

DEVICE AND METHOD FOR CLOSING SLIDING DOORS

5 Description:

The invention relates to a device for closing sliding doors, preferably glass sliding doors.

10 Moreover, the invention relates to a method for closing sliding doors.

German Preliminary Published Application DE 101 07 028 A1 describes a sliding door that can move horizontally on a running and guide rail and that is supported on rollers. In this context, the sliding door has a bolt that is configured as a stop-
15 per on one end face and that runs against a stop on the door when the sliding door is closed. At the top of the door, there is a catch of a two-stage latching element that can engage with a mandrel in a recess of the running and guide rail. When the bolt stops against the door when the latter is closed, the control bar connected to the bolt is slid lengthwise inside the door, thus releasing the mandrel that is pre-
20 tensioned by means of a spring. As a result, the mandrel is moved vertically upwards and slid is into the locking position in the recess. By means of a separate handle situated on the front of the door, the mandrel is driven back into the door, which brings about a pre-tensioning of the spring that is mounted on the mandrel. At the same time, the bolt is pressed against the door frame. The door can be
25 opened.

German Preliminary Published Application DE 36 02 440 A1 describes a running gear to guide the sliding movement of sliding windows, sliding doors, machine parts and the like. The running gear has a carriage that is guided in a U-shaped
30 running rail, whereby the sliding windows or doors or machine parts are secured on said carriage by means of trunnions which, in turn, are elastically attached by

means of bearing elements arranged on the carriage with elastomer components between them. The bearing elements are movable relative to the appertaining carriage. The bearing elements consist of a bearing bolt arranged in a transverse bore of the carriage, whereby the bearing bolt is circularly surrounded by at least one
5 elastomer component. According to a preferred embodiment of the carriage, there are two elastomer components that serve to support the bearing bolt in the transverse bore, on both sides of the trunnion.

German Patent DE 195 33 153 C2 discloses a sliding door with an emergency
10 opening or emergency closing mechanism. The sliding door consists of two door leaves, whereby these door leaves each run on two rollers along a guide rail that extends horizontally. Above the guide rail, one side of a helical spring is attached so as to be stationary while a second side of the helical spring is attached to an armature that holds a driving carriage, said helical spring using said armature to
15 cooperate with a stationary electromagnet. The door leaves of the sliding door are driven in opposite directions by means of a drive motor, whereby the helical spring is tensioned during the closing of the door leaves by one of the two door leaves. The driving carriage acts on a stop mounted on the door leaf that causes the tensioning of the helical spring.

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In an emergency situation – power failure – the armature is released from the electromagnet so that the driving carriage acts, via the stop, on the door leaf that tensions the helical spring and, via a toothed belt and a steel cable, it also acts on the second door leaf, whereby the two door leaves are pulled into the open posi-
25 tion.

German Patent DE 41 06 117 C2 discloses a sliding door guide system for shower partitions and the like, which uses rigid guide elements to simplify the movement of at least one door segment in terms of its structure and its handling when the
30 guide elements are latched into and unlatched out of a running groove. For this purpose, film hinges are arranged between an attachment foot and the running

groove, whereby a profile section that can be flipped inwards or outwards can be locked in either of these positions.

German Patent DE 199 08 191 C1 describes an automatic leaf or door system for
5 actuating an actuation member of an additional actuation mechanism without
using an additional drive means. Once at least one leaf of the leaf or door system
has reached its closed position, a drive unit or drive transmission unit that is
arranged parallel to the direction of movement of the leaf and permanently
10 attached thereto can be moved further beyond a certain distance in the closing
direction. The additional adjustment path is used to activate or to switch over the
additional actuation mechanism. The additional actuation mechanism has a lever
mechanism for manually activating or switching over the additional actuation
mechanism.

15 The sliding door fittings described in German Preliminary Published Application
DE 195 39 014 A1 can be used especially for glass doors. Here, a stationary pro-
file rod is installed below a ceiling mechanism, a running rail for a carriage that
can move on rollers being attached to said profile rod. The carriage, in turn, is
connected to the glass door by means of glass hinges that act orthogonally to the
20 running direction of the carriage. As a function of what is needed, different lock-
ing means prevent the carriage from derailing from the running rail. All of these
means have in common the fact that a bolt arranged on the carriage grasps beneath
a stop rail, whereby a driving pin that mechanically guides the bolt has shoulders
to which the driving pin can be latched. In order to open and close the locking
25 means, the bolt is moved in the horizontal plane towards or away from the stop
rail.

German Patent DE 195 31 040 C2 describes a sliding shutter for window or door
elements that can be moved along a horizontal guide rail. The guide rail is prefera-
30 bly installed in a wall. In order to achieve low-friction movement of the sliding
shutter, rollers attached to said shutter are used. The sliding shutter essentially

allows two end positions. The first end position is reached when the sliding shutter is slid completely in front of the window or door element, whereas the second end position is reached when the sliding shutter is completely next to the window. When the sliding shutter is in one of the two end positions, an electromechanically
5 activated bolt locks the sliding shutter in the appropriate position in that the bolt extends in an axis that runs vertically to the sliding direction, thus eliminating the only remaining degree of freedom of the sliding shutter.

The known sliding doors hardly or only unsatisfactorily ensure a continuous
10 functionality of the sliding door mechanisms in case of a failure of external influencing variables that are needed for the proper functioning of the sliding doors.

It is the objective of the invention to refine an existing device in such a way as to
15 provide a sliding door system with which the sliding door can be locked and unlatched as easily as possible.

According to the invention, the objective is achieved by a device for closing sliding doors according to Claim 1 and by a method according to Claim 18.
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Advantageous embodiments and refinements of the invention are the subject matter of Claims 2 to 17, 19 and 20.

In particular, the invention proposes configuring a sliding door arrangement using
25 a closing mechanism attached to a stationary part of the sliding door in such a way that the closing mechanism has a hybrid structure and thus, especially but not exclusively, is suitable for use in sliding doors that are not actuated by another external means.

The term hybrid as employed in the present invention refers especially to an interaction with an electrical or electromagnetic component having a mechanical or pneumatic component.

5 In this manner, a sliding door system is created that ensures the desired functionality, even in situations in which external influencing variables are absent, and that has an especially design-optimized construction so as to ensure a high degree of security when the doors are closed.

10 Advantageously, the hybrid structure provides a closing technique that, on the basis of an electromechanical mechanism of action, exhibits a flexible functionality that is adapted to the external circumstances of the device.

This has the advantage that the closing means can be realized without additional
15 construction work on the sliding door. The sliding door itself preferably has a means for movement guidance. This advantageous refinement of the invention allows the use of numerous different sliding door materials since an additional construction measure for locking that is independent of the sliding door material is not necessary.

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Especially advantageous door materials are glass, wood, plastics, metals, safety materials, fire-protection material or composite materials.

An especially preferred embodiment of the invention provides a mechanism that
25 brings about an unlocking of a locked sliding door in case of an absence of all of the external signals needed for the system-related functioning of the sliding door system.

An example of a situation for purposes of illustrating the resultant advantages can
30 be, for example, the case of a room security system. If this room security system is designed, among other things, in such a way that external triggering signals

bring about the closing of one or all of the sliding doors in a room complex, then the question arises as to the function status of each of the sliding doors in case of a spontaneous but prolonged absence of all external signals.

- 5 The device according to the invention for closing sliding doors ensures that a sliding door is unlocked even, for example, during a power failure, and thus makes it possible for persons or animals who are located inside the room that is delimited by the sliding door to leave the room. This situation is of crucial importance when it comes to the protection of persons or animals.

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The term room includes, for example, offices, residential rooms, commercially used spaces, public facilities or separated areas for keeping animals.

- 15 The external signals needed for the system-related functioning of the sliding door system can be of any type and form, whereby encoded as well as unencoded signal quantities can be used.

Additional advantages and practical refinements of the invention can be gleaned from the following description of preferred embodiments of the invention with
20 reference to the drawings and the subordinate claims.

The drawings show the following:

25 Figure 1 a schematic depiction of the device according to the invention and

Figure 2 a cross section through the device shown in Figure 1.

The depicted preferred device according to the invention is structured in such a way that a sliding door can be slid by means of at least one carriage **1** parallel and
30 relative to a running rail **4** that is attached to a wall or below a ceiling. Here, the running rail is installed so as to be stationary and it has a U-shaped cross section **4**

that is configured in such a way that the carriage 1 supported on rollers 7 can move in the U-shaped cross section along the longitudinal extension of the running rail. The part of the U-shaped cross section that is not closed is referred to below as the gap 8 of the running rail, whereby the gap preferably faces downwards in the direction of the floor, so that a connection is advantageously established through the gap of the running rail by means of a connection element between the carriage and the sliding door.

Due to the resultant hanging structure of the sliding door attached to the carriage, a sliding door device can be provided that is extremely easy to maintain and simple to manufacture. Moreover, the advantageous arrangement of the carriage in the running rail results in an especially compact device since the space requirement of such an arrangement concept is much less than that required for a device in which the carriage moves along outside of the running rail and in which the connection element is arranged around the carriage between the carriage and the sliding door.

In another advantageous embodiment, a second running rail, once again comprising at least one carriage, is installed on the bottom below the sliding door. The advantage of a second running rail that is located at the lower edge of the sliding door lies in the additional guide element, which leads to a further stabilization of the movement process of the sliding door along the running rail.

The carriage is preferably configured in such a way that, on the front part as well as on the back part of a rectangular compact body, there are two axles with rollers at each end. On each side of the rectangular body along its longitudinal extension, there is a cut-out whose geometrical shape is preferably a sector of a circle. The circle diameter of the sector is determined by the order of magnitude of the diameter of the rollers.

As a result, all of the preferably four rollers mounted on a carriage extend into the rectangular body, which allows an extremely compact structure of the complete carriage. The gap between the outer surface of the rollers and the cut-out on the rectangular body is advantageously only a few millimeters. In particular, the gap
5 is approximately 0.1 mm to 100 mm, whereby values between 1 mm and 30 mm are especially preferred.

On the bottom of the carriage, there is a thread extending inwards by means of which the connection element mounted on the sliding door permanently and
10 securely establishes contact with the carriage via a screwed connection. Since the connection element is constantly in contact with the sliding door, any relative movement of the carriage with respect to the stationary running rail is coupled to a movement of the sliding door.

15 Preferably, there is a total of two carriages in one running rail since this enhances the stability of the sliding door system. As a rule, the ultimate criterion for determining the absolute number of carriages depends on the length of the running rail and/or on the weight of the sliding door.

20 Furthermore, at least one carriage per running rail has a bore at one of its two end faces as well as a small magnet that is stationarily attached to the carriage. In the case that the sliding door is locked, the bore is used to accommodate a bolt that can be actuated by a rectangular electromechanical unit that is attached to the running rail. In this manner, the degree of freedom of the carriage that accommodates
25 the bolt is eliminated and the carriage – and hence also the sliding door – is held in place in the running rail.

The running surfaces in the running rail are two short projections extending over the entire length of the running rail, whereby the projections run facing each other
30 at the ends of the two walls of the U-shaped running rail but are not in contact with each other along this extension, thus resulting in a gap between the running

surfaces. The carriages can be accommodated completely movably in the running rail with this type of configuration for the running rail or for the appertaining running surfaces. The running surfaces of the running rail allow a low-friction rolling of the rollers of the carriage.

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The gap between the running surfaces is at least so large that the screwed connection between the carriage located in the running rail and the connection element of the sliding door can be established without any hindrance.

- 10 The degree of freedom of the carriage is inhibited by at least two end pieces mounted along the running rail.

In an especially preferred embodiment, the running rail is made of aluminum, which has the advantage that it is an especially lightweight unit while, at the same
15 time, the running rail retains a high torsion stiffness as a result of its U-shaped profile.

This has the additional advantage that even heavy sliding doors can be attached to the rollers without the running rail that holds the rollers becoming deformed during the course of the use of the sliding door system in such a way that would preclude the proper functioning of the system.
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The running rail is attached by means of a fastening angle bracket to a load-bearing element, whereby, in an especially preferred embodiment, at least two fastening angle brackets are attached to the two points along the running rail that correspond to the selected end points of the carriage. In this manner, the above-mentioned end pieces can be mounted onto the fastening angle brackets in order to limit the horizontal degree of freedom of a carriage, which allows an especially elegant solution for attaching the end pieces.
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In principle, the end pieces can be attached at any desired position along the running rail by means of a bore on one of the two lengthwise sides of the U-shaped profile, so that even changed ambient situations, for example, resulting from a changed door passage area, can be subsequently accommodated.

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The electromechanical unit which, in case of locking, blocks at least one carriage, is preferably attached at the level of the running rail installed below the ceiling whereby, as an alternative, also in case of another running rail located on the floor, it is also possible to block at least one carriage of this running rail by means of the electromechanical unit when in the locked position.

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In another embodiment, the electromechanical unit is mounted directly onto the running rail.

15 The electromechanical unit is preferably only installed once the entire sliding door assembly has been mounted, that is to say, only once the sliding door can already be freely moved along the guide rail mounted at the place of installation. Subsequently, the two ends pieces are affixed, whereby the final position of the end pieces is defined by the passage area left open by the sliding door.

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The sliding door is then placed into the final position in which the space behind the passage area is no longer accessible. This position of the sliding door corresponds to the position from which the sliding door can no longer be moved when it is locked. In this position of the sliding door, at least one carriage is in contact with an end piece. The exact position of the bore of the carriage used for the locking is measured on the side where the carriage is in contact with an end piece.

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At the level of the vertical projection of the bore on the carriage on the running rail, the running rail is now provided with a bore whose diameter corresponds to that of the bore of the carriage, so that the two opposing bores are exactly lined up along their connection line.

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The end face of the metal housing of the rectangular electromechanical unit has a circular opening from which the bolt can extend vertically to the end surface. An electromechanical drive is used to expel the bolt from the housing, and this is
5 done in response to an external control signal. If the bolt is not in its resting position – the position in which the bolt is completely retracted into the housing – a spring force acts on the bolt so as to counter the movement of the bolt when it is expelled from the spool. As a result, the force that expels the bolt out of its resting position acts in the opposite direction to the spring force. The term spring force
10 here is not limited to a force generated by a spring but rather also comprises forces having the same effect which can be generated, for example, by a pneumatic means.

Another especially advantageous embodiment uses a constant current flow as an
15 external signal. External signals are an especially preferred example of control signals according to the invention. A spool installed inside the electromechanical unit is thus supplied with the constant current flow, so that a voltage is induced. The Lorentz force resulting from this physical process is oriented in such a way that the bolt, which is in the resting position inside the spool, is partially expelled
20 in accordance with its degree of freedom out of the spool and thus out of the housing. The bolt is dimensioned in such a way that an end position of the bolt – that is to say, when the bolt has traversed the maximum distance out of the spool – is sufficient to extend through the bore in the running rail as well as through the bore on the carriage.

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As long as the external signal – that is to say, in this embodiment the current flow – is present at the electromechanical unit, the bolt is in the end position. The sliding door is locked.

30 This yields an especially advantageous embodiment of the device according to the invention since the sliding door system is configured in such a way that an

absence of the external signal allows the bolt to remain only under the influence of the spring force. As a consequence of this especially advantageous approach, the sliding door is unlocked if the external signal is absent, since in this situation, the bolt is returned to its resting position under the influence of the spring force.

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Another embodiment stands out for the fact that, in addition to the above-mentioned operation of the bolt, a mechanical device is attached to the electro-mechanical unit by means of which manual unlocking of the sliding door is made possible, independent of the external signals. For this purpose, there is a slit-type opening on the bottom of the rectangular housing from which a narrow, approximately 10 mm-long pin extends. A movement of the pin along the longitudinal extension of the slit-type opening causes the mechanical retraction of the bolt until the resting position of the bolt in the spool is reached.

15 The pin for the manual unlocking of the sliding door has a thread with which an additional means for actuating the manual unlocking means can be attached in order to lengthen the pin.

Another especially preferred embodiment of the device according to the invention only triggers a locking operation if the magnet fastened to a carriage induces a voltage within the electromechanical device, whereby the carriage is preferably situated in an end position for this purpose.

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List of reference numerals

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| | 1 | carriage |
| | 2 | bore on the running rail |
| 5 | 3 | bore on the carriage |
| | 4 | running rail |
| | 5 | fastening angle bracket |
| | 6 | end piece |
| | 7 | rollers on the carriage |
| 10 | 8 | gap |

Claims:

- 5 1. A device for closing sliding doors, whereby the sliding doors can be moved
by at least one carriage supported on rollers and having two end faces paral-
lel and relative to a stationary running rail that is attached to a wall or below
a ceiling and that has a U-shaped cross section, whereby furthermore, the
carriage and the sliding door are connected by means of a connecting ele-
10 ment through a gap in the running rail,
characterized in that
said device comprises an electromechanical unit mounted on the running
rail, whereby the electromechanical unit, in the presence of an external
control signal that triggers a locking operation, can block at least one
15 carriage by means of a bolt, whereby the bolt extends perpendicularly out of
a circular opening on one end face of a metal housing of the
electromechanical unit and the bolt is dimensioned in such a way that, in a
final position, the bolt extends through a bore in the running rail as well as
through a bore on one of the two side surfaces of the carriage, whereby
20 furthermore, the electromechanical unit has a slit-type opening on the
bottom of the housing from which a pin extends, whereby a movement of
the pin along the longitudinal extension of the slit-type opening causes the
mechanical retraction of the bolt.
- 25 2. The device according to Claim 1,
characterized in that
said device comprises at least one force-generating means that generates a
force that acts on the bolt when it is outside of a resting position and
whereby the force is oriented opposite to the direction of movement of the
30 bolt when it is being expelled from the spool.

3. The device according to one or both of Claims 1 and 2,
characterized in that
a spring force acts on the bolt when it is outside of the resting position.
- 5 4. The device according to Claim 1,
characterized in that
a constant current flow is used as an external control signal.
- 10 5. The device according to one or more of the preceding claims,
characterized in that
a spool installed inside the electromechanical unit is supplied with the constant current flow, so that a resulting Lorentz force partially expels the bolt – which is situated inside the spool – out of the spool.
- 15 6. The device according to Claim 1,
characterized in that
the pin for the manual unlocking of the sliding door has a thread with which an additional means for actuating the manual unlocking means is attached in order to lengthen the pin.
- 20 7. The device according to Claim 1,
characterized in that
the carriage is constructed in such a way that, on the front part as well as on the back part of a compact body, there are two axles with a roller at each end, whereby, along its longitudinal extension, the body has a cut-out whose
25 shape corresponds to a sector of a circle, whereby the sector of the circle is determined by a circle with a diameter in the order of magnitude of the diameter of the rollers.
- 30 8. The device according to one or more of the preceding claims,
characterized in that

several rollers mounted on a carriage each extend into a rectangular body of the carriage, whereby the gap between the outer surface of the rollers and the cut-out on the rectangular body is 1 mm to 30 mm.

- 5 9. The device according to one or more of the preceding claims,
 characterized in that

on the bottom of the carriage, there is a thread extending inwards by means of which the connection element mounted on the sliding door permanently and securely establishes contact with the carriage via a screwed connection.

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10. The device according to one or more of the preceding claims,
 characterized in that

a degree of freedom of at least one carriage is inhibited by at least one end piece mounted along the running rail.

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11. The device according to Claim 10,
 characterized in that

the end pieces for limiting the horizontal degree of freedom of a carriage are attached at any desired position along the running rail by means of a bore on
20 one of the two lengthwise sides of the U-shaped profile.

12. The device according to one or more of the preceding claims,
 characterized in that

the running rail is made of aluminum.

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13. The device according to one or more of the preceding claims,
 characterized in that

the running rail is attached by means of a fastening angle bracket to a load-bearing element.

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14. The device according to one or more of the preceding claims,

characterized in that at least two fastening angle brackets are attached to selected end points of the carriage along the running rail, whereby the end pieces are located on the fastening angle brackets.

- 5 15. The device according to one or more of the preceding claims,
characterized in that
a second running rail, once again comprising at least one carriage, is installed on the bottom below the sliding door.

- 10 16. The device according to one or more of the preceding claims,
characterized in that
the sliding doors delimit spaces, whereby these spaces are commercially used areas, public facilities, offices, residential rooms or separated areas for keeping animals.

- 15
17. The device according to one or more of the preceding claims,
characterized in that
the sliding door material contains one or more of the following components:
glass, wood, plastics, metals, safety materials, fire-protection material or
20 composite materials.

18. A method for closing sliding doors, whereby the sliding doors can be moved by at least one carriage along a running rail,
characterized in that
25 a magnet attached to the carriage induces a voltage within an electro-mechanical unit, thus triggering a locking operation, so that at least one carriage is blocked by a bolt, whereby a spool installed inside the electro-mechanical unit is supplied with a constant current flow, so that a resulting Lorentz force at least partially expels the bolt – which is situated inside the
30 spool – out of the spool and, in a final position, the bolt extends through a bore in the running rail as well as through a bore on the carriage.

19. The method according to Claim 18,
characterized in that
a force is generated that acts on the bolt when it is outside of a resting position and whereby the force is oriented opposite to the direction of movement of the bolt when it is being expelled from the spool.
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20. The method according to one or both of Claims 18 and 19,
characterized in that
an absence of the control signal unlocks the sliding door, whereby the bolt is returned to its resting position under the influence of the spring force.
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