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(54) **VENTILATION DEVICE**

(57) In one embodiment, a ventilation device comprises a shaft with a side wall, including a first end with an air intake, a side opening in the side wall, and a second end with an air outtake and a drain opening, wherein the side opening and the drain opening are arranged such that liquid entering the shaft through the side opening flows out of the shaft through the drain opening, and wherein the side opening is arranged in the side wall such that air entering the shaft through the air intake flows along the side opening and leaves the shaft through the air outtake. Moreover, embodiments referring to an apparatus with a drain, a functional facility, and a method for operating a ventilation device are disclosed.

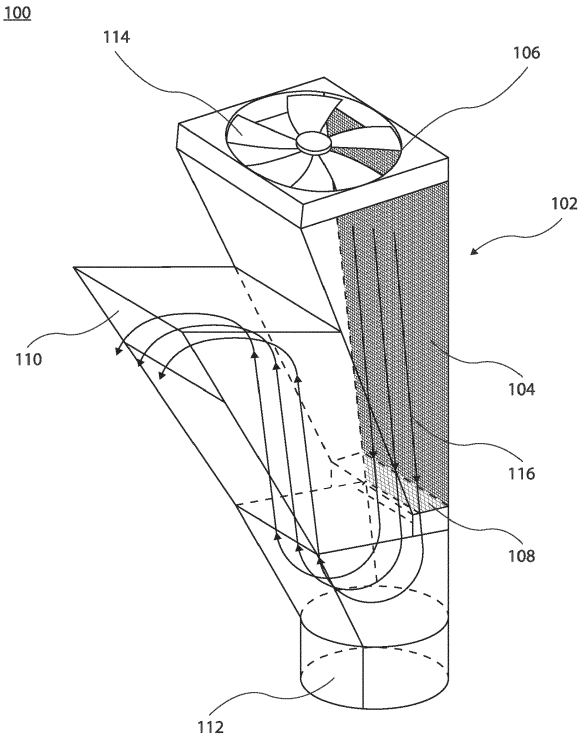

FIG. 1

EP 4 332 449 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a ventilation device and to a method for operating a ventilation device. Embodiments may relate to a ventilation device connectable to an apparatus that has a drain to allow liquid to flow out of the apparatus. The apparatus may be a sanitary equipment, which may be disposed at a functional or sanitary facility. Thus, the invention may relate to an apparatus, a sanitary equipment, a functional or sanitary facility, and a method for operating the same.

BACKGROUND

[0002] Various apparatuses enable users to interact with liquids, use liquids, or dispose liquids. The liquid may be contaminated, for example, during use or interaction, and the used or contaminated liquid may be disposed via a drain of the apparatus. To provide a safe and clean environment, it may be desirable to prevent users of the apparatus to come into contact with the used or contaminated liquid unnecessarily. The drain may be connected to a sewage system. The drain may be connected to a siphon, an outlet valve or other safeguards that create closures preventing or minimizing the escape of gases from the sewage system into the apparatus or an area surrounding the apparatus. For example, a siphon be constructed such that a section of the siphon is filled with the disposed liquid, such as wastewater, which may remain standing in the section of the siphon, which standing liquid may effectively block gases from the sewage system.

[0003] For example, the apparatus may be a sanitary equipment, which may be disposed in a functional or sanitary facility. Functional or sanitary facilities represent rooms or environments that provide various functions to users, such as sanitary functions. The sanitary equipment may include showers, toilets, washbasins, sinks, and the like. The sewage system may control disposal of human excreta or wastewater from the sanitary equipment. Preventing human contact with feces or other contaminants in the wastewater is part of the sanitary functions, as is hand washing with soap. Sanitary facilities aim to ensure hygienic standards that protect human health by providing a safe and clean environment that reduces transmission of disease.

[0004] Irrespective of regular cleaning of the apparatus or sanitary equipment, surfaces of the drain and sewage system that are exposed to the used or contaminated liquid may form a contaminated film or biofilm with a potentially growing population of contaminants. For example, the drain or an interface between the drain of the apparatus and the sewage system may include various surface areas that may be difficult to be cleaned adequately. As a result, biofilm can be formed and deposited on surfaces of the interface areas or the drain. The biofilm can lead to formation of further gases that are not blocked by the area with standing liquid and that can escape through the drain into the environment of the apparatus or sanitary equipment.

[0005] In the case of sanitary equipment, the drain or the sewage system is an open reservoir of pathogens from fecal and oral flora of human users, such as bacteria and other or further contaminants that may form part of the biofilms at the surfaces of the drain or sewage system. When water or other liquids enter the drain, the contaminants may be released into the environment. For example, bacteria may be emitted up to 1.85 m in radius from wastewater standing in the siphon. In the case of a siphon contamination of more than 105 cfu/ml, the transmission of bacteria to the hands of users during hand washing has been detected.

[0006] In view of the above, one object is to improve hygienic standards of apparatuses for handling and disposing of liquids, such as sanitary equipment. In particular, one object is to reduce gases, gas mixtures, gas dispersions, and/or aerosols that may escape drains or sewage systems into the environment.

SUMMARY

[0007] The problem is solved by a ventilation device, an apparatus, a sanitary equipment, a functional or sanitary facility, and a method according to the independent claims. Preferred embodiments are defined in the dependent claims.

[0008] According to a first aspect of the disclosure, a ventilation device comprises a shaft with a side wall, including a first end with an air intake, a side opening in the side wall, and a second end with an air outtake and a drain opening, wherein the side opening and the drain opening are arranged such that liquid entering the shaft through the side opening flows out of the shaft through the drain opening, and wherein the side opening is arranged in the side wall such that air entering the shaft through the air intake flows along the side opening and leaves the shaft through the air outtake.

[0009] The ventilation device is constructed such that when air enters the shaft via the air intake and leaves the shaft via the air outtake, an air stream passes along the side opening. The air stream effectively seals the side opening with respect to fluids within the shaft, yet does not constrict the liquid flow through the side opening and the shaft. Hence, the ventilation device effectively shields the fluids from leaving the shaft via the side opening. The fluids may be gases, gas mixtures, and/or gas dispersions that may include or carry aerosols or other suspended or floating particles that may include pathogens or contaminants.

[0010] Throughout this disclosure, the terms air flow and air stream may be used interchangeably. The term air flow may denote any flow of air within the shaft, which is caused by the motion of the air entering the shaft at the air intake. The air stream may particularly denote the

flow of the air from the air intake, along the side opening, towards the air outtake.

[0011] Irrespective of whether the fluids may include pathogens or contaminants, or not, they are controlled and prevented from leaving the shaft via the side opening. This one-way seal increases the hygienic level of the surrounding environment since it effectively controls the flow of the fluids. As an example, the ventilation device may be connectable to an outlet or drain of an apparatus and a sewage system, thereby leading liquid from the apparatus to the sewage system. Liquid from the apparatus entering the ventilation device through the side opening may flow to the drain opening and subsequently to the sewage system. The air stream formed in the ventilation device prevents fluids within the shaft or from the sewage system from escaping into the apparatus via the side opening. This effectively prevents pathogens or contaminants in the fluids from escaping into the apparatus.

[0012] In one preferred embodiment, the apparatus may be a sanitary equipment of a functional or sanitary facility and the ventilation device may be disposed of between a drain of the sanitary equipment and the sewage system in order to guide wastewater from the sanitary equipment to the sewage system. However, it is to be understood that the apparatus may be any kind of apparatus with a drain connectable to a sewage system that controls the flow of and blocks fluids from the sewage system.

[0013] In a preferred embodiment, the air flowing along the side opening forms an air curtain at the side opening. The air curtain at the side opening effectively blocks any fluids within the shaft from leaving the shaft through the side opening. Throughout this disclosure, the terms air seal, air curtain, or air blade may be used interchangeably. The air curtain may be formed by the air stream that is blown across the side opening to the other side. The air curtain separates two different environments, thereby separating the interior of the drain of the apparatus from the interior of the shaft while allowing a smooth, uninterrupted flow of the liquid through the side opening. The air curtain is an invisible air barrier over the side opening that separates the two environments without limiting the liquid flow. The air curtain may depend on physical properties of the air stream, such as velocity, density of the air, pressure, and/or energy, to name a few. The air curtain effectively seals the side opening with respect to fluids within the shaft. Yet, the liquid flowing through the side opening into the shaft is not restricted. Characteristics of the air curtain may depend on parameters of one or more devices forming the air stream, such as one or more blowers, fans or ventilators feeding or blowing the air into or out of the shaft. Thus, the ability of the air curtain to block fluids within the shaft may depend on the parameters of the air stream.

[0014] According to a particularly preferred embodiment, the air flows substantially perpendicular to an orientation of the side opening. A first portion of the side wall between the air intake and the side opening may be disposed in an angle to the orientation of the side opening. The side opening may have a form with a rim and a hole. The side opening may be further connected at the rim with a tube or a connection to a drain of a connected apparatus. The form of the rim or the connected tube or connection may define a main orientation or direction of the side opening, which may at least substantially correspond to a main direction of the liquid entering the shaft at the side opening. For example, the side opening may be a round or rectangular hole connected to a drain tube of the apparatus, wherein the drain tube may be connected at an angle to the side wall. Thus, the side opening may have an orientation or direction corresponding to the angle. The first portion of the side wall guiding the air flow in the direction of the side opening may be at least perpendicular to the orientation of the side opening. Preferably, the orientation of the first portion of the side wall and the orientation of the side opening may form substantially a right angle or preferably an obtuse angle. A second portion of the side wall which is disposed at the other end of the side opening may have an orientation that guides the air away from the side opening.

[0015] According to another embodiment, after passing the side opening, the air flows substantially in a flow direction of the liquid. This further closes any areas at the side opening that may potentially leak fluids from within the shaft through the side opening. The direction of the air flow may be controlled by the form and orientation of the second p portion of the side wall at the other end of the side opening. This second portion may be disposed at an angle to the orientation of the side opening. The second portion may be disposed substantially perpendicular to the orientation of the side opening or at an acute angle. This may ensure that liquid entering through the side opening flows in contact with the second portion while being sealed by the air flow.

[0016] In yet another embodiment, a supply portion of the shaft including the first end, the side opening, and the drain opening forms a substantially straight section of the shaft. The supply portion may have at least partially a form of a pipe with a round or oval or polygonal cross-section, wherein the side opening may be disposed in a side wall of the supply portion. Preferably, the air intake may be disposed at the top of the supply portion and the drain opening at the bottom of the supply portion. Thus, air entering the supply portion may flow downwards and passes the side opening, and liquid entering the supply portion through the side opening flows downwards towards the drain opening.

[0017] According to a particularly preferred embodiment, an exhaust portion of the shaft including the air outtake is arranged at an angle to the supply portion. Preferably, the exhaust portion may be arranged in a substantially U- or V-shaped manner. The exhaust portion may have at least partially a form of a pipe with a round or oval or polygonal cross section. The exhaust portion may be arranged and connected to the supply portion at the second end of the shaft. Thus, the exhaust

portion and the supply portion may form a U or V Thus, after passing the side opening, the direction of the air flow may be changed according to the angle of the exhaust portion and the air flow may be guided towards the air outtake. Preferably, the air flow may be redirected upwards and towards the air outtake. The liquid may continue flowing downwards towards the drain opening. The angle between the supply portion and the exhaust portion may be chosen such that characteristics of the air flow remain stable.

[0018] In yet another preferred embodiment, the side wall at the side opening includes one or more sloping sections that are configured to guide the liquid entering the shaft through the side opening towards the drain opening. The sloping sections may correspond to the second portion of the side wall in the supply portion. Additionally, or as an alternative, the sloping sections may be disposed at the second portion of the side wall. The sloping sections may ensure that the liquid enters the shaft in a controlled manner. Further, the sloping sections may ensure that the liquid is pushed against the side wall by the air flow, thereby reducing potential leaks.

[0019] In a further embodiment, the side opening is connectable to a drain of an apparatus. The apparatus may be configured to control disposal of liquid through the drain. Thus, the apparatus may supply the liquid to the shaft via the side opening. The apparatus may be a sanitary equipment. The liquid may be wastewater. According to one embodiment, the drain opening is connectable to a siphon. The siphon may further connect to a sewage system. Thus, the liquid entering the shaft via the side opening may be guided towards the sewage system. In another embodiment, the air outtake is connectable to an air exhaust system. Thus, the air entering the shaft and sealing the side opening is guided towards the air exhaust system.

[0020] According to a preferred embodiment, the ventilation device further comprises a fan or blower configured to blow air into the shaft through the air intake. The fan or blower may be any kind of device capable of forming an air stream with defined characteristics and parameters, such as pressure, speed, density, and the like. The ventilation device may comprise a plurality of fans or blowers that may be used to generate an air stream with the required characteristics or parameters. The fan or blower may be arranged at the air intake or within the shaft, such as at the first end of the shaft. It is to be understood that the fan or blower may be arranged at any suitable portion of the shaft that enables a formation of the air stream at the side opening. The ventilation device may be configured to operate the fan or blower in a continuous manner, thereby forming a continuous air stream. Additionally, or as an alternative, the ventilation device may be configured to operate the fan or blower in intervals, thereby forming a continuous air stream according to the intervals. Additionally, or as an alternative, the ventilation device may be configured to operate the fan or blower with different settings, thereby subsequently forming multiple different continuous air streams according to the different settings, such as a fast, strong, small, or slow air stream, at corresponding intervals. The control of the fan or blower may be time controlled or the fan or blower may be in continuous operation.

[0021] The terms strong or fast and small or slow as used within this disclosure define parameters of the air stream. For example, depending on the parameters, the air stream may form an air curtain. To have the desired sealing effect with regard to the entering liquid, the strength or speed of the air stream may be based on a cross-section of the side opening and an (expected) amount (and/or further properties) of liquid entering through the side opening. The skilled person would readily understand that the fan or ventilator can be set according to a first and a second, and/or a third, and/or an nth setting to form stronger or smaller air streams at the side opening with the desired intensity. Thus, the present disclosure is not limited by an air stream with absolute characteristics since this depends on the geometry of the ventilation device and the side opening. Generating a stronger air stream may require using first settings with at least one first value that may be higher than a threshold. Generating a smaller air stream may require using second settings with at least one second value that may be below the threshold. Any other number of air streams with different characteristics can be generated using respective settings based on specified thresholds. Likewise, the thresholds can be dynamically adjusted to generate an air stream with the desired characteristics.

[0022] In a preferred embodiment, the ventilation device further comprises a motion detector, wherein the motion detector is configured to operate the fan or blower. For example, the motion detector may be used to detect if a user is approaching, and the fan or blower may be switched on as soon as someone approaches and preferably well in advance of someone potentially operating the apparatus. This may include switching the fan or blower with a time duration before use. It is to be understood that the ventilation device may be configured according to a schedule. During day time or during a time period with expected operation of the connected apparatus, the ventilation device may operate the fan or blower in a continuous manner. During night time or during a time period when the apparatus is expected not to be in use, the ventilation device may be kept in idle mode and switched on using the motion detector or any other suitable sensor that may detect an approaching user or the presence of a user.

[0023] According to a particularly preferred embodiment, the ventilation device further comprises a sensor at the side opening, wherein the sensor is configured to operate the fan or blower. The ventilation device may use the sensor to detect entry of liquid via the side opening. If entry of liquid is detected, the ventilation device may set the fan or blower to form an air stream according to first settings, such as a strong air stream. When no liquid is entering the shaft, the ventilation device may set

the fan or blower to form an air stream according to second settings, such as a less strong air stream or a smaller air stream. It is to be understood that the fan or blower can be switched off if a connected apparatus is not used or expected not to be operated.

[0024] According to another embodiment, the ventilation device further comprises one or more air sensors configured to monitor parameters of the air leaving the shaft. The one or more air sensors may be disposed at the air outtake to monitor the air leaving the shaft through the air outtake. The one or more air sensors may identify or measure the degree (amount) of contamination with bacteria, germs and/or viruses and/or may detect the type of bacteria, germs and/or viruses in the air leaving the shaft or the ventilation device. This makes it possible to determine the level of contamination of the air leaving the ventilation device. If necessary, this can be used to indicate the risk of excessive contamination of the air.

[0025] In yet another embodiment, the ventilation device further comprises one or more liquid sensors configured to monitor parameters of the liquid leaving the shaft. The one or more liquid sensors may be disposed at the drain opening to monitor the liquid leaving the shaft through the drain opening. The one or more liquid sensors may identify, measure or determine a degree of pollution or contamination of the liquid leaving the ventilation device. This may be used to adjust setting of the ventilation device, such as setting of the fan or blower. For example, if contamination of the liquid reaches a threshold, the ventilation device may be configured to produce a stronger air flow. This makes it possible to determine the level of contamination of the liquid in the siphon. If necessary, this can be used to indicate the risk of excessive contamination of the liquid. Preferably, the one or more liquid sensors measure the amount of bacteria, germs and/or viruses (degree of contamination) and/or detect the type of bacteria, germs and/or viruses in the liquid.

[0026] According to a particularly preferred embodiment, the ventilation device further comprises at least one treatment apparatus configure to treat the air leaving the shaft. The at least one treatment apparatus may include active or passive components, such as filters or any other cleaning means. The at least one treatment apparatus may be connected to the one or more air sensors, such that an operation mode or effectiveness of the at least one treatment apparatus may be adjusted to a current contamination level.

[0027] Preferably, the at least one treatment apparatus includes at least one radiation source. The term radiation source is to be understood as a source for any kind of electromagnetic radiation, including radio waves, microwaves, infrared (IR), (visible) light, ultraviolet (UV), X-rays, and gamma rays, to name a few waves forming part of the electromagnetic spectrum. Preferably, the at least one radiation source is or includes a light source emitting UV light. This may include one or more UV C LEDs, and/or any kind of light or electromagnetic wave source.

[0028] In a further embodiment, the ventilation device further comprises an exhaust air shaft connected to the air outtake. The exhaust air shaft may allow a controlled exhaust of the air. The air may be guided, for example, towards a vent system or air treatment system, and the like. Preferably, the exhaust air shaft may include the at least one radiation source.

[0029] According to a preferred embodiment, the exhaust air shaft has a meandering shape. The exhaust air shaft may be compact in size, yet provide a long (meandering) air channel for the exhaust air. The at least one radiation source or components of the air treatment apparatus may be disposed along the air channel, which may improve cleaning efficiency for the exhaust air. The compact size, yet increased cleaning efficiency may allow for a stand alone ventilation device without connection to a venting system.

[0030] In a preferred embodiment, at least a portion of the side wall of the shaft includes a material with a scale-like surface structure. It is known that scale-like structures, which may, for example, correspond to the scale-like structures on the skin of sharks, prevent bacteria from adhering. Thus, the scale-like surface structure may provide a disinfecting effect for the air and/or the liquid.

[0031] A second aspect of the present disclosure provides an apparatus with a drain, comprising a ventilation device connected to the drain, the ventilation device according to one or more embodiments of the present disclosure. In particular, the drain may be connected to a ventilation device, including a shaft with a side wall, including a first end with an air intake, a side opening in the side wall, and a second end with an air outtake and a drain opening, wherein the side opening and the drain opening are arranged such that liquid entering the shaft through the side opening flows out of the shaft through the drain opening, and wherein the side opening is arranged in the side wall such that air entering the shaft through the air intake flows along the side opening and leaves the shaft through the air outtake. The drain may be connected to the side opening of the ventilation device and liquid disposed via the apparatus may be guided through the ventilation device towards the drain opening of the ventilation device.

[0032] According to one embodiment, the drain and the drain opening are formed as a unit. At least parts of the apparatus and at least parts of the ventilation device may be manufactured, for example, using 3D printing or plastic extrusion, as a single unit. For example, the drain of the apparatus and shaft with the drain opening may be manufactured as a single unit. Other components, such as fans, may be configured subsequently.

[0033] Preferably, the apparatus is a sanitary equipment.

[0034] A third aspect of the present disclosure provides a functional facility, comprising at least one functional device, wherein the at least one functional device is connected to a ventilation device according to one or more

embodiments of the present disclosure. In particular, the ventilation device may include a shaft with a side wall, including a first end with an air intake, a side opening in the side wall, and a second end with an air outtake and a drain opening, wherein the side opening and the drain opening are arranged such that liquid entering the shaft through the side opening flows out of the shaft through the drain opening, and wherein the side opening is arranged in the side wall such that air entering the shaft through the air intake flows along the side opening and leaves the shaft through the air outtake. Preferably, a drain of the functional device may be connected to the side opening of the ventilation device and liquid disposed via the functional device may be guided through the ventilation device towards the drain opening of the ventilation device.

[0035] Functional facilities, as used throughout this disclosure, denote areas, spaces, buildings, rooms, cabins, or any other kind of spatial environment that is operated by one or more users or groups of users within or at the spatial environment in order to apply, use, or consume at least one functionality provided by the functional facility. Functional facilities may include sanitary facilities, changing or dressing rooms, operating rooms or preparation areas, to name a few. A functional facility may also combine the functionality of one or more of these functional facilities, including a sanitary facility, changing or dressing room, operating room or preparation area, and the like. For example, a functional facility may provide a sanitary function of a sanitary facility with a privacy function of a changing or dressing room. To provide the intended functionality, the functional facility may contain one or more functional devices.

[0036] At least some of the one or more functional devices of the functional facility may enable users to interact with, use, or dispose potentially contaminated liquids, which functional devices may be connected to respective venting devised according to one or more embodiments of the present disclosure. Preferably, at least some of the plurality of ventilation devices may include exhaust air shafts that may be connected to a joint venting system.

[0037] A fourth aspect of the present disclosure provides a method for operating a ventilation device with a shaft with a side wall, including a first end with an air intake, a side opening in the side wall, and a second end with an air outtake and a drain opening. The method may comprise guiding liquid entering the shaft through the side opening out of the shaft through the drain opening, and blowing air through the air intake into the shaft and along the side opening and towards the air outtake.

[0038] The method may be a computer-implemented method.

[0039] The ventilation device may be a ventilation device according to one or more embodiments of the present disclosure, and the method may include operating of any structural components of the ventilation device according to the respective embodiment.,

[0040] It is to be understood that embodiments of the ventilation device, the apparatus, and/or the functional (or sanitary) facility may include structural features configured to perform processing step corresponding to individual method steps of one or more methods according to embodiments of the present disclosure, in any combination. Structural features may include hardware components that may be equipped with a general-purpose or a special-purpose processor(s) to accomplish the defined functionality. Moreover, embodiments of the method may include processing steps reflecting a functional configuration or processing of structural features of a ventilation device, apparatus and/or functional (or sanitary) facility according to embodiments of the present disclosure, in any combination. For example, a method according to one embodiment of the present disclosure may define operation of the apparatus or the ventilation device, such as setting of a fan or blower or configuration of a treatment apparatus in the ventilation devices.

[0041] According to another aspect of the present disclosure, one or more computer-readable media storing instructions thereon are provided, wherein the instructions, when executed by one or more processing devices, configure the processing devices to perform a method according to one or more embodiments of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0042] The specific features, aspects, and advantages of the present disclosure will be better understood with regard to the following description and accompanying drawings where:

Fig. 1	shows a schematic diagram of a ventilation device according to an embodiment of the present disclosure;
Fig. 2	shows a schematic diagram of an apparatus connected to a ventilation device according to an embodiment of the present disclosure;
Fig. 3	shows a schematic diagram of a ventilation device according to an embodiment of the present disclosure; and
Figures 4A to 4C	illustrate details of a side opening of a ventilation according to embodiments of the present disclosure.

DETAILED DESCRIPTION

[0043] In the following description, reference is made to drawings which show by way of illustration various embodiments. Also, various embodiments will be described below by referring to several examples. It is to

be understood that the embodiments may include changes in design and structure without departing from the scope of the claimed subject matter.

[0044] Fig. 1 shows a schematic diagram of a ventilation device according to an embodiment of the present disclosure. The ventilation device 100 comprises a shaft 102 with a side wall 104. The shaft 102 may include a first end with an air intake 106, a side opening 108 in the side wall 104, and a second end with an air outtake 110 and a drain opening 112. The air intake 106 may include a fan or a blower 114 that is configured to blow the air into the shaft 102. Preferably, the fan or blower 114 may be a standard case fan, preferably having a size of 140 x 140 x 27 mm. Case fans are available on the market in large quantities at a low price. Yet, it is to be understood that the present disclosure is not limited by a particular case fan or a particular form factor. Rather, other fan or blower technologies are envisaged and fully covered by the present disclosure.

[0045] The fan or blower 114 may generate an air stream 116, wherein the main flow direction of the air stream 116 is exemplified in Fig. 1 by three curves. The side opening 108 is arranged in the side wall 104 such that air entering the shaft 102 through the air intake 106 flows along the side opening 108 and leaves the shaft through the air outtake 110. As illustrated in Fig. 1, the shaft may have a funnel-like form. The fan or blower 114 may generate the air stream 116 such that the air stream forms an air seal, air curtain, or air blade at the side opening 108. The air seal, air curtain, or air blade at the side opening effectively blocks any fluids within the shaft 102 from leaving the shaft through the side opening 108.

[0046] As illustrated in Fig. 1, the side opening 108 and the drain opening 112 may be arranged such that liquid entering the shaft 102 through the side opening 108 flows out of the shaft 102 through the drain opening 112. The drain opening 112 may be connected to a siphon, such that liquid standing in the siphon may be at or reach the drain opening 112. The liquid in the siphon may be disposed liquid, such as wastewater. The liquid may also be an oil film that covers the disposed liquid. Irrespective of the type of liquid in the siphon, the siphon or the standing liquid may form a surface. This deviates the air stream 116 within the shaft 102 towards the air outtake 110. Due to physical properties of the air stream 116, the air flows along the side opening 108 and due to the form and design of the shaft 102 and the side opening 108, the air does not escape through the side opening 108. The air follows the flow direction towards the air outtake 110.

[0047] The shaft 102 may have a supply portion including the air intake 106, and an exhaust portion including the air outtake 110. The supply portion and the exhaust portion may be attached to each other in a substantially U- or V-like manner, as shown in Fig. 1. Depending on the attachment of the supply portion and the exhaust portion and their form, the air stream 116 could have a U-like form. Based on a position of the air outtake 110, the air stream 116 could take an S-like form within the ventilation device 100 before leaving the ventilation device 100 through the air outtake 110.

[0048] The exhaust portion may direct the air into a surrounding room. As an alternative, the air outtake 110 may be connected to an exhaust air system (not shown). UV-C LEDs or other treatment apparatuses can be installed in the exhaust portion or at the air outtake 110 to disinfect the exhausted air. Yet, it is to be understood that UV-C LEDs are one type of radiation source and any other source for a different type of electromagnetic waves can be used to treat the exhausted air. In addition, sensors for measuring pollution or contamination of the exhausted air, such as a germ/virus load can be arranged in the exhaust portion or at the air outtake 110.

[0049] At least a portion of the side wall 104 of the shaft 102 may include a material with a scale-like surface structure, preferably like a shark skin. This means that hardly any bacteria can adhere to the side wall 104 or other inner walls of the shaft 102.

[0050] The ventilation device 100 enables a controlled disposal of liquid via the side opinion 108 and the drain opening 112 and prevents any fluids that may be formed within the shaft 102, such as gases, gas mixtures, or gas dispersion that may be formed by biofilms on the inner surface of the shaft 102 or that may enter the shaft through the drain opening 112, from leaving the shaft 102 via the side opening 108. This one-way seal increases the hygienic level in the surrounding environment since it effectively controls the flow of potentially pathogenic or contaminated fluids. If the ventilation device 100 is connected via the side opening 108 to an outlet or drain of an apparatus and via the drain opening 112 to a sewage system, liquid from the apparatus is disposed to the sewage system. Yet, the air stream 116 formed in the ventilation device 100 prevents fluids within the shaft or from the sewage system from escaping into the apparatus via the side opening 108. This effectively blocks fluids from escaping into the apparatus.

[0051] A configuration of the ventilation device 100 connected to the apparatus is schematically illustrated in Fig. 2, according to one embodiment of the present disclosure. The apparatus 200 includes a drain 202. The ventilation device 100 may be a ventilation device according to one or more embodiments of the present disclosure, such as the ventilation device 100 of Fig. 1. Accordingly, same numerals have been used for denoting the same or corresponding parts in Figures 1 and 2.

[0052] The apparatus 200 may be a sanitary equipment, such as a shower, toilet, washbasin, or sink, and the like. The apparatus 200 may enable disposal of liquid via the drain. As shown in Fig. 2, the apparatus 200 may be a washbasin or sink with a water tap 204. However, it is to be understood that the apparatus 200 is not restricted to a particular kind of sanitary equipment. The drain 202 may be located in a side wall at the lowest point of the washbasin or sink. Thus, the wastewater from the washbasin or sink flows from all sides to a central drain, and is collected at the drain 202 in one place.

[0053] The drain 202 of the apparatus may be connected to a side opening 108 of the ventilation device 112. In the embodiment of Fig. 2, water from the water tap 204 may be used, for example, for hand washing or other sanitary or hygienic tasks. Wastewater leaves the washbasin or sink via the drain 202 and the connected side opening 108 into the ventilation device 100, which guides the wastewater to a drain opening 112. The drain opening 112 may be connected to a sewage system (not shown). Preferably, the drain opening 112 may be connected to a siphon and wastewater 206 standing in the drain opening 112 may enter the siphon. Thus, the ventilation device 100 interfaces the drain 202 with the siphon of the sewage system and leads wastewater from the apparatus to the sewage system.

[0054] As detailed in Figure 1, the ventilation device 100 generates an air stream the seals the side opening 108 and the drain 202 from fluids that may be formed within the ventilation device 100 or the sewage system. Thus, the apparatus is not contaminated with potential pathogens or dangerous fluids.

[0055] Fig. 3 shows a schematic illustration of a ventilation device according to an embodiment of the present disclosure. The ventilation device 100 may correspond to the ventilation devices of Figures 1 and 2. Thus, the same numerals have been used to denote corresponding parts. The ventilation device 100 may be connected to an apparatus 200, which may correspond to the apparatus as shown in Fig. 2. Thus, liquids or wastewater from the apparatus 200 may be disposed through the ventilation device 100 towards a sewage system or siphon 301.

[0056] The ventilation device 100 may include a supply portion 302 with a fan 304. The fan 304 may correspond to the fan or blower 114 in Fig. 1. The ventilation device 100 may further include an exhaust portion 306 connected to an exhaust air shaft 308. The fan 304 may blow air into the supply portion 302. Due to standing wastewater in the siphon 301, the air is guided towards the exhaust portion 306 and into the exhaust air shaft 308 that may allow a controlled exhaust of the air. The air may be guided, for example, towards a vent system or air treatment system 309, and the like. As shown in Fig. 3, the exhaust air shaft 308 may have a meandering shape.

[0057] The exhaust air shaft 308 may include a plurality of radiation sources 310, such as a plurality of UV-C LEDs, that may disinfect the exhaust air. The disinfection of the exhaust air may depend on the power (watt) and number of the radiation sources 310, a distance to the radiation sources, and a duration of exposure to the radiation sources 310. The meandering shape of the exhaust air shaft 308 allows for an increased number of radiation sources 310, thereby improving the disinfection effect. Whether, or to what extent, the use of radiation sources 310 is necessary, depends primarily on the requirements of use for the apparatus. The requirements may be higher in medical environments or care facilities or scientific environments.

[0058] The ventilation device 100 may further include one or more sensors 312 for measuring characteristics of the exhaust air, such as pollution, contamination or microorganism analysis.

[0059] The ventilation device 100 may be operated in a continuous manner or may be trigger by one or more sensors, such as motion sensors that may indicate approaching users.

[0060] The ventilation device 100 may include at least one processor or a controller configured to control operation of the ventilation device 100, including controlling the fan 304, 114, to generate an air stream with desired characteristics.

[0061] Figures 4A to 4C illustrate details of a side opening of a ventilation according to embodiments of the present disclosure. The side opening in Figures 4A to 4C may correspond to the side opening 108 in the side wall 104 as shown in Figures 1 to 3. Figures 4A to 4C further show the air stream 116 formed by the ventilation device 100 that passes the side opening 108 at an angle, preferably at a right angle, thereby in a substantially perpendicular direction.

[0062] Fig. 4A shows a direct flow of liquid from a drain of a connected apparatus. The liquid enters the ventilation device and flows down the side wall 104 towards the drain.

[0063] Fig. 4B further provides a wedge-like portion 402 that guides the liquid from the apparatus. The wedge-like portion 402 may further include a formed lower side 404 that improves flow characteristics of the air stream 116. The wedge-like portion 402 may ensure that the liquid enters the shaft in a controlled manner. Further, the wedge-like portion 402 cases the liquid to be pushed by the air stream 116 against the surface of the wedge-like portion 402. The air stream 116 follows the lower side 404. Both reduce potential leaks.

[0064] Fig. 4C further provides a sloping section 406 in the side wall 104 at the side opening 108 that guides the liquid entering the ventilation device 100 through the side opening 108 towards the drain. The sloping section 406 ensures that the liquid enters the shaft in a controlled manner. In operation, the liquid is pushed by the air stream 116 against the sloping section 406 and the side wall 104, thereby reducing potential leaks.

[0065] While some embodiments have been described in detail it is to be understood that the aspect of the disclosure can take many forms. In particular, the claimed subject matter may be practiced or implemented differently from the examples described and the described features and characteristics may be practiced or implemented in any combination. The embodiments shown herein are intended to illustrate rather than to limit the invention as defined by the claims.

Claims

1. A ventilation device, comprising:

a shaft with a side wall, including a first end with an air intake, a side opening in the side wall, and a second end with an air outtake and a drain opening,
wherein the side opening and the drain opening are arranged such that liquid entering the shaft through the side opening flows out of the shaft through the drain opening, and
wherein the side opening is arranged in the side wall such that air entering the shaft through the air intake flows along the side opening and leaves the shaft through the air outtake.

2. The ventilation device of claim 1, wherein the air flowing along the side opening forms an air curtain at the side opening.

3. The ventilation device of claim 1 or 2, wherein the air flows substantially perpendicular to an orientation of the side opening, wherein after passing the side opening, the air flows substantially in a flow direction of the liquid.

4. The ventilation device according to any one of the preceding claims, wherein a supply portion of the shaft including the first end, the side opening and the drain opening forms a substantially straight section of the shaft, and wherein an exhaust portion of the shaft including the air outtake is arranged at an angle to the supply portion in a substantially U- or V-shaped manner.

5. The ventilation device according to any one of the preceding claims, wherein the side wall at the side opening includes one or more sloping sections that are configured to guide the liquid entering the shaft through the side opening towards the drain opening.

6. The ventilation device according to any one of the preceding claims, wherein at least one of: the side opening is connectable to a drain of an apparatus, the drain opening is connectable to a siphon, and the air outtake is connectable to an air exhaust system.

7. The ventilation device according to any one of the preceding claims, further comprising one or more of a fan or blower configured to blow air into the shaft through the air intake; a motion detector, wherein the motion detector is configured to operate the fan or blower; a sensor at the side opening, wherein the sensor is configured to operate the fan or blower; and/or one or more air sensors configured to monitor parameters of the air leaving the shaft.

8. The ventilation device according to any one of the preceding claims, further comprising one or more liquid sensors configured to monitor parameters of the liquid leaving the shaft.

9. The ventilation device according to any one of the preceding claims, further comprising at least one treatment apparatus configure to treat the air leaving the shaft, wherein the at least one treatment apparatus includes at least one radiation source.

10. The ventilation device according to any one of the preceding claims, further comprising an exhaust air shaft connected to the air outtake.

11. The ventilation device according to claim 10, wherein the exhaust air shaft has a meandering shape.

12. The ventilation device according to any one of the preceding claims, wherein at least a portion of the side wall of the shaft includes a material with a scale-like surface structure.

13. An apparatus with a drain, comprising a ventilation device connected to the drain, the ventilation device according to any one of the preceding claims.

14. A functional facility, comprising at least one functional device, wherein the at least one functional device is connected to a ventilation device according to any one of the claims 1 to 12.

15. A method for operating a ventilation device with a shaft with a side wall, including a first end with an air intake, a side opening in the side wall, and a second end with an air outtake and a drain opening, the method comprising:

guiding liquid entering the shaft through the side opening out of the shaft through the drain opening; and
blowing air through the air intake into the shaft and along the side opening and towards the air outtake.

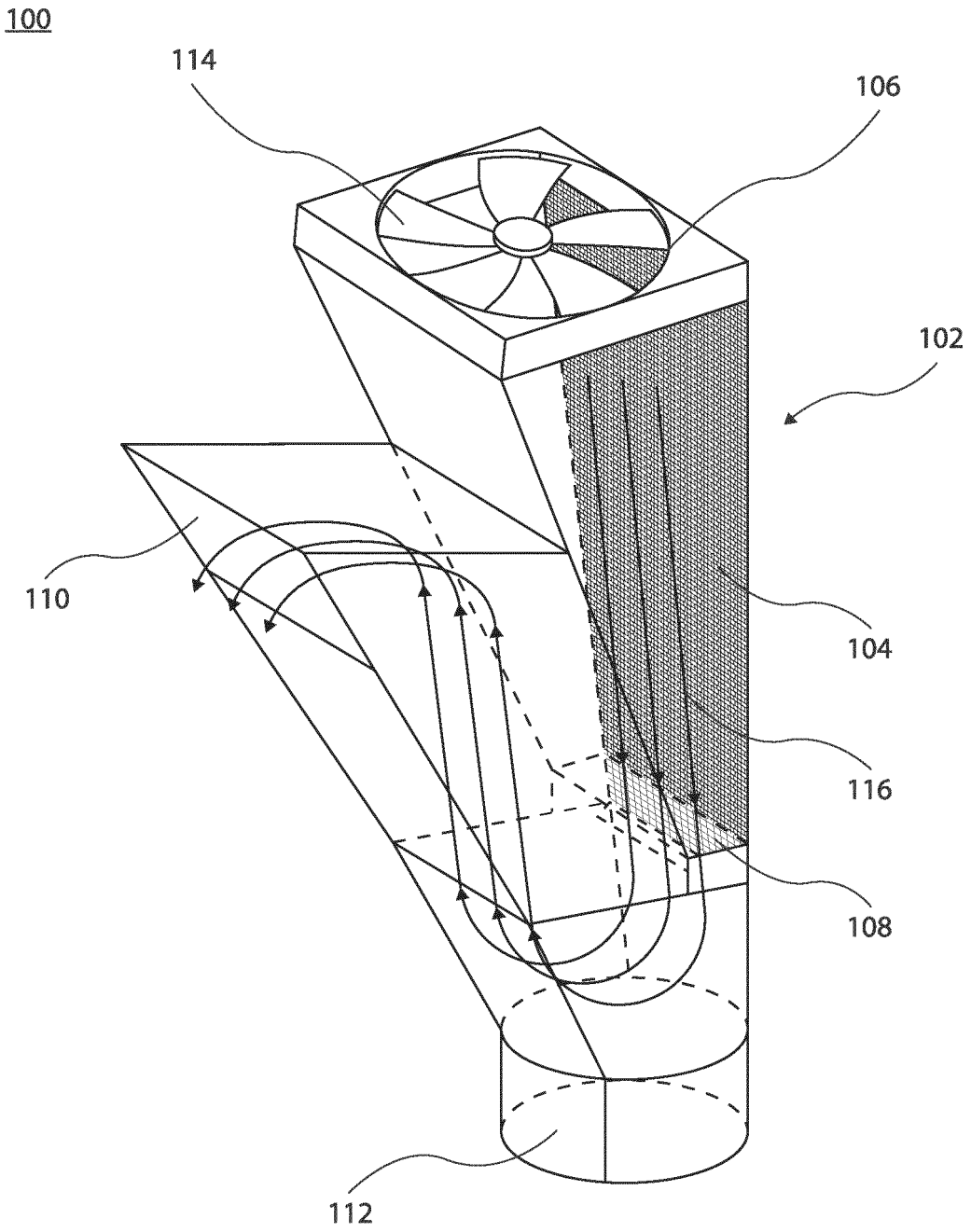

FIG. 1

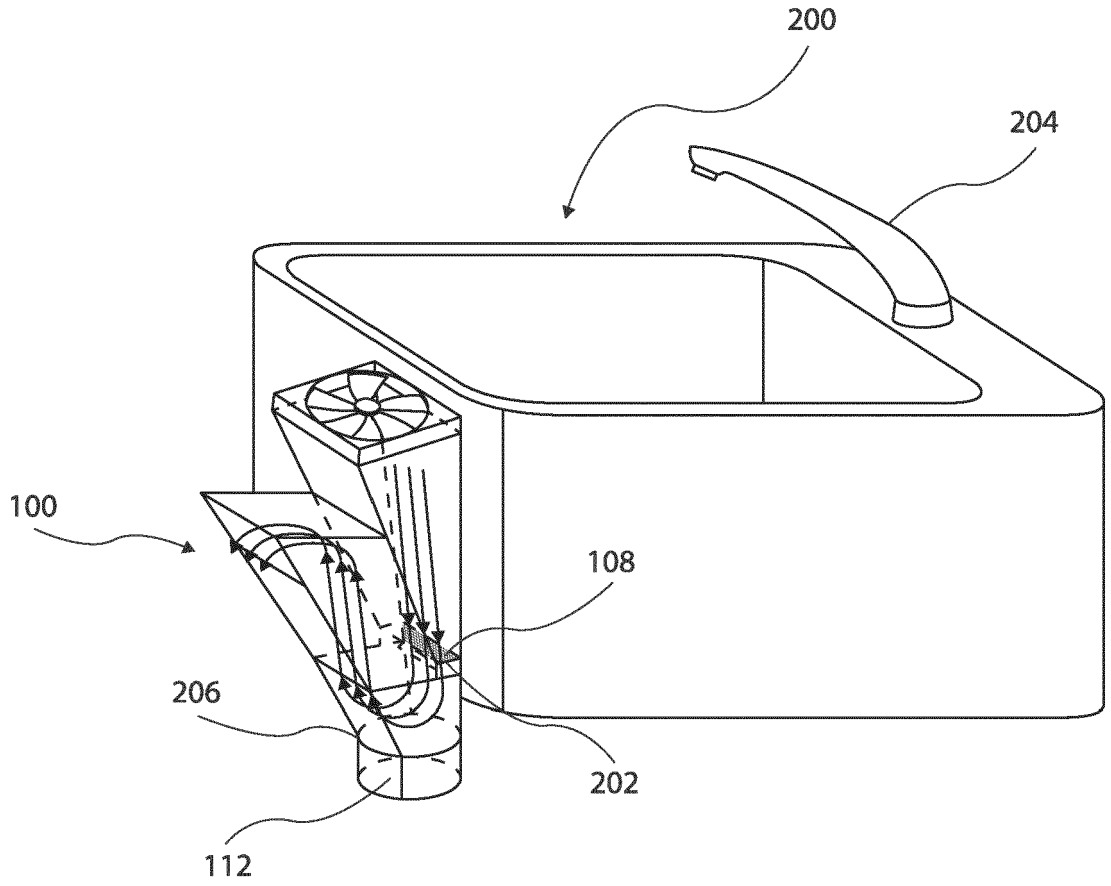

FIG. 2

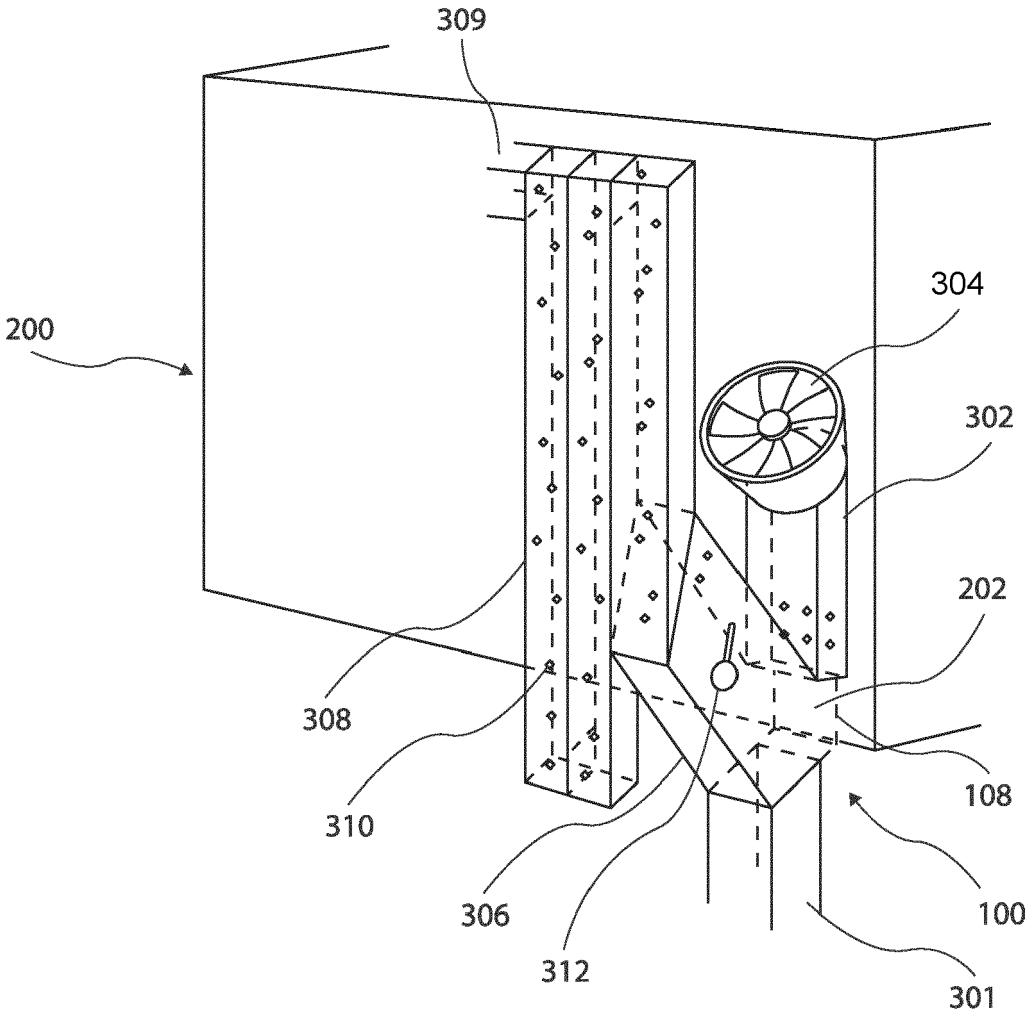

FIG. 3

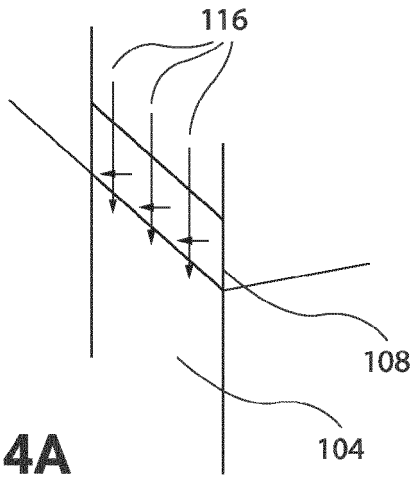

FIG. 4A

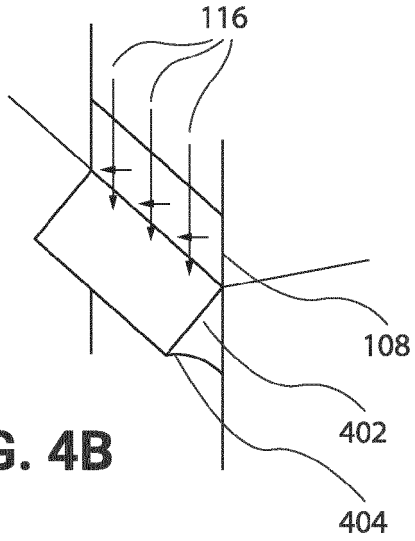

FIG. 4B

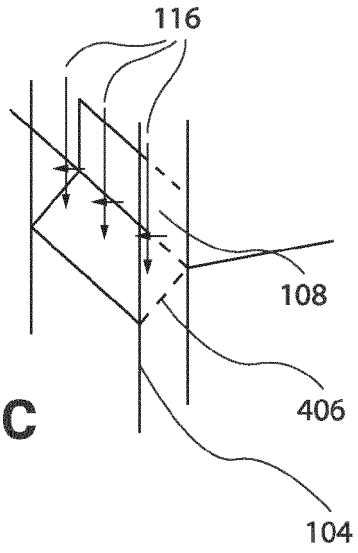

FIG. 4C

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EUROPEAN SEARCH REPORT

Application Number
EP 22 19 3514

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Munich	23 January 2023	Arndt, Markus

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