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(71) Applicant: **Bode Sud S.p.A.**
66041 Atessa (CH) (IT)

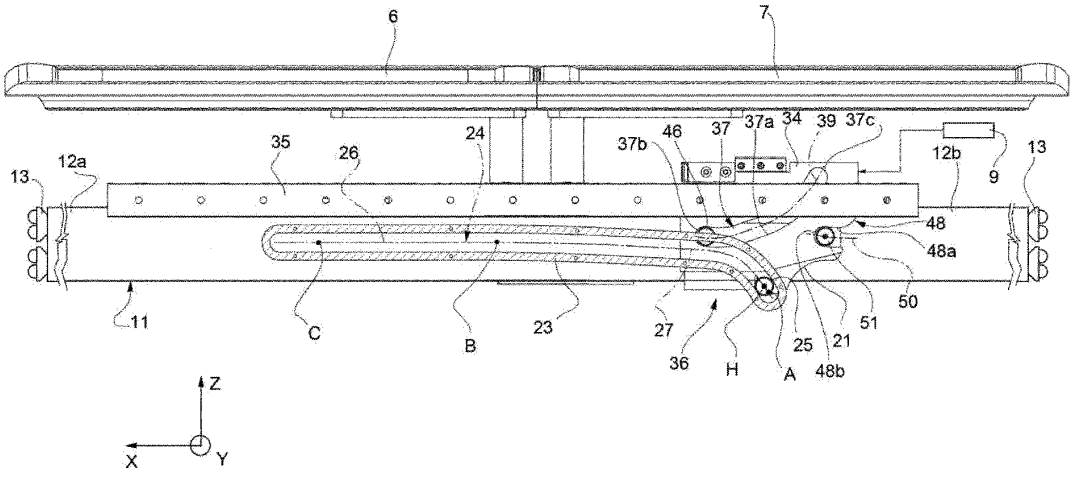
(72) Inventors:
- **RUI, Carlo**
  66034 LANCIANO (CH) (IT)
- **TELLINA, Gaetano**
  66038 SAN VITO CHIETINO (CH) (IT)

(74) Representative: **Lovino, Paolo et al**
Studio Torta S.p.A.
Via Viotti, 9
10121 Torino (IT)

(54) **MECHANISM FOR OPENING A DOOR, IN PARTICULAR FOR PUBLIC TRANSPORT VEHICLES**

(57) A door opening mechanism (8), in particular for public transport vehicles, has a supporting structure (8a), a support member (20) for carrying a leaf (6) of a door and coupling means (13, 11, 22) that couple the support member (20) to the supporting structure (8a) so that the support member (20) is movable parallel to a horizontal plane defined by a first and a second axis (X, Z); the mechanism (8) further has a guide (23) to guide the support member (20) along a trajectory (24) on the plane, a slider (34) movable along the first axis (X) between a first and a second end-of-stroke position and transmission means (36; 36') that couple the slider (34) to the support member (20) and comprise a follower (46; 46') and a cam (37; 37'); the cam is engaged by the follower (46; 46') and is shaped to prevent the slider (34) from translating towards the second end-of-stroke position when this latter is arranged in the first end-of-stroke position and the support member (20) receives a force along the second axis (Z).

FIG. 3



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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims priority from Italian patent application No. 102018000004896 filed on 26/04/2018.

TECHNICAL FIELD

[0002] The present invention relates to a door opening mechanism for opening/closing doors with one or two leafs, in particular for a public transport vehicle, for example a bus, a tram or a train.

BACKGROUND ART

[0003] Normally, the lateral sides of public transport vehicles are provided with one or more doors sliding between a closed configuration and an open configuration for the entry and the exit of passengers in the vehicle. In particular, in the closed configuration, the leaf or the leafs of each door are arranged flush with the relative vehicle side to close a passage.

[0004] On the other hand, in the open configuration, each leaf is arranged laterally with respect to the passage, outside and in a position spaced apart with respect to the vehicle side.

[0005] Some known embodiments provide a mechanism that gives to a door leaf a dual movement, i.e. a movement with a lateral sliding component, parallel to the vehicle side, and with a vehicle outward expulsion component, when opening, or with a vehicle inward return component, when closing. A second additional leaf, where provided, moves by means of known transmissions in response to the movement of the leaf dragged by the mechanism.

[0006] The mechanism typically includes a guide for constraining the movement of the leaf along a trajectory lying on a horizontal plane. The guide has a straight part and a curved end part facing the inside of the vehicle to give the leaf the expulsion/return component.

[0007] For example, EP2325404 describes a door opening mechanism comprising a sleeve, which is fixed with respect to the door leaf, engages the aforesaid guide by means of a roller and is slidable along a horizontal bar, in turn movable in a transverse direction. The mechanism further comprises a slider or cart, which is slidable along a corresponding guide parallel to the horizontal bar and is coupled to the sleeve by means of a connecting rod. When the door is closed and the roller engages the curvilinear portion of the guide, the connecting rod is inclined so that a thrust applied to the inner face of the leaf results in a thrust on the cart 20 directed to the closing direction to prevent any accidental opening of the door.

[0008] A similar solution is shown in Figure 3a of EP2362046. In this case, the connecting rod has an end that engages the guide where the roller carried by the leaf slides. Also in this case, when the door is closed the connecting rod is inclined to prevent any accidental opening of the door.

[0009] Although the described mechanisms prevent any accidental opening of the door, it is still felt the need to improve them in terms of compactness and simplicity of construction. In particular, it is felt the need to minimize the use of rotary-type levers and drive elements, which make the door opening mechanism complex.

DISCLOSURE OF INVENTION

[0010] The object of the present invention is to provide a door opening mechanism, in particular for public transport vehicles, which simply and inexpensively fulfils the requirement set forth above.

[0011] According to the present invention, a door opening mechanism is provided, in particular for public transport vehicles, as defined in the attached claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The invention will now be described with reference to the annexed drawings showing a non-limiting embodiment, in which:

- Figure 1 is a partial perspective view of a public transport vehicle provided with a preferred embodiment of the door opening mechanism according to the present invention;
- Figure 2 is a perspective view from below, on an enlarged scale, of the door opening mechanism of Figure 1;
- Figures 3 to 6 show the mechanism of Figures 1 and 2 in a plan view during the opening operation of a vehicle door;
- Figure 7 is a plan view on an enlarged scale of a detail of the mechanism of Figures 1 to 6;
- Figure 8 is similar to Figure 3 and shows a plan view of a variant of the mechanism of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0013] In Figure 1, the reference number 1 indicates, as a whole, a public transport vehicle, of which only certain parts are shown in a simplified manner. The vehicle 1 is shown in a Cartesian system of mutually orthogonal axes X, Y, Z, where the axis X is horizontal and parallel to a travel direction of the vehicle, the axis Y is vertical and the axis Z is horizontal and orthogonal to the axis X.

[0014] The vehicle 1 has a passenger compartment 2 and comprises a frame 3 that supports a pair of vehicle sides 4 (of which only one is partially shown in Figure 1) laterally delimiting the passenger compartment 2. One of the vehicle sides 4 has at least one door compartment 4a to allow the entry and the exit of the passengers.

[0015] Moreover, the vehicle 1 comprises a door 5, in

particular of the type comprising two leafs (indicated, respectively, by the reference numbers 6 and 7). The leafs 6, 7 are coupled to the frame 3 in a movable manner between a closed configuration, in which they are arranged flush with one another and with the vehicle side 4 to close the door compartment 4a, and an open configuration, in which they are arranged outside the passenger compartment 2, in positions facing the vehicle side 4 and on opposite sides of the door compartment 4a.

[0016] The door 5 comprises a door opening mechanism 8, which supports and moves the leafs 6 and 7. The mechanism 8 comprises a supporting structure 8a (partially shown) that is fixed to the frame 3 or constitutes an integral part of the frame 3.

[0017] The mechanism 8 comprises an actuator assembly 9, preferably electric or pneumatic, for opening and closing the leafs 6, 7. In particular, the mechanism 8 comprises a transmission not shown, e.g. a transmission with cables, tapes, belts or chains, which symmetrically transfers the movement of leaf 6 to leaf 7.

[0018] In order to couple the door 5 to the frame 3, the mechanism 8 comprises a support device 10 movable in response to the actuation of the actuator 9 and comprising, in turn, a horizontal crossbar 11 that is parallel to the axis X and is coupled to the supporting structure 8a to be able to move along the axis Z, i.e. orthogonally to the vehicle side 4. The crossbar 11 comprises a main body 12 of elongated shape and having two opposite ends 12a, 12b, which engage respective linear guides 13 (Figure 3) parallel to the axis Z and fixed to the supporting structure 8a.

[0019] As shown in Figure 2, the crossbar 11 comprises a linear guide 14 that is arranged below the body 12, is parallel to the axis X and is carried in a fixed position by the body 12. For example, the guide 14 is fixed to the body 12 by means of threaded members.

[0020] Furthermore, the support device 10 comprises a cart 20 slidably coupled to the guide 14. Therefore, the crossbar 11 defines a coupling element of the cart 20 to the supporting structure 8a, so that the cart 20 is able to move in a horizontal plane defined by the axes X and Z.

[0021] The cart 20 preferably comprises a bracket 21, which is substantially C-shaped and is arranged laterally and astride the body 12. The bracket 21 comprises:

- an upper plate portion 21a and a lower plate portion 21b, substantially horizontal and arranged respectively above and below the crossbar 11; and
- a lateral portion 21c that is substantially vertical, joins the portions 21a, 21b and faces one side of the body 12.

[0022] The cart 20 further comprises a slide 22, fixed to the portion 21b and slidingly engaging the guide 14, so that the slide 22 and the bracket 21 translates parallel to the axis X and relatively to the crossbar 11. The slide 22 is coupled to the leaf 6 through a connecting and supporting structure 10a having an arm that protrudes downwards and along the axis Z towards the outside and is fixed to an upper end of the leaf 6 itself. Preferably, the structure 10a has an articulation (not shown) that allows a slight relative rotation between the cart 20 and the leaf 6 about a direction parallel to the axis X.

[0023] As mentioned above, the support device 10 allows two degrees of freedom of translation to the leaf 6 that, being coupled to the cart 20, can either slide parallel to the vehicle side 4, namely to the axis X, or perpendicularly to the vehicle side 4, namely to the axis Z.

[0024] As best shown in Figure 3, the mechanism 8 further comprises a guide 23 that is carried in a fixed position by the supporting structure 8a above the cart 20 and constrains the cart 20 to move along a trajectory 24 on the aforementioned horizontal plane. Preferably, the guide 23 is a groove defined by a wall that protrudes downwards from a horizontal plate of the supporting structure 8a.

[0025] The cart 20 is coupled to the guide 23 by means of a pin or a roller 25 that is carried in a fixed position by the bracket 21, protrudes upwards from this latter and slidingly engages the guide 23 to follow the trajectory 24. The trajectory 24 comprises a straight section 26 parallel to the axis X and a curvilinear section 27. When the roller 25 runs along the section 26, the leaf 6 has a translation movement substantially parallel to the vehicle side 4. Conversely, when the roller 25 runs along the section 27, the leaf 6 has a mixed movement comprising a translation component along the axis X and a transverse translation component with respect to the vehicle side 4, namely along the axis Z.

[0026] The trajectory 24 comprises: a point A, coinciding with an end of the section 27; a point B, corresponding to a connection point between sections 26 and 27; and a point C, coinciding with an end of the section 26. Considering the axis Z, the point B has the same coordinate as the point C and is more external than the point A with respect to the passenger compartment 2.

[0027] The mechanism 8 further comprises a slider 34 that is operated by the actuator assembly 9 in a manner not described in detail and is slidable parallel to the axis X between a first end-of-stroke position, corresponding to the aforementioned closed configuration, and a second end-of-stroke position, corresponding to the above open configuration. In particular, the slider 34 is arranged vertically between the bracket 21 and the guide 23 and is slidably coupled to a guide 35 that is parallel to the axis X and is fixed to the supporting structure 8a.

[0028] To couple the slider 34 to the bracket 21, the mechanism 8 comprises a transmission 36, which is configured so that the translation of the slider 34 causes a corresponding displacement of the roller 25 along the trajectory 24.

[0029] The transmission 36 is of the cam-followerfollower type or of the guide-slide type, and comprises a first cam or guide preferably defined by a slot 37, which is formed on a plate of the slider 34 and extends horizontally, i.e. parallel to the plane defined by the axes X, Z.

The slot 37 is delimited by a pair of facing edges 37a and by a pair of semi-circular end edges 37b, 37c, which connect the edges 37a to each other.

[0030] Moreover, the transmission 36 comprises a followerfollower or slide, preferably defined by a pin or roller 46, which slidingly engages the slot 37, is in contact with the edges 37a, is carried in a fixed position by the cart 20, and in particular protrudes upwards from the bracket 21.

[0031] As best shown in Figure 3, the slot 37 defines a curvilinear path 39 that is followed by the roller 46. The path 39 has such a length and a shape to guide the roller 46 and then drag the bracket 21 along the trajectory 24, avoiding that the roller 25 sticks in the guide 23.

[0032] As better shown in Figure 7, the path 39 comprises two opposite extreme points E and F, respectively near the edges 37b and 37c, and an intermediate point D between the points E and F defining a point of minimum coordinate along the axis Z, or a dead point position for the stroke of the roller 46. In other words, the point D coincides with the apex of an elbow-shaped section of the path 39. This elbow-shaped section is indicated by the reference number 40 and extends starting from the point E up to a point G, intermediate between the points D and F and having the same coordinate of the point E along the axis Z.

[0033] Along the axis Z, the distance between the points D and F is equal to the distance between the points A and B (i.e. between the points A and C). Therefore, when the roller 25 engages the guide 23 between the points B and C, the roller 46 occupies the point F of the path 39. Preferably, in this operating condition an empty space is provided between the roller 46 and the edge 37c.

[0034] The elbow-shaped section 40 consists of two sections 41, 42, separated from each other by the point D. A straight line tangent to any point of the section 41 and a further straight line tangent to any point of the section 42 have slopes of opposite sign with respect to the axis Z.

[0035] The section of the path 39 that goes from the point G to the point F is indicated by the reference number 44 and can be defined by a single straight part, or can be defined by several straight parts filleted together, or can be curvilinear.

[0036] With a further reference to Figure 3, when the slider 34 is in the first end-of-stroke position (leafs 6, 7 in the closed configuration), the roller 25 engages the guide 23 at a point H, intermediate between the points A and B. At the same time, the roller 46 engages the slot 37 at the point E. For example, in this operating condition an empty space is provided between the roller 46 and the edge 37b.

[0037] Along the axis Z, the point H is arranged at a distance from the point A that is equal to the one of the point D from the points E and G. During the translation of the slider 34, the roller 25 reaches the point A only when the roller 46 reaches the point D. In this operating condition, the crossbar 11 and the cart 20 are retracted slightly inside the passenger compartment 2 with respect to the position assumed in the closed configuration.

[0038] In other words, when the door 5 opens, the slider 34, under the action of the actuator assembly 9, starts to translate from the first end-of-stroke position (Figure 3) to the second end-of-stroke position (Figure 6). Therefore, the translation of the edges 37a along the axis X causes the roller 46 to slide from the point E to the point D, i.e. along the section 41. Consequently, the roller 25 and therefore the cart 20 move from the point H to the point A, i.e. towards the inside of the passenger compartment 2 (Figure 4). Correspondingly, as mentioned above, the leafs 6 and 7 of the door 5 also fall slightly inside the passenger compartment 2.

[0039] A further translation of the slider 34 towards the second end-of-stroke position causes the roller 46 to slide along the portion 42, i.e. from the point D to the point G. In this step, the roller 25 returns from the point A to the point H and, consequently, the crossbar 11 and the cart 20 return to the position they had when the door 5 was in the closed configuration.

[0040] Subsequently, as the slider 34 keeps moving towards the second end-of-stroke position, the roller 46 is guided along the section 44 from the point G to the point F. Consequently, the roller 25 runs along the entire section 27 from the point H to the point B (Figure 5). During this sliding, the crossbar 11 moves towards the outside of the vehicle 1, up to a configuration in which the leafs 6 and 7 of the door 5 have reached a maximum distance from the vehicle side 4.

[0041] Finally, by means of a subsequent translation of the slider 34 up to the second end-of-stroke position, the roller 46 remains at the point F along the path 39, so that the cart 20 moves integrally with the slider 34. The roller 25, in this phase, runs along the entire section 26 until it reaches the point C, i.e. the most advanced end of the trajectory 24. The crossbar 11 remains in the previous position, along the axis Z, while the leafs 6 and 7 run substantially in parallel with the vehicle side 4 until reaching the open configuration, in which they are arranged at a maximum distance from each other in the direction of the axis X.

[0042] To return the leafs 6, 7 to the closed configuration, the actuator assembly 9 is operated to translate the slider 34 in the opposite direction, namely from the second end-of-stroke position to the first end-of-stroke position. The movement of the rollers 25 and 46 is exactly the reverse of the one described above for opening the door 5, so that it is not further described in detail for brevity's sake.

[0043] During the movement between the open and closed configurations, the mechanism 8 preferably supports and drags also the lower ends of the leafs 6, 7. In particular, the mechanism 8 comprises two crank mechanisms 47 (Figure 1), of a known type and not described in detail, which are arranged on opposite sides of the door compartment 4a and respectively couple the ends 12a, 12b of the crossbar 11 to the lower ends of the leafs

6, 7. Possibly, the crank mechanisms 47 can be designed to impose to the leafs 6 and 7 a slight rotation about the axis Y in response to the translation of the crossbar 11, namely during the opening/closing movement of the leafs 6, 7.

[0044] During the translation of the slider 34, the shape of the section 44 of the slot 37 imposes the relative speed component of the roller 46 with respect to the slot 37 along the axis X. Therefore, the slope or inclination of the section 44 determines, depending on the speed of the slider 34, also the absolute speed component of the rollers 25, 46 along the axis X.

[0045] Along the axis Z, on the other hand, the relative speed component of the roller 46 with respect to the slot 37 is equal to the absolute speed component of the roller 25, 46, which is imposed by the shape of the guide 23 (as well as by the speed of the slider 34).

[0046] When the roller 25 engages the guide 23 between the points A and B, the more inclined or sloping the section 44 with respect to the axis X, the closer the absolute speed component of the roller 46 along the axis X to the one of the slider 34.

[0047] Moreover, the more inclined or sloping the section 27 with respect to the axis X, the higher the relative speed component of the roller 46 with respect to the slot 37 along the axis Y and, consequently, the closer the absolute speed component of the roller 46 along the axis X to the one of the slider 34.

[0048] When, instead, the roller 25 engages the guide 23 between the points B and C, the absolute speed component along the axis X of the roller 46 is equal to the one of the slider 34, as mentioned above.

[0049] Besides the slot 37, the transmission 36 optionally comprises a second cam or guide preferably defined by a recess 48 formed at an edge 49 (Figure 7) of the slider 34. The recess 48 is delimited by a pair of facing edges 48a and by a semicircular edge 48b connecting the edges 48a. The edges 48a are spaced apart, preferably by the same distance existing between the edges 37a, and end at an opening 49a formed along the edge 49.

[0050] The recess 48 extends along a path 50, which is identical in shape and orientation to the section 41, i. e. to the portion of the path 39 between the points E, D. In other words, the path 50 is parallel to the section 41. In particular, the path 50 results from a translation of the section 41 along the axis X in the opposite direction with respect to the translation of the slider 34 from the first to the second end-of-stroke position.

[0051] Together with the slot 48, the transmission 36 comprises a pin or roller 51, which has an axis parallel to the roller 46, is carried in a fixed position by the bracket 21 so as to protrude upwards from this latter and slidingly engages the slot 48 when the roller 46 runs along the section 41. In this phase, the edges 48a guide the roller 51 along the path 50. When, on the other hand, the roller 46 runs along the portion 42, the roller 51 disengages from the slot 48 and is uncoupled from the slider 34.

[0052] Thanks to the parallelism between the path 50 and the section 41, the coupling of the roller 51 in the recess 48 does not hinder the movement of the roller 46 in the slot 37. In particular, when the roller 46 is at the point D (dead point configuration), the roller 51 is arranged at a point L at the opening 49a; when the roller 46 is at the point E (leafs 6, 7 in the closed configuration), the roller 51 is arranged at a point M. Possibly, an empty space could be provided between the point M and the edge 48b.

[0053] According to a variant not shown, the recess 48 is rearranged by a further slot defining a path perfectly identical in the form and orientation to the path 39.

[0054] When the roller 46 engages the slot 37 in the section 41, the orientation of the section 41 in the plane defined by the axes X and Z prevents the slider 34 from translating towards the second end-of-stroke position, in case of an attempt to open the door 5 by exerting a horizontal thrust on the leafs 6 and/or 7 (along the axis Z) from the inside of the passenger compartment 2 to the outside of the vehicle 1.

[0055] This thrust is transmitted to the rollers 46, 51 through the connecting structure 10a and the cart 20. As regards the roller 46, the thrust is divided into two components, one of which is normal to the path 39 and is transferred to the frame 3 via the guide 35, whereas the other component is tangent to the path 39 and is directed from the point D to the point E. This last tangential thrust component tends to make the roller 46 slide in the slot 37 in the direction going from the point D to the point E, namely in a direction opposite to the one the roller 46 should have when the slider 34 moves from the first to the second end-of-stroke position to open the door 5.

[0056] Therefore, the thrust exerted on the leafs 6, 7 tends to lock more the leafs 6, 7 in the closed position, instead of opening them. The same phenomenon occurs in the recess 48, where the thrust of the roller 51 is divided into two components, the one tangential and the other normal to the path 50. The tangential component tends to translate the roller 51 in a direction that goes from the point L to the point M and, therefore, also causes the locking of the leafs 6, 7 in the closed configuration. The coupling between the recess 48 and the roller 51 is redundant with respect to the coupling between the slot 37 and the roller 46 as far as the locking function is concerned, but allows distributing the thrust from the cart 20 on the slider 34 on two points spaced apart along the axis X and therefore avoiding the transmission of torques on the slider 34.

[0057] According to the variant shown in Figure 8, the mechanism 8 comprises, in replacement of the transmission 36, a transmission 36' that has the same function as the transmission 36 and has a dual configuration and structure with respect to the one shown in Figures 3 to 6. Components, paths, locations, etc. relating to the transmission 36' have been indicated by the same reference numbers used in Figures 3 to 6, but followed by a superscript.

[0058] The transmission 36' differs from the transmission 36 due to the fact that the slot 37' and the possible recess 48' are carried by the cart 20, in particular are formed on the bracket 21, more particularly on the plate portion 21a. The slot 37' has the same shape as the slot 37 but, with respect to this latter, it has an orientation rotated by 180° about the axis Y. The point D' defines a dead point configuration as it has a maximum coordinate with respect to the points of the path 39' along the axis Z.

[0059] Similarly, also the recess 48' is rotated by 180° with respect to the recess 48 about the axis Y.

[0060] Moreover, the pins or rollers 46' and 51' are carried in fixed positions by the slider 34, from which they protrude downwards. When the slider 34 is in the first end-of-stroke position (closed configuration of door 5), the roller 46' engages the slot 37' in the point E' and the roller 51' engages the recess 48' in the point M'. On the other hand, when the roller 25 engages the guide 23 in the point B, the roller 46' is at the point F' of the profile 39', while the roller 51' is at the point L'. When the roller 25 runs along the guide 23 between the points B and C, the roller 46' remains at the point F', while the roller 51' is outside the recess 48.

[0061] The operation of the transmission 36' is entirely similar to the one of the transmission 36: the edges 37a' of the slot 37' and the edges 48a' of the recess 48' are respectively pushed by the rollers 46' and 51' (instead of translating together with the slider 34, as it occurred in the transmission 36). However, the difference in orientation between the slots 37 and 37' determines the equivalence of the resulting movement of the cart 20.

[0062] Clearly, also the transmission 36' locks the door 5 if a thrust is exerted on the leafs 6, 7 along the axis Z from inside the passenger compartment 2. In fact, the thrust transmitted to the rollers 46' and 51' is divided into two components, one of which is normal to the profiles 39' and 50', whereas the other one is tangential and directed towards the points E' and M', namely in the opposite direction with respect to the slider 34 when this latter moves towards the second end-of-stroke position for opening the door 5.

[0063] From the foregoing, the advantages of the door opening mechanism 8 according to the present invention are clear to a person skilled in the art.

[0064] In particular, the mechanism 8 prevents any accidental opening of the door 5 by means of the transmission 36, 36', which has a self-locking function and includes a minimum number of components to perform this function.

[0065] At the same time, the cams (defined by the slots 37, 37' and by the recesses 48, 48') and the followers (defined by the rollers 46, 46', 51, 51') cause the movement of the bracket 21 (and therefore of the cart 20 and of the leafs 6, 7) in response to the pure and exclusive translation of the slider 34 for the entire stroke of this latter following the direction of the axis X.

[0066] Moreover, the mechanism 8 does not comprise rotating or flexible elements, for example cables or tie rods, which would involve an unnecessary complication of the mechanism 8. In particular, thanks to the guide 35, the slider 34 has only a translation movement without rotations. The simplicity of the mechanism 8 also derives from the fact that the slider 34 must not be coupled directly to the guide 23 during assembly.

[0067] Thanks to the self-locking function of the transmission 36, 36', it is not necessary to provide additional actuators or safety mechanisms to prevent the accidental opening of the door 5 when the leafs 6, 7 are in the closed configuration.

[0068] Moreover, when the self-locking function is performed, the presence of the slot 48 and of the roller 51 allows a distribution of the thrust between the rollers 46, 51 that are therefore less stressed. Furthermore, a suitable arrangement of the rollers 46, 51 with respect to the centre of gravity of the bracket 21 avoids the transmission of a torque on the slider 34 due to this thrust.

[0069] Finally, the project definition of the design of the slot 37, 37' allows determining a variable speed profile for the bracket 21 and for the leafs 6, 7, although the slider 34 is translated with a constant speed.

[0070] From the foregoing it is also clear that modifications and variations can be made to the mechanism 8 described above with reference to the attached figures without thereby departing from the scope of protection of the present invention as defined in the attached claims.

[0071] In particular, the shape of the slots 37, 37' may be different from the one described and shown, although suitable for performing the aforementioned self-locking function. For example, in the paths 39, 39' the section between the points G and E and, respectively, the section between the points F' and E' could be straight and parallel to the axis X. Consequently, in this variant, the points H and A would coincide, and the paths 50, 50' would be straight and parallel to the axis X. In this case, the thrust caused by an attempt to open the door 5 is transferred by the cart 20 with a single component, orthogonal to the paths 39, 39', 50, 50' (i.e. directed along the axis Z), without any tangential component.

[0072] The transmission 36, 36' could include a number of cams different from the one indicated, for example the slot 48, 48' and the roller 51, 51' could be absent. Moreover, the structure 10a could be coupled to the structure 8a by means of a coupling device different from the crossbar 11, but always such as to allow movement on a horizontal plane. Finally, the door 5 could have only one leaf, for example identical to the leaf 6, and/or be used in a field other than the vehicle field.

Claims

1. A door opening mechanism (8), in particular for public transport vehicles, the mechanism comprising:

   - a supporting structure (8a);
   - a support member (20) designed to carry a leaf

(6) of a door (5);
- coupling means (13, 11, 22) that couple said support member (20) to said supporting structure (8a) so that the support member (20) is movable parallel to a horizontal plane, said plane being defined by a first and by a second axis (X, Y) orthogonal to one another;
- a guide (23) fixed with respect to said supporting structure (8a), slidingly engaged by said support member (20) and shaped so as to guide said support member (20) along a trajectory (24) on said horizontal plane to open/close said leaf (6);
- a slider (34) designed to be actuated by an actuator assembly (9) so as to translate with respect to said supporting structure (8a) along said first axis (X) between a first end-of-stroke position, corresponding to a closed leaf condition, and a second end-of-stroke position, corresponding to an open leaf condition; and
- transmission means (36; 36') that couple said slider (34) to said support member (20) so that a translation of said slider (34) corresponds to a movement of said support member (20) along said trajectory (24);

characterised in that said transmission means (36; 36') comprise a first cam (37; 37') carried by a first element defined by one of either said support member (20) and said slider (34), and a first follower (46; 46') engaging said first cam (37; 37') and carried by a second element defined by the other of either said support member (20) and said slider (34); said first cam (37; 37') being shaped so as to prevent said slider (34) from translating towards the second end-of-stroke position, when said slider (34) is arranged in the first end-of-stroke position and said support member (20) receives a force directed parallel to said second axis (Z).

2. The mechanism according to claim 1, **characterised in that** said slider (34) does not engage said guide (23).

3. The mechanism according to claim 1 or 2, **characterised in that** said slider (34) is coupled to said supporting structure (8a) so as to be able to translate only parallel to said first axis (X).

4. The mechanism according to claim 2, **characterised in that** it comprises a straight guide (35) fixed to said supporting structure (8a); said slider (34) being slidingly coupled to said straight guide (35).

5. The mechanism according to any one of the preceding claims, **characterised in that** said coupling means comprise a crossbar (11) movable with respect to said supporting structure (8a) along said second axis (Z); said support member (20) comprising a cart slidingly coupled to said crossbar (11) along said first axis (X).

6. The mechanism according to any one of the preceding claims, **characterised in that** said trajectory (24) comprises:

- a first end point (A) corresponding to an intermediate position of said slider (34), arranged between said first and second end-of-stroke positions;
- a second end point (C) corresponding to the second end-of-stroke position of said slider (34);
- a closed leaf point (H) corresponding to said first end-of-stroke position;

said first cam (37; 37') comprising a locking section (41) shaped so as to prevent said slider (34) from translating towards said second end-of-stroke position when said slider (34) is arranged between said first end-of-stroke position and said intermediate position and said support member (20) receives a force directed parallel to said second axis (Z).

7. The mechanism according to claim 6, **characterised in that** said closed leaf point (H) coincides with said first end point (A).

8. The mechanism according to claim 6, **characterised in that** said closed leaf point (H) is arranged in an intermediate position between said first and second end points (A, C); said locking section being shaped so as to force said support member (20) to move between said closed leaf point (H) and said first end point (A), when said slider (34) is translated between the first end-of-stroke position and the intermediate position.

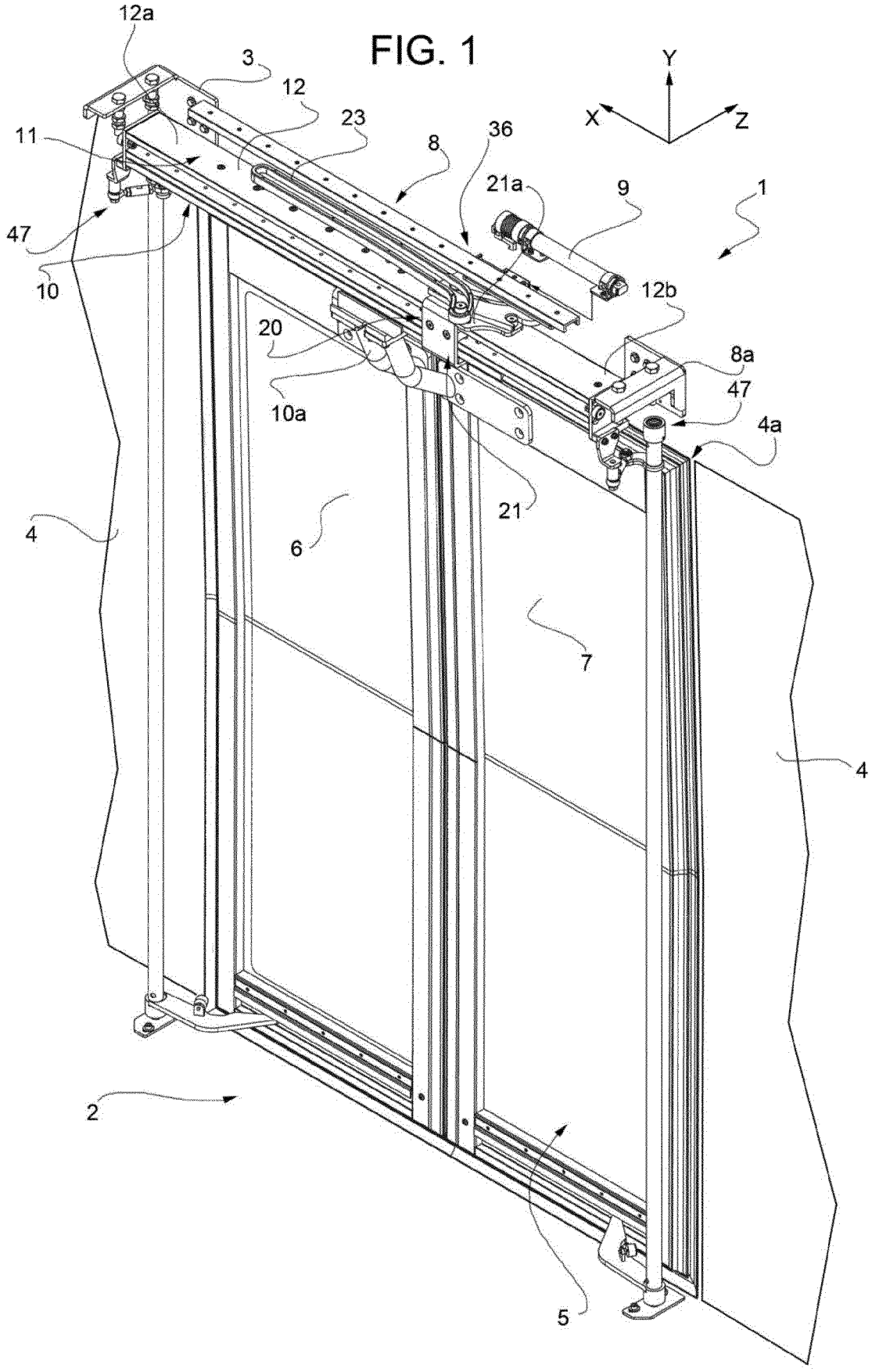
9. The mechanism according to claim 7 or 8, **characterised in that** said closed leaf point (H) is arranged in an intermediate position between said first and second end points (A, C); said first cam (37; 37') comprising an elbow-shaped section (40) having a dead point (D), from which said locking section (41) extends; said follower occupying said dead point (D) when said slider (34) is arranged in the intermediate position.

10. The mechanism according to any one of the claims from 6 to 9, **characterised in that** said transmission means (36; 36') further comprise:

- a second cam (48; 48') parallel to said locking section and carried by said first element; and
- a second follower (51, 51') carried by said second element (46; 46') and slidingly engaging said second cam (48; 48') when said slider (34)

is arranged and/or slides between a first end-of-stroke position and the intermediate position.

FIG. 1



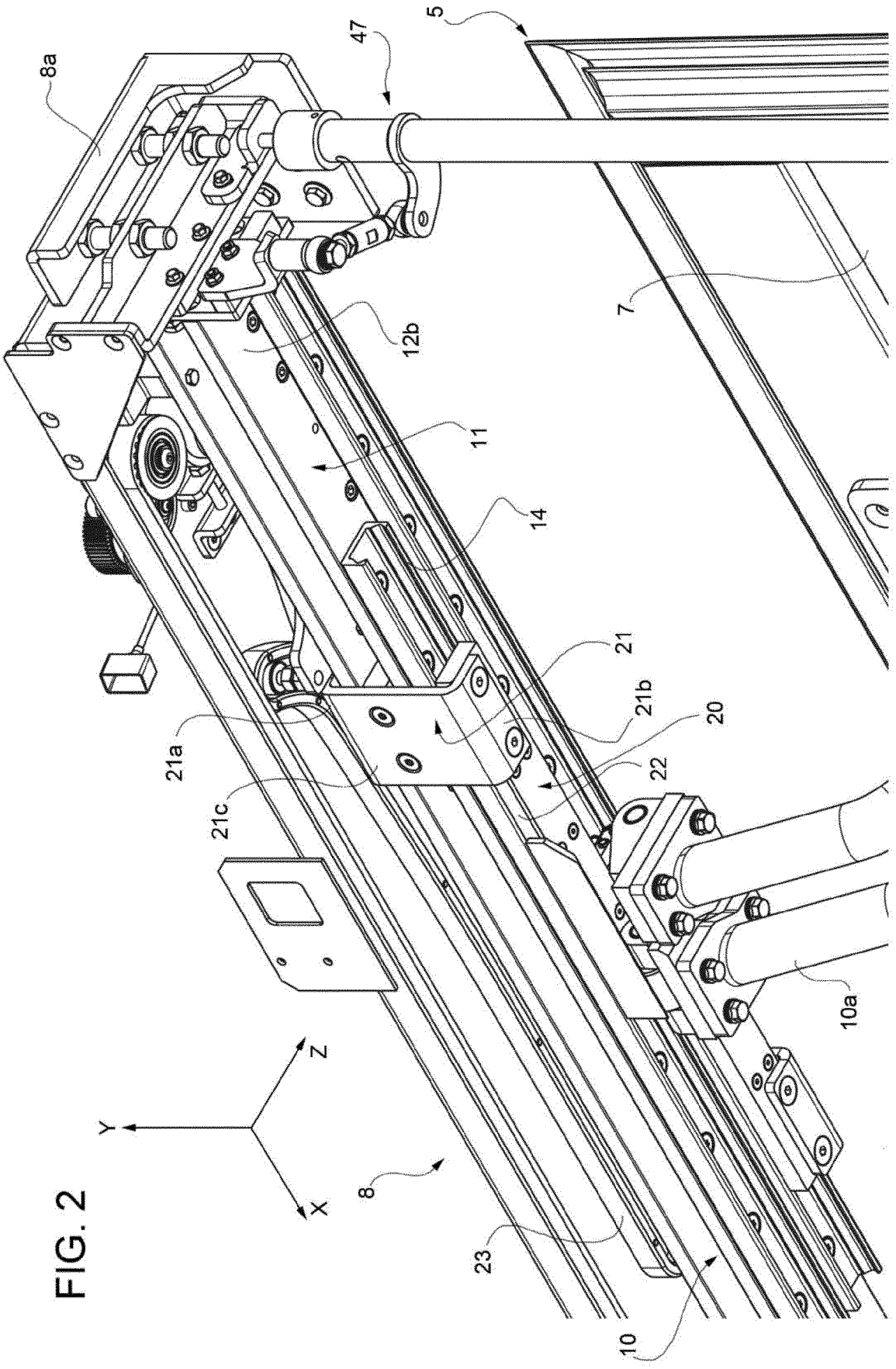
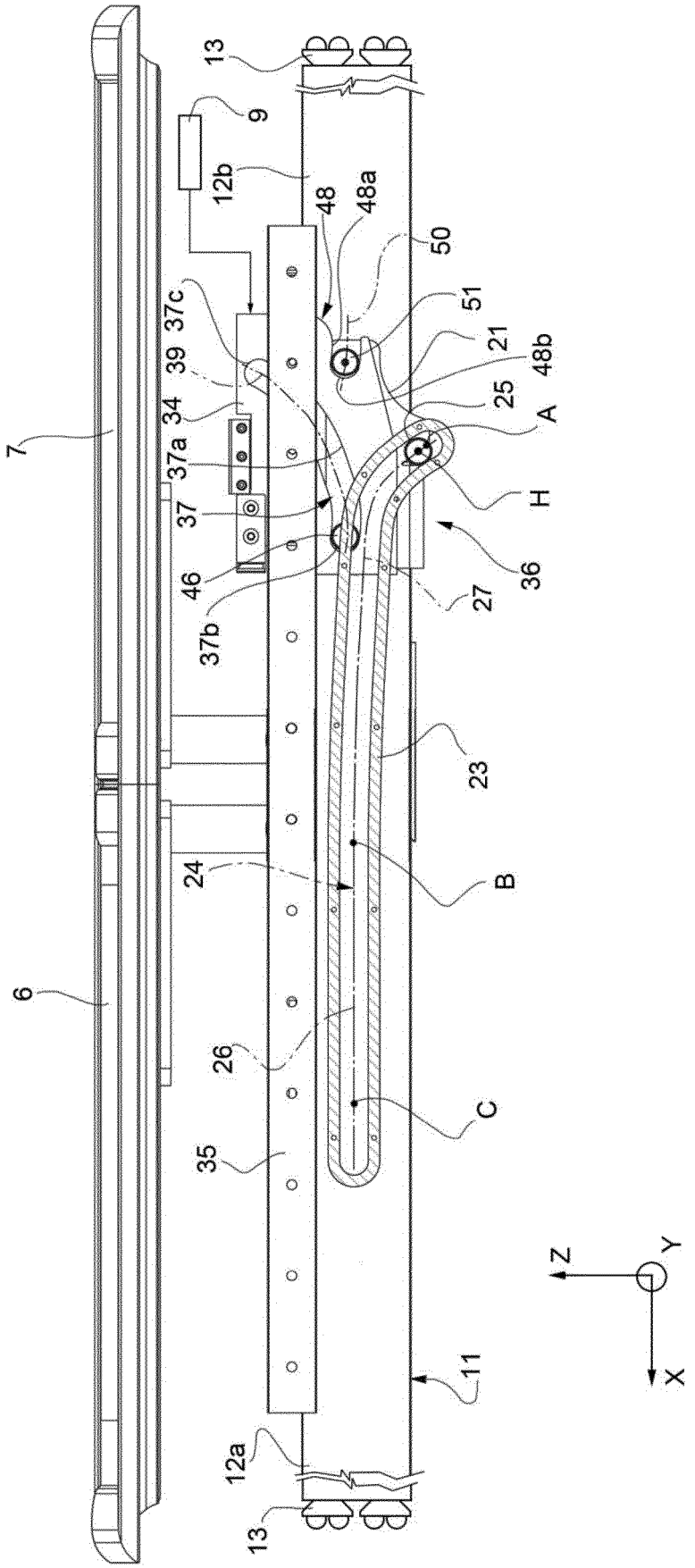


FIG. 2

FIG. 3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9
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48
48a
50
51
21
48b
25
A
H
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27
23
B
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37c
39
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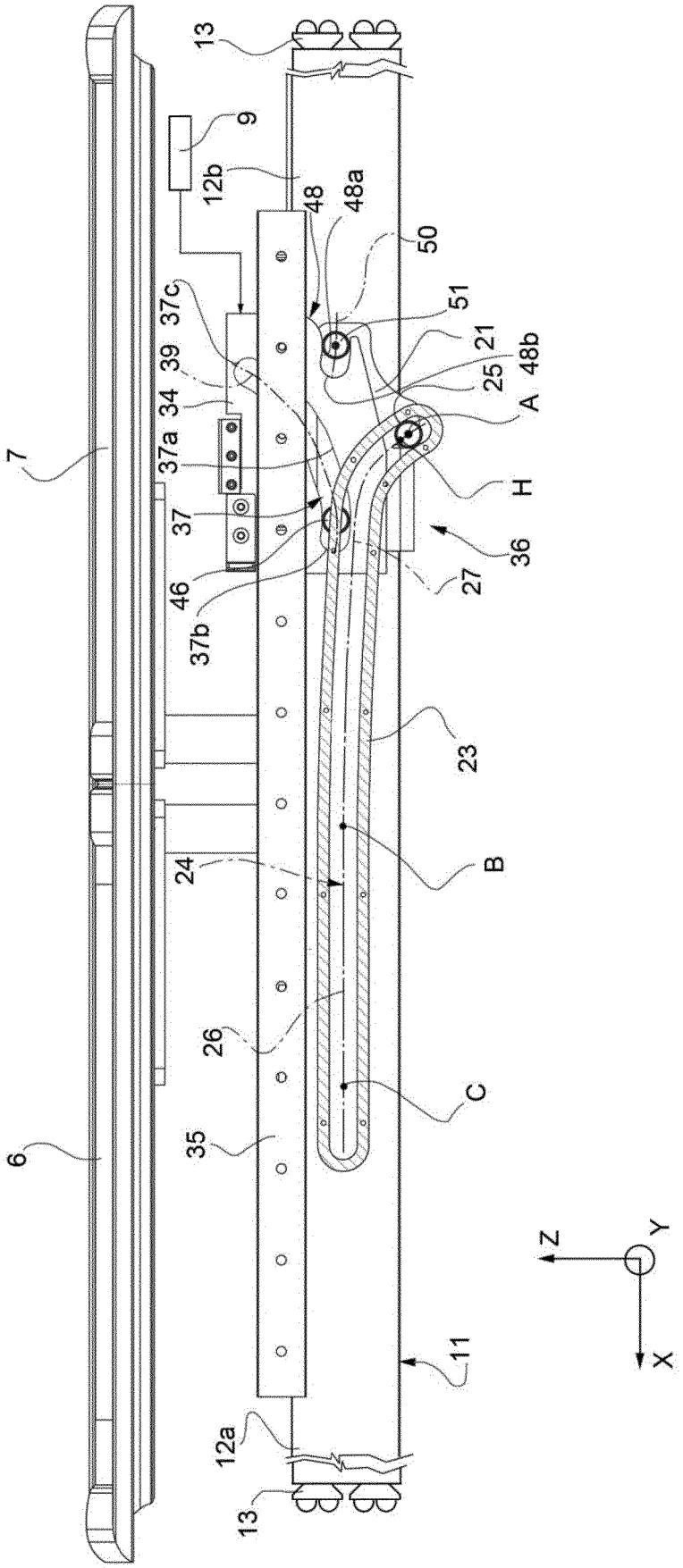
37a
37
46
37b
7
6
26
C
35
11
12a
13
Z
Y
X

FIG. 4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7
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H
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46
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37b
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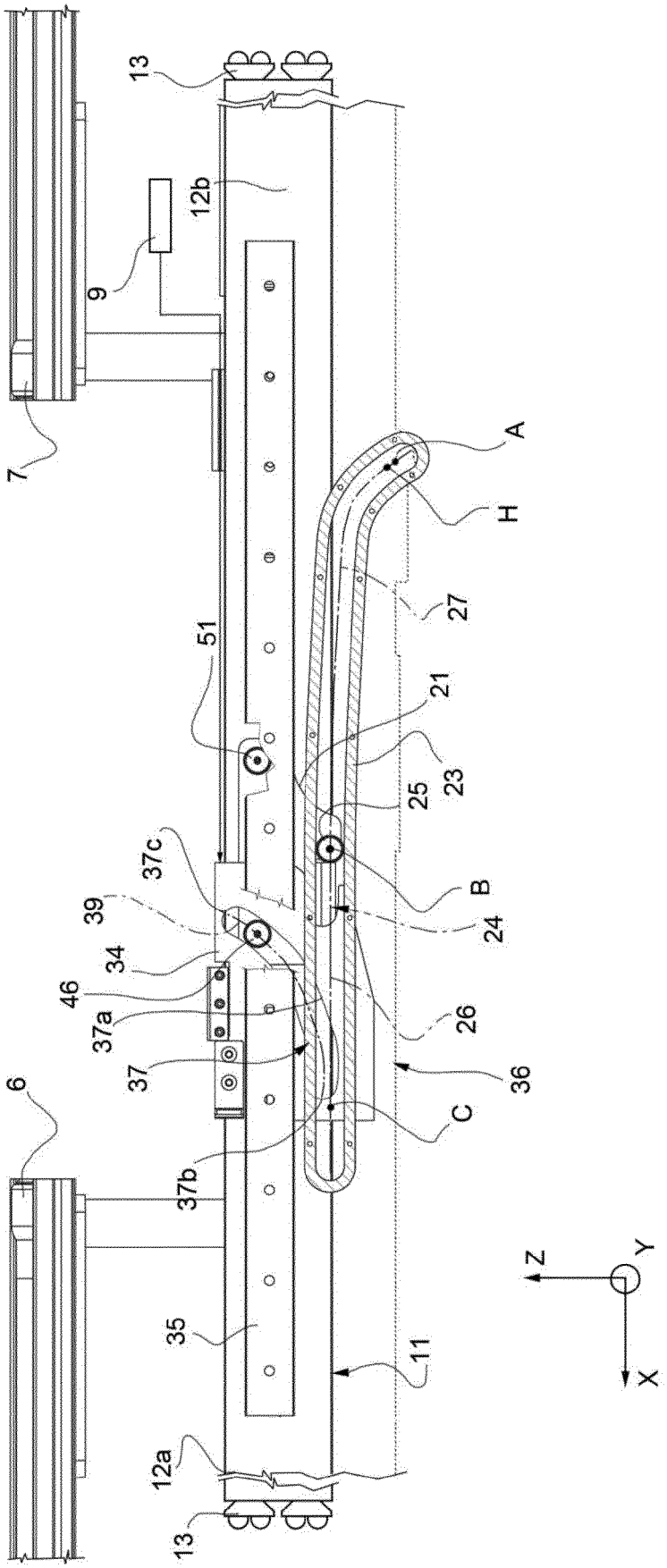
B
24
26
C
35
6
11
12a
13
Z
Y
X

FIG. 5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6
C
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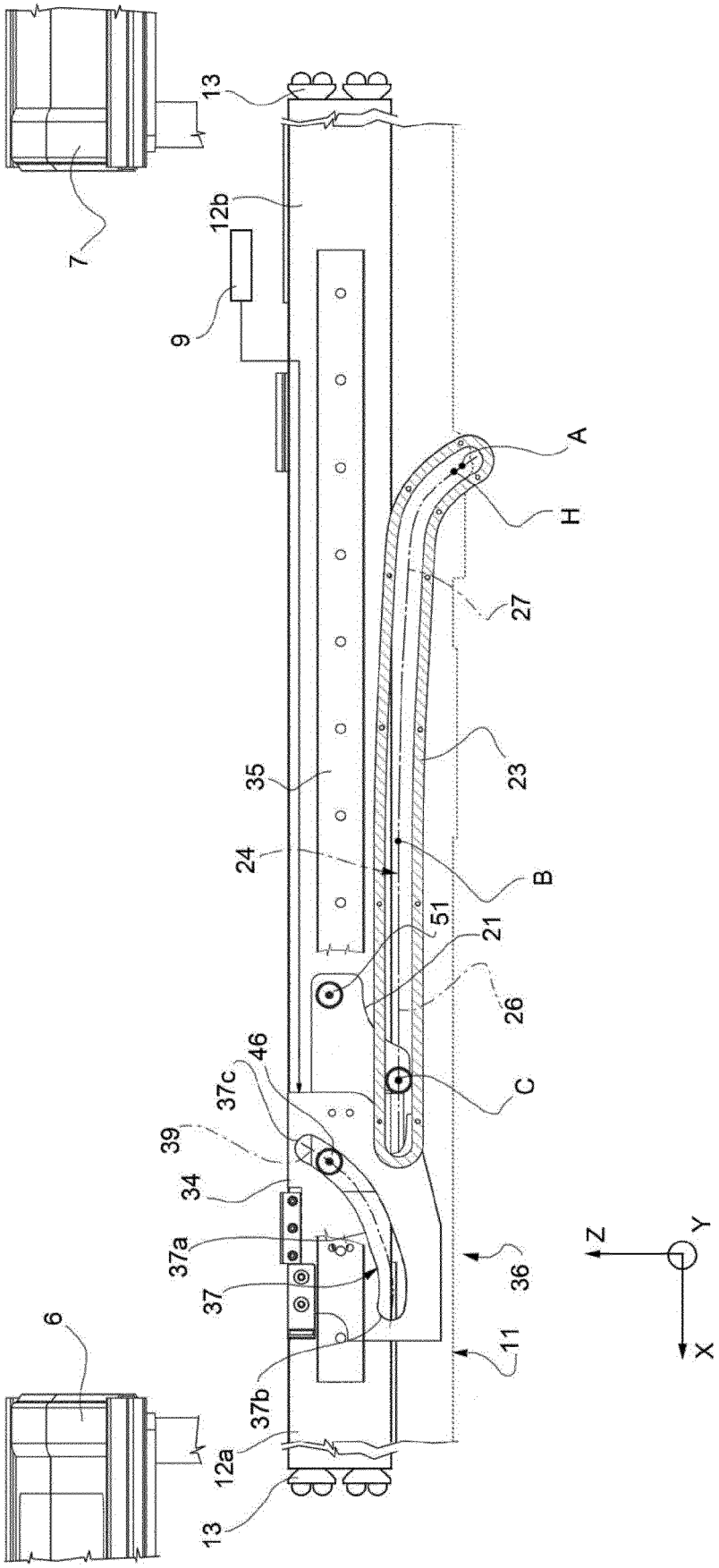
12a
13
Z
Y
X

FIG. 6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6
Z
Y
X

FIG. 7

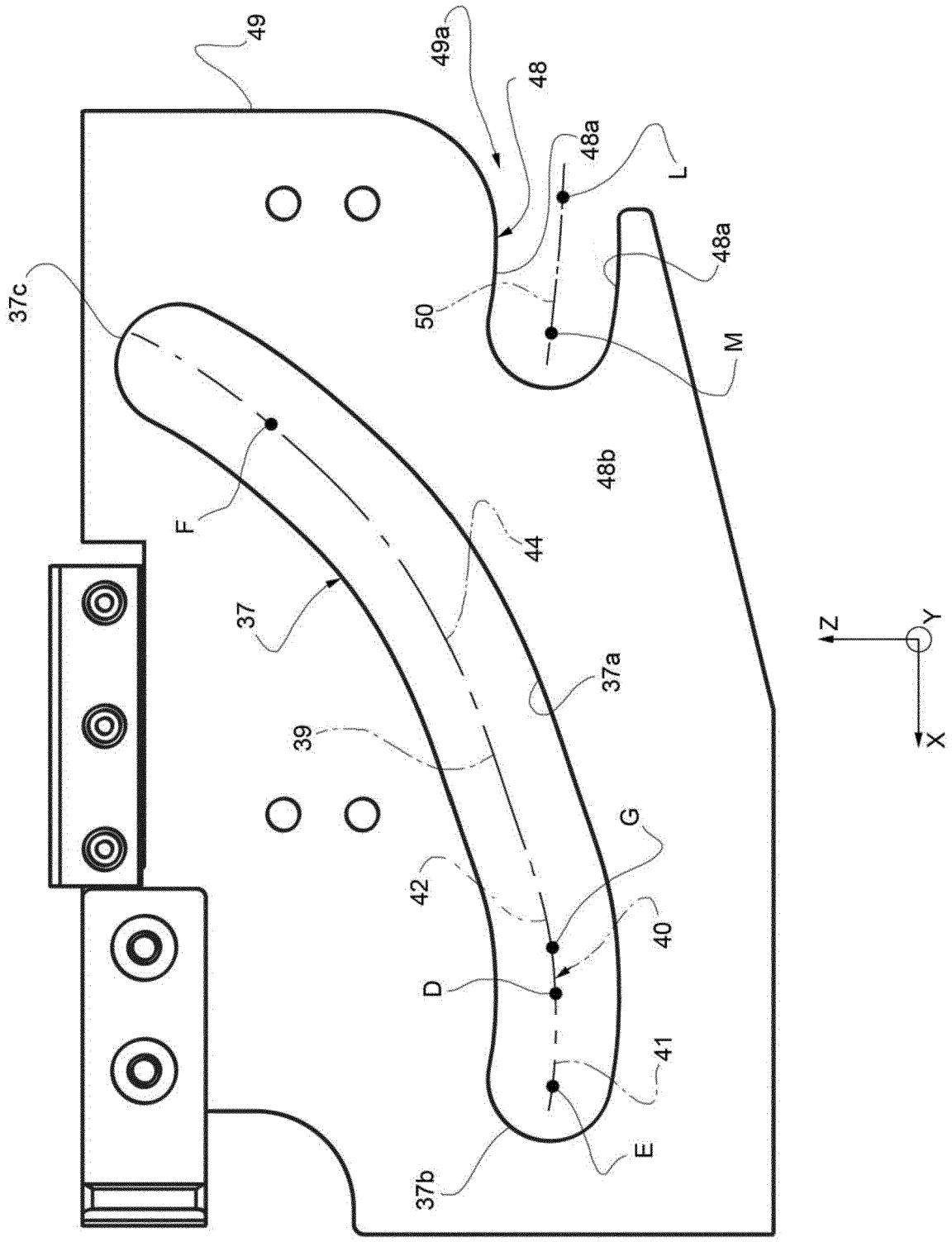
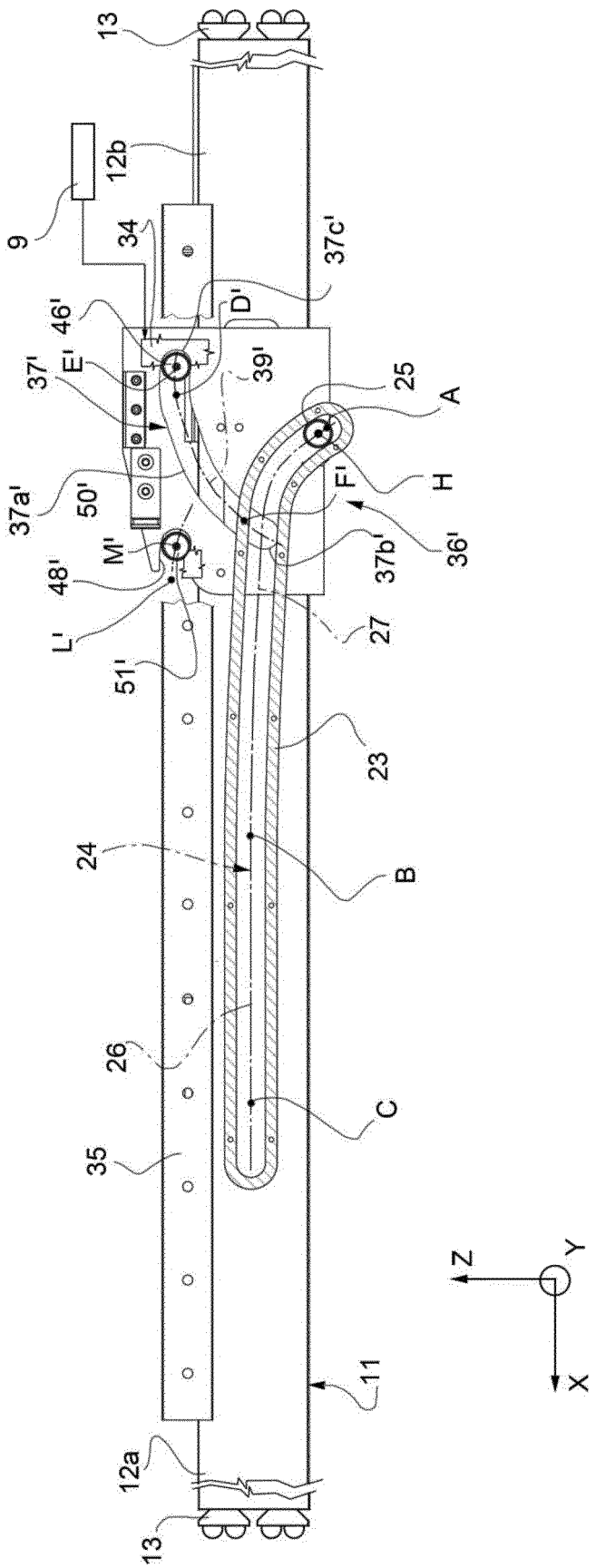


FIG. 8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9
34
37c'
D'
46'
37'
E'
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A
37a'
50'
F'
H
M'
37b'
36'
48'
L'
27
51'
23
24
B
26
C
35
11
12a
13
Z
Y
X

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EUROPEAN SEARCH REPORT

Application Number
EP 19 17 1268

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	GB 2 447 226 A (DOOR SYSTEMS GROUP LTD [GB]) 10 September 2008 (2008-09-10) * page 6, paragraph 4 - page 10, paragraph 1; figures 1-6 *	1-9 10	INV. E05D15/10 E05F15/646 E05F15/655
X	EP 1 767 427 A1 (FAHRZEUGTECHNIK DESSAU AG RAIL [DE]) 28 March 2007 (2007-03-28) * column 5, line 25 - column 9, line 56; figures 1-7 *	1-9	
A	EP 1 724 138 A2 (BODE GMBH & CO KG [DE]) 22 November 2006 (2006-11-22) * abstract; figure 6 *	10	

TECHNICAL FIELDS SEARCHED (IPC)

E05D
E05F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	9 September 2019	Witasse-Moreau, C

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09-09-2019

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		EP 1724138 A2	22-11-2006

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