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(54) A door actuated by a direct linear motor for public transport means, particularly rail vehicles

(57) The door actuated by a direct linear motor for public transport means is designed as a sliding door, while a mechanism guide holder /2/ is attached to the vehicle body over the door opening, with a holder /10/ and a linear motor /4/, and a movably attached actuator /3/, on which the door wing /1/ is suspended, a rotor of the linear motor /4/ is a part of the actuator /3/, while at least two end sensors /7/ detecting the end position of the door, at least two stops /5/ fixing the door in the open and closed positions and a cable guiding rod /9/ are arranged on the holder /2/, while at least two tongues /6/ are arranged on the actuator /3/ of the sliding door.

The door actuated by a direct linear motor for public transport means is designed as a push-out sliding door, a mechanism frame /3/ is attached to the vehicle body over the door opening, a holder /4/ is attached by means of at least two balance beams /5,6/, an electric linear motor /8/ and a movably attached carriage /7/ are arranged on the holder, the carriage is guided by a pulley /10/ in shape of the guiding rail against the frame /3/, while a linear motor rotor /8/ is a part of the carriage /7/, and the door wing /1/ is placed by its arm /2/ by means of a traveller /9/ on the holder /4/, and the carriage /7/ is connected by gearing via the traveller /9/ with the door wing /1/.

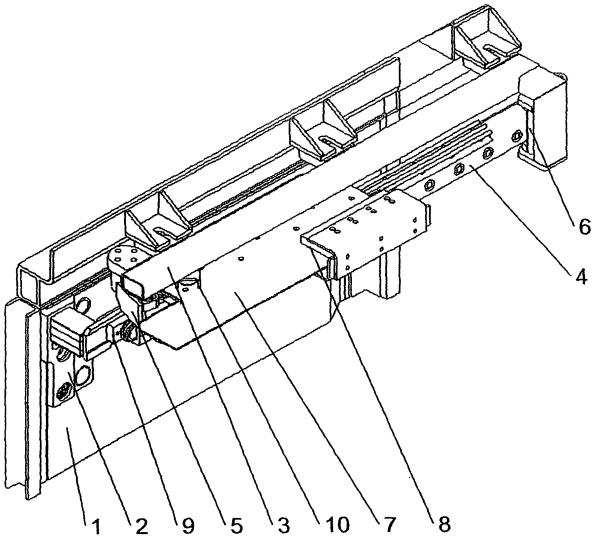

Fig. 4

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Description

[0001] A door actuated by a direct linear motor for public transport means, particularly rail vehicles.

Field of technology

[0002] The invention deals with a sliding and push-out sliding doors actuated by a direct linear motor for public transport means, particularly rail vehicles.

The existing state of technology

[0003] The sliding door wings slide into the walls or along the walls when opening. The wings may move on a linear or arched path. The mechanism is usually placed under a cover in the space over the door opening and the wings are suspended on that. The mechanism may also be placed behind the back edge of the wing where the wing moves to open. A guiding element with a shifting slider is the main part of the mechanism. The guiding element is attached on the fixed part of the vehicle body.

[0004] Movement of the wings of the push-out sliding doors, where the wing first shifts to the front of the side wall and then slides linearly outside along the side wall away from the door opening, is provided by the door mechanism, which is usually located in the space over the door opening, and the wing is suspended on the mechanism.

[0005] Both the sliding and the push-out sliding doors are equipped with an actuator unit for easier handling. The actuator unit may consist of a mechanical actuator unit or an electric actuator unit, according to the available energy source. The actuator units of electric door may be rotating geared electric motors or direct linear electric motors. A disadvantage of rotating electric motors is, that gearing mechanisms changing rotation movement to linear are necessary. Gearing mechanisms however have considerable friction, flexibility and slack, which reduce the life (increases wear) rigidity, dynamics and accuracy of movement.

[0006] Direct linear electric motors remove the main disadvantage of geared rotating electric motors, the gearing.

The nature of the invention

[0007] The aim of the invention is to solve compact actuation and a new generation mechanism opening sliding and push-out sliding doors of rail vehicles with a direct linear electric motor, while the actuator design has to meet the demanding criteria of safety and reliability and also has to show high degree of technical and technological level.

[0008] The principle of the novelty of the sliding door actuated by a direct linear electric motor for public transport means, particularly for rail vehicles, is based on the fact that a holder of mechanism guide with a linear motor holder are attached to the vehicle body in the middle of the space over the door opening. A sliding door actuator is movably mounted to the mechanism guide holder, on which the sliding door wing itself is suspended. A linear motor rotor is a part of the sliding door actuator, for example in the form of an electronic aluminium sheet, which forms a rotor (slider) of the linear motor. End sensors controlling the end position of the door wings are mounted on the holder of the mechanism guide. There are also at least two stops mounted on the mechanism guide holder, fixing the door in the open or closed positions by positioning a tongue against the particular stop, while at least two tongues are arranged on the sliding door actuator.

[0009] A cable guiding rod is also arranged on the mechanism guide holder. A holder with a sensor detecting people in the door opening is attached to the sliding door actuator.

[0010] The principle of the novelty of the push-out sliding door actuated by a direct linear electric motor for public transport means, particularly for rail vehicles, is based on the fact that a mechanism frame is attached to the vehicle body in the middle of the space over the door opening. There is a holder attached to the frame through at least two balance beams. A linear electric motor and a carriage guided against the frame by a pulley in the shape of the guiding rail, are arranged on the holder. A linear motor rotor is a part of the slider, for example in the form of an electronic aluminium sheet (slider). The door wing is movably mounted to the holder by means of a traveller. The carriage is connected through the traveller with the door wing by 1 : 2 gearing.

Summary of the pictures on the drawing

[0011] The enclosed drawings show the doors of public rail vehicles actuated by linear motor, while figures 1 and 2 present the sliding doors and the push-out sliding doors are in figures 3 and 4.

Examples of the invention implementation

[0012] Figures 1 and 2 show the sliding doors actuated by a linear motor designed for public rail vehicles. On the vehicle wall in the space over the door opening there is a holder 2 of the mechanism guide with a holder 10 of the linear motor 4. A sliding door actuator 3 with a sheet of electronic aluminium forming a rotor (slider) of the linear motor 4, is movably attached to the mechanism guide holder 2. The sliding door wing 1 is suspended on the sliding door actuator 3. Stops 5, end sensors 7 and a cable guiding rod 9 are mounted at both ends of the mechanism guide holder 2. Tongues 6 of the stops 5 and a holder 8 with a sensor of movement of people are attached to the sliding door actuator 3.

[0013] After switching the linear motor 4 on the sliding door actuator 3 together with the slide door wing 1 start shifting on the mechanism guide holder 2. End positions of the sliding door are detected by the end sensors 7.

The sliding door is fixed in the open and closed positions by a tongue 6 touching the flexible stop 5. Slide door opening may be initiated either by a button or automatically after detection of movement at the door by a sensor attached to the holder 8.

[0014] Figures 3 and 4 show push-out sliding doors actuated by a linear motor designed for public rail vehicles. A frame 3 of the push-out sliding door controlling mechanism is mounted on the vehicle body over the door opening. A holder 4 is fixed on the frame 3 of the push-out sliding door controlling mechanism via a front balance beam 5 and a rear balance beam 6, which are arranged on ... A linear motor 8 is attached and a carriage 7 movably arranged on the holder 4. The carriage 7 is guided against the controlling mechanism frame 3 on a pulley in a shaped rail 10. A sheet of electronic aluminium forming the linear motor 8 rotor (slide) is a part of the carriage 7. The wing 1 of the push-out sliding door is movably attached with its arm 2 by means of a traveller 9 on the holder 4. The carriage 7 is connected with the push-out sliding door wing 1 through a traveller 9 via gearing 1:2.

[0015] After switching the linear motor 8 on the carriage 7 starts shifting as against the holder 4. The carriage 7 is shifted in the guiding rail 10 in longitudinal as well as transversal directions in the first phase of the movement, by which the whole holder 4 tilts closer to the side wall of the vehicle thanks to the front balance beam 5 and the rear balance beam 6. That will make the door wing 1 shift to the front of the side wall of the vehicle and in the next phase the door wing shifts along the shape of the guiding rail 10 along the vehicle side wall until it is fully open. Closing of the door happens in the opposite order.

[0016] The door is fully automatic with a microcomputer control.

[0017] It is equipped with a non-contact safety sensors against squeezing on both sides.

[0018] For better safety the actuator is equipped with a sensor signalling presence of people at the door.

[0019] The front edge of the door wing is equipped with a contact ledge indicating a touch with an obstacle, as a safety element against squeezing.

[0020] The actuator may be switched off by switches on both sides and the door may be opened and closed manually.

[0021] The door is mechanically stabilized in the open and dosed positions. It may be locked in the dosed position.

[0022] Force transfer between the actuating unit and the door wing is done by a gear element with proportion 1:2.

[0023] Thanks to a completely new solution of location of the balance beams against the guiding element and the actuator unit attachment the invention ensures the maximum actuating power in closing.

Industrial applicability

[0024] The door according to the invention in the sliding version is designed for interiors of public transport means, particularly rail vehicles. It may also be applied in buildings where extensive movement of people is expected.

[0025] The door according to the invention in the push-out sliding version is designed as an entrance door of public transport means, particularly rail vehicles.

Claims

1. A door actuated by a direct linear motor for public transport means in sliding version **characterized by** the fact, that a mechanism guide holder /2/ is attached to the vehicle body over the door opening, with a holder /10/ and a linear motor /4/, and a movably attached actuator /3/, on which the door wing /1/ is suspended, a rotor of the linear motor /4/ is a part of the actuator /3/, while at least two end sensors /7/ detecting the end position of the door, at least two stops /5/ fixing the door in the open and closed positions and a cable guiding rod /9/ are arranged on the holder /2/, while at least two tongues /6/ are arranged on the actuator /3/ of the sliding door.

2. A door actuated by a direct linear motor for public transport means in sliding version **characterized by** the fact, that a mechanism frame /3/ is attached to the vehicle body over the door opening, a holder /4/ is attached by means of at least two balance beams /5,6/, an electric linear motor /8/ and a movably attached carriage /7/ are arranged on the holder, the carriage /7/ is guided by a pulley /10/ in shape of the guiding rail against the frame /3/, while a linear motor rotor /8/ is a part of the carriage /7/, and the door wing /1/ is placed by its arm /2/ by means of a traveller /9/ on the holder /4/, and the carriage /7/ is connected by gearing via the traveller /9/ with the door wing /1/.

3. A door actuated by a direct linear motor according to claim 1 **characterized by** the fact, that the sliding door is equipped with a sensor detecting movement at the door, located on the actuator /3/.

4. A door actuated by a direct linear motor according to claim 2 **characterized by** the fact, that the push-out sliding door is equipped with a sensor detecting movement at the door, located on the holder /4/.

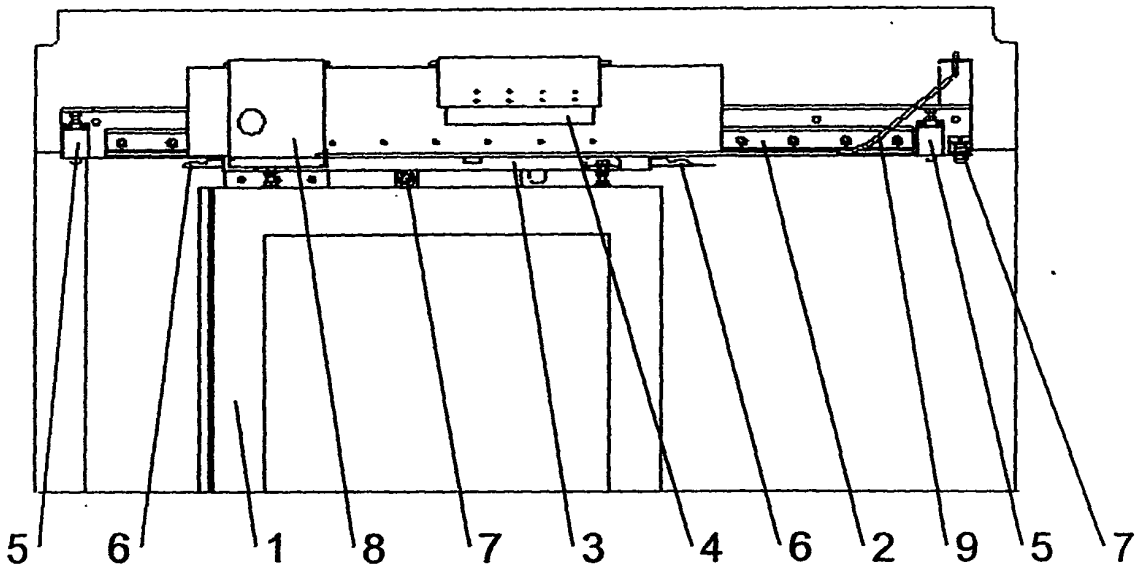

Fig. 1

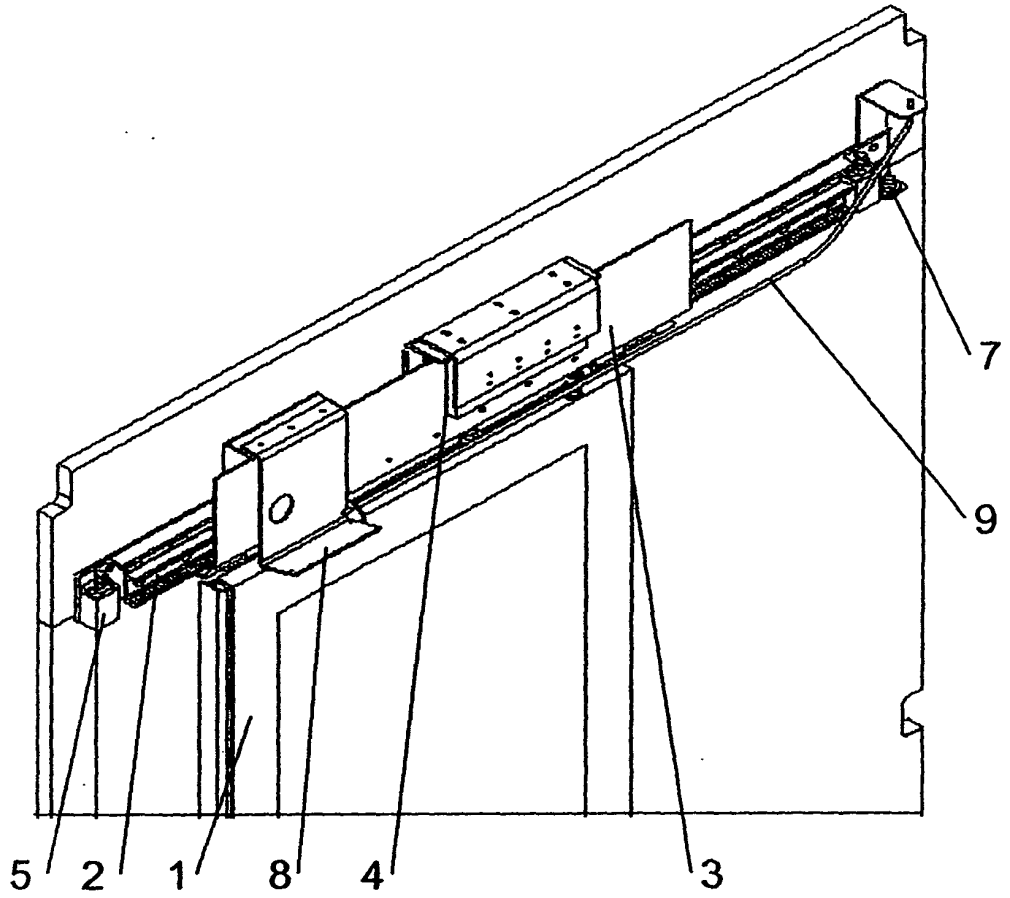

Fig. 2

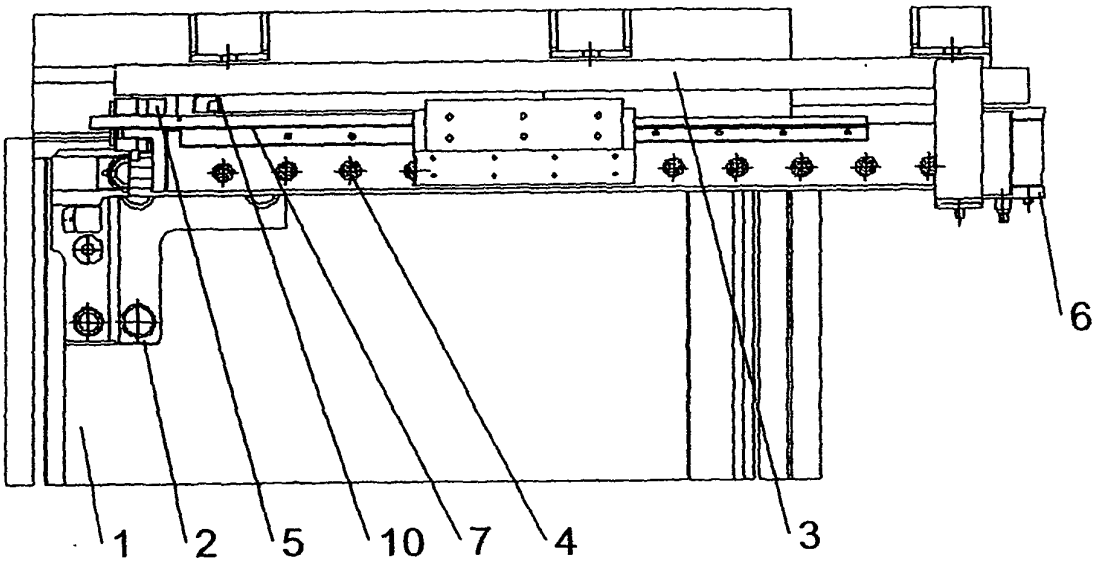

Fig. 3

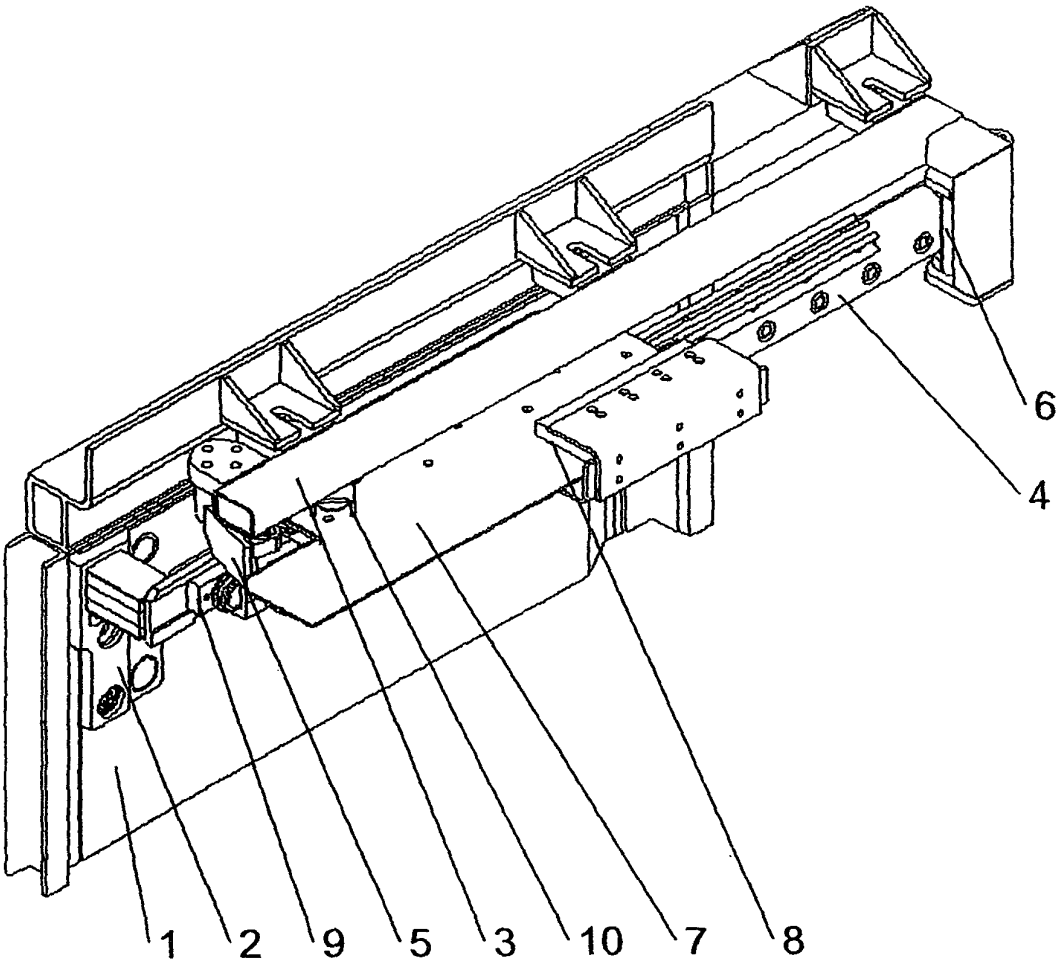

Fig. 4