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(71) Applicant: **Envirocloud Ltd**
Malpas Cheshire SY14 7ES (GB)

(72) Inventor: **Makin, Thomas**
Malpas, SY14 7ES (GB)

(74) Representative: **Forresters IP LLP**
Skygarden
Erika-Mann-Straße 11
80636 München (DE)

(54) **METHOD OF SANITIZING A WETTED SYSTEM AND DEVICES FOR USE IN SUCH**

(57) The present invention provides a device and a method for sanitizing a wetted system, such as a building plumbing system, to reduce the environment hazards of bacteria build up in systems that have been left dormant for an extended period. The method operates by inducing the movement of a gas through pipes and fixtures of said system to dry out the internal surfaces and structures of the system. The gas movement is achieved by blowing the gas into and through the pipes and fixtures of said system and/or sucking the gas through and out of the pipes and fixtures of said system.

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Description

Field of the Invention

[0001] The present invention relates to methods of sanitizing wetted systems, such as building plumbing systems, and also the devices used in such sanitizing processes.

Background of the Invention

[0002] Water carrying systems are utilised in a wide range of situations, ranging from a building's plumbing system to beer brewing equipment. In general use the constant flow of water through these systems prevents the build-up of unwanted bacteria and other waterborne pathogens.

[0003] However when underused or left idle for a time these 'wetted' systems are prone to outbreaks of colonies of waterborne pathogen, examples of which include Legionella and Pseudomonas. If these pathogen colonies are allowed to proliferate they can bring with them to risk of infections and even fatalities when the water system is used after a period of non-use.

[0004] In addition to the clear health risks, the proliferation of waterborne pathogens, examples of which include viruses, bacteria, parasites and other microbial entities, can lead to the formation of biofilms on the internal surfaces of water carrying systems. Biofilm growing within water systems reduces water quality and the efficacy of sensitive equipment connected to the water system. This issue can effect a wide range of sensitive equipment, ranging from dialysis machines to fluid flow meters.

[0005] Under current practises, the proliferation of bacteria and other pathogens in wetted systems is achieved by the regular flushing of water through the systems and by the use of disinfectants. Although effective, these approaches are not environmentally friendly due to the levels of waste water, some of which may contain chemical disinfectant, that need to be disposed of.

Summary of the Invention

[0006] In the light of the environmental issues associated with both the build-up of bacteria in wetted systems and also the current processes used to counter pathogen proliferation, the present invention provides a method of sanitizing a wetted system according to claim 1.

[0007] In this regard, there is provided a method of sanitizing a wetted system by inducing the movement of a gas through pipes and fixtures of said system to dry out the internal surfaces and structures of the system, and wherein the gas movement is achieved by blowing the gas into and through the pipes and fixtures of said system and/or sucking the gas through and out of the pipes and fixtures of said system.

[0008] In the method of the present invention, a suitable gas can be blown and/or sucked through the pipes and fixtures that make up the water system so as to achieve a drying effect on the internal surfaces of the pipes and fixtures where residual water would otherwise accumulate and, in so doing, provide an environment for bacteria to thrive.

[0009] In view of this, in its broadest application, the sanitizing method of the present invention could usefully be employed in any wetted systems that are left dormant for a noticeable period of time (i.e. long enough to allow bacteria to establish a colony).

[0010] With that said, the method of the present invention is considered particularly suitable for sanitizing the plumbing systems of buildings where the water system may be subjected to initial pressure testing after construction/repair and then left idle for a period. It is envisioned that this situation would not be uncommon in newly constructed buildings, for example.

[0011] Although the method of the present invention might be usefully employed in entire wetted systems it is also envisaged that the approach may be applied to limited sections of wetted systems (e.g. hot water tanks of domestic and commercial plumbed systems). Also, the method may be employed on a range of systems that typically have inaccessible pipework, examples of which range from hot tubs and closed circuit systems such as endoscope washers.

[0012] It is appreciated that a range of gases may be suitably used in the method of the present invention. However, preferably the gas may be selected from a group consisting of: air, carbon dioxide, nitrogen, ozone (O_3) and other inert gases.

[0013] It is envisioned that inducing the movement of a gas within the pipes and fixtures of a wetted system will not only achieve a drying effect on any standing water in the system, it will also help to extract accumulated pathogenic materials from within the system.

[0014] Preferably the movement of the gas within the wetted system may comprise a one-way flow of gas. This could be achieved by sucking or blowing the gas from a single port in the system. This could also be achieved by blowing gas from a first port in a first location in the system and sucking gas from a second port in a second location in the system.

[0015] Alternatively, the movement of gas within the wetted system may comprise a tidal flow of gas. In the case of a tidal flow, gas is periodically blown into the system and then sucked out again in a manner similar to that of the human lungs.

[0016] Preferably the gas may be heated before it enters the wetted system. In this way the drying effects of the gas as it moves through the pipes and fixtures of the system is increased. Further preferably the temperature of the gas entering the system may be in the range of 1 to 100 degrees C.

[0017] Preferably the gas may be dehumidified before it enters the wetted system. Reducing the moisture content of the gas also serves to increase the drying effect of the gas as it moves through the pipes and fixtures of

the system.

[0018] Preferably the gas may be filtered prior to entering the wetted system and/or after it leaves the system. In this way it is possible to prevent contamination or environmental ingress into the system and/or the release into the environment of harmful bacteria extracted from the wetted system by the gas flow.

[0019] Preferably the flow rate of gas leaving the system may be monitored. By monitoring the flow rate it is possible to adjust the extent to which the gas is blown into and/or sucked out of the system.

[0020] Preferably the humidity of the gas leaving the system is monitored. Further preferably the humidity level of the gas may be used to adjust the extent to which the gas is dehumidified and/or heating before it enters the wetted system.

[0021] Monitoring the characteristics of the gas as it leaves the wetted system is particularly relevant in embodiments where a gas flow is recirculated within the system, which may be in the case in both a one-way gas flow and a tidal gas flow.

[0022] Preferably the method of the present invention further comprises the step of installing at least one port in the system to facilitate the blowing and/or sucking of the gas through the system.

[0023] It is envisioned that in some situations where the wetted system does have a suitable inlet/outlet available it may be necessary to install at least one port on the system that is capable of forming a gas tight seal with a wetted system sanitization device so that the device can induce the movement of gas by blowing/sucking gas through the system. It is further envisioned that the port may take the form of an adaptor that is securely connectable to an existing inlet/outlet of the system.

[0024] Preferably the method of the present invention may further comprise the step of adding a biocide to the gas before it enters the system. It is envisioned the delivering a biocide along with the gas helps to neutralise bacteria within the system at the same time as they are being dried out and extracted by the movement of gas through the pipes and fixtures.

[0025] Preferably the movement of gas through the wetted system can be achieved using pumping means. Alternatively, the movement of gas may be achieved using a compressed gas source to blow gas through the system.

[0026] Preferably the method of the present invention may be used to sanitize a building plumbing system.

[0027] In another aspect of the present invention there is provided a wetted system sanitization device for use in accordance with the method of the present invention, said device comprising: attachment means configured to form a gas tight connection with a wetted system; actuation means configured to move gas through the wetted system via said attachment means.

[0028] Preferably the actuation means may comprise a pump. Alternatively the actuation means may comprise a compressed gas source, such as a gas canister.

[0029] Preferably the device may further comprise a heater to heat the gas being moved through the wetted system.

[0030] Preferably the device may further comprise a dehumidifier to control the humidity of the gas moving through the wetted system.

[0031] Preferably the device may further comprise one or more filters configured to capture material extracted from the system by the induced movement of gas.

[0032] It is envisioned that such material would likely include harmful organisms and spores that might otherwise be released into the environment when the leave the wetted system. As such, preferably the device may further comprise pathogen containment means to safely house pathogenic materials recovered from the wetted system.

[0033] Preferably the attachment means are configured to form a closed circuit between the wetted system and the device. Once again, this is considered beneficial because it prevents the release of recovered pathogenic materials into the environment.

[0034] Preferably the device may further comprise control means that monitor the rate of gas flow leaving the wetted system and adjust the operation of the actuation means accordingly.

[0035] For example, in situations where the flow rate of gas leaving the system is lower than expected the operation level of the actuation means may be increased to increase the flow rate. This in turn may help to dislodge blockages (e.g. biofilms) within the system. In situations where the flow rate is higher than expected (possibly after the clearance of a blockage) the operation level of the actuation means may be reduced.

[0036] In a further aspect of the present invention there is provided a sanitizing device adaptor that is configured to connect an existing inlet/outlet of a wetted system to a wetted system sanitizing device of the present invention.

Brief Description of the Drawings

[0037] The present invention will now be described with reference to drawings, wherein:

Figure 1 shows a diagrammatic view of a house with a plumbing system that is connected to the wetted system sanitization device of the present invention; and

Figure 2 shows a diagrammatic view of an alternative embodiment of the present invention.

Detailed Description of the Preferred Embodiments of the Present Invention

[0038] It is envisioned that the method of the present invention can be utilized to sanitize a range of systems comprising conduits/pipes that carry water between fix-

tures/tools. Such systems are referred to herein as wetted systems because, even when not in use, they tend to contain water. It is this water that provides an environment in which certain bacteria can flourish overtime if the water is left to sit.

[0039] In order to describe the method of the present invention in more detail, reference will be made to Figure 1. The wetted system shown in Figure 1 is a house 1 with a plumbing system 2, to which is connected various fixtures (e.g. water storage tank 3, water heater 4, taps 7).

[0040] As noted above, when the plumbing system of a house is left dormant for an extended period of time - for example after initial testing of the system in a newly built house or when a previously inhabited house is left uninhabited — the sitting water left in the pipes and fixtures of the house's plumbing system can harbour a range of bacteria and other waterborne pathogens.

[0041] It is envisioned that, if left unchecked, bacteria can proliferate to levels that can be harmful to humans when they eventually inhabit the property and start using the house's various water based utilities (e.g. by drinking water from the taps).

[0042] In order to address these potential health risks, the present invention provides a method of sanitizing wetted systems, such as building plumbing systems, by inducing the movement of gases (such as air, although other forms of gas may be employed) within the pipes and fixtures of the wetted system.

[0043] By inducing the movement of gases within the pipes and fixtures, any water and bacteria resident therein can be extracted from the wetted system, thereby effectively sanitizing the system.

[0044] In order to induce the movement of gases within the system a wetted system sanitization device 5 is connected in fluid communication with the wetted system (i.e. plumbing system 2).

[0045] Although this connection may be achieved by attaching the device 5 to an existing inlet/outlet of the system - such as a sample/drain valve or a tap for example - it is considered preferable that an adaptor 6 is fitted to the wetted system 2 to ensure the creation of an efficient gas-tight seal between the wetted system sanitization device 5 and the wetted system 2.

[0046] It is also envisioned that a section of pipe may be removed from the wetted system to enable the wetted system sanitization device 5 of the present invention to be operatively connected thereto.

[0047] Once the device 5 and the wetted system 2 are connected, the device 5 can be operated to induce the movement of gases within the pipes and fixtures 3, 4.

[0048] In an arrangement shown in Figure 1, the pumping means may be operated so as to cycle between blowing and sucking actions so as to create a tidal flow of gas movement within the system that is akin to that of the human lungs. It is envisioned that employing the approach allows gases to enter and leave the wetted system via a single entry point (e.g. adapter 6).

[0049] In an alternative arrangement, such as that shown in Figure 2, the wetted system sanitization device 5 may be operated to create a one way flow of gas through the wetted system 2.

[0050] In the preferred example shown in Figure 2, the wetted system sanitization device 5 is configured to capture air from the local environment via an intake 9, heat the air using heating means 10 and then blow the heated air into the wetted system 2 via adaptors 6.

[0051] The heated air is pumped through the various conduits and pipes of the system until it escapes for example, and as shown in Figure 2, via taps 7 or outlet 12. It is envisaged, therefore, that when the movement of gas within the system is of a one-way nature the gas flow may be enhanced by either opening the inlets/outlets of the wetted system (e.g. taps, radiator valves).

[0052] Alternatively, or additionally, at least one additional outlet may be installed on the wetted system to provide an exit for gases blown from the system.

[0053] Also, in those embodiments of the present invention where gas is sucked through the wetted system, at least one additional inlet may be installed on the wetted system to provide an inlet for gases sucked into the system.

[0054] It is envisioned that both the tidal flow approach and the one-way flow approach can be delivered using a pumping means with suitable control means. However, it is envisaged that other gas movement actuation means may be employed to induce movement within a wetted system, such as the plumbing system shown in Figure 1.

[0055] In one alternative preferred actuation means, a source of compressed gas may be used to generate a flow of gas within the pipes and fixtures of the wetted system. By replacing the pumping means with a gas canister, this arrangement may provide for a more compact and convenient design of wetted system sanitization device.

[0056] The use of gas canisters as actuation means is considered particularly suitable for one-systems such as that shown in Figure 2.

[0057] Further preferably, and as shown in Figure 2, sensors 11 may be provided at the points in the system where the gas escapes (e.g. taps 7). These sensors 11 can be configured to measure various characteristics of the escaping air, such as temperature, humidity and flow rate.

[0058] Using this information, which can be transmitted back to the wetted system sanitization device 5 using wired or wireless communication means, the control system of the device 5 can adjust its operational levels appropriately. For example, when the flow rate of gas escaping the system 2 is lower than a desired level, the device can increase the pressure under which gas is pumped into the system.

[0059] In another example, a high humidity reading may trigger the heating means of the device to increase the temperature of the gas being pumped into the system. Although not shown in the tidal flow system of Figure 1, it is envisaged that sensors may also be employed here.

Although in these types of system it may be more beneficial to locate the sensors within the wetted system sanitization device 5.

Claims

1. A method of sanitizing a wetted system by inducing the movement of a gas through pipes and fixtures of said system to dry out the internal surfaces and structures of the system, and
wherein the gas movement is achieved by blowing the gas into and through the pipes and fixtures of said system and/or sucking the gas through and out of the pipes and fixtures of said system.

2. The method of claim 1, wherein the gas is selected from a group consisting of: air, carbon dioxide, and other inert gases.

3. The method of claim 1 or 2, wherein the gas movement comprises a one-directional flow of gas through the system.

4. The method of claim 1 or 2, wherein the gas movement comprises a tidal flow of gas into and out of the system.

5. The method of any one of claims 1 to 4, wherein the gas is heated and/or dehumidified before entering the system.

6. The method of any one of claims 1 to 5, wherein the gas is filtered prior to entering the system and/or upon leaving the system.

7. The method of any one of the preceding claims, wherein the flow rate and/or humidity of the gas leaving the system is monitored; and wherein preferably:

    a) the humidity level is used to adjust the extent to which the gas is dehumidified and/or heated before entering the system; and/or
    b) the gas flow rate and/or humidity level is used to adjust the extent to which the gas is blown and/or sucked through the system.

8. The method of any one of the preceding claims, further comprising the step of installing at least one port in the system to facilitate the blowing and/or sucking of the gas through the system.

9. The method of any one of the preceding claims, further comprising the step of adding a biocide to the gas prior to it entering the system.

10. The method of any one of the preceding claims, wherein a compressed gas source is used to blow gas through the system.

11. The method of any one of the preceding claims, wherein the wetted system is a building plumbing system.

12. A wetted system sanitization device for use in accordance with the method of any of the preceding claims, said device comprising:

    attachment means configured to form a gas tight connection with a wetted system;
    actuation means configured to move gas through the wetted system via said attachment means.

13. The device of claim 12, wherein the actuation means comprises either a pump or a compressed gas source.

14. The device of claim 12 or 13, wherein the device further comprises:

    a) a heater to heat the gas moved through the wetted system;
    b) a dehumidifier to control the humidity of the gas moving through the wetted system;
    c) filters;
    d) pathogen containment means to safely house pathogenic materials recovered from the wetted system; and/or
    e) control means that monitors the rate of gas flow leaving the wetted system and adjusts the operation of the actuation means accordingly.

15. The device of any one of claims 12-14, wherein the attachment means are configured to form a closed circuit between the wetted system and the device.

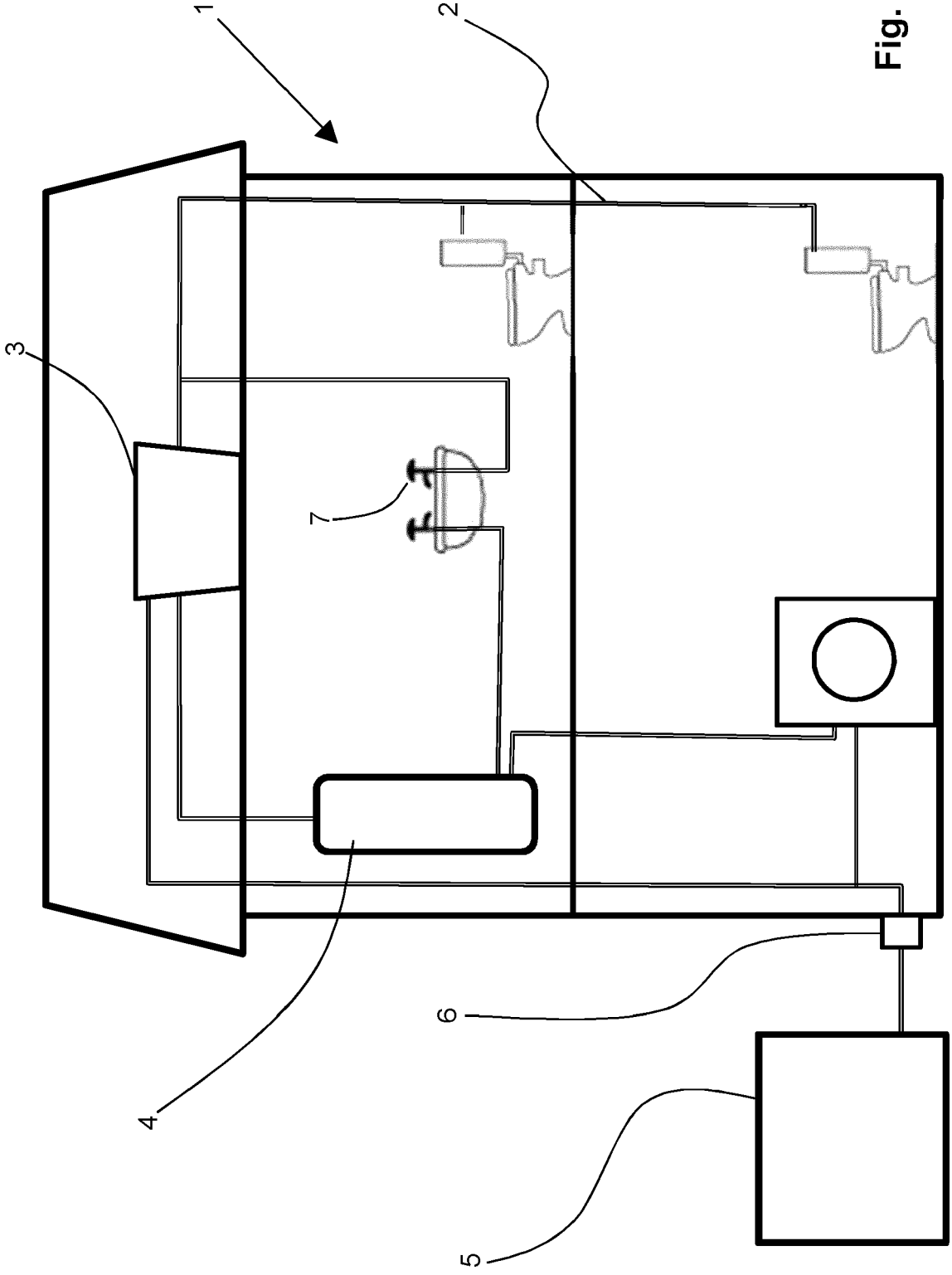

Fig. 1

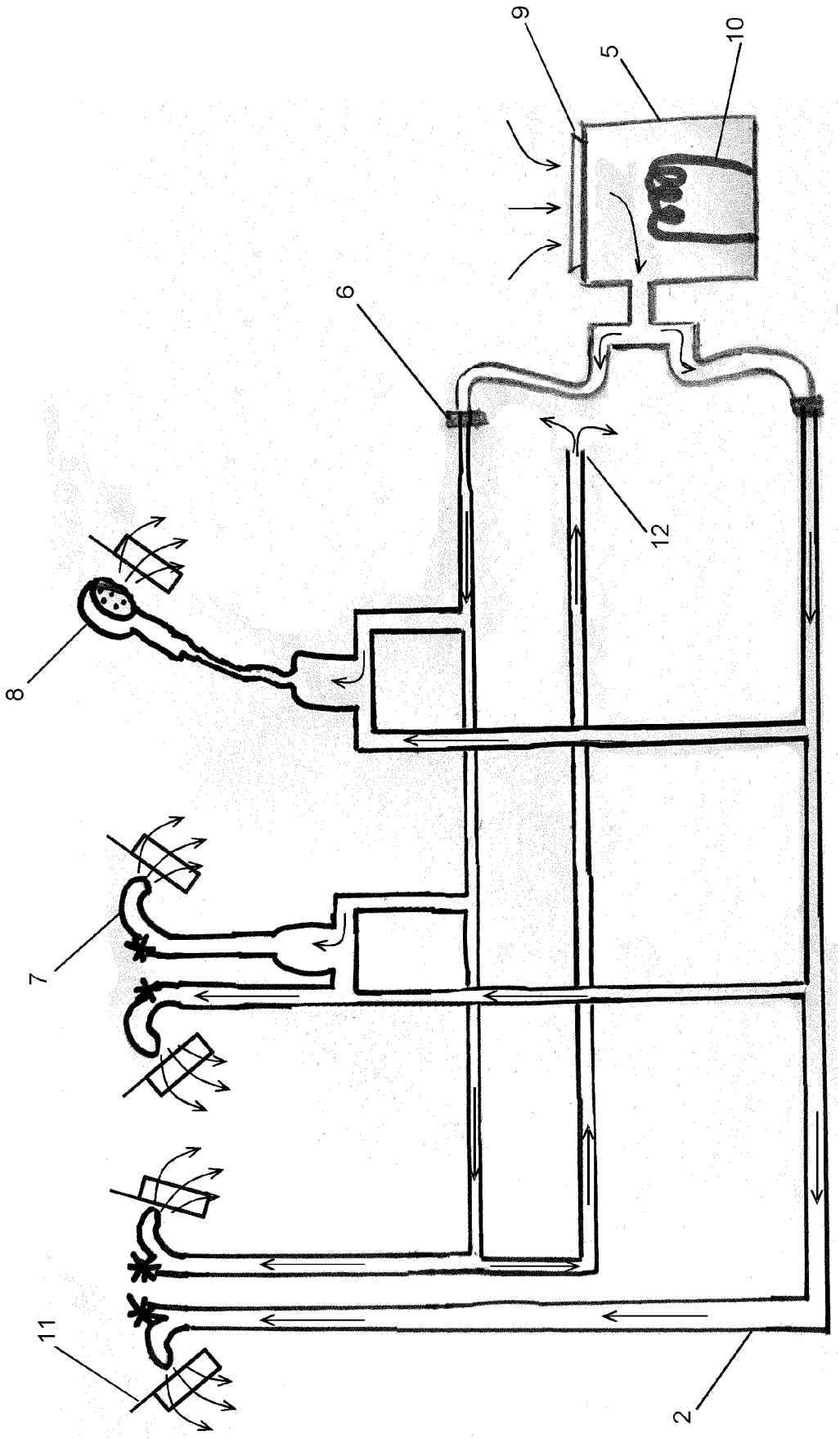

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 21 20 2160

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 10 2013 203156 A1 (CARELA GMBH [DE]) 28 August 2014 (2014-08-28) * abstract *; figures * * paragraph [0021] - paragraph [0048] *	1-15	INV. B08B9/032
X	WO 01/24836 A1 (PIPE STERILIZATION LTD [US]) 12 April 2001 (2001-04-12)	1-13,15	
A	* abstract *; figures * * page 6 - page 24 *	14	
X	CN 205 399 577 U (WENZHOU SHI-AN PACKING CO LTD) 27 July 2016 (2016-07-27)	1-4, 8-13,15	
A	* abstract *; figures *	5-7,14	

TECHNICAL FIELDS SEARCHED (IPC)
B08B
A61L

1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	4 March 2022	Plontz, Nicolas

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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P : intermediate document

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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
& : member of the same patent family, corresponding document

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 21 20 2160

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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04-03-2022

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82