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(54) **MUSEUM DISPLAY CASE WITH A FILTRATION SYSTEM AND A CLIMATE CONTROL SYSTEM**

(57) This museum display case comprises a display space (14), a filtration system (20) and a climate control system (30) to treat the air in the display space (14). It comprises a first air circulation circuit (21) and a second air circulation circuit (31), which are separate from each other but both originating and terminating in the display space (14); the filtration system (20) is included in the first air circulation circuit (21) and the climate control sys-

tem (30) is included in the second air circulation circuit (31).

The provision of two independent and separate circulation circuits (21 and 31) makes it possible to operate them at different intervals, each according to their respective needs, thus avoiding, for example, filtration being unnecessarily activated due to the need to intervene on climate control or vice versa.

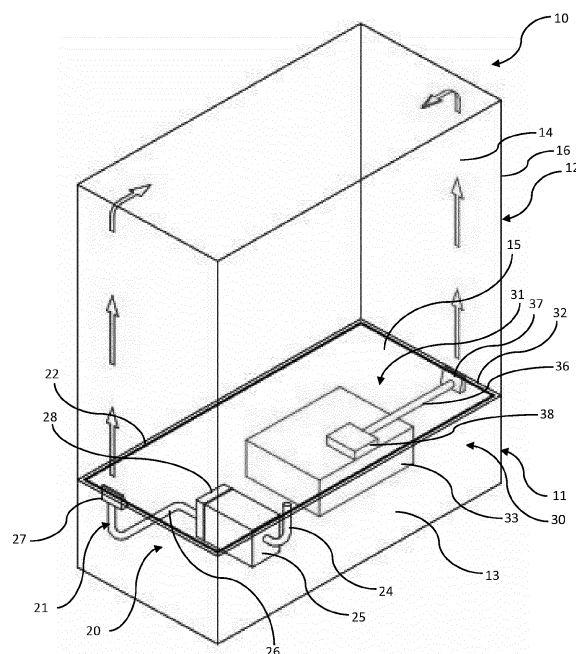


Fig. 1

Description

[0001] The present invention relates to a museum display case, i.e., a display case designed and constructed for the conservation and display in a protected environment of cultural heritage goods, such as works of art, historical artefacts and the like, within the context of an exhibition environment such as a museum, exhibition or the like. The term display case alone will be sometimes used below for the sake of brevity, although it still means a museum display case.

[0002] Protected environment means herein and below an environment in which the atmosphere can be controlled, by monitoring one or more parameters among temperature, humidity, dust content, and pollutant content, in order to maintain the required preservation conditions of the displayed objects, and in which the possibility of access to unauthorized personnel is prevented, to avoid theft or damage to the displayed objects.

[0003] Display case of this type must therefore meet different requirements, in relation to conservation and integrity of the objects displayed. Furthermore, these display cases must of course ensure the best visibility for the objects displayed.

[0004] In order to maintain the desired climatic and air purity conditions in the display case, an air circulation system is normally provided, which takes air from the display space of the display case, feeds it into a circulation circuit where the air is treated and finally returns it to the display space. In the circulation path, all the necessary equipment for air treatment is active; this may include climate control and filtration systems. Climate control systems may comprise -for example- a dehumidification system (which may be passive, e.g. a tray containing silica gel or other hygroscopic material, or active, with an active relative humidity control machine. Filtration systems can include filters of various kinds, depending on the substances to be removed from the air.

[0005] The presence of these systems obviously affects the cost of the display case, but even more so the running costs of the display case over time, in terms of the absorption of electricity by the various active systems, the consumption of hygroscopic material, the periodic replacement of static filters, and the maintenance of the machines.

[0006] The problem underlying the present invention is to reduce the operating costs of such a museum display case by improving the efficiency of use of each component.

[0007] This problem is solved, in accordance with the invention, by a display case according to claim 1. Preferred features are set forth in the dependent claims.

[0008] More particularly, a museum display case according to the invention comprises a display space, a filtration system and a climate control system for treating the air in the display space, and is characterised in that it comprises a first air circulation circuit and a second air circulation circuit, separate from each other but both orig-

inating and terminating in the display space, wherein the filtration system is included in the first air circulation circuit and the climate control system is included in the second air circulation circuit.

[0009] The inventor realised that filtration requirements are often very different from climate control requirements. Both certainly depend on the environmental climate conditions and the conservation requirements of the exhibits, but in a way that is not necessarily equal; the inventor noted that very often for adequate climate control of the air in the display case, it is necessary to treat the air much more frequently than is required for adequate filtration.

[0010] The provision of two independent and separate circulation circuits makes it possible to operate them at different intervals, each according to their respective needs, thus avoiding, for example, filtration being unnecessarily activated due to the need to intervene on climate control or vice versa.

[0011] Preferably, each air circulation circuit comprises a respective pumping means to move air within the circuit from an intake port facing into the display space to a delivery port facing into the display space. In this way, the air flow in each air circulation circuit can be better controlled, according to specific requirements.

[0012] Preferably, the intake port of each circuit is in a remote position with respect to the delivery port of the same circuit. This positioning ensures that there is an adequate exchange of air within the display space, avoiding freshly treated air being immediately returned to the circulation circuit to the detriment of the air already present in the display space.

[0013] In a preferred configuration, the display case has at least one opaque vertical wall, and each air circulation circuit comprises a section extending in the opaque vertical wall; one from between the intake port and the delivery port of each circuit is located at the top of the display space, and the other from between the intake port and the delivery port is located at the bottom of the display space. It is in fact advantageous to exploit the opaque vertical wall so that the intake and delivery ports can be spaced vertically apart, thus involving the entire volume of the display space more effectively in the air exchange.

[0014] Preferably, the delivery ports of both circuits are located at the top of the display space, while the intake ports of both circuits are located at the bottom of the display space. This arrangement is preferred because the extended sections in the opaque vertical wall are under pressure, whereas with an inverted arrangement they would be in depression and thus the air circulation in the circuit would be less regular.

[0015] In another preferred configuration, the display case has all-transparent vertical walls; the intake port and delivery port of each circuit are both located at the bottom of the display space. This configuration, although less effective from the point of view of air exchange, is often preferred because it ensures the best visibility of

the objects displayed in the display case.

[0016] In a preferred embodiment, the filtration system comprises a simple passive mechanical filter, which is sufficient to meet most filtering needs. Alternatively, the filtration system may comprise a complex filtering machine, suitably designed and structured to remove specific substances that are harmful to the objects displayed in the display case. When a filtering machine is planned, it is advantageous for it to include the pumping means in order to guarantee the most suitable air flow for the filtering machine itself.

[0017] Preferably, the climate control system includes a compartment containing hygroscopic material and/or a machine for controlling humidity and/or air temperature.

[0018] Further characteristics and advantages of a museum showcase according to the invention will become clearer from the following detailed description of preferred embodiments thereof, made with reference to the appended drawings. In such drawings:

- figure 1 schematically shows a museum display case according to a first embodiment of the invention;
- figure 2 is a schematic view of the lower part of the display case in figure 1, showing the air circulation circuits;
- figure 3 is a schematic view similar to figure 2, referring to a variant of the display case in figure 1;
- figure 4 schematically shows a museum display case according to a second embodiment of the invention.

[0019] In figures 1 and 2, **10** shows a museum display case, which comprises a base **11** topped by a case **12**. In the base **11**, there is a technical space **13**, in which control equipment and systems for the display case **10** are housed, which will be discussed below. In the case **12**, there is a display space **14**, in which the objects intended for viewing by the public are accommodated; for this purpose, there is a display plate **15** in the display space **14** on which the objects can be placed.

[0020] The case **12** is bordered by walls **16**, all transparent. One or more of the walls **16** may be a wall that can be opened in a known manner, for example by hinging or sliding.

[0021] The display case **10** is equipped with a filtration system **20**, inserted in a first air circulation circuit **21**. The first air circulation circuit **21** comprises, in this order, an intake port **22**, a first section **24** of circuit, one or more passive mechanical filters **25**, a second section **26** of circuit and a delivery port **27**. The intake port **22** and the delivery port **27** are both facing into the display space **14**, so that this display space **14** is traversed by the air circulating in the first circuit **21**. The delivery port **27** is shaped like an open end chamber of the second section **26** of the circuit **21**, while the intake port **22** is formed by the free space around the display plate **15**; the first sec-

tion **24** of circuit is thus simply open on the free space below the display plate **15**.

[0022] The filters **25** are housed in the base **11**, as are the sections **24** and **26** of the circuit **21**, and are combined with a pumping means **28**, e.g. a fan, to induce air circulation in the circuit **21**.

[0023] The display case **10** is then equipped with a climate control system **30**, inserted into a second air circulation circuit **31**. The second air circulation circuit **31** comprises in this order an intake port **32**, a compartment **33** (e.g. a drawer for housing hygroscopic material, such as silica gel), a fan **38**, a section **36** of the circuit and a delivery port **37**. The intake port **32** and the delivery port **37** are both facing into the display space **14**, so that this display space **14** is traversed by the air circulating in the second circuit **31**. The delivery port **37** is shaped like an open end chamber of the section **36** of the circuit **31**, while the intake port **32** is formed by the free space around the display plate **15**; the compartment **33** is thus simply open to the free space below the display plate **15**.

[0024] In a variant of the display case **10**, referred to as display case **110** and shown in figure 3, the climate control system **30** also comprises a thermal machine **135**, between the compartment **33** and the section **36** of the circuit **31**. In the presence of the thermal machine **135**, the fan **38** can be omitted, or rather replaced by a fan inside the machine **135**. Note that in figure 3, all the elements of the display case **110** that correspond to equivalent elements of the display case **10** are marked with the same reference numbers.

[0025] The thermal machine **135** may be of various types, capable of regulating the temperature and/or relative humidity of the air circulating therein. It could therefore also be a relatively simple device, such as a water atomiser, if the desired thermal intervention is only an increase in relative humidity, or a heater, if the desired thermal intervention is only an increase in temperature; it could instead be a more complex machine, such as a refrigeration cycle machine, if the relative humidity and/or air temperature needs to be reduced.

[0026] The thermal machine **135** is housed in the base **11**, as are the compartment **33** and the section **36** of the circuit **31**.

[0027] Similarly, the display case **10** may lack the compartment **33** (or may be devoid of hygroscopic material) if the thermal machine **135** is capable of meeting all the relative humidity control requirements on its own.

[0028] Figure 4 schematically shows a museum display case **210** according to a different embodiment of the invention.

[0029] Similar to the display case **10**, the display case **210** comprises a base **211** surmounted by a case **212**. In the base **211**, there is a technical space **213**, in which control equipment and systems for the display case **210** are housed, which will be discussed below. In the case **212**, there is a display space **214**, in which the objects intended for viewing by the public are accommodated; for this purpose, there is a display plate **215** in the display

space 214 on which the objects can be placed.

[0030] The case 212 is bordered by walls **216**, all transparent except for one opaque wall **217**. One or more of the walls 216 may be a wall that can be opened in a known manner, for example by hinging or sliding. The display case 210 can therefore be placed against a wall of the museum environment with its own opaque wall 217.

[0031] The display case 210 is equipped with a filtration system **220**, inserted in a first air circulation circuit **221**. The first air circulation circuit 221 comprises in this order an intake port **222**, a first section **224** of circuit, one or more filters **225**, a second section **226** of circuit and a delivery port **227**. The intake port 222 and the delivery port 227 are both facing into the display space 214, so that this display space 214 is traversed by the air circulating in the first circuit 221. The second section of circuit 226 extends vertically into the opaque wall 217 and the delivery port 227 is shaped like an end chamber of this second section 226, located high up in the display space 214. The intake port 222 is formed by the free space around the display plate 215; the first section 223 of circuit is therefore simply open to the free space below the display plate 215.

[0032] The filters 225, like the filters 25, are housed in the base 211 and are coupled to a pumping means **228**, e.g. a fan, to induce air circulation in the circuit 221.

[0033] The display case 210 is then equipped with a climate control system **230**, inserted into a second air circulation circuit **231**. The second air circulation circuit 231 comprises in this order an intake port **232**, a compartment **233** (e.g. a drawer for housing hygroscopic material, such as silica gel), a fan **238**, a section **236** of the circuit and a delivery port **237**. The intake port 232 and the delivery port 237 are both facing into the display space 214, so that this display space 214 is traversed by the air circulating in the second circuit 231. The circuit section 236 extends vertically into the opaque wall 217 and the delivery port 237 is shaped like an open end chamber of the section 236 of the second circuit 231, while the intake port 232 is formed by the free space around the display plate 215; the compartment 233 is thus simply open to the free space below the display plate 215.

[0034] As in the case of the display case 10, a thermal machine may be provided, which may be of various types, capable of regulating the temperature and/or relative humidity of the air circulating therein; the thermal machine may include a pumping means, such as a fan, which replaces the fan 238.

[0035] From the above description, it is clear that with a display case 10, 110 or 210 according to the invention, it is possible to regulate and control filtration and climate control completely independently of each other. Both of these operations can then be optimised so that the filtering and climate control capabilities can be utilised to their fullest potential without unnecessary waste of resources.

Claims

1. Museum display case, comprising a display space (14; 214), a filtration system (20; 220) and a climate control system (30; 230) for treating the air in the display space (14; 214), **characterised by** comprising a first air circulation circuit (21; 221) and a second air circulation circuit (31; 231), separate from each other but both originating and terminating in the display space (14; 214), wherein the filtration system (20; 220) is included in the first air circulation circuit (21; 221) and the climate control system (30; 230) is included in the second air circulation circuit (31; 231).
2. Museum display case according to claim 1, wherein each air circulation circuit (21, 31; 221, 231) comprises a respective pumping means (28, 38; 228, 238) for moving air within the circuit from an intake port (22, 32; 222, 232) facing into the display space (14; 214) to a delivery port (27, 37; 227, 237) facing into the display space (14; 214).
3. Museum display case according to claim 2, wherein the intake port (22, 32; 222, 232) of each circuit (21, 31; 221, 231) is in a remote position with respect to the delivery port (27, 37; 227, 237) of the same circuit (21, 31; 221, 231).
4. Museum display case according to claim 3, wherein the display case has at least one opaque vertical wall (217), wherein each air circulation circuit (221, 231) comprises a section (226, 236) extending in the opaque vertical wall (217), and wherein one from between the intake port (222, 232) and the delivery port (227, 237) of each circuit (221, 231) is located at the top of the display space (214), and the other from between the intake port (222, 232) and the delivery port (227, 237) is located at the bottom of the display space (214).
5. Museum display case according to claim 4, wherein the delivery ports (227, 237) of both circuits (221, 231) are located at the top of the display space (214), whereas the intake ports (222, 232) of both circuits (221, 231) are located at the bottom of the display space (214).
6. Museum display case according to claim 2, wherein the display case has vertical walls (16) that are all transparent, wherein the intake port (22, 32) and the delivery port (27, 37) of each circuit (21, 31) are both located at the bottom of the display space (14).
7. Museum display case according to any one of the preceding claims, wherein the filtration system (20; 220) comprises at least one passive mechanical filter (25; 225).

8. Museum display case according to any one of the preceding claims, wherein the climate control system (30; 230) comprises a compartment (33; 233) containing hygroscopic material and/or a thermal machine (135), for controlling humidity and/or air temperature. 5

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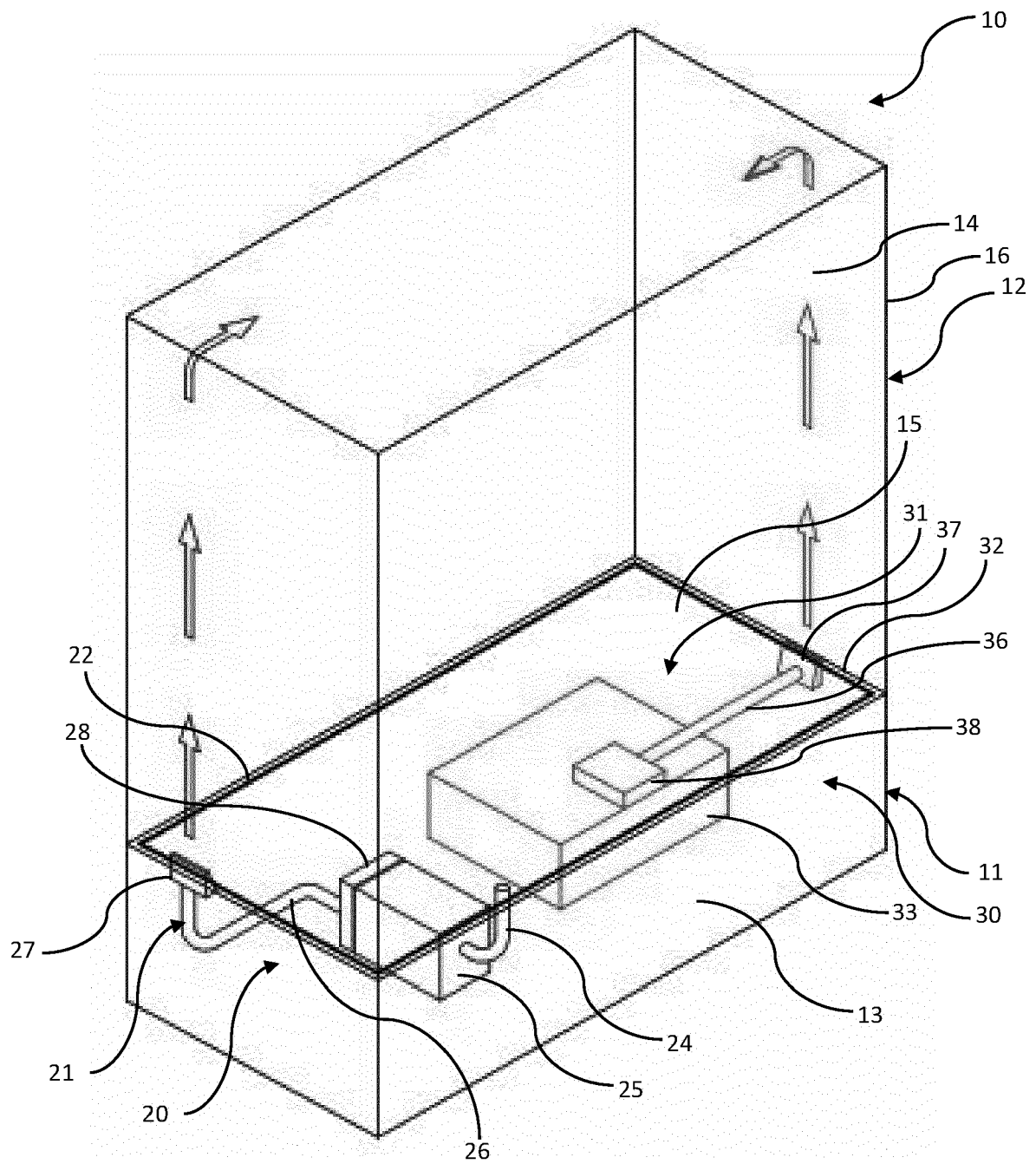


Fig. 1

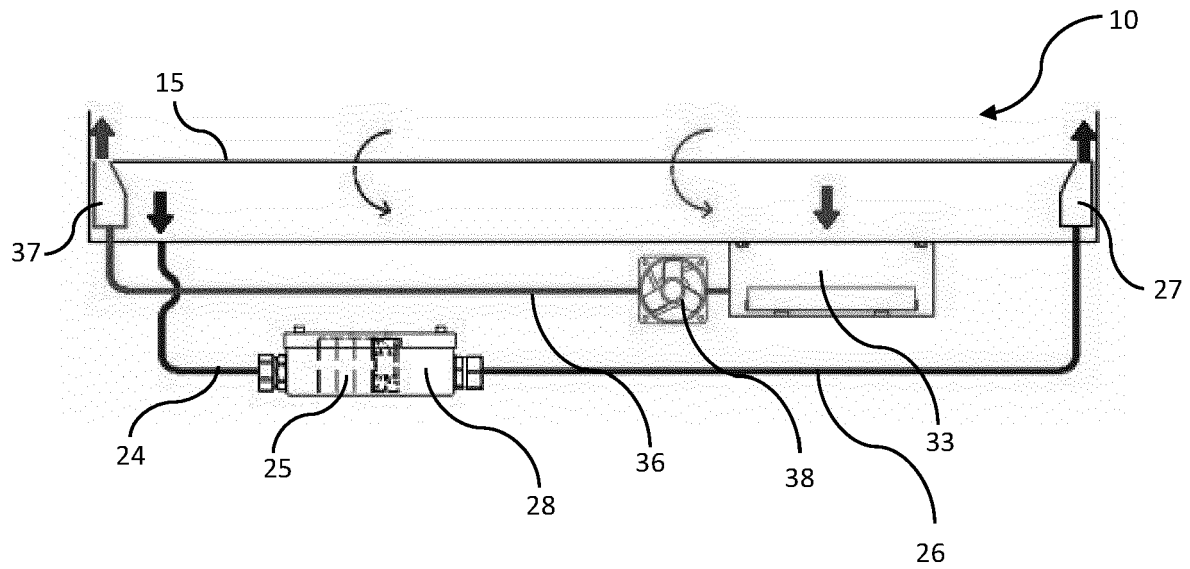


Fig. 2

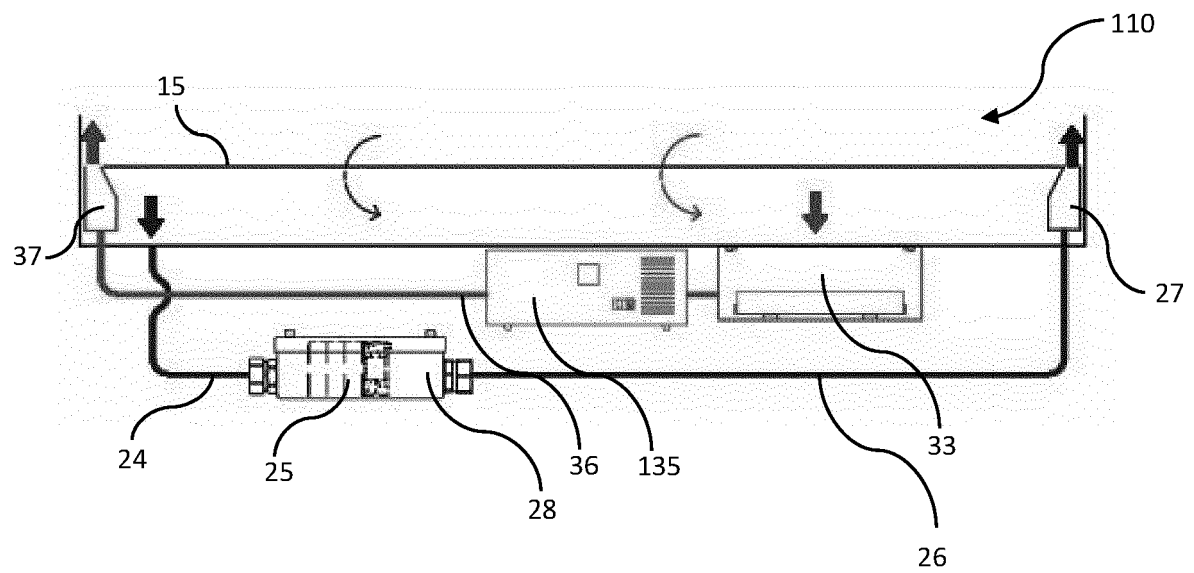


Fig. 3

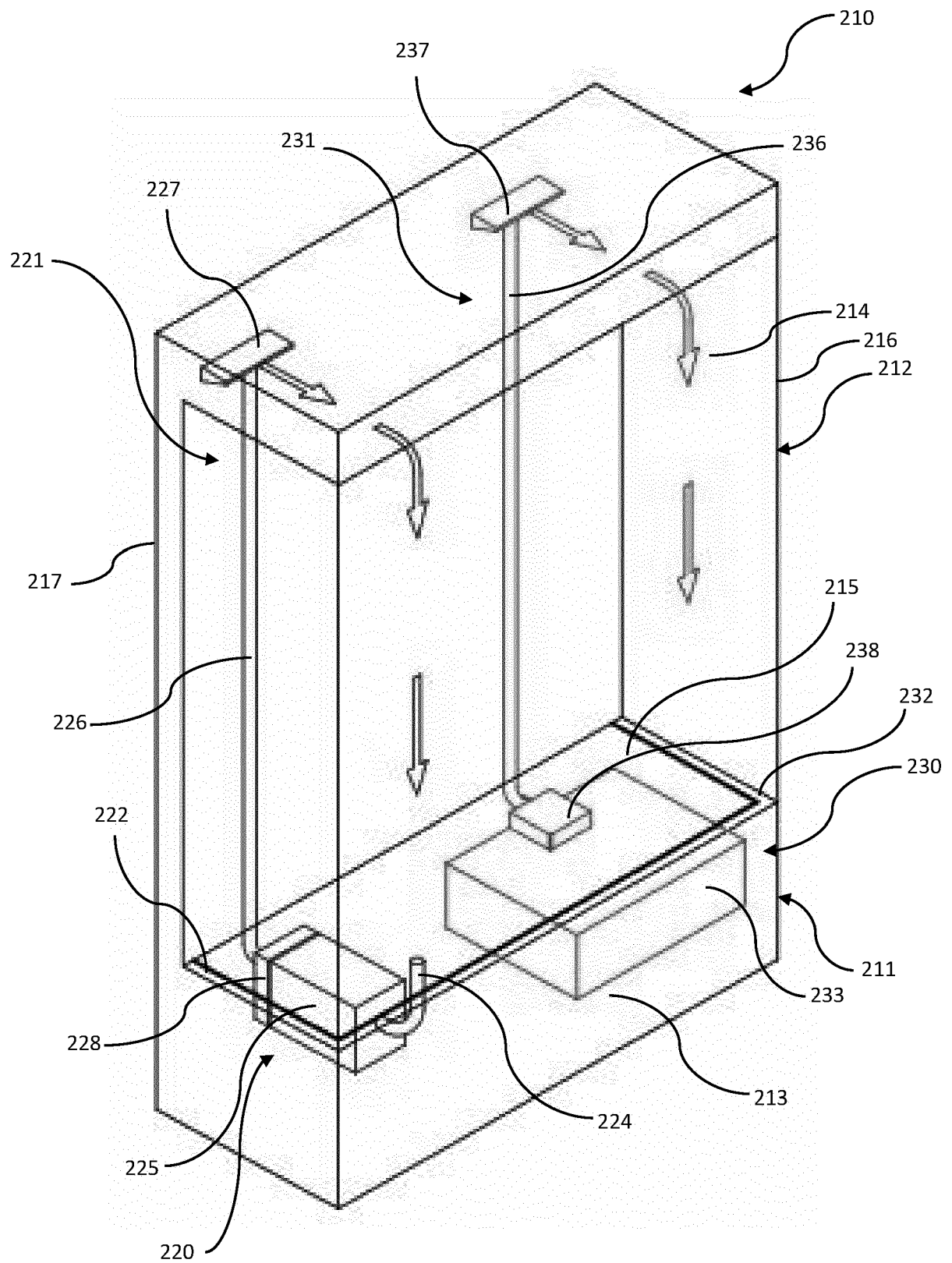


Fig. 4



EUROPEAN SEARCH REPORT

Application Number

EP 23 18 0487

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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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			TECHNICAL FIELDS SEARCHED (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
The Hague		3 July 2023	Vigilante, Marco
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention 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	

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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