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(54) Title: PREFABRICATED BATHROOM MODULE WITH LEAKAGE PROTECTION

(57) Abstract: In accordance with one or more embodiments herein, a prefabricated bathroom module (200) is provided. The prefabricated bathroom module (200) comprises a watertight tray (410), made from an age-resistant material and having the same size as the floor area of the bathroom module (200). The watertight tray (410) is arranged in the floor of the bathroom module (200), below a watertight covering membrane, and is age-resistantly sealed together with a floor drain (420) of the bathroom module (200). The watertight tray (410) may e.g. be a stainless steel tray that is welded together with the floor drain (420).

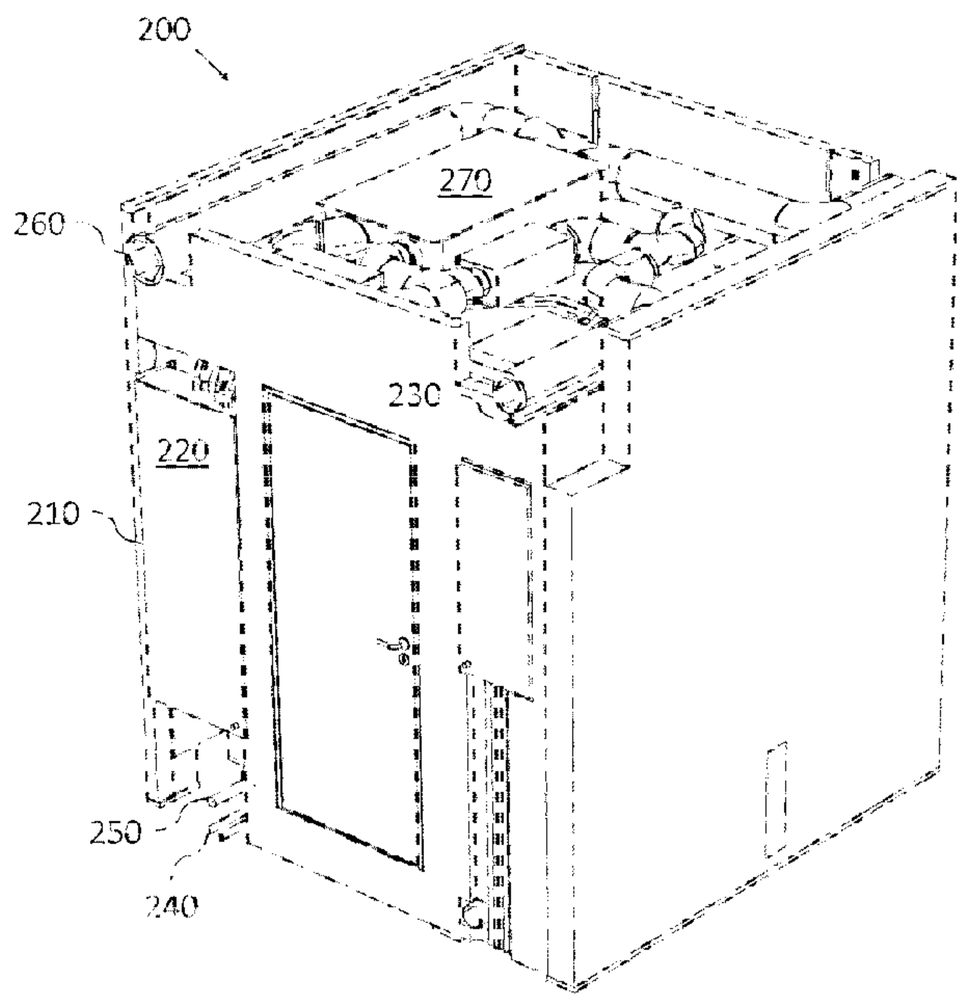

Figure 2

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PREFABRICATED BATHROOM MODULE WITH LEAKAGE PROTECTION

TECHNICAL FIELD

The present disclosure relates generally to prefabricated bathroom modules, methods of prefabricating bathroom modules, and buildings comprising such prefabricated bathroom modules.

BACKGROUND

US10287782 describes a building concept where the location of rooms such as bathrooms and kitchens can be easily changed during the lifespan of the building. The building concept is based on a load bearing frame made of vertical duct elements joined by floors to a load bearing lattice framework. Sewers, water, air removal and communications are arranged in the load bearing vertical duct elements, which comprise openable sections that provide access to the inside, and are dimensioned to carry structural loads without the openable sections. This provides flexibility by allowing division of the room spaces to be done as non-load bearing structures.

US9556632 describes a building method using prefabricated room modules, including prefabricated bathroom modules. The prefabricated bathroom modules may comprise all technical installations, such as e.g. ventilation ducts, mains electricity cables, low voltage electrical cables, water supply pipes, sewage pipes, heating systems, cooling systems, and sprinkler systems. They may also have a watertight covering membrane on the interior walls and floor, so that the bathroom modules are completely finished and ready for mounting and connection.

PROBLEMS WITH THE PRIOR ART

In the building concept described in US10287782, bathrooms can only be placed in connection with the load bearing frame, and all installation work must be done on-site.

The bathroom modules described in US9556632 comprise shafts within which the installations extend. Vertical (or horizontal) ducts for the installations are created by placing the bathroom modules on top of each other (or side by side) and connecting the installations with each other using connecting devices. This means that the bathroom modules most be placed in the same position in each apartment, in order to create ducts for the installations in the building.

There is a need for a prefabricated bathroom module that allows free placement of the bathrooms in a building.

SUMMARY

The above described problem is addressed by the claimed prefabricated bathroom module comprising a watertight tray made from an age-resistant material. The watertight tray preferably has the same size as the floor area of the bathroom module, and is arranged in the floor of the bathroom module, below a watertight covering membrane. The watertight tray is preferably age-resistantly sealed together with a floor drain of the bathroom module. This arrangement provides long-lasting leakage protection in a prefabricated bathroom module. The age-resistant material is preferably a material that lasts for at least 100 years, since this is the expected lifetime of most buildings.

The age-resistant material of the watertight tray is preferably the same as the material of the floor drain. In embodiments, the watertight tray and the floor drain are made of stainless steel, and are age-resistantly sealed together by being welded together.

In embodiments, the floor drain is connected to external sewer piping through sewer pipes in the floor of the bathroom module, and the floor drain and the sewer pipes are arranged in a sewer enclosure together with a moisture sensor. Preferably, all sewer pipes in the bathroom module, i.e. also sewer pipes from e.g. a toilet and/or a sink, are arranged in the same sewer enclosure. In this way, any leakage from any of the sewer pipes in the bathroom module may be detected, using one single moisture sensor.

In embodiments, the bottom of the sewer enclosure is sealed with a watertight, age-resistant material. Preferably, the watertight, age-resistant material also extends up to at least parts of the side walls of the sewer enclosure. Any leakage from any of the sewer pipes in the bathroom module will then be contained in the sewer enclosure.

In embodiments, the prefabricated bathroom module comprises one single cold water connection point to an external water supply for all cold water pipes in the bathroom module, and one single sewer connection point to external sewer piping for all sewer pipes in the bathroom module, wherein said connection points are positioned to allow connection to external water supply and sewer piping that is horizontally placed below a floor of an apartment in which the bathroom module is to be installed. The building in which the prefabricated bathroom modules are to be installed preferably comprises at least one vertical duct that is arranged separate from the apartments, e.g. in a stairwell duct. Easy connection to horizontal piping under the floor of an apartment to such a vertical duct enables free placement of the prefabricated bathroom module in the apartment.

In embodiments, the bathroom module further comprises other technical installations, such as one or more of mains electricity cables, low voltage electrical cables, heating systems, cooling systems, and sprinkler systems. The prefabricated bathroom module preferably comprises one single connection point for each type

of technical installation. The prefabricated bathroom module may comprise all technical installations that are needed, such as e.g. mains electricity cables, low voltage electrical cables, water supply pipes, sewage pipes, heating systems, cooling systems, and sprinkler systems. For each of the technical installations, the prefabricated bathroom module preferably comprises one single connection point to external installations that are horizontally placed below a floor of an apartment in which the bathroom module is to be installed. These connection points are preferably arranged adjacent to each other, for easier connection of the bathroom module to external technical installations. The connections are preferably standardized, so that no specialist skills are required for installation.

In embodiments, the floor of the bathroom module is arranged to have the same height as a floor of an apartment in which the bathroom module is to be installed. This simplifies the installation of the bathroom module and the connection of the technical installations, since the external piping and cables may be arranged below the floor of the apartment.

In embodiments, the bathroom module comprises central control equipment, in the form of a central control unit or a number of different control units, for control and monitoring of one or more of water, electricity, heating and ventilation for an entire apartment. A number of different sensors are preferably arranged in the prefabricated bathroom module for monitoring purposes. This allows the building to be constructed without any other control functionality, since each apartment may be controlled from its bathroom module. The central control equipment may comprise any number of control units, and it may be arranged to collect data. This data may optionally be transmitted to external control and monitoring equipment, which may be located remotely from the building.

In embodiments, the bathroom module comprises a water heating arrangement for heating water, such as e.g. a heat exchanger, and one single hot water connection point for supplying hot water to an entire apartment from the bathroom module. This allows the building to be constructed without any means for supplying hot water to the apartments, since each apartment is able to generate its own hot water in the bathroom module. However, hot water may also be supplied to the bathroom module from an external hot water supply.

In embodiments, all water pipes are arranged in first recesses of wall elements of the bathroom module, where the first recesses are arranged to allow the water pipes to be exchanged from the inside of the bathroom module, and all sewer pipes are arranged in second recesses of wall and/or floor elements of the bathroom module, where the second recesses are arranged to allow the sewer pipes to be exchanged from the inside of the bathroom module. Arrangement of water pipes and sewer pipes in recesses in wall and floor elements of the bathroom module means that water pipes and sewer pipes can be exchanged without this affecting the apartment outside of the bathroom module. Since the expected lifetime of most buildings is

much longer than the expected lifetime of the water pipes and sewer pipes, it is an advantage to be able to exchange the water pipes and sewer pipes from the inside of the bathroom module.

In embodiments, the bathroom module comprises ventilation pipes installed above the ceiling of the bathroom module. The ventilation pipes of the room module may be connected to ventilation pipes above the ceiling and/or below the floor of the apartment, which connect the ventilation pipes in the room module to air inlets and air outlets that are preferably arranged at the outside of the building. The ventilation pipes of the room module in this way do not have to be connected to any central ventilation system for the entire building. Instead, the ventilation may be controlled by a ventilation control system that is arranged above the ceiling of the bathroom room module.

In embodiments, the bathroom module is constructed as a load-bearing structure to allow it to be installed at any position within an apartment, so that the bathroom module does not have to be placed on top of another bathroom module. The bathroom module preferably has the same bearing capacity as the surrounding building frame.

In embodiments, the bathroom module comprises a structure comprising cross-laminated timber (CLT). Preferably, the entire load-bearing structure of the bathroom module is constructed from CLT.

In embodiments, the bathroom module comprises a supporting structure in the form of horizontal and/or vertical steel beams, in order to allow the bathroom module to be installed in a building made of concrete. Since CLT is a material with different material properties than concrete, installation of a bathroom module constructed entirely from CLT in a concrete building may lead to problems. If there is a supporting structure in the form of horizontal and/or vertical steel beams in the bathroom module, the frame of the concrete building may be connected to this supporting structure instead of to the CLT.

The above described problem is further addressed by the claimed method of prefabricating a bathroom module. The method may comprise: arranging a watertight tray, made from an age-resistant material and having the same size as the floor area of the bathroom module, in the floor of the bathroom module; age-resistantly sealing together the watertight tray and a floor drain of the bathroom module; and arranging a watertight covering membrane above the watertight tray. This arrangement provides long-lasting leakage protection in a prefabricated bathroom module. The age-resistant material is preferably a material that lasts for at least 100 years, since this is the expected lifetime of most buildings.

In embodiments, the age-resistant material of the watertight tray is the same as the material of the floor drain. In embodiments, the age-resistant material is stainless steel, and the sealing comprises welding together the stainless steel tray with the floor drain.

In embodiments, the method further comprises arranging the floor drain, together with sewer pipes arranged for connecting the floor drain to external sewer piping, in a sewer enclosure together with a moisture sensor. Preferably, all sewer pipes in the bathroom module, i.e. also sewer pipes from e.g. a toilet and/or a sink, are arranged in the same sewer enclosure. In this way, any leakage from any of the sewer pipes in the bathroom module may be detected, using one single moisture sensor.

In embodiments, the method further comprises sealing the bottom of the sewer enclosure with a watertight, age-resistant material. Preferably, the watertight, age-resistant material also extends up to at least parts of the side walls of the sewer enclosure. Any leakage from any of the sewer pipes in the bathroom module will then be contained in the sewer enclosure.

In embodiments, the method further comprises arranging one single cold water connection point to an external water supply for all cold water pipes in the bathroom module, in a position that allows connection to external water supply piping that is horizontally placed below a floor of an apartment in which the bathroom module is to be installed; and arranging one single sewer connection point to external sewer piping for all sewer pipes in the bathroom module, in a position that allows connection to external sewer piping that is horizontally placed below a floor of an apartment in which the bathroom module is to be installed.

In embodiments, the method further comprises arranging also other technical installations, such as one or more of: mains electricity cables, low voltage electrical cables, heating systems, cooling systems, and sprinkler systems, in the prefabricated bathroom module, with one single connection point for each type of technical installation. The prefabricated bathroom module may comprise all technical installations that are needed, such as e.g. mains electricity cables, low voltage electrical cables, water supply pipes, sewage pipes, heating systems, cooling systems, and sprinkler systems. For each of the technical installations, the prefabricated bathroom module preferably comprises one single connection point to external installations that are horizontally placed below a floor of an apartment in which the bathroom module is to be installed. These connection points are preferably arranged adjacent to each other, for easier connection of the bathroom module to external technical installations. The connections are preferably standardized, so that no specialist skills are required for installation.

In embodiments, the method further comprises arranging the floor of the bathroom module to have the same height as a floor of an apartment in which the bathroom module is to be installed. This simplifies the installation of the bathroom module and the connection of the technical installations, since the external piping and cables may be arranged below the floor of the apartment.

In embodiments, the method further comprises arranging central control equipment, in the form of a central control unit or a number of different control units, for control and monitoring of one or more of water,

electricity, heating and ventilation for an entire apartment in the bathroom module. A number of different sensors are preferably arranged in the prefabricated bathroom module for monitoring purposes. This allows the building to be constructed without any other control functionality, since each apartment may be controlled from its bathroom module. The central control equipment may comprise any number of control units, and it may be arranged to collect data. This data may optionally be transmitted to external control and monitoring equipment, which may be located remotely from the building.

In embodiments, the method further comprises arranging a water heating arrangement for heating water, such as e.g. a heat exchanger, and one single hot water connection point for supplying hot water to an entire apartment, in the bathroom module. This allows the building to be constructed without any means for supplying hot water to the apartments, since each apartment is able to generate its own hot water in the bathroom module. However, hot water may also be supplied to the bathroom module from an external hot water supply.

In embodiments, the method further comprises arranging all water pipes in the bathroom module in first recesses of wall elements of the bathroom module, wherein the first recesses are arranged to allow the water pipes to be exchanged from the inside of the bathroom module, and arranging all sewer pipes in the bathroom module in second recesses of wall and/or floor elements of the bathroom module, wherein the second recesses are arranged to allow the sewer pipes to be exchanged from the inside of the bathroom module. Arrangement of water pipes and sewer pipes in recesses in wall and floor elements of the bathroom module means that water pipes and sewer pipes can be exchanged without this affecting the apartment outside of the bathroom module. Since the expected lifetime of most buildings is much longer than the expected lifetime of the water pipes and sewer pipes, it is an advantage to be able to exchange the water pipes and sewer pipes from the inside of the bathroom module.

In embodiments, the method further comprises installing ventilation pipes above the ceiling of the bathroom module. The ventilation pipes of the room module may be connected to ventilation pipes above the ceiling and/or below the floor of the apartment, which connect the ventilation pipes in the room module to air inlets and air outlets that are preferably arranged at the outside of the building. The ventilation pipes of the room module in this way do not have to be connected to any central ventilation system for the entire building. Instead, the ventilation may be controlled by a ventilation control system that is arranged above the ceiling of the bathroom room module.

In embodiments, the method further comprises constructing the bathroom module as a load-bearing structure to allow it to be installed at any position within an apartment, so that the bathroom module does not have to be placed on top of another bathroom module. The bathroom module preferably has the same bearing capacity as the surrounding building frame.

In embodiments, the method further comprises constructing the bathroom module to comprise a structure comprising cross-laminated timber (CLT). Preferably, the entire load-bearing structure of the bathroom module is constructed from CLT.

In embodiments, the method further comprises constructing the bathroom module to comprise a supporting structure in the form of horizontal and/or vertical steel beams, in order to allow the bathroom module to be installed in a building made of concrete. Since CLT is a material with different material properties than concrete, installation of a bathroom module constructed entirely from CLT in a concrete building may lead to problems. If there is a supporting structure in the form of horizontal and/or vertical steel beams in the bathroom module, the frame of the concrete building may be connected to this supporting structure instead of to the CLT.

The above described problem is further addressed by the claimed building comprising a number of apartments, where each apartment comprises at least one prefabricated bathroom module according to the above. The building preferably comprises at least one vertical duct, in which water supply and sewer piping is arranged, wherein the at least one vertical duct is arranged separate from the apartments, e.g. in a stairwell duct.

In this application, the term “apartment” means a self-contained unit that occupies only part of a building, generally but not necessarily on a single storey. The apartment may be a housing unit, but it may also be e.g. a business suite.

In this application, the term “floor” means the physical floor of an apartment, which is sometimes called the surface floor or the interior floor. The floor of an apartment is usually laid on top of joists or girders that are placed on top of a subfloor, which leaves room for installations in the space between the surface flooring and the subfloor. One example of such a flooring solution is the Granab subfloor system.

The scope of the invention is defined by the claims, which are incorporated into this section by reference. A more complete understanding of embodiments of the invention will be afforded to those skilled in the art, as well as a realization of additional advantages thereof, by a consideration of the following detailed description of one or more embodiments. Reference will be made to the appended sheets of drawings that will first be described briefly.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates a building comprising apartments with prefabricated bathroom modules, in accordance with one or more embodiments described herein.

Fig. 2 illustrates a prefabricated bathroom module, in accordance with one or more embodiments described herein.

Figs. 3a-c illustrate installations in a prefabricated bathroom module, in accordance with one or more embodiments described herein.

Figs. 4a-b illustrate a watertight tray which may be arranged in the floor of a prefabricated bathroom module, in accordance with one or more embodiments described herein.

Fig. 5 schematically illustrates a method of prefabricating a bathroom module, in accordance with one or more embodiments described herein.

Embodiments of the present disclosure and their advantages are best understood by referring to the detailed description that follows. It should be appreciated that like reference numerals are used to identify like elements illustrated in one or more of the figures.

DETAILED DESCRIPTION

Prior art bathroom modules impose restrictions to the placement of the bathrooms in a building. The bathroom module according to the disclosure instead enables free placement of the bathrooms in a building. Embodiments of the disclosed solution are presented in more detail in connection with the figures.

Fig. 1 illustrates a building 100 comprising apartments 110 with prefabricated bathroom modules 200. The building 100 comprises at least one vertical duct 120 that is arranged separate from the apartments 110, e.g. in a stairwell duct. Easy connection to horizontal piping 130 under the floor 140 of an apartment 110 to such a vertical duct 120 enables free placement of the prefabricated bathroom module 200 in the apartment 110.

In embodiments, the bathroom module 200 is constructed as a load-bearing structure to allow it to be placed in any position within an apartment 110, so that the bathroom module 200 does not have to be placed on top of another bathroom module 200. The bathroom module 200 preferably has the same bearing capacity as the surrounding building frame, and may thus form a part of the building frame.

In embodiments, the bathroom module 200 comprises a structure comprising cross-laminated timber (CLT). Preferably, the entire load-bearing structure of the bathroom module 200 is constructed from CLT.

In embodiments, the bathroom module 200 comprises a supporting structure in the form of horizontal and/or vertical steel beams, in order to allow the bathroom module 200 to be installed in a building 100 made of concrete. Since CLT is a material with different material properties than concrete, installation of a bathroom module 200 constructed entirely from CLT in a concrete building may lead to problems. If there is a

supporting structure in the form of horizontal and/or vertical steel beams in the bathroom module 200, the frame of the concrete building may be connected to this supporting structure instead of to the CLT. Such steel beams are preferably placed along the edges of the bathroom module 200, and may e.g. be placed in recesses in the CLT or be mounted outside of the CLT.

Fig.2 illustrates a prefabricated bathroom module 200, and Figs. 3a-c illustrate installations in a prefabricated bathroom module 200.

The prefabricated bathroom module 200 shown in Fig. 2 comprises ventilation pipes 260 installed above the ceiling of the bathroom module 200. The ventilation pipes 260 of the bathroom module 200 may be connected to ventilation pipes above the ceiling and/or below the floor of the apartment 110, which connect the ventilation pipes 260 in the bathroom module 200 to air inlets and air outlets that are preferably arranged at the outside of the building 100. The ventilation pipes 260 of the bathroom module 200 do in this way not have to be connected to any central ventilation system for the entire building 100. Instead, the ventilation may be controlled by a ventilation control system 270 that is arranged above the ceiling of the bathroom room module 200.

The prefabricated bathroom module 200 shown in Fig. 2 comprises central control equipment, in the form of a central control unit 210 or a number of different control units, for control and monitoring of one or more of water, electricity, heating and ventilation for an entire apartment 110. A number of different sensors are preferably arranged in the prefabricated bathroom module 200 for monitoring purposes. This allows the building 100 to be constructed without any other control functionality, since each apartment 110 may be controlled from its bathroom module 200. The central control equipment may comprise any number of control units, and it may be arranged to collect data. This data may optionally be transmitted to external control and monitoring equipment, which may be located remotely from the building 100. The central control equipment and all other installations in the prefabricated bathroom module 200 may be pre-engineered for apartments 110 of any size.

In embodiments, the prefabricated bathroom module 200 comprises a water heating arrangement 220 for heating water, such as e.g. a heat exchanger, and one single hot water connection point 230 for supplying hot water to an entire apartment 110 from the bathroom module 200. This allows the building 100 to be constructed without any means for supplying hot water to the apartments 110, since each apartment 110 is able to generate its own hot water in the bathroom module 200. However, hot water may also be supplied to the bathroom module 200 from an external hot water supply.

In the prefabricated bathroom module 200 shown in Figs. 3a-b, water pipes 350 are arranged in first recesses 340 of wall elements 330 of the bathroom module 200, where the first recesses 340 are arranged to allow the water pipes 350 to be exchanged from the inside of the bathroom module 200.

In the prefabricated bathroom module 200 shown in Figs. 3a-b, sewer pipes 380 are arranged in second recesses 370 of wall and/or floor elements 330, 360 of the bathroom module 200, where the second recesses 370 are arranged to allow the sewer pipes 380 to be exchanged from the inside of the bathroom module 200.

Arrangement of water pipes 350 and sewer pipes 380 in recesses 340, 370 in wall and floor elements 330, 360 of the bathroom module 200 means that water pipes 350 and sewer pipes 380 can be exchanged without this affecting the apartment 110 outside of the bathroom module 200. Since the expected lifetime of most buildings is much longer than the expected lifetime of the water pipes 350 and sewer pipes 380, it is an advantage to be able to exchange the water pipes 350 and sewer pipes 380 from the inside of the bathroom module 200.

The prefabricated bathroom module 200 shown in Fig. 2 comprises one single cold water connection point 240 to an external water supply for all cold water pipes 350 in the bathroom module 200, and one single sewer connection point 250 to external sewer piping for all sewer pipes 380 in the bathroom module. As shown in Fig. 2, these connection points 240, 250 may be positioned below the floor of the bathroom module 200, in order to allow connection to external water supply and sewer piping 130 that is horizontally placed below a floor 140 of an apartment 110 in which the bathroom module 200 is to be installed.

In embodiments, the floor of the prefabricated bathroom module 200 is arranged to have the same height as a floor 140 of the apartment 110 in which the prefabricated bathroom module 200 is to be installed. This simplifies the installation of the prefabricated bathroom module 200 and the connection of the technical installations, since the external piping 130 and cables may be arranged below the floor 140 of the apartment 110.

The prefabricated bathroom module 200 may also comprise a number of other technical installations. Such technical installations may e.g. be one or more of mains electricity cables, low voltage electrical cables, heating systems, cooling systems, and sprinkler systems. In embodiments, the prefabricated bathroom module 200 comprises all technical installations that are needed, such as e.g. mains electricity cables, low voltage electrical cables, water supply pipes, sewage pipes, heating systems, cooling systems, and sprinkler systems. For each type of technical installation, the prefabricated bathroom module 200 preferably comprises one single connection point to external installations. These connection points may be horizontally placed below a floor 140 of an apartment 110 in which the prefabricated bathroom module 200 is to be

installed. The connection points are preferably arranged adjacent to each other, for easier connection of the bathroom module 200 to external technical installations. The connections are preferably standardized, so that no specialist skills are required for installation.

As shown in Figs. 3a-c, the prefabricated bathroom module 200 preferably comprises a sewer enclosure 310, arranged in the floor of the prefabricated bathroom module 200. The floor drain 420 of the prefabricated bathroom module 200 is preferably connected to external sewer piping through sewer pipes 380. The floor drain 420 and the sewer pipes 380 are preferably arranged in the sewer enclosure 310 together with a moisture sensor 320, shown in Fig. 3c. Preferably, all sewer pipes 380 in the bathroom module, i.e. also sewer pipes 380 from e.g. a toilet and/or a sink, are arranged in the same sewer enclosure 310. In this way, any leakage from any of the sewer pipes 380 in the bathroom module 200 may be detected, using one single moisture sensor 320.

In embodiments, the bottom 315 of the sewer enclosure 310 is sealed with a watertight, age-resistant material. Preferably, the watertight, age-resistant material also extends up to at least parts of the side walls of the sewer enclosure 310. Any leakage from any of the sewer pipes 380 in the bathroom module 200 will then be contained in the sewer enclosure 310.

Figs. 4a-b illustrate a watertight tray 410, made from an age-resistant material and having the same size as the floor area of the bathroom module 200, which may be arranged in the floor of the bathroom module 200, below a watertight covering membrane. The watertight covering membrane is a waterproofing layer that is often required by law and/or regulations to be present in a bathroom. When a watertight tray 410 is used, such a watertight covering membrane is not strictly necessary, but serves to protect the watertight tray 410, so that it will be even more age-resistant.

Fig. 4a is a view from the above of the watertight tray 410, and Fig. 4b is a view from the below of the watertight tray 410. The watertight tray 410 may be age-resistantly sealed together with the floor drain 420 of the bathroom module, e.g. by being welded together with the floor drain 420. This arrangement provides long-lasting leakage protection in a prefabricated bathroom module 200. The age-resistant material of the watertight tray 410 may be the same as the material of the floor drain 420. The age-resistant material is preferably a material that lasts for at least 100 years, since this is the expected lifetime of most buildings. The age-resistant material may e.g. be stainless steel.

The watertight tray 410 shown in Figs. 4a-b is shaped to create a fall towards the floor drain 420. The fall may be arranged already in the floor elements 360 of the bathroom module 200, below the watertight tray 410, but the watertight tray 410 preferably has a shape corresponding to the surface shape of the floor elements 360.

Figure 5 schematically illustrates a method 500 of prefabricating a bathroom module 200. The method 500 may comprise:

Step 520: arranging a watertight tray 410, made from an age-resistant material and having the same size as the floor area of the bathroom module 200, in the floor of the bathroom module 200. The age-resistant material is preferably a material that lasts for at least 100 years, since this is the expected lifetime of most buildings.

Step 525: age-resistantly sealing together the watertight tray 410 and a floor drain 420 of the bathroom module 200. In embodiments, the age-resistant material of the watertight tray 410 is the same as the material of the floor drain 420. In embodiments, the age-resistant material is stainless steel, and the sealing comprises welding together the stainless steel tray 410 with the floor drain 420.

Step 530: arranging a watertight covering membrane above the watertight tray 410.

This provides long-lasting leakage protection in a prefabricated bathroom module 200, which enables free placement of the prefabricated bathroom module 200 in the apartment 110, also in a position not directly above another prefabricated bathroom module 200.

In embodiments, the method 500 further comprises one or more of the following:

Step 510: arranging the floor drain 420, together with sewer pipes arranged for connecting the floor drain 420 to external sewer piping, in a sewer enclosure 310 together with a moisture sensor 320. Preferably, all sewer pipes 380 in the bathroom module, i.e. also sewer pipes 380 from e.g. a toilet and/or a sink, are arranged in the same sewer enclosure 310. In this way, any leakage from any of the sewer pipes 380 in the bathroom module 200 may be detected, using one single moisture sensor 320.

Step 515: sealing the bottom 315 of the sewer enclosure 310 with a watertight, age-resistant material. Preferably, the watertight, age-resistant material also extends up to at least parts of the side walls of the sewer enclosure 310. Any leakage from any of the sewer pipes 380 in the bathroom module 200 will then be contained in the sewer enclosure 310.

Step 535: arranging all water pipes 350 in the bathroom module 200 in first recesses 340 of wall elements 330 of the bathroom module 200, wherein the first recesses 340 are arranged to allow the water pipes 350 to be exchanged from the inside of the bathroom module 200.

Step 540: arranging all sewer pipes 380 in the bathroom module in second recesses 370 of wall and/or floor elements 330, 360 of the bathroom module 200, wherein the second recesses 370 are arranged to allow the sewer pipes 380 to be exchanged from the inside of the bathroom module 200.

Arrangement of water pipes 350 and sewer pipes 380 in recesses 340, 370 in wall and floor elements 330, 360 of the bathroom module 200 means that water pipes 350 and sewer pipes 380 can be exchanged without this affecting the apartment 110 outside of the bathroom module 200. Since the expected lifetime of most buildings is much longer than the expected lifetime of the water pipes 350 and sewer pipes 380, it is an advantage to be able to exchange the water pipes 350 and sewer pipes 380 from the inside of the bathroom module 200.

Step 545: arranging one single cold water connection point 240 to an external water supply for all cold water pipes 350 in the bathroom module 200, in a position that allows connection to external water supply piping 130 that is horizontally placed below a floor 140 of an apartment 110 in which the bathroom module 200 is to be installed.

Step 550: arranging one single sewer connection point 250 to external sewer piping for all sewer pipes 380 in the bathroom module 200, in a position that allows connection to external sewer piping 130 that is horizontally placed below a floor 140 of an apartment 110 in which the bathroom module 200 is to be installed.

Step 555: arranging also other technical installations, such as one or more of mains electricity cables, low voltage electrical cables, heating systems, cooling systems, and sprinkler systems, in the prefabricated bathroom module 200, with one single connection point for each type of technical installation. The prefabricated bathroom module 200 may comprise all technical installations that are needed, such as e.g. mains electricity cables, low voltage electrical cables, water supply pipes, sewage pipes, heating systems, cooling systems, and sprinkler systems. For each of the technical installations, the prefabricated bathroom module 200 preferably comprises one single connection point to external installations that are horizontally placed below a floor 140 of an apartment 110 in which the bathroom module 200 is to be installed. These connection points are preferably arranged adjacent to each other, for easier connection of the bathroom module 200 to external technical installations. The connections are preferably standardized, so that no specialist skills are required for installation.

The building 100 in which the prefabricated bathroom modules 200 are to be installed preferably comprises at least one vertical duct 120 that is arranged separate from the apartments 110, e.g. in a stairwell duct. Easy connection to horizontal piping 130 under the floor 140 of an apartment 110 to such a vertical duct 120 then allows free placement of the prefabricated bathroom module 200 in the apartment 110.

Step 560: arranging central control equipment, in the form of a central control unit 210 or a number of different control units, for control and monitoring of one or more of water, electricity, heating and ventilation for an entire apartment 110 in the bathroom module 200. A number of different sensors are preferably

arranged in the prefabricated bathroom module 200 for monitoring purposes. This allows the building 100 to be constructed without any other control functionality, since each apartment 110 may be controlled from its bathroom module 200. The central control equipment may comprise any number of control units, and it may be arranged to collect data. This data may optionally be transmitted to external control and monitoring equipment, which may be located remotely from the building 100.

Step 565: arranging a water heating arrangement 220 for heating water, such as e.g. a heat exchanger, and one single hot water connection point 230 for supplying hot water to an entire apartment 110, in the bathroom module 200. This allows the building 100 to be constructed without any means for supplying hot water to the apartments 110, since each apartment 110 is able to generate its own hot water in the bathroom module 200. However, hot water may also be supplied to the bathroom module 200 from an external hot water supply.

Step 570: arranging the floor of the bathroom module 200 to have the same height as a floor 140 of an apartment 110 in which the bathroom module 200 is to be installed. This simplifies the installation of the bathroom module 200 and the connection of the technical installations, since the external piping 130 and cables may be arranged below the floor 140 of the apartment 110.

Step 575: installing ventilation pipes 260 above the ceiling of the bathroom module 200. The ventilation pipes 260 of the room module 200 may be connected to ventilation pipes above the ceiling and/or below the floor of the apartment 110, which connect the ventilation pipes 260 in the room module 200 to air inlets and air outlets that are preferably arranged at the outside of the building 100. The ventilation pipes 260 of the room module 200 in this way do not have to be connected to any central ventilation system for the entire building 100. Instead, the ventilation may be controlled by a ventilation control system 270 that is arranged above the ceiling of the bathroom room module 200.

Step 580: constructing the bathroom module 200 as a load-bearing structure to allow it to be installed at any position within an apartment 110, so that the bathroom module 200 does not have to be placed on top of another bathroom module 200. The bathroom module 200 preferably has the same bearing capacity as the surrounding building frame.

Step 585: constructing the bathroom module 200 to comprise a structure comprising cross-laminated timber (CLT). Preferably, the entire load-bearing structure of the bathroom module 200 is constructed from CLT.

Step 590: constructing the bathroom module 200 to comprise a supporting structure in the form of horizontal and/or vertical steel beams, in order to allow the bathroom module 200 to be installed in a building 100 made of concrete. Since CLT is a material with different material properties than concrete, installation of a bathroom module 200 constructed entirely from CLT in a concrete building may lead to problems. If there is a

supporting structure in the form of horizontal and/or vertical steel beams in the bathroom module 200, the frame of the concrete building 100 may be connected to this supporting structure instead of to the CLT.

The foregoing disclosure is not intended to limit the present invention to the precise forms or particular fields of use disclosed. It is contemplated that various alternate embodiments and/or modifications to the present invention, whether explicitly described or implied herein, are possible in light of the disclosure. For example, the steps of the method may be performed in any order that makes technical sense, including simultaneously. Accordingly, the scope of the invention is defined only by the claims.

CLAIMS

1. Prefabricated bathroom module (200) comprising a watertight tray (410), made from an age-resistant material and having the same size as the floor area of the bathroom module (200), arranged in the floor of the bathroom module (200), below a watertight covering membrane, wherein the watertight tray (410) is age-resistantly sealed together with a floor drain (420) of the bathroom module (200).

2. Prefabricated bathroom module (200) according to claim 1, wherein the age-resistant material of the watertight tray (410) is the same as the material of the floor drain (420).

3. Prefabricated bathroom module (200) according to claim 1 or 2, wherein the floor drain (420) is connected to external sewer piping through sewer pipes (380) in the floor of the bathroom module (200), and the floor drain (420) and the sewer pipes (380) are arranged in a sewer enclosure (310) together with a moisture sensor (320).

4. Prefabricated bathroom module (200) according to claim 3, wherein the bottom (315) of the sewer enclosure (320) is sealed with a watertight, age-resistant material.

5. Prefabricated bathroom module (200) according to any one of claims 1-4, wherein the bathroom module (200) comprises one single cold water connection point (240) to an external water supply for all cold water pipes in the bathroom module (200), and one single sewer connection point (250) to external sewer piping for all sewer pipes in the bathroom module (200), wherein said connection points (240, 250) are positioned to allow connection to external water supply and sewer piping (130) that is horizontally placed below a floor (140) of an apartment (110) in which the bathroom module (200) is to be installed.

6. Prefabricated bathroom module (200) according to claim 5, further comprising other technical installations, such as one or more of mains electricity cables, low voltage electrical cables, heating systems, cooling systems, and sprinkler systems, wherein the bathroom module (200) comprises one single connection point for each type of technical installation.

7. Prefabricated bathroom module (200) according to any one of claims 1-6, wherein the floor of the bathroom module (200) is arranged to have the same height as a floor (140) of an apartment (110) in which the bathroom module (200) is to be installed.

8. Prefabricated bathroom module (200) according to any one of claims 1-7, wherein the bathroom module (200) comprises central control equipment, in the form of a central control unit (210) or a number of different control units, for control and monitoring of one or more of water, electricity, heating and ventilation for an entire apartment (110).

9. Prefabricated bathroom module (200) according to any one of claims 1-8, wherein the bathroom module (200) comprises a water heating arrangement (220) for heating water, such as e.g. a heat exchanger, and one single hot water connection point (230) for supplying hot water to an entire apartment (110) from the bathroom module (200).

10. Prefabricated bathroom module (200) according to any one of claims 1-9, wherein all water pipes (350) are arranged in first recesses (340) of wall elements (330) of the bathroom module (200), where the first recesses (340) are arranged to allow the water pipes (350) to be exchanged from the inside of the bathroom module (200), and all sewer pipes (380) are arranged in second recesses (370) of wall and/or floor elements (330, 360) of the bathroom module (200), where the second recesses (370) are arranged to allow the sewer pipes (380) to be exchanged from the inside of the bathroom module (200).

11. Prefabricated bathroom module (200) according to any one of claims 1-10, wherein the bathroom module (200) comprises ventilation pipes (260) installed above the ceiling of the bathroom module (200).

12. Prefabricated bathroom module (200) according to any one of claims 1-11, wherein the bathroom module (200) is constructed as a load-bearing structure to allow it to be installed at any position within an apartment (110), so that the bathroom module (200) does not have to be placed on top of another bathroom module (200).

13. Prefabricated bathroom module (200) according to any one of claims 1-12, wherein the bathroom module (200) comprises a structure comprising cross-laminated timber (CLT).

14. Prefabricated bathroom module (200) according to claim 13, wherein the bathroom module (200) comprises a supporting structure in the form of horizontal and/or vertical steel beams, in order to allow the bathroom module (200) to be installed in a building (100) made of concrete.

15. Method (500) of prefabricating a bathroom module (200), characterized in that the method (500) comprises:

arranging (520) a watertight tray, made from an age-resistant material and having the same size as the floor area of the bathroom module (200), in the floor of the bathroom module (200);

age-resistantly sealing (525) together the watertight tray (410) and a floor drain (420) of the bathroom module (200); and

arranging (530) a watertight covering membrane above the watertight tray (410).

16. Method (500) according to claim 15, wherein the age-resistant material of the watertight tray (410) is the same as the material of the floor drain (420).

17. Method (500) according to claim 15 or 16, further comprising arranging (510) the floor drain (420), together with sewer pipes (380) arranged for connecting the floor drain (380) to external sewer piping, in a sewer enclosure (310) together with a moisture sensor (320).

18. Method (500) according to any one of claims 15-17, further comprising sealing (515) the bottom (315) of the sewer enclosure (310) with a watertight, age-resistant material.

19. Method (500) according to any one of claims 15-18, further comprising:

arranging (545) one single cold water connection point (240) to an external water supply for all cold water pipes (350) in the bathroom module (200), in a position that allows connection to external water supply piping (130) that is horizontally placed below a floor (140) of an apartment (110) in which the bathroom module (200) is to be installed; and

arranging (550) one single sewer connection point (250) to external sewer piping for all sewer pipes (380) in the bathroom module (200), in a position that allows connection to external sewer piping (130) that is horizontally placed below a floor (140) of an apartment (110) in which the bathroom module (200) is to be installed.

20. Method (500) according to claim 19, further comprising arranging (555) also other technical installations, such as one or more of: mains electricity cables, low voltage electrical cables, heating systems, cooling systems, and sprinkler systems, in the bathroom module, with one single connection point for each type of technical installation.

21. Method (500) according to any one of claims 15-20, further comprising arranging (570) the floor of the bathroom module (200) to have the same height as a floor (140) of an apartment (110) in which the bathroom module (200) is to be installed.

22. Method (500) according to any one of claims 15-21, further comprising arranging (560) central control equipment, in the form of a central control unit (210) or a number of different control units, for control and monitoring of one or more of water, electricity, heating and ventilation for an entire apartment (110) in the bathroom module (200).

23. Method (500) according to any one of claims 15-22, further comprising arranging (565) a water heating arrangement (220) for heating water, such as e.g. a heat exchanger, and one single hot water connection point (230) for supplying hot water to an entire apartment (110), in the bathroom module (200).

24. Method (500) according to any one of claims any one of claims 15-23, further comprising arranging (535) all water pipes (350) in the bathroom module (200) in first recesses (340) of wall elements (330) of the bathroom module (200), wherein the first recesses (340) are arranged to allow the water pipes (350) to be exchanged from the inside of the bathroom module (200), and arranging (540) all sewer pipes (380) in the bathroom module (200) in second recesses (370) of wall and/or floor elements (330, 360) of the bathroom module (200), wherein the second recesses (370) are arranged to allow the sewer pipes (380) to be exchanged from the inside of the bathroom module (200).

25. Method (500) according to any one of claims 15-24, further comprising installing (575) ventilation pipes (260) above the ceiling of the bathroom module (200).

26. Method (500) according to any one of claims 15-25, further comprising constructing (580) the bathroom module (200) as a load-bearing structure to allow it to be installed at any position within an apartment (110), so that the bathroom module (200) does not have to be placed on top of another bathroom module (200).

27. Method (500) according to any one of claims 15-26, further comprising constructing (585) the bathroom module (200) to comprise a structure comprising cross-laminated timber (CLT).

28. Method (500) according to any one of claims 15-27, further comprising constructing (590) the bathroom module (200) to comprise a supporting structure in the form of horizontal and/or vertical steel beams, in order to allow the bathroom module (200) to be installed in a building (100) made of concrete.

29. Building (100) comprising a number of apartments (110), characterized in that:

the building (100) comprises at least one vertical duct (120), in which water supply and sewer piping is arranged, wherein the at least one vertical duct (120) is arranged separate from the apartments (110), e.g. in a stairwell duct; and

each apartment (110) comprises at least one prefabricated bathroom module (200) according to any one of claims 1-14.

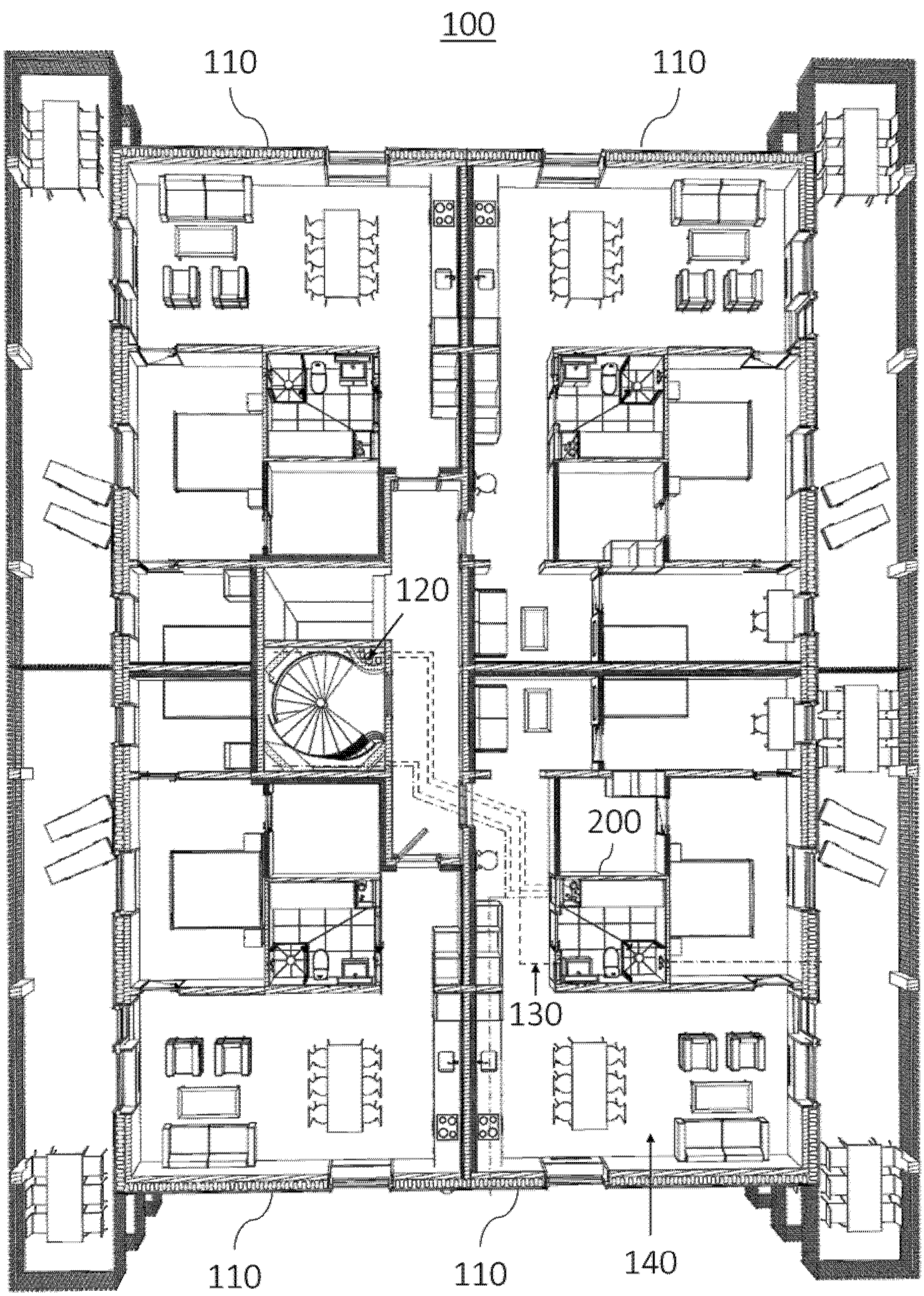

Figure 1

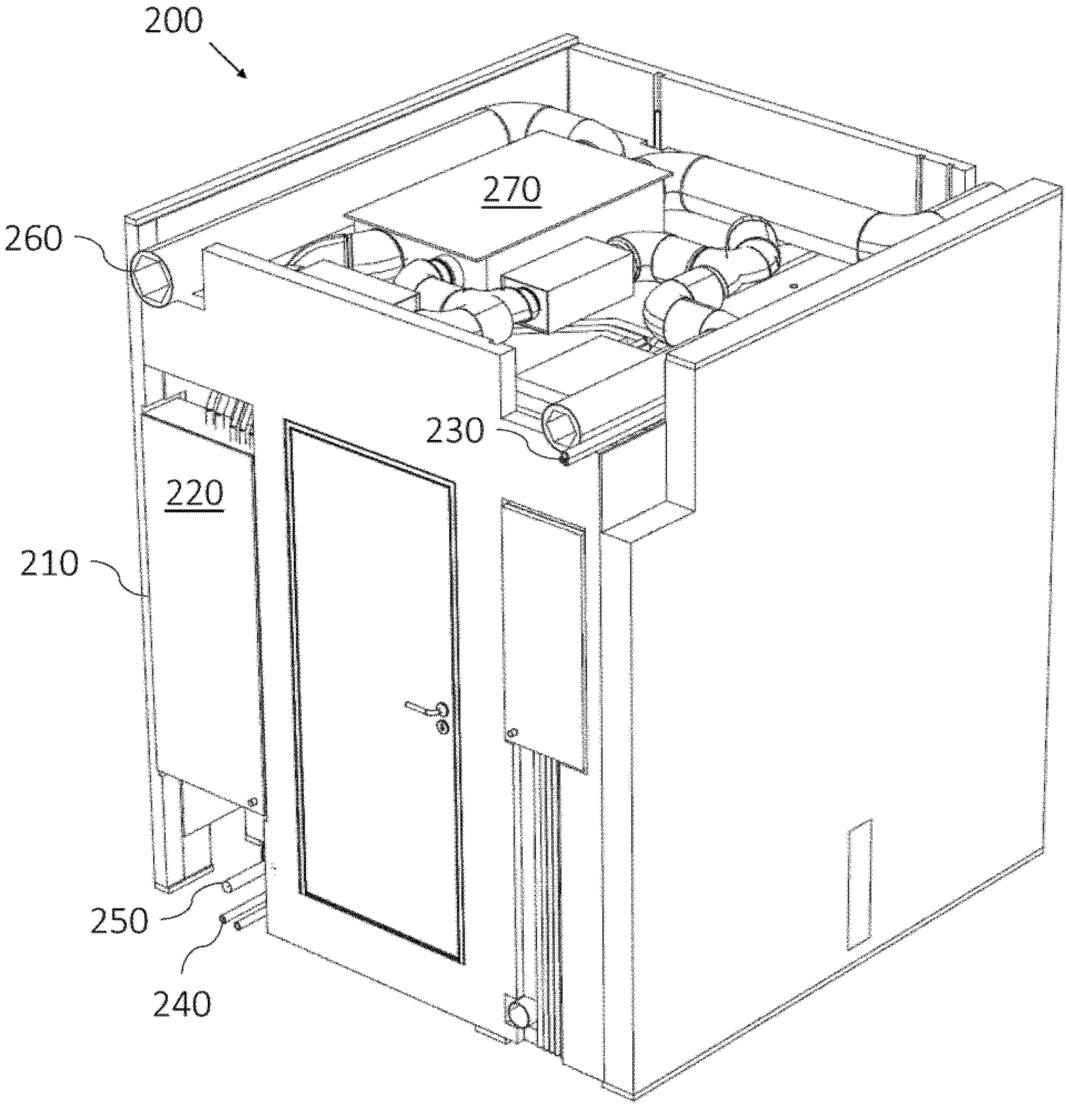

Figure 2

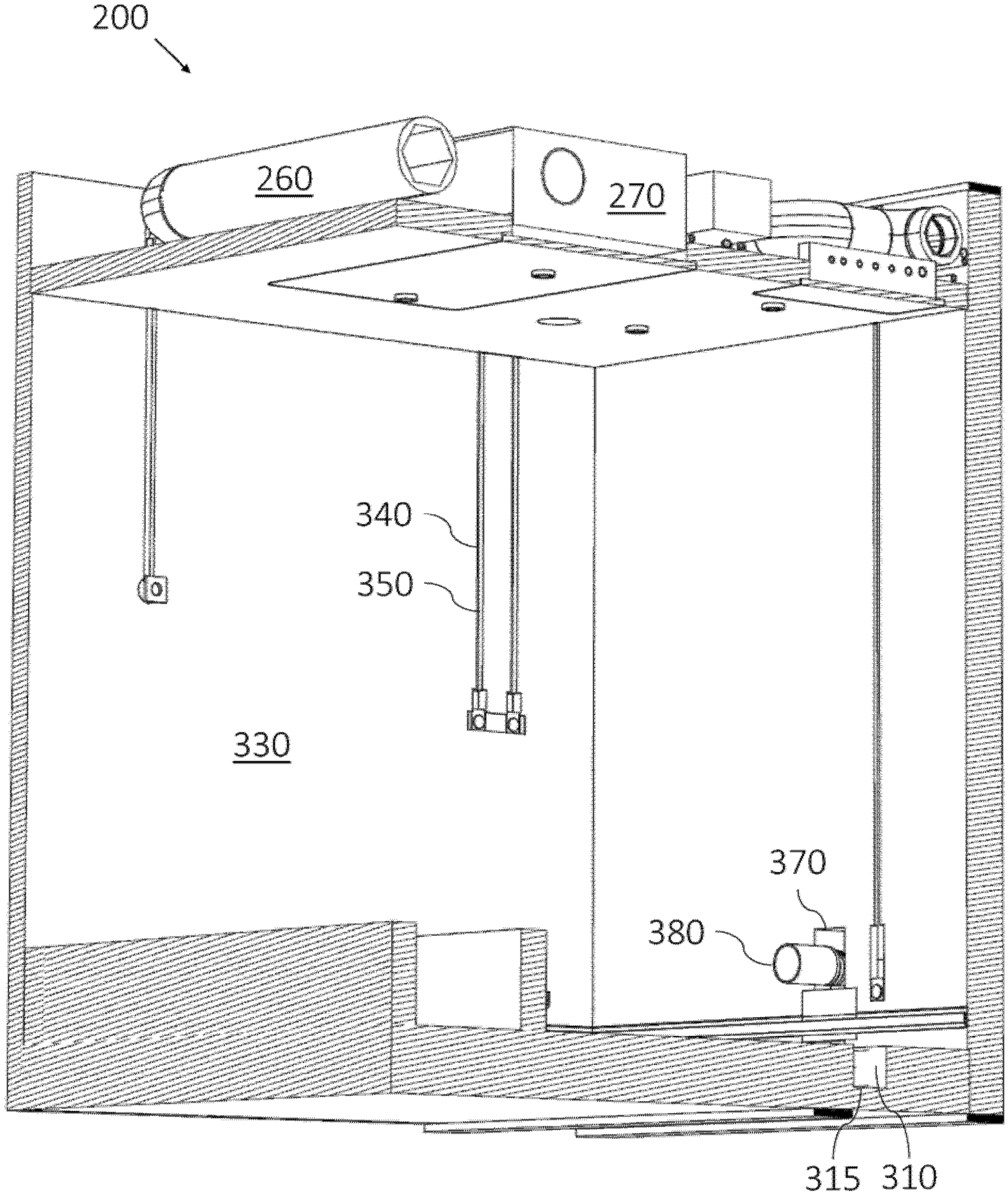

Figure 3a

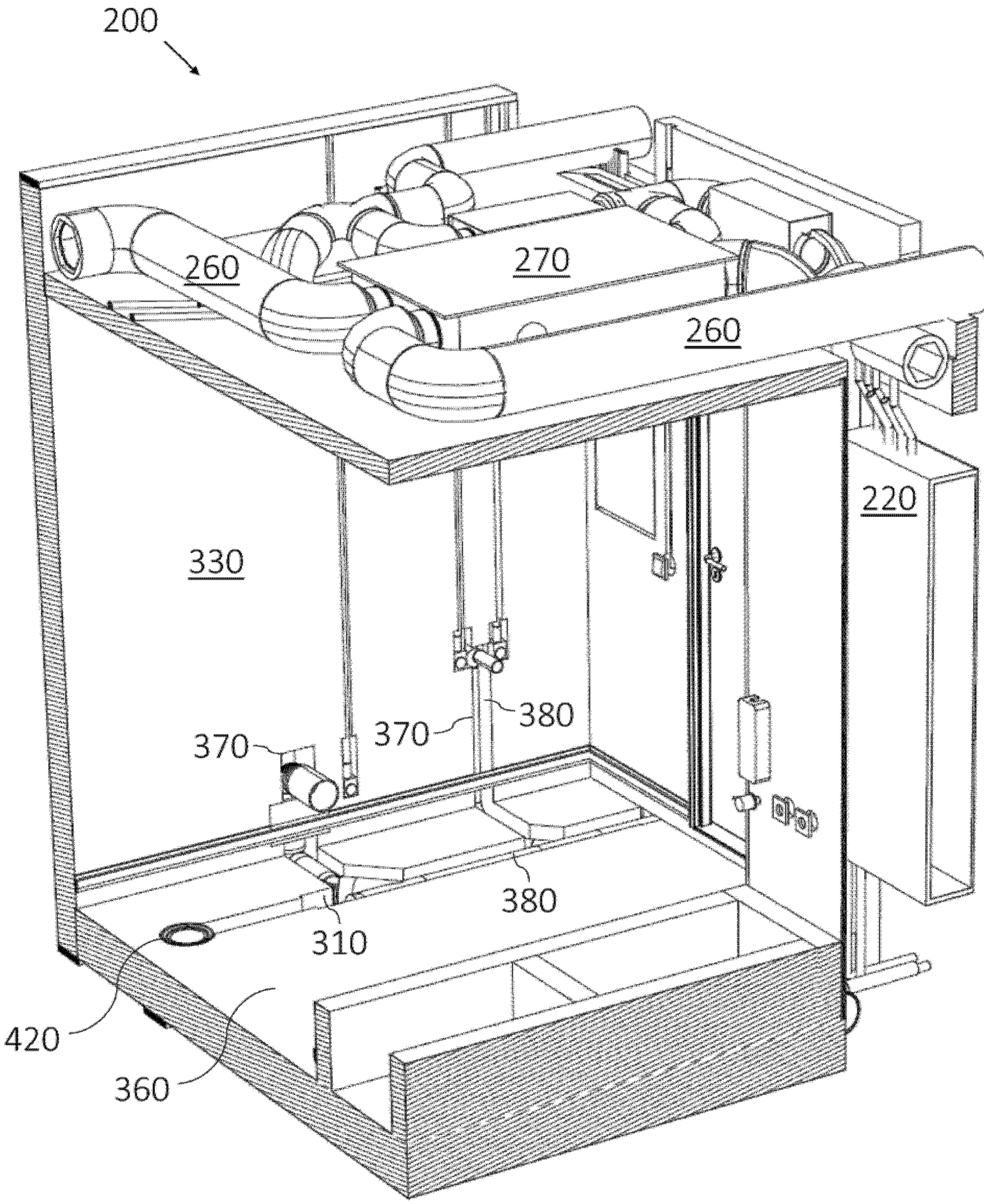

Figure 3b

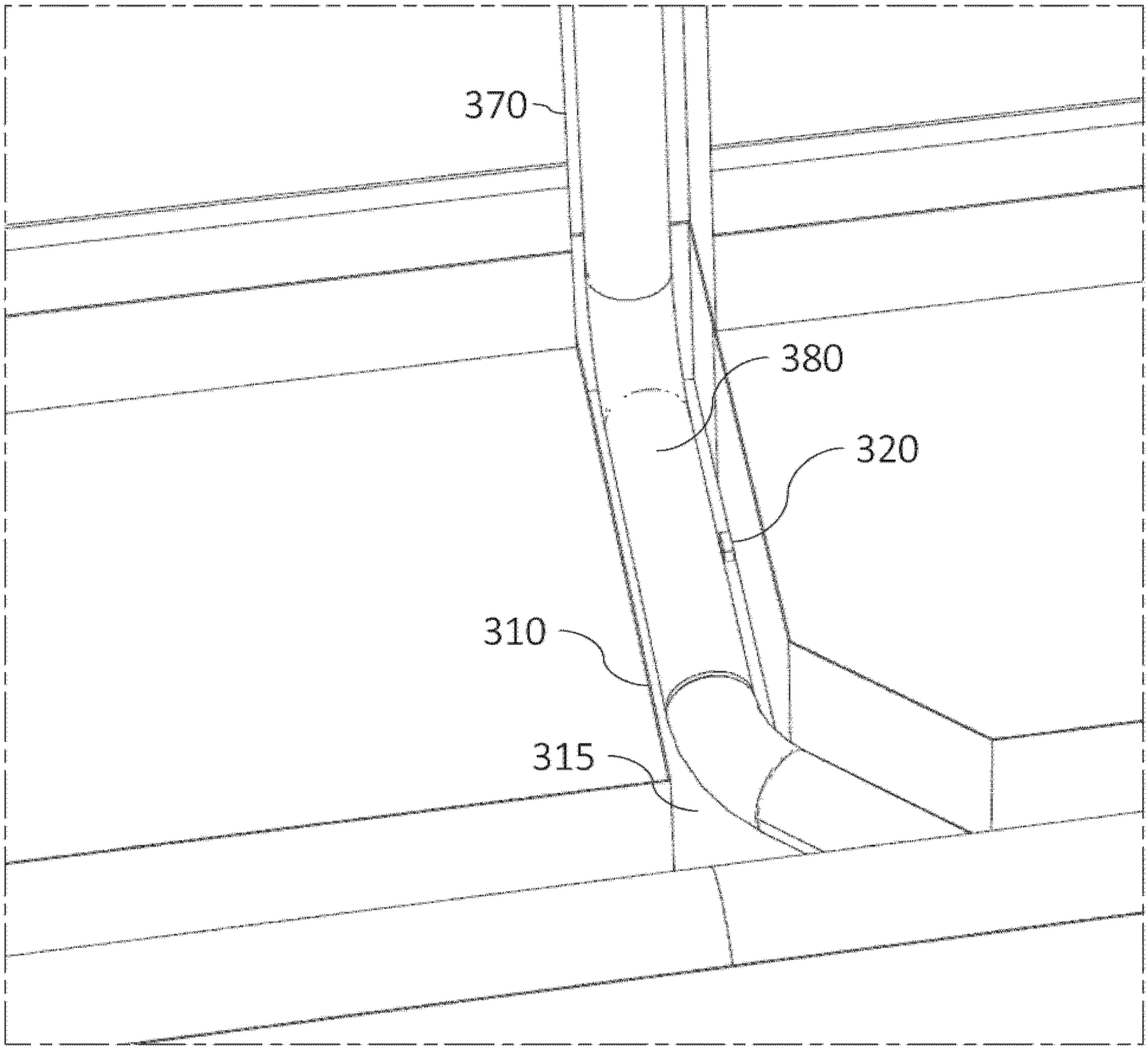

Figure 3c

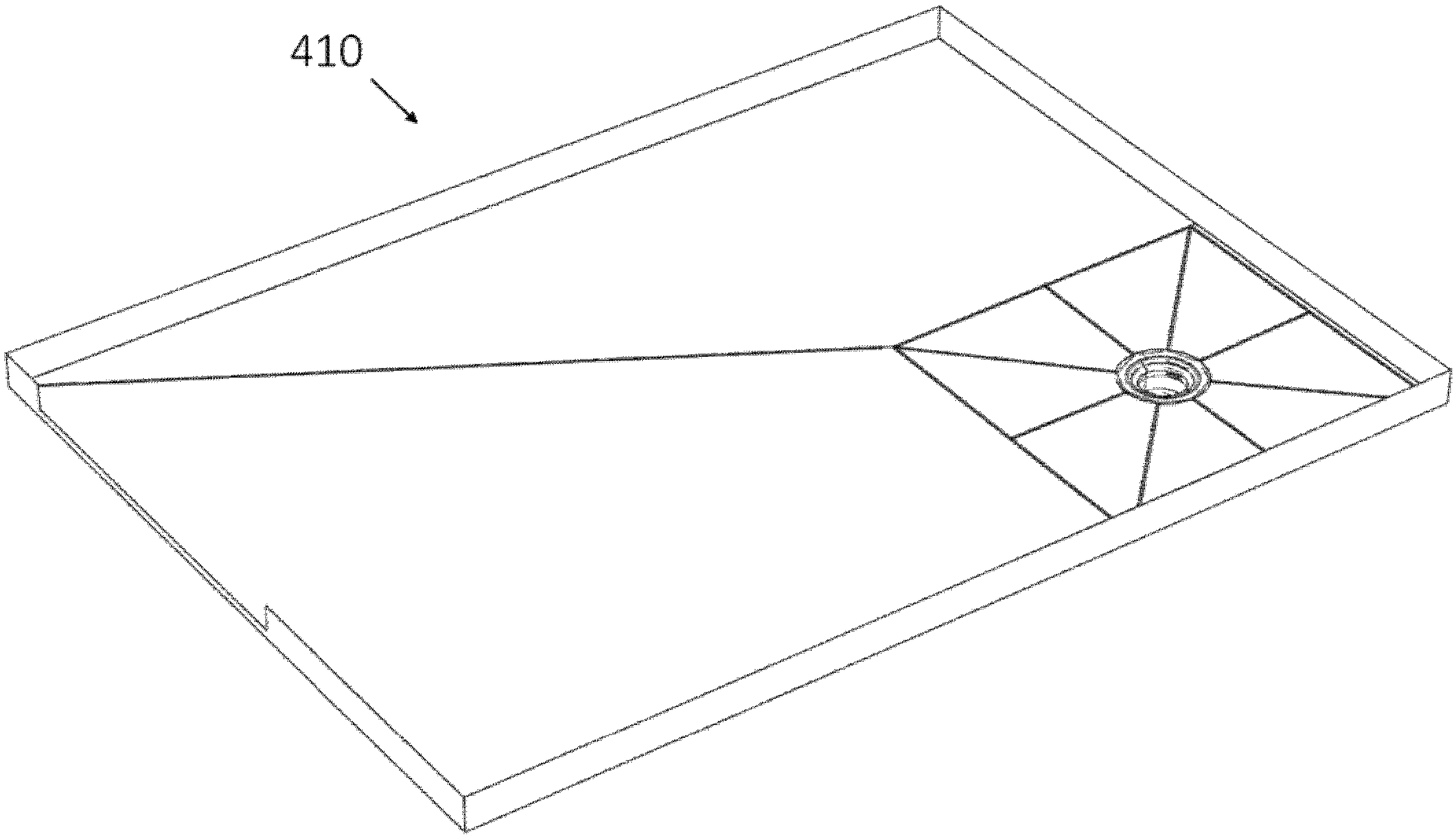

Figure 4a

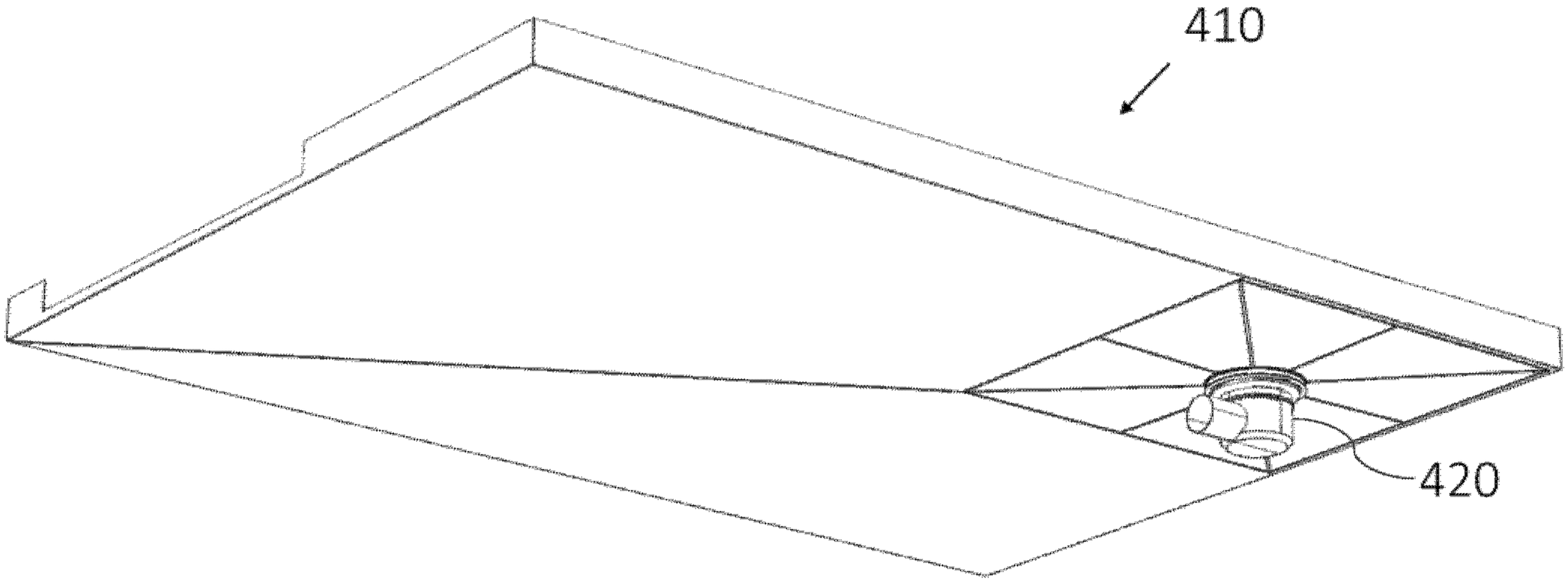

Figure 4b

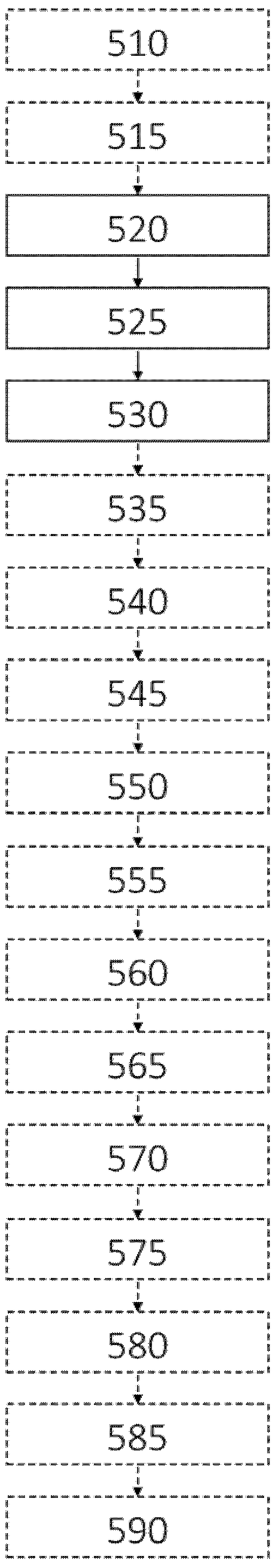
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Figure 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/079952

A. CLASSIFICATION OF SUBJECT MATTER
INV. E04B1/348
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E04B F24D A47K E03F E03C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2014/096849 A1 (RIVERBED LTD [GB]) 26 June 2014 (2014-06-26) page 12, line 20 - page 14, line 2; figures 1-6 -----	1,2,15, 16
X	WO 2010/130000 A1 (AUSCO MODULAR PTY LTD [AU]; DRUMMOND BRADLEY JOHN [AU] ET AL.) 18 November 2010 (2010-11-18) page 8, line 31 - page 17, line 22; figures 1-8 -----	1-29
X	DE 34 40 545 A1 (HUSTER FRANK DIPL ING) 15 May 1986 (1986-05-15) the whole document -----	1-29

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 January 2021	02/02/2021
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Galanti, Flavio

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2020/079952

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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