

Door system for a lift car, lift system and method for evacuating a lift car

The present invention relates to a door system for a lift car. Furthermore, the invention relates to a lift system comprising at least one lift car equipped with such a door system, as well as to a method for evacuating a lift car equipped with such a door system.

A lift car of a lift system, such as can be used to transport people or goods in buildings, can comprise a car opening and a sliding door mechanism, which releases or closes the car opening to the particular floors of the building by horizontally sliding one or more door leaves. In addition to the car opening, the lift car may have a separate emergency opening, through which the lift car can be evacuated in an emergency.

US 9,284,159 B2 shows an example of a separate side emergency opening, which can be closed via a pivoting door.

In embodiments without such an emergency opening, evacuation can take place via the car opening. However, in the event of a malfunction, the lift car may become stuck at a point in the lift shaft where the door leaf or leaves cannot be pushed open or cannot be pushed open far enough, for example because the sliding path is blocked by a support in the lift shaft.

There may therefore be a need for an improved door system for a lift car that allows evacuation through the car opening even if sliding open the door leaf or leaves is not possible for any reason. Furthermore, there may be a need for a corresponding lift system and a corresponding method for evacuating a lift car.

These needs can be met by the subject matter of the independent claims. Advantageous embodiments are defined in the dependent claims, in the following description and in the accompanying drawings.

A first aspect of the invention relates to a door system for a lift car which is movable in a lift shaft between several floors and has at least one car opening. The door system comprises at least one door leaf for closing at least a partial region of the car opening and a mounting device, which is designed to mount the door leaf on the lift car slidably in the

direction of a sliding axis between an open position, in which the door leaf releases the partial region, and a closed position, in which the door leaf closes the partial region, and additionally rotatably about a rotation axis so that the door leaf, when it is slid into the closed position and/or into an intermediate position between the open position and the closed position, can be rotated into an emergency open position, in which the car opening is released to such an extent that the lift car can be evacuated via the car opening.

This makes it possible, with relatively little design effort, for the car opening to be at least partially released (and without the use of destructive force) even if the sliding path of the door leaf or leaves is blocked for any reason, for example because the lift car has stopped at the unfavorable height of a support crossing the lift shaft. This can, for example, be a retaining clip of the guide rail.

A second aspect of the invention relates to a lift system. The lift system comprises a lift shaft and at least one lift car, which is movable in the lift shaft between several floors and has at least one car opening. The lift car comprises at least one door system as described above and below, wherein the door leaf is mounted via the mounting device on the lift car slidably in the direction of the sliding axis between the open position and the closed position and additionally rotatably about the rotation axis.

A third aspect of the invention relates to a method for evacuating a lift car of a lift system as described above and below. The method comprises at least the following step: if the lift car is to be evacuated via the car opening and the door leaf is slid into the closed position and/or an intermediate position between the open position and the closed position (and, for example, blocked therein): rotating the door leaf about its rotation axis into an emergency open position, in which the car opening is released to such an extent that the lift car can be evacuated via the car opening.

Features of the method can also be features of the door system described above and below and/or of the lift system described above and below, and vice versa.

Without restricting the scope of the invention in any way, embodiments of the invention may be considered to be based on the concepts and findings described below.

The car opening can be a main opening of the lift car through which passengers can enter the lift car from a floor and/or exit it to a floor during normal operation of the lift system. For example, the car opening may be opposite a door opening in a side wall of the lift shaft when the lift car regularly stops at a floor. The lift car can also have several car openings, for example opposite one another, wherein each car opening can be combined with a door system as described above and below.

The rotation axis can, for example, be orthogonal to the sliding axis. For example, the rotation axis in the operational state of the lift car can be a vertical axis.

The rotation axis can, for example, be slidable together with the door leaf in the direction of the sliding axis (see also further below).

The rotation axis can intersect the sliding axis or can be offset laterally, for example horizontally, to the sliding axis. The orientation of the rotation axis relative to the sliding axis can be constant when sliding the door leaf between the open position and the closed position. However, it is also conceivable to change the lateral offset of the rotation axis to the sliding axis depending on the sliding path of the door leaf.

The door leaf may only be mountable rotatably about a single rotation axis. However, embodiments in which the door leaf can be mounted rotatably or pivotably about two or more rotation axes are also conceivable.

For example, the door leaf can comprise several slidable door leaf segments, each of which can additionally be mounted rotatably about its own rotation axis. Such an embodiment would allow a door leaf that is not completely closed, in particular a door leaf in the middle between the open position and the closed position, to be rotated about its rotation axis into an emergency open position.

According to one embodiment, the mounting device can comprise at least one folding part and at least one sliding part. The sliding part can be mountable on the lift car slidably in the direction of the sliding axis between the open position and the closed position, wherein the folding part can be mountable on the sliding part rotatably about the rotation axis so that the folding part can be slid together with the sliding part. Furthermore, the

door leaf can be fastenable to the folding part so that the door leaf can be rotated together with the folding part.

5 The folding part and/or the sliding part can be designed in one or more parts, for example in the form of an elongate profile or a strip.

The sliding part can, for example, be designed as a guide shoe for guiding in a corresponding guide rail, which can be arranged above and/or below the car opening.

10 The folding part can be fastened to the door leaf as a separate part, for example by screwing and/or welding. However, the folding part can also be integrated into the door leaf, i.e., both can be different portions of one and the same component manufactured in one piece.

15 According to one embodiment, the folding part can be elongate and can be rotatably connectable to the sliding part at its first end. For example, the longitudinal axis of the (elongate) folding part can run horizontally when the lift car is in the operational state. It is possible that the longitudinal axis of the folding part runs parallel to the sliding axis in an initial position and forms an obtuse, acute or right angle with the sliding axis in the
20 emergency open position.

Likewise, for example, the sliding part can be elongate and have a longitudinal axis that runs horizontally when the lift car is in the operational state. The orientation of the longitudinal axis of the sliding part to the sliding axis can be constant or can vary when
25 sliding between the open position and the closed position. Thus, the mounting device can be implemented with little design effort. The door system can therefore be easily retrofitted.

30 According to one embodiment, the folding part can be rotatably connectable to the sliding part via a mounting bolt which engages partially in the folding part and partially in the sliding part. For example, the longitudinal axis of the mounting bolt can lie on the rotation axis when the door system is in the assembled state. Such a mounting is robust and allows easy assembly (or disassembly) of the door system. Alternatively or additionally, the folding part can be rotatably mounted via at least one hinge.

According to one embodiment, the folding part can be lockable to the sliding part, wherein rotation of the folding part about the rotation axis is prevented in the locked state of the folding part and is made possible in the unlocked state of the folding part. This prevents the folding part, and thus the door leaf, from accidentally being rotated into the emergency open position.

According to one embodiment, the folding part can be locked to the sliding part via at least one locking bolt, wherein the locking bolt engages partially in the folding part and partially in the sliding part in the locked state and does not engage in the folding part, does not engage in the sliding part or neither in the folding part nor in the sliding part in the unlocked state. The locking bolt can engage in a corresponding locking receptacle on the folding part and/or sliding part, for example in the form of a locking opening. Accordingly, the folding part can be unlocked by moving the locking bolt out of the locking receptacle. Locking and/or unlocking can take place manually and/or automatically.

According to one embodiment, the locking bolt can engage in a second end of the folding part in the locked state. In this case, the folding part can, for example, extend over the entire or a large part of the width of the door leaf, wherein “width” can be understood as an extension of the door leaf in the horizontal direction in the operational state of the lift car. In other words, the mounting bolt and the locking bolt can be arranged at opposite ends of the door leaf, as viewed in the horizontal direction or in the direction of the width of the door leaf.

According to one embodiment, the locking bolt can be displaceable, in particular slidable, between an unlocking position associated with the unlocked state and a locking position associated with the locked state. In this case, the locking bolt can be coupleable to a spring mechanism, which can be designed to apply a restoring force, acting in the direction of the locking position, to the locking bolt coupled to the spring mechanism. For example, in the operational state of the lift car, the locking bolt can have a longitudinal axis that is parallel or orthogonal to the longitudinal axis of the mounting bolt and/or to the rotation axis. However, other orientations of the locking bolt are also possible. The unlocking position and the locking position can be specified by a corresponding mechanical stop.

The restoring force can be a spring force applied via at least one spring. Thus, the locking bolt can only be moved from the locking position to the unlocking position by overcoming the restoring force. This prevents the folding part from being unlocked accidentally, for example due to mechanical shocks. The restoring force also causes the locking bolt to return to the locking position on its own when released, which simplifies locking.

According to one embodiment, the locking bolt can be connectable to an elongate traction means and can be displaceable or slidable from the locking position to the unlocking position by pulling on the traction means connected to the locking bolt. The traction means can be a flexible means of sufficient tensile strength, such as a rope or wire. When the door system is in the assembled state, the traction means can be accessible from inside and/or outside the lift car. For example, the traction means can be suitably protected against unauthorized access during normal operation of the lift system. Such a locking mechanism or actuating mechanism is particularly low-maintenance and only requires little space.

According to one embodiment, the mounting device can also comprise a further folding part and a further sliding part. The further sliding part can be mountable on the lift car slidably in the direction of the sliding axis between the open position and the closed position, wherein the further folding part can be mountable on the further sliding part rotatably about the rotation axis so that the further folding part can be slid together with the further sliding part. Furthermore, the door leaf can be fastenable at its first end to the folding part and at its second end to the further folding part so that the door leaf can be rotated together with the folding part and the further folding part. For example, in the operational state of the lift car, as viewed in the vertical direction, the first end can be an upper end of the door leaf and the second end can be a lower end of the door leaf. The door leaf can, for example, rigidly connect the folding parts to one another. For this purpose, the door leaf can be designed to be appropriately torsionally rigid. As indicated above, the folding parts can at least partially enclose the door leaf in the horizontal direction. However, it is also possible that at least one of the folding parts additionally encloses the door leaf at least partially in the vertical direction. For example, the folding parts can also surround the door leaf like a frame. The door leaf can thus be mounted very stably with relatively little design effort.

In particular, when closed, the sliding part can close at least part of the car opening. In particular, the sliding part, as an upper sliding part, can close an upper edge region of the door opening in the emergency open position, and/or the further sliding part, as a lower sliding part, can close a lower edge region of the door opening in the emergency open position. The fact that both the upper sliding part and the lower sliding part remain in the emergency open position has the advantage that the locking bolt fastened thereto is easily accessible and that the sliding part can be designed to be stable. According to one embodiment, the door system can furthermore comprise at least one further door leaf for closing a further partial region of the car opening. Accordingly, the mounting device can furthermore be designed to mount the further door leaf on the lift car slidably in the direction of the sliding axis between an open position, in which the further door leaf releases the further partial region, and a closed position, in which the further door leaf closes the further partial region, and/or rotatably about a further rotation axis parallel to the rotation axis. The door leaves can, for example, be a left and a right door leaf, wherein the car opening in the operational state of the lift car can be closed by moving the door leaves toward one another in opposite directions or can be released by moving the door leaves away from one another in opposite directions. It is also possible that both door leaves can be slid in the same direction from the same side of the car opening and/or toward the same side of the car opening. This embodiment makes it possible, for example, for more than one door leaf to be rotated into the emergency open position. This reduces the risk that the car opening cannot be opened wide enough in the event of an evacuation.

For example, the door leaves can rotate independently of one another about their rotation axes.

According to one embodiment, the door leaf can first be unlocked by unlocking the folding part and then be rotated into the emergency open position. The fact that the door leaf must first be unlocked prevents the door leaf from being accidentally opened during normal operation of the lift system.

According to one embodiment, the door leaf can be pivoted into the lift car when rotated into the emergency open position. The door leaf can thus largely project into the lift car in

the emergency open position. This can be advantageous in narrow lift shafts. Additionally or alternatively, the door leaf can be rotated about a vertical axis as the rotation axis. Accordingly, the door leaf or leaves can be mounted slidably in the direction of a horizontal axis as the sliding axis.

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Preferably, a single door leaf can be rotated into the emergency open position at any one time. In the case of telescopic sliding doors with several telescopically moving door leaves, it is preferable that only the frontmost door leaf can be rotated into the emergency open position. This is enough to evacuate the passengers from the car.

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Advantageous embodiments of the invention are described in more detail below with reference to the accompanying drawings, wherein neither the drawings nor the description are intended to be interpreted as limiting the invention in any way.

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Fig. 1 shows a lift system according to one embodiment of the invention from above.

Fig. 2 shows a lift car of the lift system of Fig. 1 from the front.

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The drawings are merely schematic and are not to scale. Identical reference signs in the different drawings refer to identical or identically acting features.

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Fig. 1 shows a plan view of a lift system 1 with a lift shaft 2, which connects several floors of a building to one another. A lift car 3 movable between floors is arranged in the lift shaft 2. The lift car 3 has a car opening 4, which is closable by means of a door system 5.

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In this example, the door system 5 comprises a first door leaf 6a and a second door leaf 6b, which are mounted slidably in opposite directions along a horizontal sliding axis 8, in each case between an open position, in which the car opening 4 is released by both door leaves 6a, 6b, and a closed position, in which the car opening 4 is closed by both door leaves 6a, 6b.

In addition, the first door leaf 6a is mounted rotatably about a vertical first rotation axis 9a and the second door leaf 6b is mounted rotatably about a vertical second rotation axis

9b, in such a way that each door leaf 6a, 6b, when it is blocked in the closed position and/or in an intermediate position between the open position and the closed position, for example due to a support running in the lift shaft 2, can be rotated in an emergency into an emergency open position in which the car opening 4 is released to such an extent that people can leave the lift car 3 via the car opening 4.

For example, in the emergency open position of one of the or both door leaves 6a, 6b, the car opening 4 can have a width of at least 20 cm, preferably of at least 35 cm or at least 50 cm. For this purpose, the door leaf 6a, 6b or the door leaves 6a, 6b can be rotatable about the rotation axis 9a or 9b, for example, by at least 20°, preferably by at least 40°, at least 60° or at least 80°.

The rotation axes 9a, 9b can intersect the sliding axis 8, as shown here. Alternatively, one or both of the rotation axes 9a, 9b can be offset horizontally to the sliding axis 8.

Each door leaf 6a, 6b can, for example, be pivoted at least partially into the lift car 3 by rotating about its rotation axis 9a or 9b.

Fig. 1 shows the two door leaves 6a, 6b in the closed position, wherein the open position and emergency open positions of the door leaves 6a, 6b are indicated by dashed lines.

Fig. 2 shows a front view of the lift car 3 with details of a mounting device 10, via which the two door leaves 6a, 6b are slidably and rotatably mounted on the lift car 3.

In this example, the mounting device 10 comprises an upper folding part 11 and a lower folding part 12 as well as an upper sliding part 13 and a lower sliding part 14 for each door leaf 6a, 6b. The upper sliding parts 13 can be mounted above the car opening 4 and the lower sliding parts 14 can be mounted below the car opening 4 on the lift car 3 slidably along the sliding axis 8 between the open position and the closed position.

For example, the sliding parts 13, 14 can be designed as guide shoes, which can be guided by corresponding guide rails on the lift car 3.

Each upper folding part 11 is on the one hand mounted on one of the upper sliding parts 13 rotatably about the rotation axis 9a or 9b and is on the other hand fastened to an upper end of one of the two door leaves 6a, 6b.

5 Analogously, each lower folding part 12 is on the one hand mounted on one of the lower sliding parts 14 rotatably about the rotation axis 9a or 9b and is on the other hand fastened to a lower end of one of the two door leaves 6a, 6b.

10 The door leaves 6a, 6b are thus rotatable together with the corresponding folding parts 11, 12 about the corresponding rotation axis 9a, 9b, wherein the upper folding parts 11 are slidable together with the corresponding upper sliding part 13, and the lower folding parts 12 are slidable together with the corresponding lower sliding part 14.

15 The folding parts 11, 12 can, for example, be screwed and/or welded to the corresponding door leaf 6a, 6b. However, the folding parts 11, 12 can also be designed as correspondingly shaped portions of the corresponding door leaf 6a, 6b.

20 The folding parts 11, 12 and/or the sliding parts 13, 14 can be designed, for example, as elongate profiles, angles or strips.

25 In the example shown in Fig. 2, the folding parts 11, 12 each extend over the entire width of the corresponding door leaf 6a, 6b. However, the folding parts 11, 12 can also extend only partially in the width direction and/or at least partially in the height direction of the door leaves 6a, 6b, for example in order to form a frame around the corresponding door leaf 6a, 6b.

Each folding part 11, 12 can, for example, be rotatably mounted about the rotation axis 9a or 9b at its first end (here adjacent to a side edge of the car opening 4) via a mounting bolt 15 which extends from the folding part 11, 12 into the adjacent sliding part 13 or 14.

30 In addition, each folding part 11, 12 can be lockable at its second end, opposite the first end in the horizontal direction, via a locking bolt 16 to the corresponding sliding part 13 or 14.

Fig. 2 shows the locking bolt 16 of each door leaf 6a, 6b in the locked state, in which the locking bolt 16 engages both in the corresponding folding part 11, 12 and in the corresponding sliding part 13, 14 and thus prevents rotation of the corresponding folding part 11, 12, i.e., of the corresponding door leaf 6a, 6b, into the emergency open position.

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For example, each locking bolt 16 can be mounted vertically slidably between an unlocking position, in which the locking bolt 16 is completely moved out of the corresponding folding part 11, 12, and a locking position, in which the locking bolt 16 engages partially in the corresponding folding part 11, 12.

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In addition, the locking bolt 16 can be coupled to a spring mechanism 17, which applies a restoring force, acting in the direction of the locking position, to the locking bolt 16.

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Each locking bolt 16 can optionally be connected to an elongate traction means 18, for example a rope or wire, wherein the locking bolt 16 is slidable into the unlocking position by pulling on the traction means 18.

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As shown by way of example in Fig. 2, the two locking bolts 16 of the same door leaf 6a or 6b can be connected to different ends of the same traction means 18. By pulling on the traction device 18, both locking bolts 16 can be slid into the unlocking position at the same time (when the traction means 18 is released, the locking bolts 16 move back into the locking position by themselves due to the restoring force).

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Alternatively, the position of the mounting bolts 15 can be swapped with the position of the locking bolts 16.

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Finally, it should be noted that terms such as “having,” “comprising,” etc. do not exclude other parts or steps, and indefinite articles such as “a” or “an” do not exclude a plurality. Furthermore, it should be noted that features or steps described with reference to one of the above embodiments can also be used in combination with features or steps described with reference to other of the above embodiments. Reference signs in the claims should not be considered to be limiting.

Claims

1. Door system (5) for a lift car (3), wherein the lift car (3) is movable in a lift shaft (2) between several floors and has at least one car opening (4), wherein the door system (5) comprises:
- 5 at least one door leaf (6a, 6b) for closing at least a partial region of the car opening (4); and
- a mounting device (10) which is designed to mount the door leaf (6a, 6b) on the lift car (3) slidably in the direction of a sliding axis (8) between an open position, in which the door leaf (6a, 6b) releases the partial region, and a closed position, in which the door leaf (6a, 6b) closes the partial region, and additionally rotatably about a rotation axis (9a, 9b) so that the door leaf (6a, 6b), when it is slid into the closed position and/or into an intermediate position between the open position and the closed position, can be rotated into an emergency open position in which the car opening (4) is released to such an extent that the lift car (3) can be evacuated via the car opening (4),
- 10 wherein the mounting device (10) comprises at least one folding part (11, 12) and at least one sliding part (13, 14);
- wherein the sliding part (13, 14) is slidably mountable on the lift car (3) in the direction of the sliding axis (8) between the open position and the closed position, wherein the folding part (11, 12) is mountable on the sliding part (13, 14) rotatably about the rotation axis (9a, 9b) so that the folding part (11, 12) is slidable together with the sliding part (13, 14), and wherein the door leaf (6a, 6b) is fastenable to the folding part (11, 12) so that the door leaf (6a, 6b) is rotatable together with the folding part (11, 12).
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2. Door system (5) according to claim 1,
- 25 wherein the folding part (11, 12) is elongate and is rotatably connectable to the sliding part (13, 14) at its first end.
3. Door system (5) according to claim 1 or 2,
- 30 wherein the folding part (11, 12) is rotatably connectable to the sliding part (13, 14) via a mounting bolt (15), which engages partially in the folding part (11, 12) and partially in the sliding part (13, 14).
4. Door system (5) according to any one of claims 1 to 3,

wherein the folding part (11, 12) is lockable to the sliding part (13, 14), wherein rotation of the folding part (11, 12) about the rotation axis (9a, 9b) is prevented in the locked state of the folding part (11, 12) and is made possible in the unlocked state of the folding part (11, 12).

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5. Door system (5) according to claim 4,
wherein the folding part (11, 12) is lockable to the sliding part (13, 14) via at least one locking bolt (16), wherein the locking bolt (16) in the locked state engages partially in the folding part (11, 12) and partially in the sliding part (13, 14) and in the unlocked state
10 does not engage in the folding part (11, 12) and/or does not engage in the sliding part (13, 14).

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6. Door system (5) according to claim 5, as dependent on claim 2,
wherein the locking bolt (16) engages in a second end of the folding part (11, 12) in the locked state.

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7. Door system (5) according to claim 5 or 6,
wherein the locking bolt (16) is displaceable between an unlocking position associated with the unlocked state and a locking position associated with the locked state;
wherein the locking bolt (16) is couplable to a spring mechanism (17), which is designed to apply a restoring force, acting in the direction of the locking position, to the locking bolt (16) coupled to the spring mechanism (17).

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8. Door system (5) according to claim 7,
wherein the locking bolt (16) is connectable to an elongate traction means (18) and is displaceable from the locking position into the unlocking position by pulling on the traction means (18) connected to the locking bolt (16).

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9. Door system (5) according to any one of claims 1 to 8,
wherein the mounting device (10) furthermore comprises a further folding part (12) and a further sliding part (14);
wherein the further sliding part (14) is slidably mountable on the lift car (3) in the direction of the sliding axis (8) between the open position and the closed position, wherein the further folding part (12) is mountable on the further sliding part (14)

rotatably about the rotation axis (9a, 9b) so that the further folding part (12) is slidable together with the further sliding part (14), and wherein the door leaf (6a, 6b) is fastenable at its first end to the folding part (11) and at its second end to the further folding part (12) so that the door leaf (6a, 6b) is rotatable together with the folding part (11) and the further folding part (12).

10. Door system (5) according to any one of the preceding claims, furthermore comprising:

at least one further door leaf (6b) for closing a further partial region of the car opening (4);

wherein the mounting device (10) is furthermore designed to mount the further door leaf (6b) on the lift car (3) slidably in the direction of the sliding axis (8) between an open position, in which the further door leaf (6b) releases the further partial region, and a closed position, in which the further door leaf (6b) closes the further partial region, and/or rotatably about a further rotation axis (9b) parallel to the rotation axis (9a).

11. Lift system (1), comprising:

a lift shaft (2); and

at least one lift car (3), which is movable in the lift shaft (2) between several floors and has at least one car opening (4);

wherein the lift car (3) comprises at least one door system (5) according to any one of the preceding claims, wherein the door leaf (6a, 6b) is mounted via the mounting device (10) on the lift car (3) slidably in the direction of the sliding axis (8) between the open position and the closed position and additionally rotatably about the rotation axis (9a, 9b).

12. Method for evacuating a lift car (3) of a lift system (1) according to claim 11, wherein the method comprises:

if the lift car (3) is to be evacuated via the car opening (4) and the door leaf (6a, 6b) is slid into the closed position and/or an intermediate position between the open position and the closed position: rotating the door leaf (6a, 6b) about its rotation axis (9a, 9b) into an emergency open position in which the car opening (4) is released to such an extent that the lift car (3) can be evacuated via the car opening (4).

13. Method according to claim 12,

wherein the lift car (3) comprises the door system (5) according to claim 5;
wherein the door leaf (6a, 6b) is first unlocked by unlocking the folding part (11, 12) and then rotated into the emergency open position.

- 5 14. Method according to claim 12 or 13,
wherein the door leaf (6a, 6b) is pivoted into the lift car (3) when rotated into the emergency open position; and/or
wherein the door leaf (6a, 6b) is rotated about a vertical axis as the rotation axis (9a, 9b).