detect when the state of the exchange air or the inlet vent 41 has reached the threshold providing sufficient exchange air. In some embodiments, reaching the threshold may refer to opening the inlet vent 41. In some embodiments, the exchange air provider 4 may be configured to transmit a third signal to the user interface unit 2 to indicate threshold is not reached or the status of the exchange air is unavailable, and to transmit a fourth signal to the user interface unit 2 to indicate the exchange air threshold is reached. The exchange air provider 4 can further comprise a fan to facilitate the exchange and an actuator to open the inlet vent 41.

[0045] The ventilation system may further comprise a smoke detector and an alarm system with an audible alarm. The central unit 1 may be further configured to transmit a signal to a fire department when the smoke detector detects smoke. The ventilation system may further comprise a separate and/or rechargeable power supply, such as a battery, to provide electricity to the system in case of power blackouts.

[0046] In Figure 2, the switch 21 is illustrated as a physical button configured to activate ventilation by opening the hatch of the ventilation device 3, and after the predetermined time, activate the smoke removal by turning on the fan. In an exemplified normal testing situation, upon receiving the first user input by pushing or turning the switch 21, the activation indicator 23-1 emits discontinuous green light and the exchange air indicator 28-1 is off or emits discontinuous white light when the state of the exchange air is low or unavailable. When the threshold is reached, the exchange air indicator 28-1 changes to the exchange air threshold indicator 28-2 and emits continuous white light. After 30 seconds from the first user input the smoke removal activates, and the activation indicator 23-1 changes to the smoke removal indicator 23-2 and emits continuous green light. The ventilation activation indicator 24-1 emits discontinuous white light when the outlet 31 of the ventilation device 3 is opening and once the outlet 31 is fully open, the ventilation indicator 24-2 emits continuous white light. After 120 seconds from the first user input, opening the outlet 31 is stopped unless the outlet 31 has already reached the fully opened state. When the system is deactivated, by pushing the switch or turning the switch off, the activation indicator 23-1 and the smoke removal indicator 23-2 are not emitting any light, but the ventilation indicator 24-2 emits continuous white light until the hatch is in closed position. If the exchange air status is available, the exchange air indicator 28-1 and the exchange air threshold indicator 28-2 are not emitting any light after reaching below the threshold. If the exchange air status is unavailable, the exchange air indicator 28-1 is emitting light until the switch 21 is turned off.

[0047] In an exemplified dysfunction situation, where the bypass activator 22 is illustrated as a physical button, the outlet 31 is unable to open due to a dysfunction, the activation indicator 23-1 continues to emit discontinuous green light after the predetermined time (for example 30 seconds). The smoke removal is unable to activate because the ventilation is disabled. The ventilation indicator 24-2 does not emit any light. The ventilation dysfunction indicator 25-1 emits discontinuous red light. After the user activates the bypass activator 22, the smoke removal is activated and the smoke removal indicator 23-2 emits continuous green light. The ventilation activation indicator 24-1 and the ventilation indicator 24-2 are not emitting any light, but the bypass activation indicator 25-2 emits continuous red light. In this embodiment, the ventilation dysfunction indicator 25-1 and the bypass activation indicator 25-2 may be a light source surrounding the bypass activator 22. When the system is deactivated, none of the indicators emit any light.

[0048] The object of the present invention is to facilitate the process of periodic checking the ventilation system and to help the user by indicating if there is a dysfunction in the ventilation device or disruption in the system. The present invention also forces the activation of the smoke removal even if the ventilation is disabled by extracting smoke from the burning room to the ventilation channel.

Parts list:

[0049]

1	central unit
2	user interface unit
3	ventilation device
4	exchange air provider
21	switch
22	bypass activator
23-1	activation indicator
23-2	smoke removal indicator
24-1	ventilation activation indicator
24-2	ventilation indicator
25-1	ventilation dysfunction indicator
25-2	bypass activation indicator
26	disruption indicator
27	exchange air status acceptor
28-1	exchange air indicator
28-2	exchange air threshold indicator
31	outlet
32	extractor
33	actuator
34	sensor
41	inlet vent
42	exchange air sensor

Claims

1. A ventilation control system, comprising

a central unit (1) configured to transmit signals to and receive signals from a ventilation device (3),
a user interface unit (2) communicatively connected to the central unit (1),
wherein the central unit (1) is configured to cause

- the ventilation device (3) to initiate ventilation in response to receiving a first user input via the user interface unit (2),
- the ventilation device (3) to initiate smoke removal after a predetermined time from initiating the ventilation in response to receiving said first user input if the ventilation is functional, and
- the ventilation device (3) to initiate smoke removal in response to receiving a second user input via the user interface unit (2) if the ventilation is dysfunctional.

2. The ventilation control system as claimed in claim 1, wherein the central unit (1) is further configured to cause

- the user interface unit (2) to indicate activation of ventilation via an activation indicator (23-1), and
- the user interface unit (2) to indicate smoke removal via a smoke removal indicator (23-2).

3. The ventilation control system as claimed in claim 1 or 2, wherein the central unit (1) is further configured to cause

- the user interface unit (2) to indicate ventilation via a ventilation activation indicator (24-1), and
- the user interface unit (2) to indicate successful ventilation via a ventilation indicator (24-2).

4. The ventilation control system as claimed in claim 2, wherein the activation indicator (23-1) and the smoke removal indicator (23-2) is a same first light source emitting respectively discontinuous and continuous light.

5. The ventilation control system as claimed in claim 3, wherein the ventilation activation indicator (24-1) and the ventilation indicator (24-2) is a same second light source emitting respectively discontinuous and continuous light.

6. The ventilation control system as claimed in any preceding claims 1-5, wherein the central unit (1) is further configured to cause the user interface unit (2) to indicate ventilation dysfunction via a ventilation dysfunction indicator (25-1).

7. The ventilation control system as claimed in any preceding claims 1-6, wherein the second user input is configured to initiate bypass activation, and the central unit (1) is further configured to cause the user interface unit (2) to indicate the bypass activation via a bypass activation indicator (25-2).

8. The ventilation control system as claimed in claim 6 or 7, wherein the ventilation dysfunction indicator (25-1) and the bypass activation indicator (25-2) is a same third light source emitting respectively discontinuous and continuous light.

9. The ventilation control system as claimed in any preceding claims 1-8, wherein the central unit (1) is further configured to cause

- the user interface unit (2) to indicate state of exchange air via an exchange air indicator (28-1), and
- the user interface unit (2) to indicate reaching an exchange air threshold via an exchange air threshold indicator (28-2).

10. The ventilation control system as claimed in claim 9, wherein the exchange air indicator (28-1) and the

exchange air threshold indicator (28-2) is a same fourth light source emitting respectively discontinuous and continuous light.

11. The ventilation control system as claimed in any preceding claims 1-10, wherein the central unit (1) is further configured to cause the user interface unit (2) to indicate disturbance in the system via a disruption indicator (26).

12. The ventilation control system as claimed in claim 11, wherein the disruption indicator (26) is preferably a fifth light source emitting discontinuous red light and configured to indicate overcurrent or fuse discharge or both.

13. A ventilation system, comprising a ventilation control system according to any preceding claims, and a ventilation device (3) for ventilation and smoke removal, and an exchange air provider (4).

14. The ventilation system as claimed in claim 13, wherein the ventilation device (3) comprises an openable outlet (31) for the ventilation and an extractor (32) for the smoke removal.

15. The ventilation control system as claimed in claim 14, wherein the ventilation device (3) comprises a sensor (34) configured to detect if the outlet (31) is in an open or a closed state.

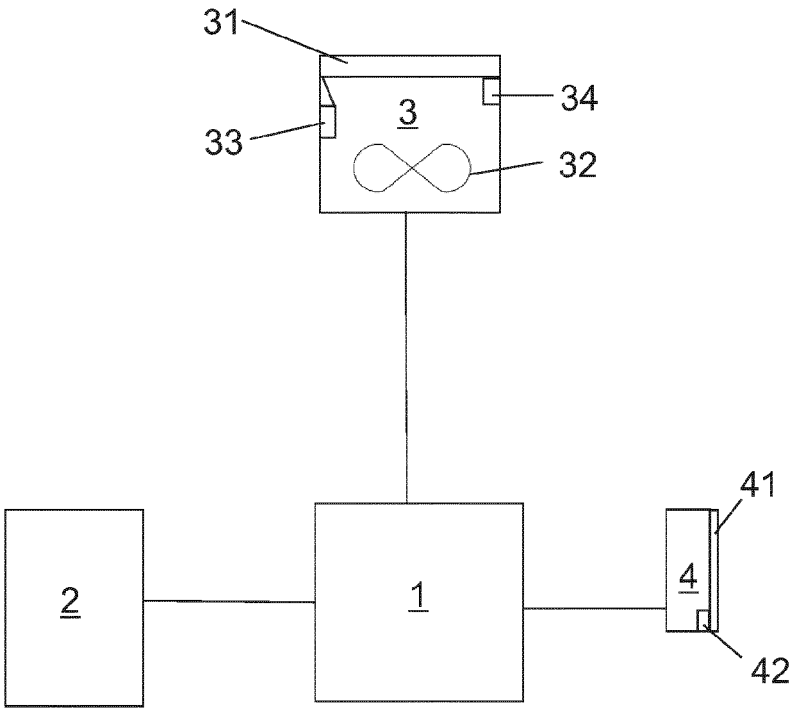

Figure 1

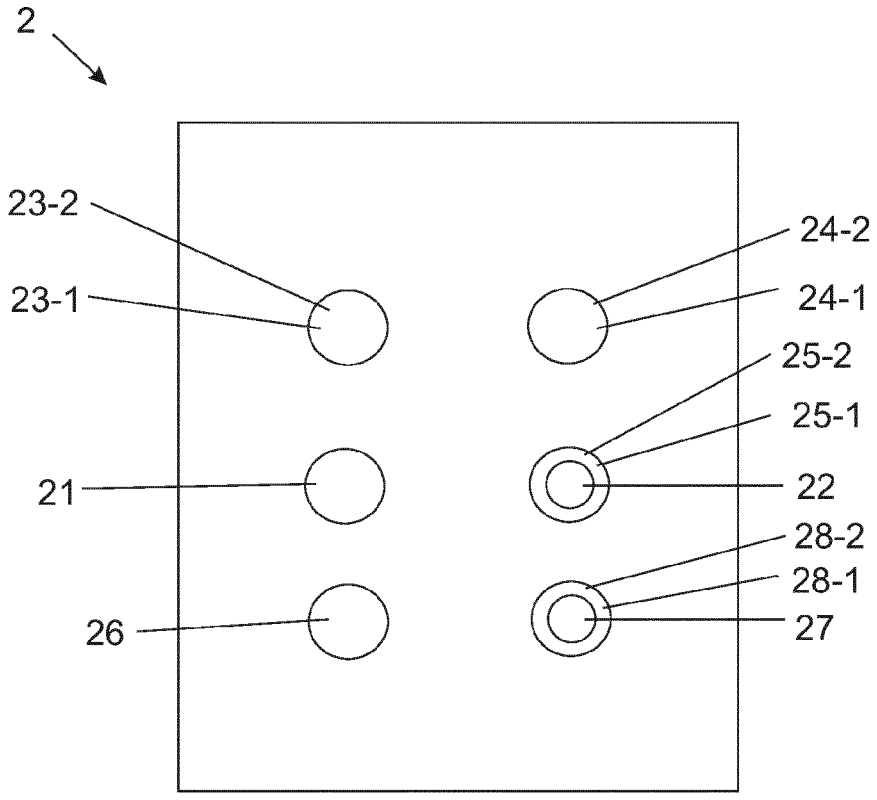

Figure 2

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EUROPEAN SEARCH REPORT

Application Number
EP 23 18 1487

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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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
Munich	16 November 2023	Anconetani, Mirco

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 18 1487

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