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(54) SELF-CLOSING DOOR ASSEMBLY OF A SLIDING DOOR, TOILET CABIN FOR A RAILWAY VEHICLE, AND SELF-CLOSING DOOR ASSEMBLY KIT

(57) A self-closing door assembly of a curved sliding door, includes a curved sliding door (140) movable along a predefined curved path between an open position and a closed position, and a closing mechanism. The closing mechanism includes a spring device (210, 260) to move the sliding door (140) into the closed position; a connecting element (220) having a first end connected to the spring device (210, 260) and a second end connected to the sliding door (140), the spring device (210, 260) being tensioned when moving the sliding door (140) towards the open position; a plurality of diverter elements (240, 240a) arranged along the curved path of the sliding door (140) for guiding the connecting element (220); and a damping element (230) in engagement with the connecting element (220) to limit movement of the connecting element (220) when the connecting element (220) is pulled by the spring device (210, 260) for moving the sliding door (140) into the closed position.

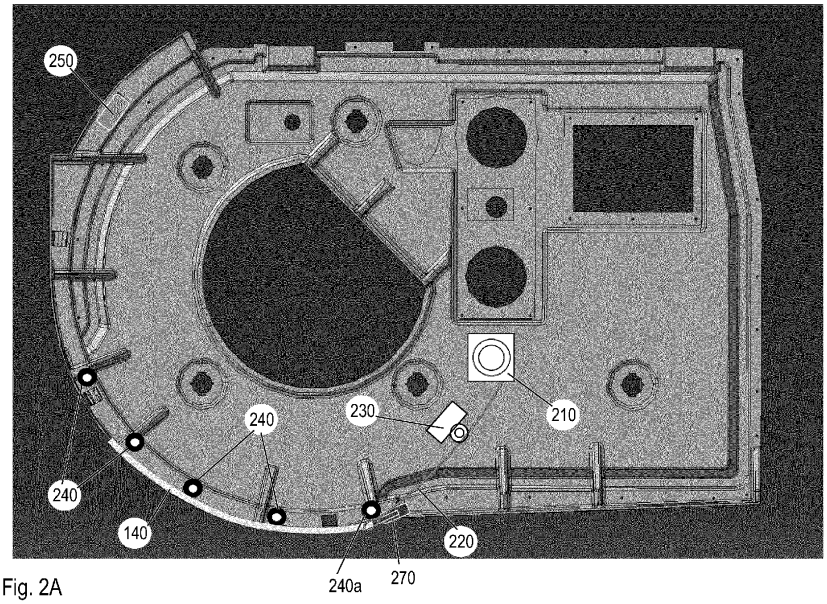

Fig. 2A

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Description

TECHNICAL FIELD

[0001] Embodiments of the present invention relate to a self-closing door assembly for a curved sliding door such as a curved sliding door for a toilet cabin of a railway vehicle. Further embodiments pertain to a toilet cabin for railway vehicles having a self-closing door assembly for the curved sliding door of the toilet cabin. Further embodiments of the present invention pertain to a self-closing door assembly kit for retrofitting manual sliding doors particularly curved sliding doors moving along a predefined curved path between an open position and a closed position.

BACKGROUND

[0002] Railway vehicles for public mass transport are equipped with facilities such as toilets to improve passengers' comfort. The space in a railway vehicle is often limited so that the facilities are configured so as to use the available space most efficiently. For that reason, toilet compartments are designed to have, at least partially, walls with a curved or arc-shaped (shape of circular segment) outer contour. To take most advantage of this outer contour of the walls, the door leaf of a curved sliding door used to close the toilet compartment has also a curved or arc-shape so that the door can be moved along a circular path following the curved contour of the toilet compartment.

[0003] Modern railway vehicles are often equipped with fully automatic doors which can be operated by pressing a button by which an opening and closing mechanism is actuated. While those automatic doors are very convenient, they require extra equipment such as an electrical motor or other suitable electromechanical components which not only contribute to the total weight of the railway vehicle but may be prone to failure and require additional maintenance.

[0004] Sliding doors with different closing mechanisms are known. For example, CN 112027869 A and CN 210558803 U describe a self-closing structure of an elevator landing door. KR 102001453 B1 describes a door assembly of a toilet compartment for handicapped persons using electromechanical components. CN 109693992 A describes an electromagnetic type landing door self-closing system. CN 108974027 A discloses a double linkage sliding door device for a toilet compartment of a railway vehicle. CN 206049681 U describes another self-closing mechanism for railway vehicles. EP 3259166 B1 describes a cabin with a rotatable cabin door for a vehicle. CN 204237414 U describes a self-closing door assembly for an elevator. KR 101407381 B1 describes an automatically closing sliding door. CN 102296901 B discloses a device for automatically opening and closing a cabin door. EP 1409824 A1 discloses a closing sequence control device for a self-closing door. DE 3934269 A1 discloses a self-closing device for a door or window.

[0005] However, these mechanisms are often complicated and not suited for the limited space available in a railway vehicle.

[0006] In view of the above, there is need for improvement.

BRIEF DESCRIPTION OF THE INVENTION

[0007] The above problem is solved by a self-closing door assembly for a sliding door according to claim 1, a toilet cabin for a railway vehicle according to claim 12, and a self-closing door assembly kit according to claim 15. Further embodiments, modifications, aspects and advantages are disclosed in the dependent claims and the following description.

[0008] According to an embodiment, which can be combined with any other embodiment described herein, a self-closing door assembly of a curved sliding door includes a curved sliding door movable along a predefined curved path between an open position and a closed position, and a closing mechanism. The closing mechanism includes a spring device to move the sliding door into the closed position; a connecting element having a first end connected to the spring device and a second end connected to the sliding door; a plurality of diverter elements arranged along the curved path of the sliding door for guiding the connecting element along the curved path; and a damping element in engagement with the connecting element to limit movement of the connecting element when the connecting element is pulled by the spring device for moving the sliding door into the closed position. The spring device is tensioned, through transmission by the connecting element, when the sliding door towards the open position.

[0009] The self-closing door assembly is composed of few reliable mechanical elements and allows retrofitting of existing manual curved sliding doors. A challenge for curved sliding doors moving along a predefined curved path is that the door leaf of the sliding door rotates about a vertical axis which is off-set to the door leaf. Thus, a simple push-pull mechanism would not be a suitable choice for curved sliding doors. The present invention overcomes these drawbacks by using a connecting element which connects the spring device with the sliding door. The diverter elements are arranged along the moving path of the curved sliding door and guide the connecting element so that the connecting element can follow the predefined curved path along which the sliding door moves. The connecting element can therefore always pull the sliding door tangentially along the predefined curved path maximising the force transmitted from the spring device on the sliding door when closing the sliding door.

[0010] As a connecting element and diverter elements are used, the directional operation of the spring device does not need to be aligned with any tangential direction

of the predefined curved path. This provides more freedom for arranging the spring device. The connecting element is typically bendable so that, when it moves together with the door leaf, it is bent to follow the curved path.

[0011] The diverter elements of the plurality of diverter elements can be arranged separately along the curved path. Along the curved path, a diverter element of the plurality of diverter elements can be arranged distant to another diverter element of the plurality of diverter elements, in particular distant to each other diverter element of the plurality of diverter elements. According to an embodiment, all diverter elements are arranged spaced from each other. In an embodiment, along the path, a gap is arranged between a diverter element and another diverter element, particularly a consecutive diverter element of the plurality of diverter elements. A length of the gap along the direction of the curved path can be larger than an extension of a diverter element along the curved path. Particularly, the length of the gap can be larger than a diameter of the diverter element of the plurality of diverter elements. Along the curved path, the plurality of diverter elements can be arranged equally distributed.

[0012] When referring to a curved path and a curved sliding door, basically any shape of a curve is meant. The curved path and the curved sliding door are specifically arc-shaped (circularly arc-shaped), i.e. they correspond to a segment of a circle. In typical embodiments, the segment is not more than a 90-degree circular arc.

[0013] The driving element for closing the sliding door is provided by the spring device which is tensioned when the sliding door is manually opened by user. As the sliding door advances into its open position by action of the user, the connecting element pulls on the spring device and tensions a spring arranged within the spring device. If the user does not actively keep the sliding door open or block the sliding door, or if the door is not blocked by other means, the energy stored in the spring device results in a retracting force pulling the sliding door back into its closed position. Thus, the spring device acts as a mechanical energy storage means which stores tension energy supplied to the spring device, particularly to a spring of the spring device, when the sliding door is manually opened. The stored tension energy is used to close the sliding door.

[0014] The damping element limits the movement of the door, particularly the maximum speed at which the sliding doors closes. This is for the users' comfort and safety. The damping element can limit the movement of the door with respect to the speed at which the sliding door can move, particularly the speed at which the sliding door opens and/or closes.

[0015] The damping element can be arranged and configured to restrict the speed at which the sliding door closes. The damping element can decelerate the closing of the sliding door. The damping element can be arranged and configured for a smooth closing of the sliding door. The damping element can be arranged and configured to limit the speed of the sliding door during the movement of the door from its open position to its closed position.

[0016] The damping element can limit the maximum speed at which the sliding doors opens. Preferably, a damping element with asymmetric action is used. For example, the damping element may damp the closing movement of the sliding door more than the opening movement to allow the user to open the door more quickly. The maximum speed at which the sliding door can be opened may also be limited for safety reasons. The damping element can be arranged and configured to restrict the speed at which the sliding door opens. The damping element can decelerate the opening of the sliding door. The damping element can be arranged and configured for a smooth opening of the sliding door. The damping element can be arranged and configured to limit the speed of the sliding door during the movement of the door from its closed position to its open position. According to an embodiment, the damping element can be arranged and configured to restrict the speed at which the sliding door opens less than the speed at which the sliding door closes.

[0017] The self-closing door assembly described herein is particularly suitable for manually operated doors, i. e. for non-automatic doors which are not driven, or not partly driven, by electromechanical drive units. Moreover, the self-closing door assembly is easy to install, allows great flexibility for adapting to local geometries and designs, and is a cost-efficient solution. Specifically, for opening of the sliding door, manual operation, i.e. manual moving of the door by a user or passenger, is needed. The closing of the sliding door occurs automatically in the sense that the spring device brings the sliding door back into its closed position. The sliding door can also be closed manually. The self-closing door assembly is therefore autonomous as it does not require supply of electrical energy. It is semi-automatic (as it closes the sliding door automatically but requires manual work to open it) and fully mechanical as the closing can occur by action of the closing mechanism without requiring any electromechanical component and supply of electrical energy.

[0018] In addition to that, the self-closing door assembly described herein is particularly of advantage for curved sliding doors such as arc-shaped doors as diverter elements are used to guide the connecting element virtually along any curved path.

[0019] The spring device may include a housing for accommodating a spring arranged within the housing. The housing may include fastening means for attaching the spring device to structural elements such as a ceiling or a wall.

[0020] According to an embodiment, which can be combined with any other embodiment described herein, the spring device includes a spiral spring (torsion spring) for winding up the connecting element, which may be bendable or flexible but inelastic. For example, the spring device may be a spring rope pulley. A spiral spring allows

for a compact design of the spring device. Furthermore, the spring force can be easily adjusted by the number of windings of the spiral spring. For example, if the spiral spring is provided with a higher number of windings and is pretensioned, the spring force can be kept in a linear range of the spring regardless of whether the door is fully opened or closed. In fact, when using a higher number of windings, the spring force can be kept approximately constant over the operating range defined by the maximum opening range of the sliding door.

[0021] According to an embodiment, which can be combined with any other embodiment described herein, the spring device includes an outer tube accommodating a helical spring (helical tension spring - linear tension spring) which is expanded along a longitudinal extension of the outer tube when moving the sliding door towards the open position. Instead of a spiral spring that winds up the connecting element, a helical spring can be used which linearly expands when the sliding door is opened. The spring device may have an elongated shape such as a shape of a tube. Specifically, an outer tube can accommodate the helical spring so that the helical spring is protected and guided at its outer side. The helical spring expands within and along the longitudinal extension of the outer tube. The outer tube may be provided with the fastening means for attaching the spring device to structural elements such as the ceiling of a cabin.

[0022] According to an embodiment, which can be combined with any other embodiment described herein, the spring device further includes an inner guiding element arranged in and extending along the outer tube, wherein the helical spring is wound around the inner guiding element and between the inner guiding element and the outer tube. Inner and outer tube cooperate together for guiding the helical spring and to prevent the helical spring from disengaging or deforming when expanding or contracting. The inner and outer tubes may be arranged coaxially relative to each other.

[0023] According to an embodiment, which can be combined with any other embodiment described herein, the inner guiding element includes an inner tube for guiding the connecting member therein. The inner tube may have a longitudinal slit through which a forward end of the helical spring connected with the connecting element extends into an interior of the inner tube. The connecting element is drawn into the inner tube when the helical spring contracts. The connection between the forward end of the helical spring and the connecting element is established through the longitudinal slit. For example, a fastener may be provided at the forward end of the helical spring which establishes the connection with the connecting element. The fastener may be guided along the slit to facilitate linear movement of the forward end of the helical spring and the connecting element.

[0024] According to an embodiment, which can be combined with any other embodiment described herein, the connecting element is flexible and inelastic. For example, the connecting element may be an inelastic rope, a chain, a cable, or a belt. The connecting element is preferably not elastic so that the connecting element can immediately transmit the force exerted from the spring device, i.e. from the spring of the spring device, to the sliding door or, when the sliding door is manually opened, from the sliding door to the spring device. The connecting element is thus, unlike the spring device, not an energy storage means. The connecting element can also be described as being limp. The flexibility the connecting element is provided with allows the connecting element to follow the curved path defined by the diverter elements without requiring application of a force, or only of a marginal force, for bending the connecting element.

[0025] According to an embodiment, which can be combined with any other embodiment described herein, the damping element is a radial damper, particularly a radial damper with adjustable predefined damping force. The predefined damping force may define the maximum speed for the closing movement of the sliding door. The predefined damping force is adjustable to allow adaptation to different scenarios and door constructions. Furthermore, the damping force may need to be adjusted after some time of operation, such as at regular maintenance intervals.

[0026] According to an embodiment, which can be combined with any other embodiment described herein, the closing mechanism further includes a timer element adapted to keep the sliding door in the open position for a predetermined delay time and to release the sliding door after lapse of the predetermined delay time. Keeping the sliding door in its open position for a predetermined time provides more comfort for the user as he passes the door. There is no need for the user to manually keep the door open. This is of particular importance for elderly people or differently abled persons, for example a person needing a wheelchair.

[0027] According to an embodiment, which can be combined with any other embodiment described herein, the timer element is a mechanical timer, particularly a mechanical timer with adjustable delay time, preferably without electromechanical components.

[0028] According to an embodiment, which can be combined with any other embodiment described herein, the closing mechanism further comprises a safety element for stopping the sliding door from reaching the closed position. The safety element is particularly an end position stopper decelerating movement of the door. The safety element prevents trapping of fingers or other body parts by the closing door.

[0029] According to an embodiment, which can be combined with any other embodiment described herein, a toilet cabin for a railway vehicle is provided. The toilet cabin includes a bottom, a ceiling assembly, at least two sidewalls extending between the bottom and the ceiling assembly, and a self-closing door assembly according to any of the embodiments described herein. The spring device, the plurality of diverter elements and the damping element of the self-closing door assembly are attached

to the ceiling assembly. The connecting element is attached to an upper end of the sliding door. The self-closing door assembly as described herein is particularly useful for toilet cabins of railway vehicles. However, the invention is not limited thereto and can also be applied to other cabins having a manually operated curved sliding door, for example for any cabin in a railway vehicle, in any other vehicle such as vessels, or in buildings.

[0030] According to an embodiment, which can be combined with any other embodiment described herein, the spring device, the plurality of diverter elements and the damping element of the self-closing door assembly are arranged in a common level plane extending parallel to the bottom of the cabin. Preferably, all elements of the self-closing assembly are attached or fastened on the ceiling of the cabin. The working operation of all moving and movable parts of the self-closing assembly are preferably within a common level plane.

[0031] According to an embodiment, which can be combined with any other embodiment described herein, the toilet cabin further includes a bottom guiding rail in engagement with a lower end of the sliding door to guide the sliding door at its lower end. This bottom guiding rail stabilizes the door leaf of the sliding door at its lower end. Alternatively or in addition to the bottom guiding rail, a top guiding rail may also be provided which is in engagement with an upper end of the sliding door.

[0032] According to an embodiment, which can be combined with any other embodiment described herein, a self-closing door assembly kit for a curved sliding door, which is movable along a predefined curved path between an open position and a closed position, is provided. The kit includes a spring device; a connecting element having a first end for connecting to the spring device and a second end for connecting to the sliding door; a plurality of diverter elements for arranging along the curved path of the sliding door for guiding the connecting element; and a damping element for engagement with the connecting element to limit movement of the connecting element. The self-closing door assembly kit can further optionally include a timer element adapted to keep the sliding door in the open position for a predetermined delay time and to release the sliding door after the elapsing of the predetermined delay time; and a safety element for stopping movement of the sliding door.

[0033] The assembly kit may be used to retrofit an existing manual sliding door, for example in railway vehicles.

FIGURES

[0034] The invention will now be described with reference to embodiments without limiting the scope as defined by the claims.

[0035] The appended drawings illustrate embodiments and serve in combination with the description for explaining the principles of the invention. Elements in the drawings are relative to each other and are not necessarily to scale unless otherwise stated.

Figure 1 illustrates a toilet cabin for a railway vehicle according to an embodiment.

Figures 2A and 2B illustrates, from above, a top view onto a ceiling of a toilet cabin equipped with a self-closing door assembly according to an embodiment, wherein Figure 2A illustrates the operation of the self-closing door assembly when the sliding door is in its closed position and Figure 2B illustrates the operation of the self-closing door assembly when the sliding door is in its open position.

Figure 3 illustrates an example of a spring device having a spiral spring.

Figures 4A and 4B illustrates, from above, a top view onto a ceiling of a toilet cabin equipped with a self-closing door assembly according to another embodiment, wherein Figure 4A illustrates the operation of the self-closing door assembly when the sliding door is in its closed position and Figure 4B illustrates the operation of the self-closing door assembly when the sliding door is in its open position.

Figure 5 illustrates a partial view of a spring device having an inner tube, and outer tube and a helical spring.

DETAILED DESCRIPTION

[0036] Figure 1 illustrates a toilet cabin 100 for a railway vehicle. The toilet cabin 100 includes a ceiling assembly 110, at least two sidewalls 120a, 120b extending between the bottom 150 and the ceiling assembly 110, and a curved sliding door 140. A door opening 145 is arranged between and defined by opposite side edges of the at least two sidewalls 120. At least one of the sidewalls 120a can be at least partially curved to form, together with the curved sliding door 140, a partially curved outer shape of the toilet cabin. The toilet cabin 100 may include a substantially flat sidewall 120b, such as shown to the right of the door opening 145, and an at least partially curved sidewall 120a, such as shown to the left of the door opening. The sliding door 140 closes the door opening 145 when moving towards the substantially flat sidewall 120b. A closing mechanism for the sliding door 140 is attached above the top side of the ceiling assembly 110.

[0037] When opening the sliding door 140, the door leaf of the sliding door 140 moves behind the partially curved sidewall 120a at the inner side of the curved sidewall 120.

[0038] The toilet cabin 100 may be a self-supporting toilet cabin where the bottom 150, the at least two sidewalls 120a, 120b, and the ceiling assembly 110 form a self-supporting structure. Alternatively, the bottom 150

may be formed by the inner floor of the railway vehicle and the at least two sidewalls 120a, 120b are fixed to the floor or to a supporting structure attached to the floor.

[0039] The specific arrangement of the toilet cabin 100 is not limited as the closing mechanism can be used for any type of toilet cabins 100.

[0040] Embodiments of the self-closing door assembly comprising a curved sliding door 140 and a closing mechanism are described with reference to Figures 2A, 2B, 4A and 4C. Figure 3 shows a spring device with a spiral spring which may be used in the embodiment shown in Figures 2A and 2B. Figure 5 shows a spring device with a helical spring which may be used in the embodiment shown in Figures 4A and 4B.

[0041] Turning first to Figures 2A and 2B, a self-closing door assembly having a spring device 210 with a spiral spring for winding up a connecting element 220 according to an embodiment is described. In the following, the connecting element 220 is referred to as flexible connecting element as it is preferably flexible and inelastic. The sliding door 140 is shown in a closed position in Figure 2A and in an open position in Figure 2B.

[0042] The flexible connecting element 220 connects a leading edge 141 of the door leaf of the sliding door 140 with the spiral spring of the spring device 210. The spiral spring 211, see Figure 3, is accommodated within a housing 213 of the spring device 210. The spring device 210 may be a spring rope pulley. The spring device 210 may further include a roll 212 that is connected with the spiral spring 211 which is arranged within the roll 212. The flexible connecting element 220 is wound up on the outer circumference of the roll 212. The flexible connecting element 220 may be a rope which is a simple and cost-efficient, yet a reliable, flexible but inelastic connecting element. Another preferred embodiment includes a cable. Further embodiments include a chain or a belt. The spiral spring 211 engages with the roll to drive the roll 212 for winding up the flexible connecting element 220. On the other hand, when the sliding door 140 is manually opened by a passenger the flexible connecting element 220 is unwound by the action of the sliding door 140 moving towards its open position and causes the roll 212 to tension the spiral spring 211.

[0043] While the present embodiments show that the flexible connecting elements 220 is connected to the leading edge 141 of the door leaf, the flexible connecting element 220 can also be connected with other portions of the door leaf such as at a position spaced by a given distance from the leading edge 141.

[0044] Turning back to Figures 2A and 2B, the flexible connecting element 220 engages with a damping element 230 which is arranged between the spring device 210 and the leading edge 141 of the closed sliding door 140. The damping element 230 may also divert the flexible connecting element 220 to increase engagement between the flexible connecting element 220 and the damping element 230.

[0045] The damping element 230 may be a radial damper that damps rotation of a roll or wheel which engages with the flexible connecting element 220. If a chain or a belt is used as the flexible connecting element 220, the roll of the damping element 230 may include teeth to improve engagement with the chain. A belt may also be used in combination with a cylindrical roll. Alternatively, the flexible connecting element 220 may be wound around the roll which also increases the engagement.

[0046] If the damping element 230 does not divert the flexible connecting element 220, additional auxiliary pulleys can be used to locally divert the flexible connecting element 220 partially around the roll of the damping element 230. For example, by means of cooperation of one or two auxiliary pulleys with the roll of the damping element 230, the flexible connecting element 220 may be locally forced to follow an S-shaped or U-shaped path to increase engagement with the roll or wheel of the damping element 230.

[0047] The damping force of the damping element 230 may be adjustable.

[0048] According to an embodiment, the damping element 230 may not even decelerate movement of the sliding door 140 but also actively draws the sliding door 140 into its final closed position.

[0049] As illustrated in Figures 2A and 2B, a plurality of diverter elements 240, 240a are arranged approximately along the curved path of the sliding door 140. For example, five diverter elements 240, 240a can be used without being limited thereto. Typically, at least three, particularly at least four diverter elements 240, 240a are used.

[0050] The diverter elements 240, 240a cooperate with and guides the flexible connecting element 220 so that the flexible connecting element 220 approximately follows the course of the sliding door 140. This results in a mutual action between the sliding door 140 and the flexible connecting element 220 to be always tangential relative to the predefined curved path of the sliding door 140. Forces acting radially on the sliding door 140 are thus avoided which prevents impairing movement of the sliding door 140.

[0051] The sliding door 140 is shown in its closed position in Figure 2A. To prevent the passenger's finger becoming trapped when the sliding door 140 closes, a safety element 270 is provided which damps movement of the sliding door 140 immediately before the sliding door 140 is fully closed. The safety element 270 may be an end position damper which may be fastened to that sidewall 120b towards which the sliding door 140 moves when closing. For example, the safety element 270 may be a hydraulic element including a piston that displaces oil in a cylinder and thus absorbs the kinetic energy of the moving sliding door 140. The safety element 270 may have different damping characteristics such as uniform damping over the whole stroke of the piston or progressive characteristic with initial gentle start and progressive damping as the piston is moving. To return the piston into its initial position when the sliding door 140 is opened,

the safety element 270 may include an internal spring which pushes the piston back. The hydraulic damping also provides for a controlled and reliably, particularly gently, damping irrespective of the size and weight of the sliding door 140. Furthermore, impact on the movement of the sliding door 140 by vehicle movement can be absorbed by the safety element 270.

[0052] Turing to Figure 2B the sliding door 140 is shown in its open position with the flexible connecting element 220 pulled out from the spring device 210 to is maximum extension. As shown in Figure 2B, the flexible connecting element 220 follows the predefined curved path of the sliding door 140 because of the diverter elements 240, 240a arranged along the curved path.

[0053] When the sliding door 140 is moved towards its open position, the spring device 210 becomes increasingly tensioned. It is not required to always open the sliding door 140 to its maximum open position as the spring device 210 will be sufficiently tensioned even when the sliding door 140 is opened to any intermediate position. Preferably, the spring device 210 is already tensioned when the sliding door 140 is in its closed position. The "pre-tension" of the spring device 210 ensures that the sliding door 140 can reliably be closed and is kept closed even when the railway vehicle moves.

[0054] When the passenger opens the sliding door 140, it comes in engagement with a timer element 250 which keeps the sliding door 140 open for a predetermined delay time. The predetermined delay time can be adjusted and may be about few seconds. After lapse of the predetermined delay time the timer element 250 releases the sliding door 140 which then closes by action of the spring device 210. The timer element 250 is preferably a mechanical timer, particularly a mechanical timer with adjustable delay time, preferably without electromechanical components. For example, a lever of the timer element 250 may be in engagement with a counterpart attached to the sliding door 140. The lever is movable and is pushed into engagement when the sliding door 140 is opened and thus blocks the counterpart. Releasing the counterpart by the lever being in engagement with the counterpart is hydraulically damped using an oil piston. The hydraulic damping can be adjusted, for example by controlling the opening size of a value that limits flow of a hydraulic fluid within a piston that acts on the lever.

[0055] With reference to Figures 4A and 4B another embodiment of the self-closing door assembly is described. Unlike the embodiment of Figures 2A and 2B, the embodiment of Figures 4A and 4B employs a spring device 260 with a helical spring that is expanded, and which contracts, along a straight line. Figure 5 illustrates a spring device 260 which may be used in combination with the embodiment of Figures 4A and 4B. The remaining parts may be the same as in the embodiment shown in Figures 2A and 2B.

[0056] The spring device 260 may include an outer tube 261, an inner tube 262, and a helical spring 265 which is wound around the inner tube 262. The outer tube 261 and the inner tube 262 define together a space between the inner tube 262 and the outer tube 261 along which the helical spring 265 can be linearly expanded and contracted. Thus, inner tube 262 and outer tube 261 guides movement of the helical spring 265.

[0057] The outer tube 261 may be provided with fastening means to attach the spring device 260 at the ceiling of the toilet cabin 100.

[0058] A forward end of the helical spring 265 is connected with the flexible connecting element 220. For example, a fastener 267 connects the forward end of the helical spring 265 with the flexible connecting element 220.

[0059] For guiding the flexible connecting element 220 within the spring device 260, the inner tube 262 may be provided with a slit 263 extending along the longitudinal extension of the inner tube 262. The fastener 267 extends through the slit 263. When the helical spring 265 contracts, the fastener 267 draws the flexible connecting element 220 into the inner tube 262 so that the flexible connecting element 220 and the helical spring 265 do not accommodate the same space.

[0060] Similar to Figures 2A and 2B, Figure 4A shows the sliding door 140 in its closed position while Figure 4B shows the sliding door 140 in its open position. The opening and closing sequence are the same so that a repetition of the detailed explanation is omitted.

[0061] In all embodiments shown herein, the spring device 210, 260 can be arranged at virtually any position when additional diverter elements are used to divert the flexible connecting element 220 towards the spring device 210, 260. A diverter element 240a may be arranged where the leading edge 141 of the sliding door 140 comes to rest when the sliding door 140 is in the closed position. In the embodiments shown in Figures 2A, 2B, 4A and 4B, no additional diverter element is arranged between the diverter element 240a and the respective spring device 210, 260. However, an additional diverter element may be positioned such that the spring device 210, 260 can be arranged at a location other than that shown in the drawings.

[0062] The self-closing door assembly kit can be used with advantage to retrofit manual curved sliding doors, not only in railway vehicles but also in buildings. Only few components are needed which can be arranged in a flexible manner to take account of the specific design and the available installation space.

[0063] Although specific embodiments are illustrated and described herein, the skilled person will appreciate that the embodiments can be modified without departing from the scope of the invention as defined by the claims.

LIST OF REFERENCE NUMBERS

[0064]

100	toilet cabin
110	ceiling assembly

120a, 120b	side wall
130	bottom guiding rail
140	door
141	leading edge
145	door opening
150	bottom
210	spring device
211	spiral spring
212	roll
213	housing of spring device
220	connecting element / rope
230	damping element
240, 240a	diverter element
250	timer element
260	spring device
261	outer tube
262	inner tube
263	slit
265	helical spring / helical tension spring
267	fastener
270	safety element

Claims

1. Self-closing door assembly of a curved sliding door, comprising:

a curved sliding door movable along a predefined curved path between an open position and a closed position; and
a closing mechanism comprising:

a spring device to move the sliding door into the closed position;
a connecting element having a first end connected to the spring device and a second end connected to the sliding door, the spring device being tensioned when moving the sliding door towards the open position;
a plurality of diverter elements arranged along the curved path of the sliding door for guiding the connecting element along the curved path; and
a damping element in engagement with the connecting element to limit movement of the connecting element when the connecting element is pulled by the spring device for moving the sliding door into the closed position.

2. Self-closing door assembly according to claim 1, wherein the spring device comprises a spiral spring for winding up the connecting element.

3. Self-closing door assembly according to claim 1 or 2, wherein the spring device comprises a spring rope pulley.

4. Self-closing door assembly according to claim 1, wherein the spring device comprises an outer tube accommodating a helical spring which is expanded along a longitudinal extension of the outer tube when moving the sliding door towards the open position.

5. Self-closing door assembly according to claim 4, wherein the spring device further comprises an inner guiding element arranged in and extending along the outer tube, wherein the helical spring is wound around the inner guiding element and between the inner guiding element and the outer tube.

6. Self-closing door assembly according to claim 5, wherein the inner guiding element comprises an inner tube for guiding the connecting element therein, wherein the inner tube has a longitudinal slit through which a forward end of the helical spring connected with the connecting element extends into an interior of the inner tube.

7. Self-closing door assembly according to any of the previous claims, wherein the connecting element is flexible but inelastic and comprises one of an inelastic rope, a cable, a chain, or a belt.

8. Self-closing door assembly according to any of the previous claims, wherein the damping element is a radial damper, particularly a radial damper with adjustable predefined damping force.

9. Self-closing door assembly according to any of the previous claims, wherein the closing mechanism further comprises a timer element adapted to keep the sliding door in the open position for a predetermined delay time and to release the sliding door after elapsing of the predetermined delay time.

10. Self-closing door assembly according to the previous claim, wherein the timer element is a mechanical timer, particularly a mechanical timer with adjustable delay time, preferably without electromechanical components.

11. Self-closing door assembly according to the previous claim, wherein the closing mechanism further comprises a safety element for stopping the sliding door prior to reaching the closed position, wherein the safety element is particularly an end position stopper decelerating movement of the sliding door.

12. Toilet cabin for a railway vehicle, comprising a bottom, a ceiling assembly, at least two sidewalls extending between the bottom and the ceiling assembly, and a self-closing door assembly according to any of the previous claims, wherein the spring device, the plurality of diverter elements and the damping element of the self-closing door assembly are

attached to the ceiling assembly, wherein the connecting element is attached to an upper end of the sliding door.

13. Toilet cabin of claim 12, wherein the spring device, the plurality of diverter elements and the damping element of the self-closing door assembly are arranged in a common level plane extending parallel to the bottom.

14. Toilet cabin of claim 12 or 13, further comprising a bottom guiding rail in engagement with a lower end of the sliding door to guide the sliding door at its lower end.

15. Self-closing door assembly kit for a curved sliding door, preferably for a self-closing door assembly according to any of claims 1 to 11, which is movable along a predefined curved path between an open position and a closed position, the self-closing door assembly kit comprising:

a spring device;
a connecting element having a first end for connecting to the spring device and a second end for connecting to the sliding door;
a plurality of diverter elements for arranging along the curved path of the sliding door for guiding the connecting element; and
a damping element for engagement with the connecting element to limit movement of the connecting element;

further optionally comprising:

a timer element adapted to keep the sliding door in the open position for a predetermined delay time and to release the sliding door after elapsing of the predetermined delay time; and
a safety element for stopping movement of the sliding door.

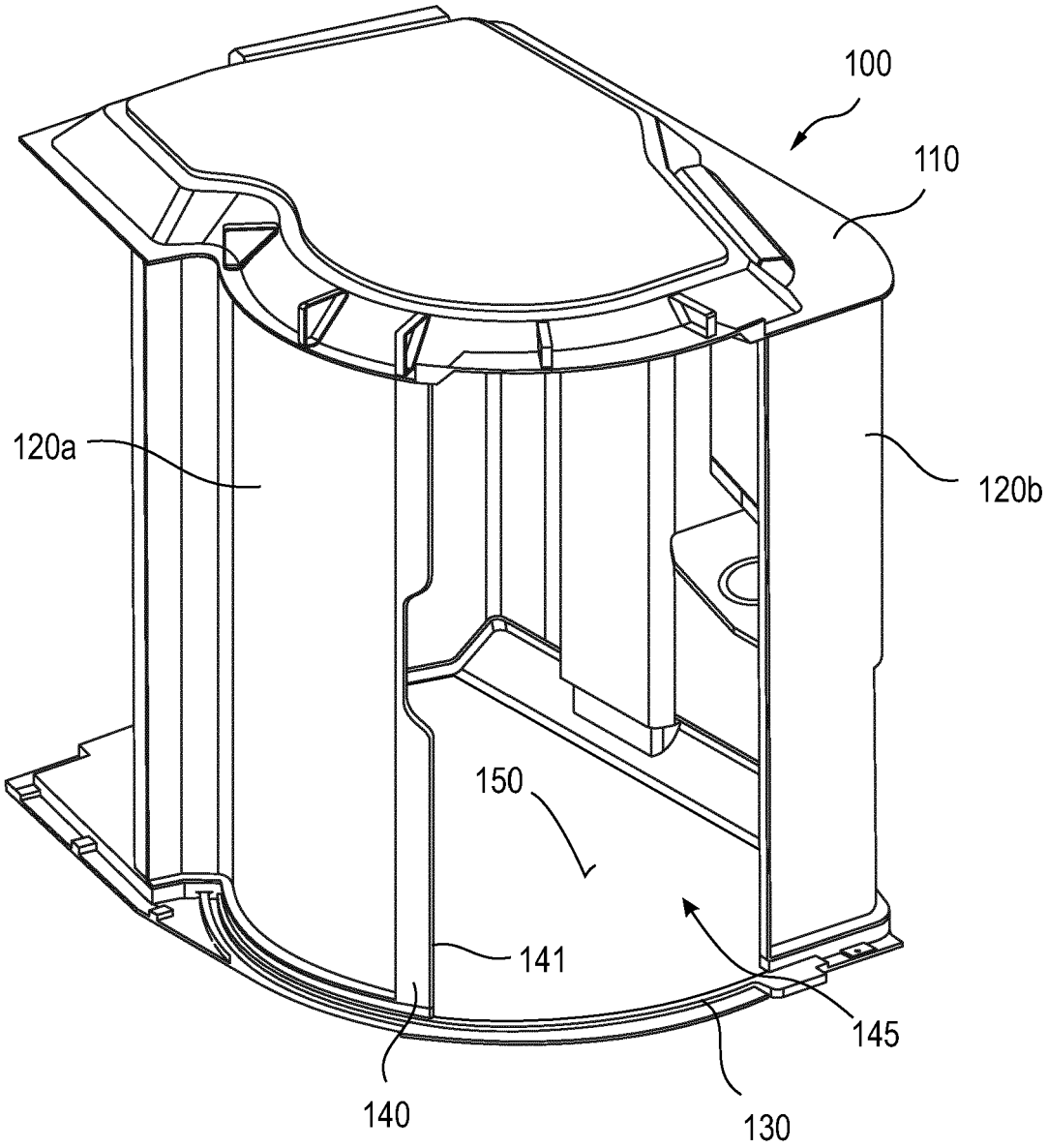

Fig. 1

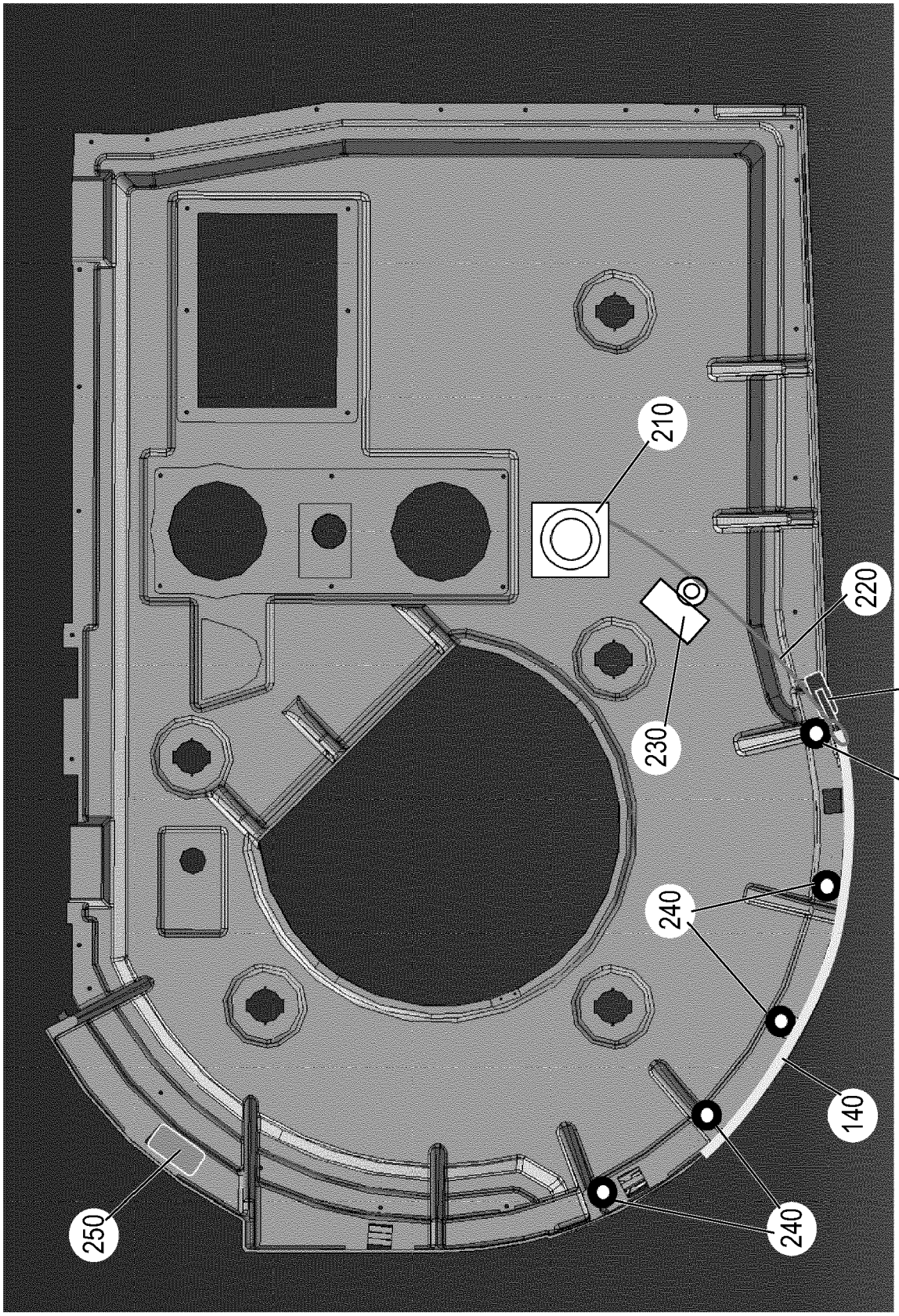

Fig. 2A

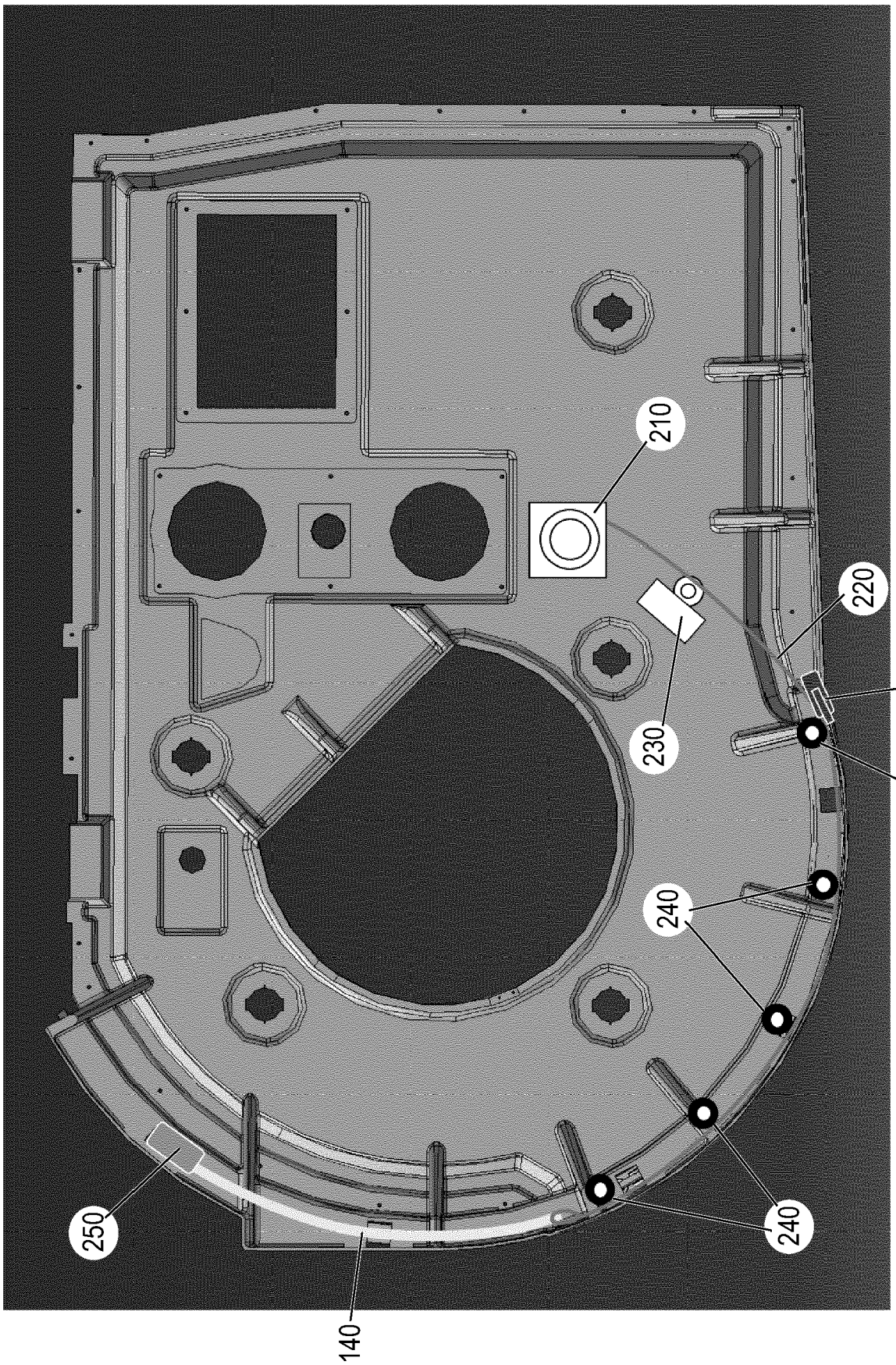

Fig. 2B

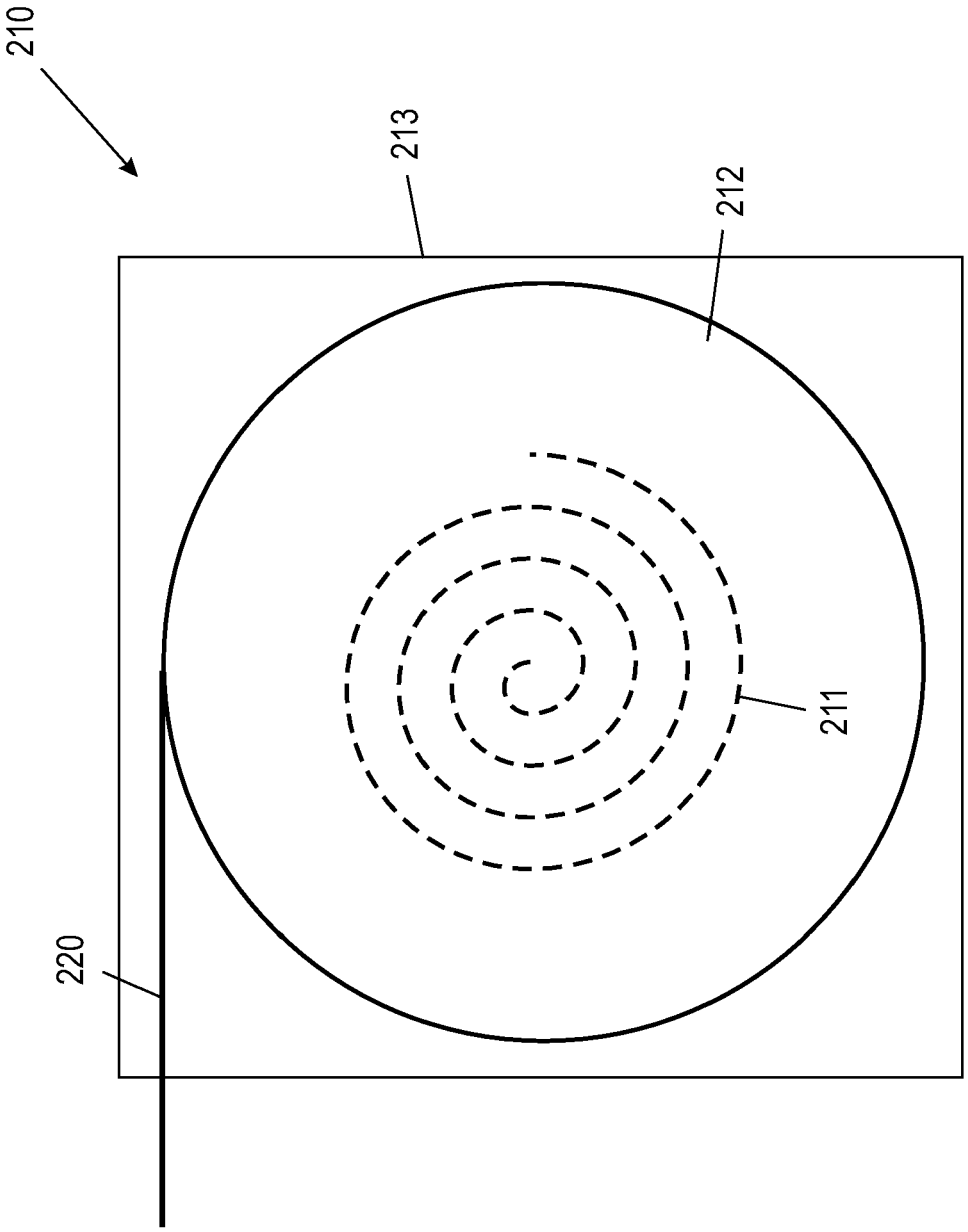

Fig. 3

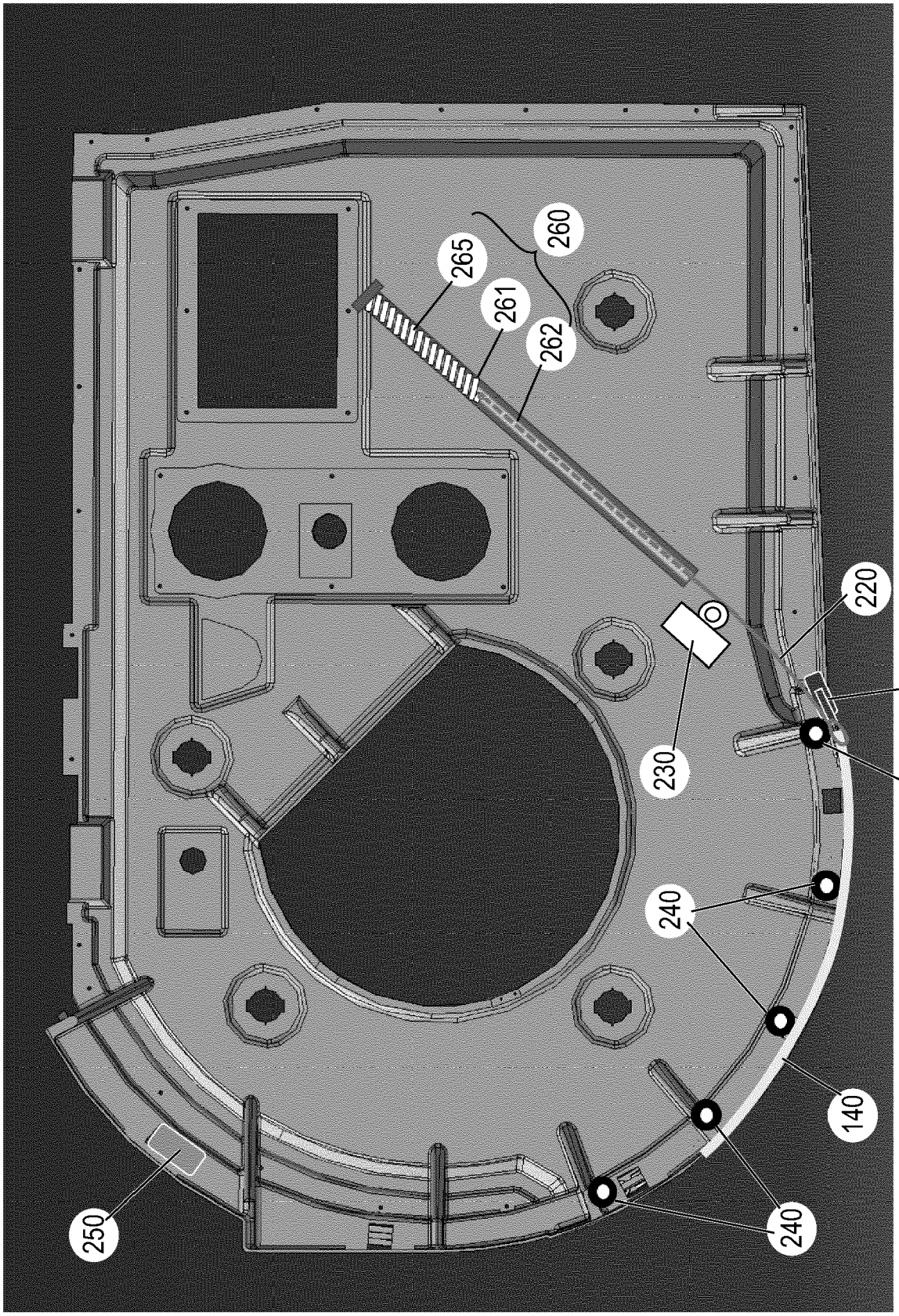

Fig. 4A

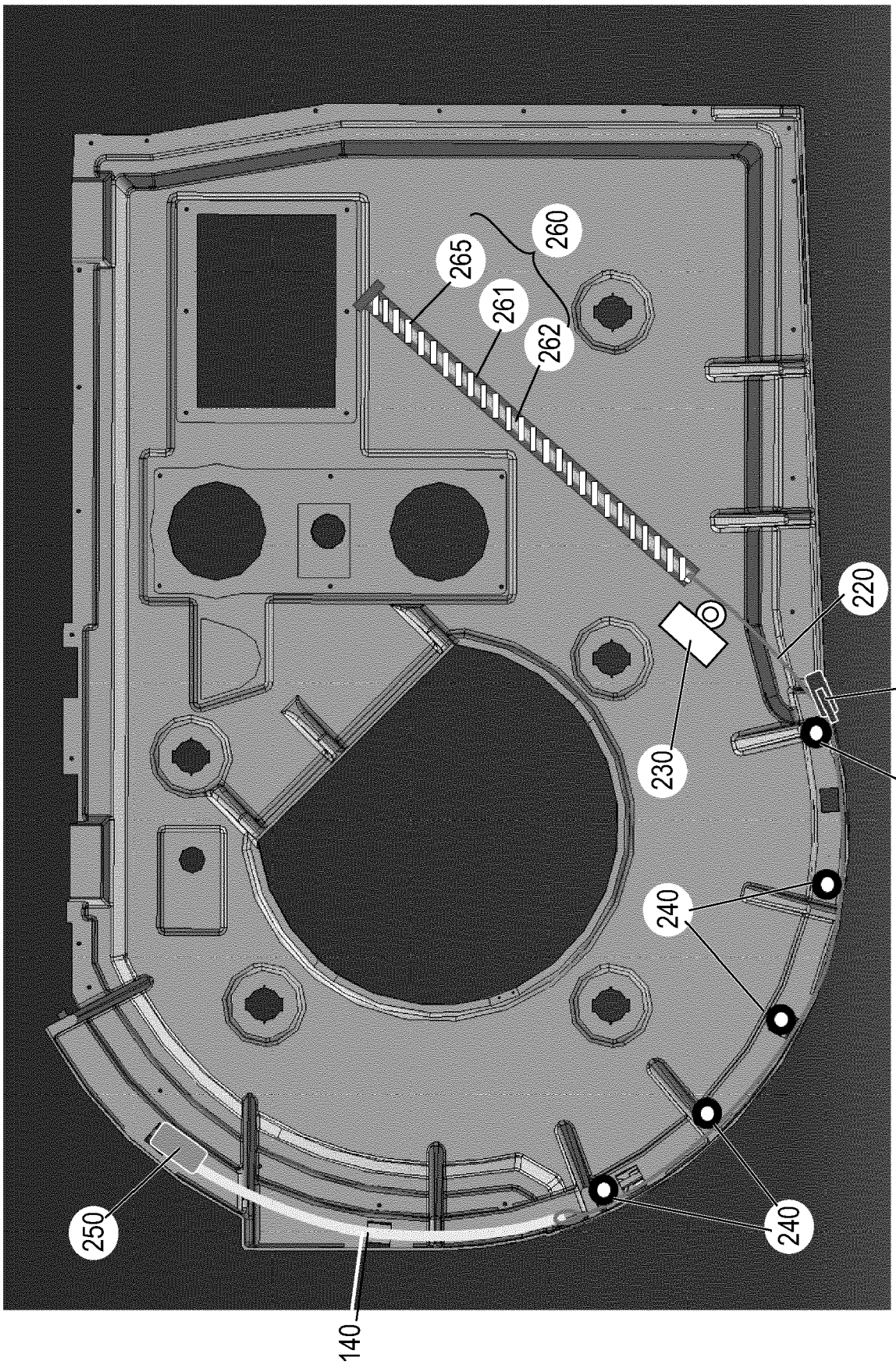

Fig. 4B

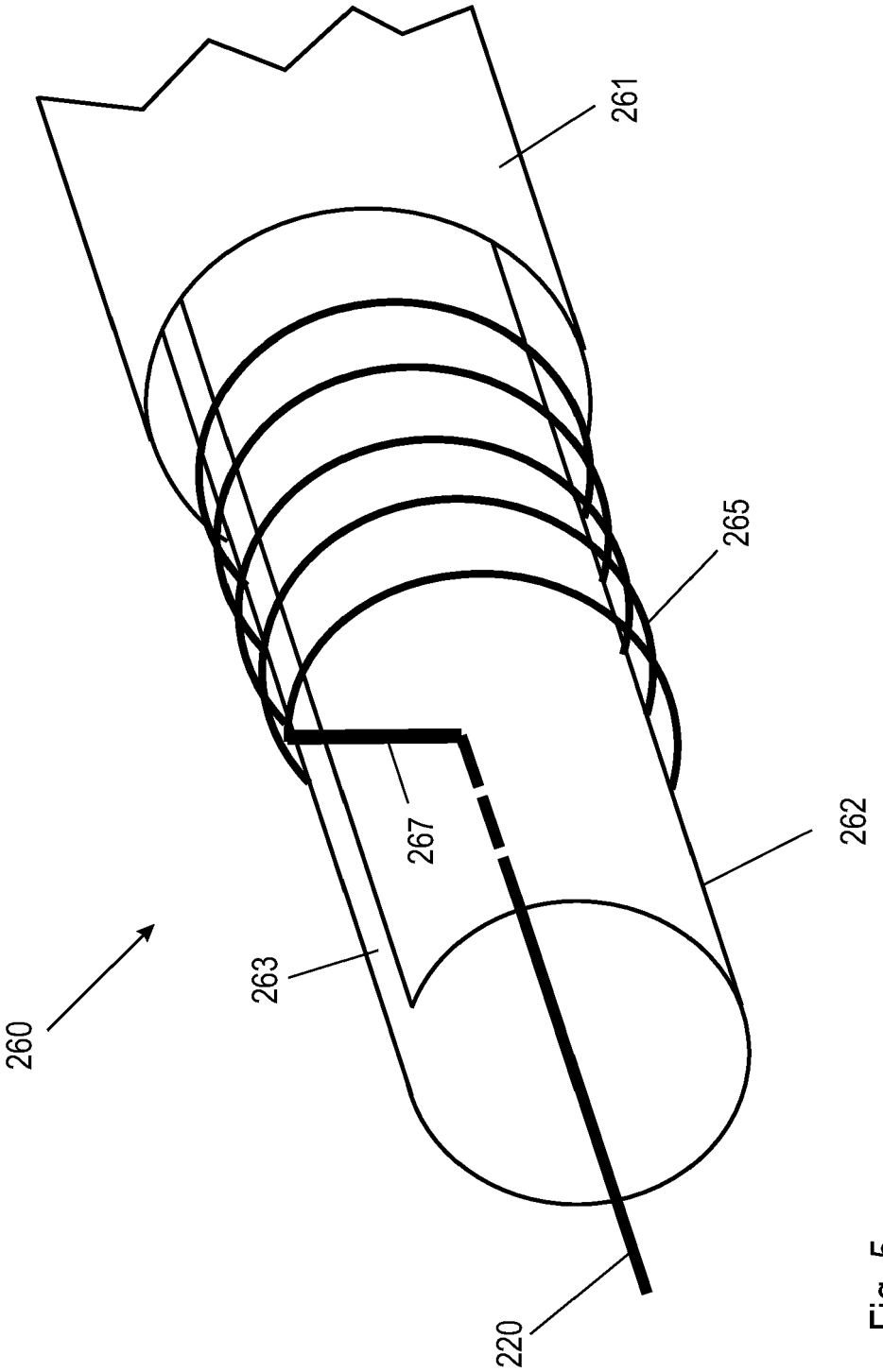

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 22 18 2856

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A	JP H11 71924 A (OKAMURA CORP) 16 March 1999 (1999-03-16) * the whole document *	1-15	INV. B61D35/00 B61D19/02
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 November 2022	Denis, Marco

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