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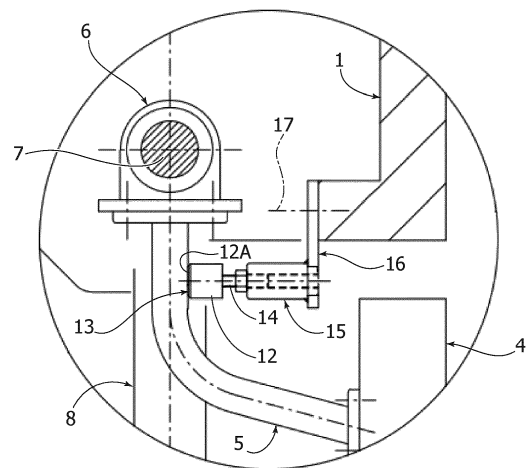
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(54) **SAFETY DEVICE FOR DOORS OF PUBLIC TRANSPORT VEHICLES**

(57) A door device for public transport vehicles, such as buses, trams or the like, comprises at least one door wing (4) having an upper end connected to a door wing-supporting arm (5) protruding from a bushing (6) mounted on an upper horizontal guiding rod (7). A vertical shaft (8) is rotatably supported on one side of the doorway, and carries a lower arm (9) at its lower end for guiding the door wing, which is operationally connected to a lower end of the door wing (4) by means of an engagement member in the form of a wheel (10) guided within a horizontal track (11) carried by the lower end of the door wing (4). In case of breakage of the pin of the aforesaid wheel engagement member (10), and the consequent release of the lower end of the door wing (4) from the lower guiding arm (9), an outward swinging of the door wing (4) around the axis of the aforesaid horizontal guiding rod (7) is prevented by a safety device (13) including a stop element (12) mounted on the stationary structure of the door, and configured and arranged to come into contact with the door wing-supporting arm (5) in order to prevent the above rotation. In a variant, the stop element is supported by the vehicle structure in such a way as to be movable between an operative position and an inoperative position, by means of an electrically-operated actuator. In this variant, the stop element is only kept in its operative position when the vehicle speed is above a predetermined threshold value, for example in the order of 5 km/h.

FIG. 7



Description

Field of the invention

[0001] The present invention relates to door devices for vehicles for public transport by road or rail, such as buses, trams or the like.

[0002] In particular, the invention relates to a door device of the type comprising:

- at least one door wing, having an upper end connected to a door wing-supporting arm,
- wherein said door wing-supporting arm is carried by, and protrudes from a bush slidably mounted on an upper horizontal guiding rod, which is configured for being connected to a stationary door structure, above a doorway, in such a way that said rod can be moved outwards to cause the door wing to move out of the doorway general plane,
- a vertical shaft arranged to be rotatably supported on one side of the doorway and carrying a lower arm adjacent to its lower end, for guiding the door wing,
- wherein said lower arm for guiding the door wing is operatively connected to a lower end of the door wing by means of an engagement member guided within a horizontal guiding track associated with the lower end of the door wing.

Prior art

[0003] Door devices having the above characteristics have been known and used for some time. Figures 1A and 1B illustrate, respectively, a cross-sectional view, in a plane perpendicular to the plane of the door, and a front view, in the plane of the door, of a door device according to the prior art, in the closed door condition. Figures 2A and 2B are a front view in the plane of the door, and a cross-sectional view in a plane perpendicular to the plane of the door of the device of Figures 1A and 1B, illustrated in the open door condition.

[0004] In the aforesaid figures, the reference number 1 indicates - in its entirety - the stationary structure of a vehicle for public transport, for example, a bus, tram or the like, equipped with a door device which is indicated - in its entirety - by the reference 2 and which it is arranged at a doorway 3 defined by the structure 1. In the example illustrated, the door device 2 comprises two wings 4 slidably mounted between the closed condition, mutually adjacent, which is illustrated in Figure 1B, and an open condition illustrated in Figure 2A, wherein the wings 4 are displaced outside the plane of the doorway 3 and spaced apart from each other.

[0005] Each door wing 4 has an upper end which, on its side adjacent to the median plane A of the doorway, is rigidly connected to the end of a door wing-supporting arm 5. The door wing-supporting arm 5 protrudes from a bushing 6 slidably mounted on an upper horizontal guiding rod 7, which is guided with respect to the stationary

structure 1 of the door, above the doorway 3 (by means of a mechanism not shown in the attached drawings, for greater simplicity of illustration) so as to be able to translate horizontally outwards (see Figure 2B).

[0006] A vertical shaft 8 is associated with each door wing 4 rotatably supported by the stationary structure 1 on the respective side of the doorway 3, and carrying a lower arm 9 adjacent to its lower end, for guiding the respective door wing 4, which is operatively connected at a lower end of the door wing 4 by means of an engagement member 10 guided within a horizontal guiding track 11 carried by the lower end of the door wing 4. The vertical shaft 8 also carries an upper arm (not illustrated in the drawings) for moving the mechanism that causes the horizontal translation outwards (for a distance, for example, in the order of 10 mm - see Figure 2B) of the guiding rod 7.

[0007] More specifically, in the known solution the aforesaid engagement member 10 is constituted by a wheel supported by the arm 9 in a freely rotatable way around an axis 10A, which is engaged in a guide channel 11 (see Figures 3,4) mounted on the lower end of the door wing (see in particular Figure 4 that illustrates the detail indicated by the arrow IV in Figure 3).

[0008] As can be seen, each door wing 4 is connected to the door opening control device at only two points, arranged at the end of a theoretical diagonal D (see Figure 1B). At its upper end, the door wing 4 is connected to the door wing-supporting arm 5, while at its lower end, the door wing 4 is operationally connected to the wheel 10 carried by the guiding arm 9.

[0009] Figures 2A, 2B illustrate the door device in its open condition.

[0010] The present description and the attached drawings do not illustrate the details of the system for actuating the movement of the wings 4 between the open condition and the closed condition. According to a per se conventional technique, the actuation system includes, for example, an actuator of any known type, for example, a fluid actuator, arranged horizontally above the doorway, which is capable of controlling the movement of the wings between the open condition and the closed condition. These constructive details are not illustrated here because they can be made in any known way, and because, taken on their own, they do not fall within the scope of the present invention, and finally because elimination of these details from the drawings makes the drawing more readily and easily understood.

[0011] In door devices of the type described above, there is sometimes a breakage of the pin 10B on which the wheel 10 is mounted (see Figure 5). In the case of such an event, the connection between the lower end of the door wing 4 and the guide device of the door ceases. This determines the possibility for the door wing 4 to swing outwards, around the axis of the rod 7 (see Figure 3), generating a critical condition for the safety of passengers and a high risk of collision with other vehicles and/or people.

[0012] Devices of the type indicated in the preamble of claim 1 are, for example, known from EP 3 205 801 A1 and EP 2 752 546 A2.

Object of the invention

[0013] The object of the present invention is to improve the known device described above, in order to avoid the drawbacks that have been described above.

[0014] In particular, one object of the invention is to obtain a second safety device, independent from the door system, on doors installed on vehicles for collective transport on road or rail, having as a characteristic that the door wing is only supported in two points (one upper and one lower) placed at the ends of a diagonal of the door.

The invention

[0015] In order to achieve this object, the invention relates to a door device having the characteristics indicated at the beginning of the present description, and characterized in that it comprises a safety device including a stop element designed to be mounted on the stationary structure of the door, and configured and arranged to come into contact with the door wing-supporting arm in order to prevent rotation of the door wing outwards, beyond a predetermined maximum angle, around the axis of the upper guiding rod, following an accidental disengagement of said engagement member from said guiding track associated with the lower end of the door wing.

[0016] Thanks to the aforesaid characteristic, in the event of a failure of the type described above, i.e. a disengagement of the lower guiding arm 9 from the guiding track 11 provided at the lower end of the door wing 4, the device according to the invention ensures - in any case - that the door wing itself remains in its plane, without swinging dangerously outwards, so as to allow the vehicle to proceed in a safe situation to a repair workshop.

[0017] According to another preferred characteristic, a sensor device capable of producing an alarm signal each time the safety device comes into operation can be associated with the safety device according to the invention.

[0018] An important advantage of the safety device according to the invention lies in the fact that it is "external" with respect to the movable part of the door, and is, therefore, easily and quickly adaptable to the stationary structure of the door, in particular to the structure of the upper case.

[0019] In a variant, the stop element is supported by the vehicle structure in such a way as to be movable between an operative position and an inoperative position, by means of an electrically-operated actuator. In this variant, the actuator is preferably controlled by an electronic unit in such a way that the stop element is only kept in its operative position when the vehicle speed is above a predetermined threshold value, for example, in the order of 5 km/h.

Detailed description of an embodiment

[0020] Further characteristics and advantages of the invention will become apparent from the description that follows with reference to the attached drawings, provided purely by way of non-limiting example, wherein:

Figures 1A, 1B are a cross-sectional view and a front view of a door device according to the prior art, in the closed door condition,

Figures 2A, 2B are a front view and a cross-sectional view of the device of Figures 1A, 1B in the open door condition,

Figure 3 is a cross-sectional view similar to that of Figure 1A, which shows the outward swinging of the door wing that occurs in the case of the known device when the operative connection fails between the lower arm for guiding the door wing and the door wing itself,

Figure 4 illustrates - on an enlarged scale - the detail indicated by the arrow IV of Figure 3,

Figure 5 illustrates the same detail as Figure 4 in the hypothesis of breakage of the pin on which the wheel that engages the guiding track at the lower end of the door wing is mounted,

Figures 6A, 6B are a cross-sectional view and a front view of the door device according to the invention, in the closed door condition, and

Figure 7 is an enlarged scale view of the detail indicated by the arrow VII in Figure 6A, which illustrates the safety device according to the invention.

[0021] Figures 1A, 1B, 2A, 2B, 3, 4, 5 have already been described above.

[0022] In Figures 6A, 6B, the parts corresponding to those of Figures 1A, 1B are indicated with the same reference numbers.

[0023] As shown in the Figures, the configuration and arrangement of the various components of the door device remain substantially the same. The difference with respect to the known solution consists simply in the addition of a safety device consisting, for each door wing 4, of a stop pad 12 carried by the stationary structure 1 of the door, in such a position as to interfere with the door wing-supporting arm 5 if said arm tends to swing outwards of the doorway around the axis of the guiding rod 7 (see Figure 7).

[0024] In the specific example illustrated, the safety device, indicated - in its entirety - by the reference 13, comprises the pad 12, in the form of a cylindrical body made of any suitable material (for example, rubber) having a front surface 12A suitable for cooperating with the surface of the door wing-supporting arm 5. The surface 12A may have a configuration corresponding to the shape of the outer surface of the arm 5, to improve the mutual contact between these elements. The body of the pad 12 is carried at the end of a screw 14 mounted inside a cylindrical bushing 15, which protrudes horizontally

from a plate 16 fixed by means of screws (of which only the axis 17 is illustrated) to the stationary structure 1. As can be seen in Figure 6, this arrangement is repeated for each of the two wings 4.

[0025] According to an optional characteristic, the safety device consisting of the pad 12 can be associated with a sensor of any known type configured to activate the emission of an acoustic or light signal in the event of activation of the safety device.

[0026] In a variant (not illustrated), the pad or other equivalent stop element is supported by the door structure in such a way as to be movable, for example, by means of a rotation movement, between an operative position, wherein it is able to perform the function indicated here, and an inoperative position. In the case of this variant, an electrically-operated actuator is provided, for example, an electromagnetic actuator with a return spring, to move the stop element between its operative position and its inoperative position. Preferably, in this case, the electrically-operated actuator is controlled by an electronic unit designed to receive a signal indicative of the vehicle speed (from the electronic control unit of the vehicle) and programmed in such a way that the stop element is only kept in its operative position when the vehicle speed is above a threshold value, for example, in the order of 5 km/h. When the vehicle speed is below this threshold value, the stop element is kept in its inoperative position.

[0027] Of course, without prejudice to the principle of the invention, the details of construction and the embodiments may vary widely with respect to those described and illustrated purely by way of example, without departing from the scope of the present invention, as defined by the attached claims.

Claims

1. A door device for public transport vehicles such as buses, trams or the like, comprising:

- at least one door wing (4), having an upper end connected to a door wing-supporting arm (5),
- wherein said door wing-supporting arm (5) is carried by, and protrudes from a bushing (6), which is slidably mounted on an upper horizontal guiding rod (7), said rod being configured for being connected to a stationary door structure (1), above a doorway (3), in such a way that said rod can be moved outwards to cause the door wing to leave the general plane of the doorway,
- a vertical shaft (8) designed to be rotatably supported on one side of the doorway (3) and carrying a lower arm (9) adjacent to its lower end, for guiding the door wing (4),
- wherein said lower arm (9) for guiding the door wing (4) is operatively connected to a lower end of the door wing (4) by means of an engagement

member (10) guided within a horizontal guiding track (11) associated with the lower end of the door wing (4),

said door device being **characterized in that** it comprises a safety device (13) including a stop element (12) arranged to be mounted on the stationary structure (1) of the door and configured and arranged to come into contact with said door wing-supporting arm (5) in order to prevent an outward rotation of the door wing (4) beyond a predetermined maximum angle, around the axis of said upper guiding rod (7), following an accidental disengagement of said engagement member (10) from said guiding track (11) associated with the lower end of the door wing (4).

2. A door device according to claim 1, **characterized in that** said stop element (12) is arranged and configured in such a way that said predetermined maximum angle is substantially equal to 0°.

3. A door device according to claim 1, **characterized in that** a sensor configured to generate an alarm signal in the event of activation of said stop element (12) is associated with said stop element (12).

4. A door device according to claim 1, **characterized in that** it comprises two wings (4) movable between a closed position and an open position, **characterized in that** a safety device is provided for each of said wings (4).

5. A door device according to claim 1, **characterized in that** the stop element is supported by the vehicle structure (1) in such a way as to be movable between an operative position and an inoperative position, said device also comprising an electrically-operated actuator for moving the stop element between its operative position and its inoperative position.

6. A door device according to claim 5, **characterized in that** it comprises an electronic control unit arranged to receive a signal indicating the speed of the vehicle, and programmed in such a way as to keep the stop element in its operative position only when the speed of the vehicle is above a threshold value, for example in the order of 5 km/h, and in such a way as to keep the stop element in its inoperative position when the vehicle speed is below this threshold value.

7. A safety device for a door device according to any one of the preceding claims **characterized in that** it comprises said stop element (12) arranged to be mounted on the stationary structure (1) of the door and configured and arranged to come into contact with said door wing-supporting arm (5) in order to prevent an outward rotation of the door wing (4) be-

yond a predetermined maximum angle, around the axis of said upper guiding rod (7), following an accidental disengagement of said engagement member (10) from said guiding track (11) provided at the lower end of the door wing (4).

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8. A safety device according to claim 7, **characterized in that** the stop element is supported by the door structure (1) in such a way as to be movable between an operative position and an inoperative position, said device also comprising an electrically-operated actuator for moving the stop element between its operative position and its inoperative position. 10
9. A safety device according to claim 8, **characterized in that** it comprises an electronic control unit arranged to receive a signal indicating the speed of the vehicle, and programmed in such a way as to keep the stop element in its operative position only when the speed of the vehicle is above a threshold value, for example in the order of 5 km/h, and in such a way as to keep the stop element in its inoperative position when the vehicle speed is below this value threshold. 15 20 25

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FIG. 1A

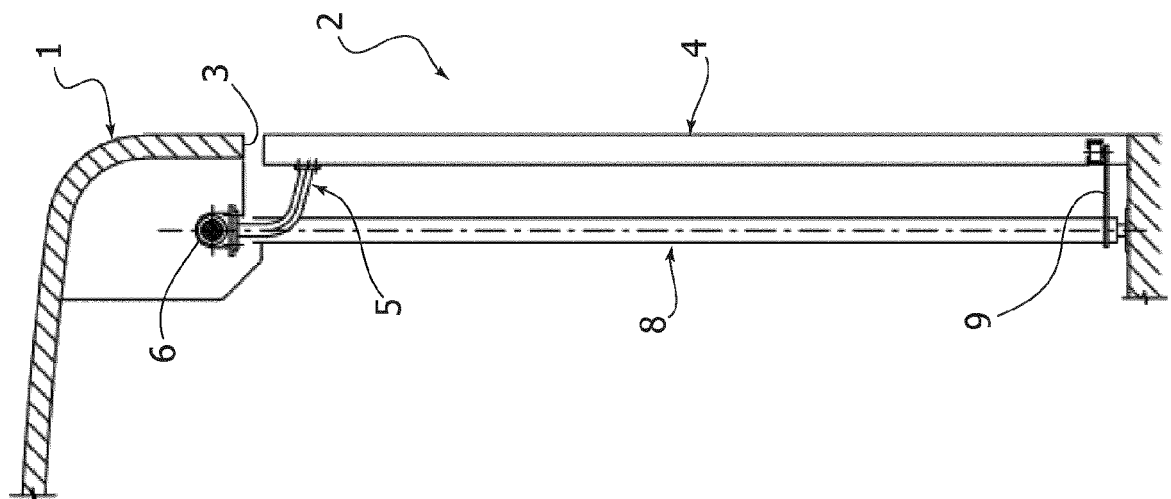


FIG. 1B

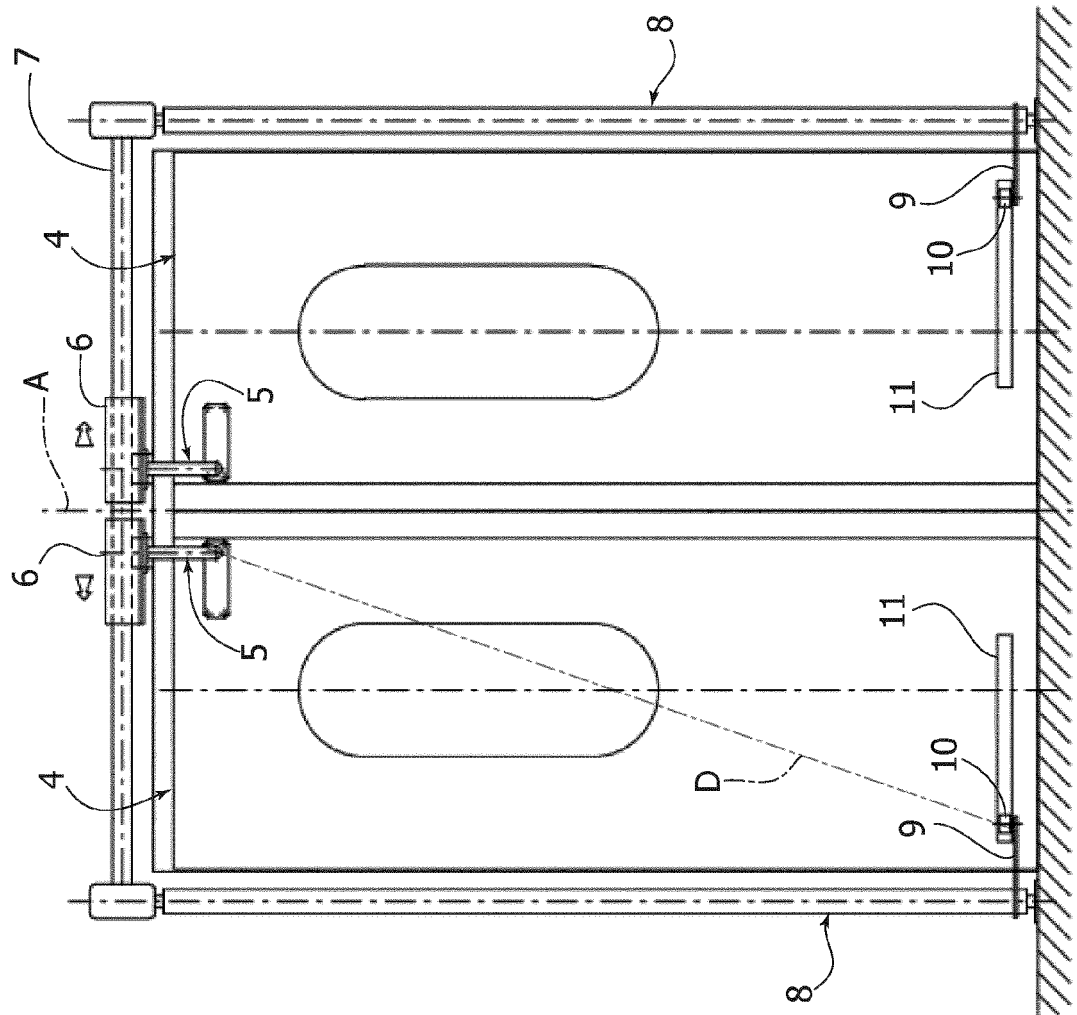


FIG. 2B

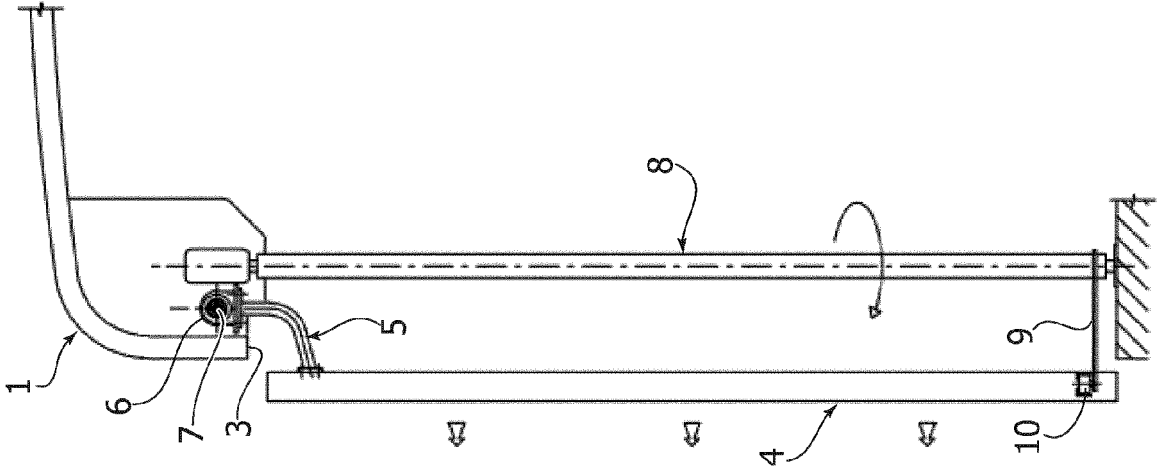


FIG. 2A

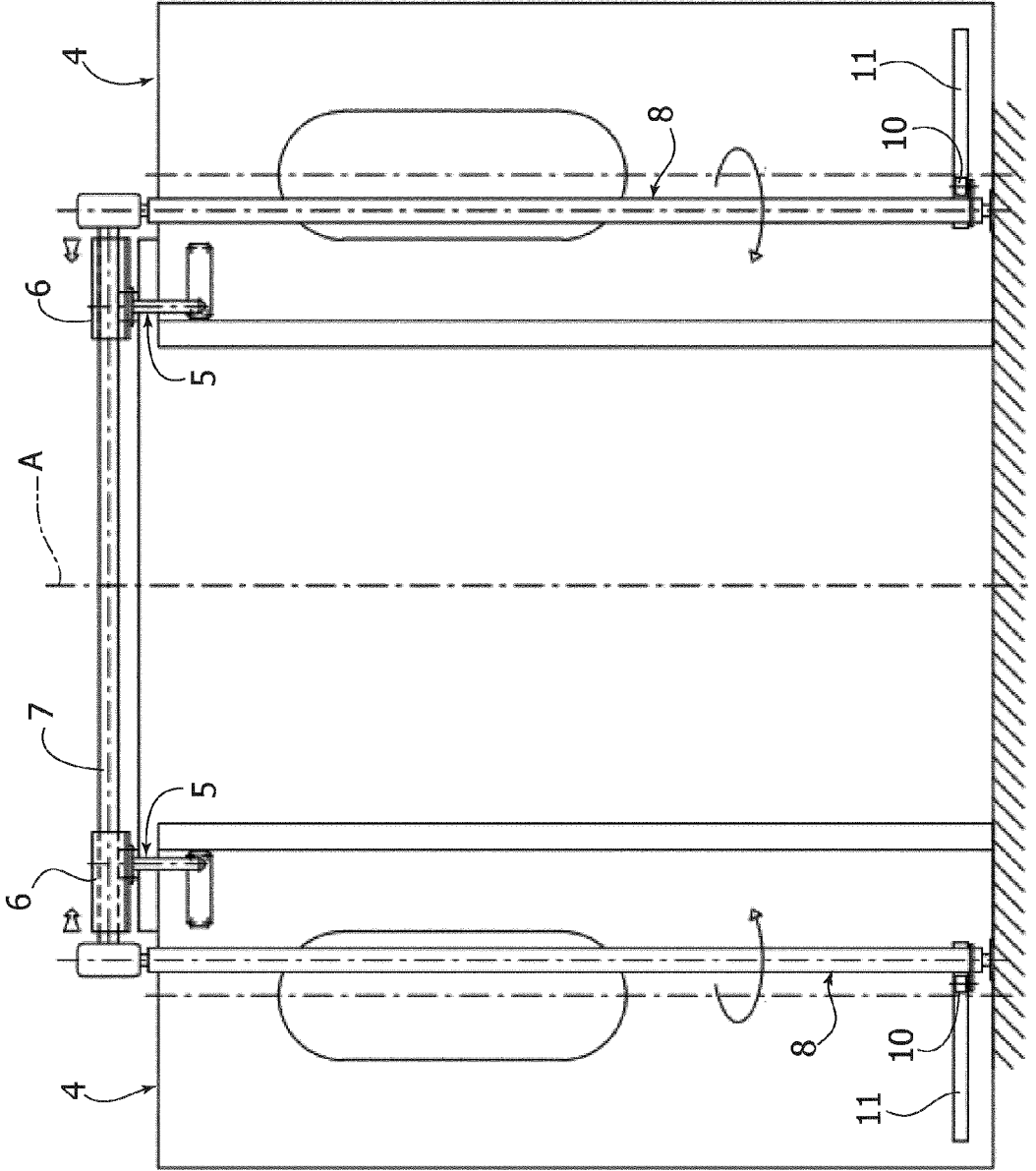


FIG. 3

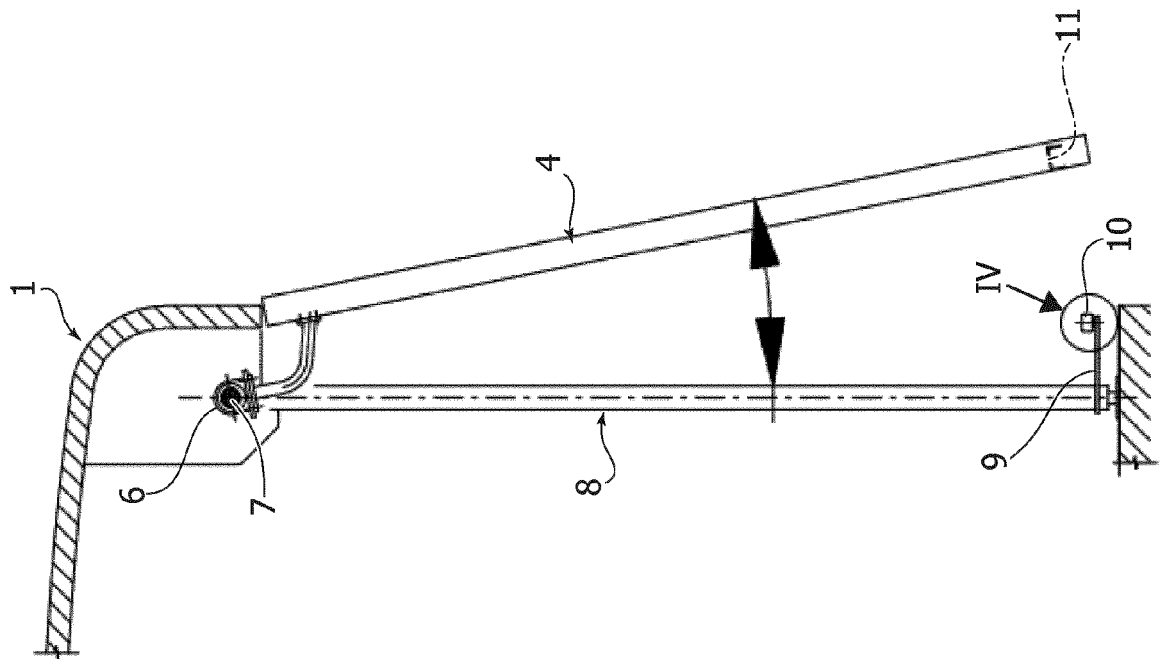


FIG. 4

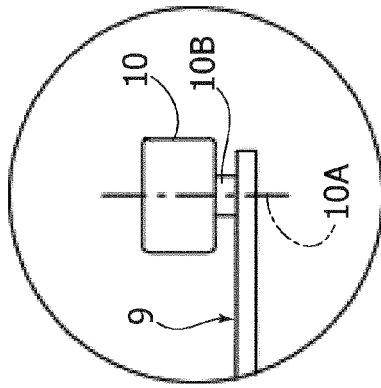


FIG. 5

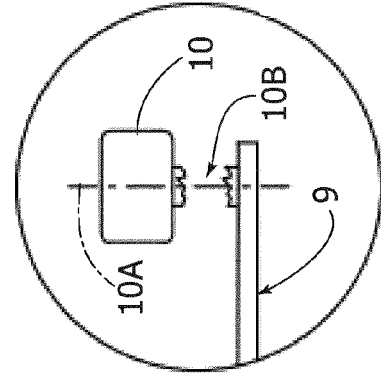


FIG. 6A

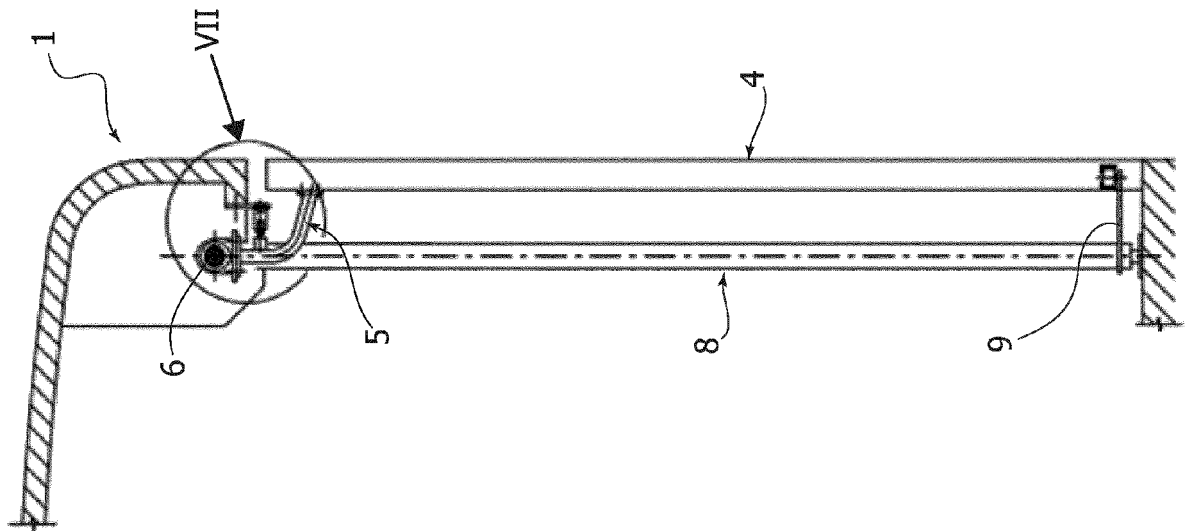


FIG. 6B

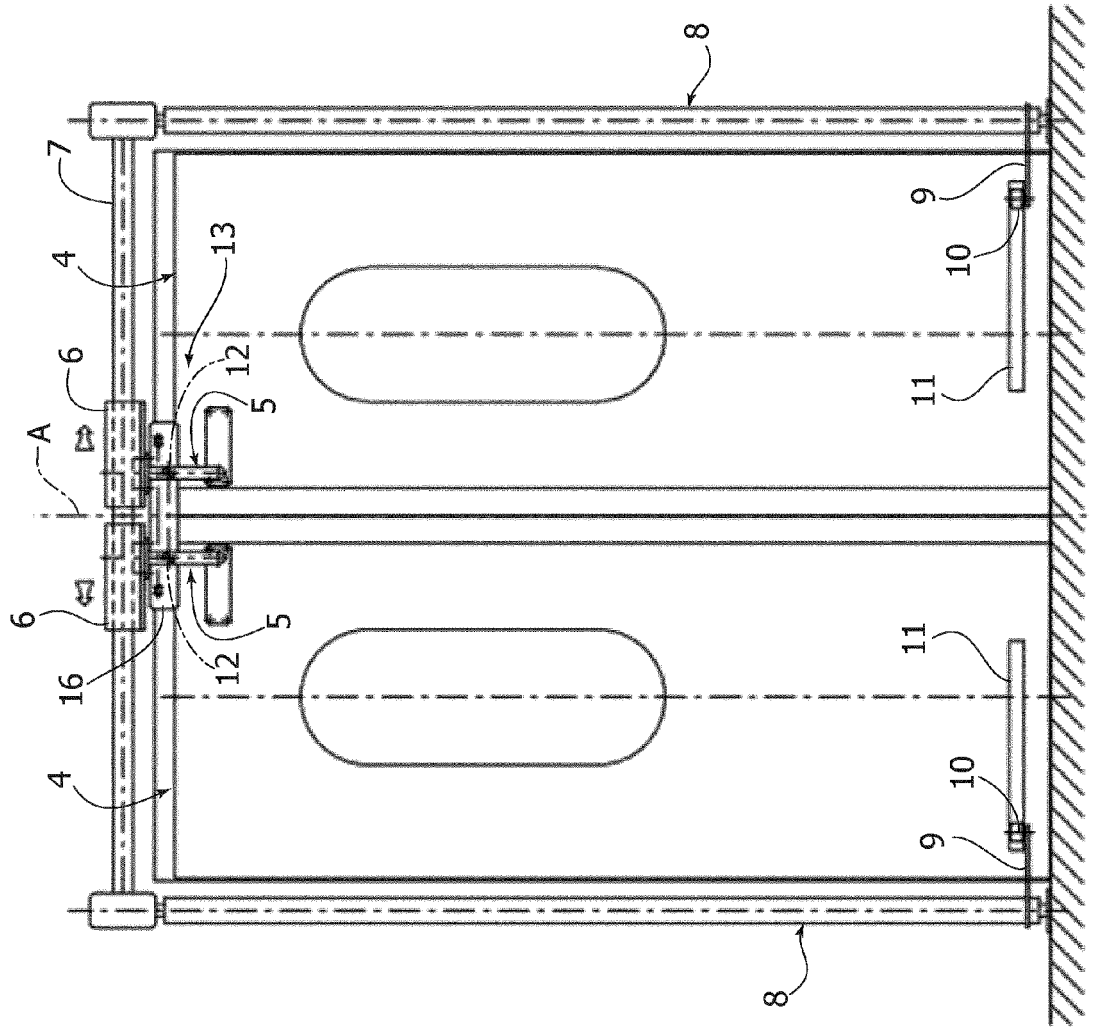
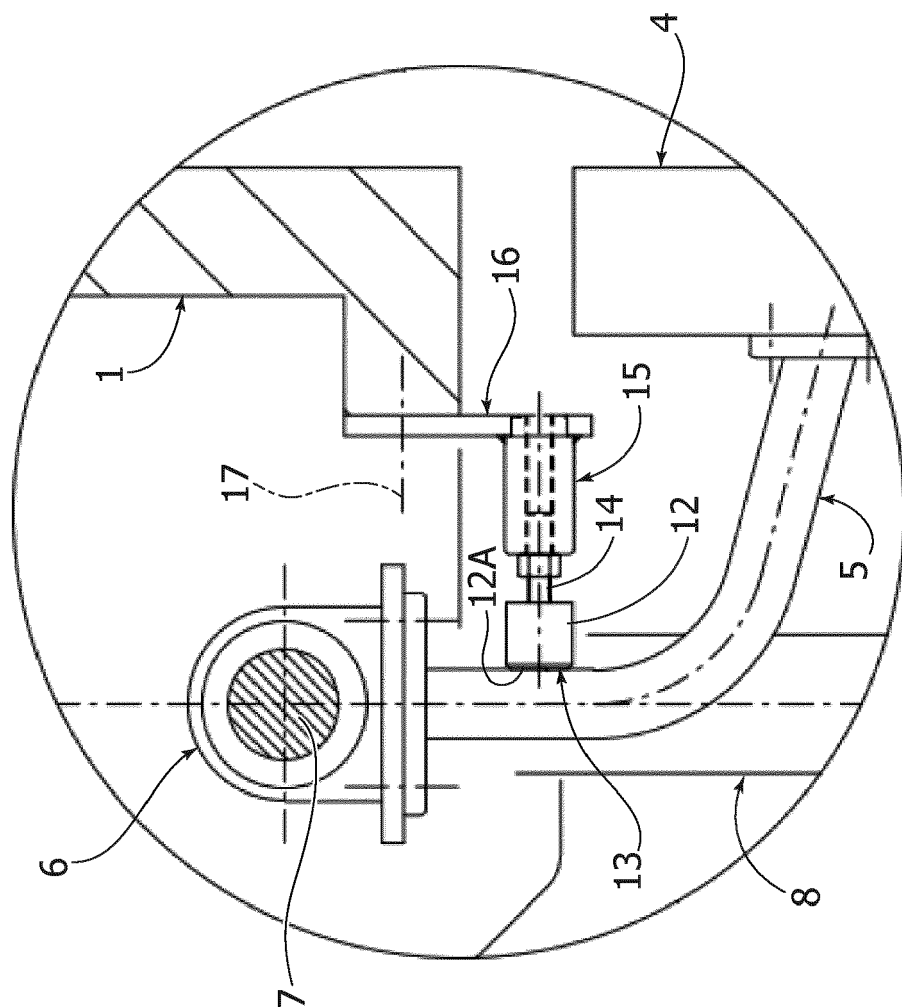


FIG. 7





EUROPEAN SEARCH REPORT

Application Number
EP 21 15 5130

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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A	EP 3 205 801 A1 (IWN GMBH & CO KG [DE]; SCHULTE REINHOLD [DE]) 16 August 2017 (2017-08-16) * paragraphs [0024] - [0032]; figures 1-5 *	1-9	INV. E05D15/10
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			TECHNICAL FIELDS SEARCHED (IPC)
			E05D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 10 June 2021	Examiner Klemke, Beate
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EP 21 15 5130

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10-06-2021

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