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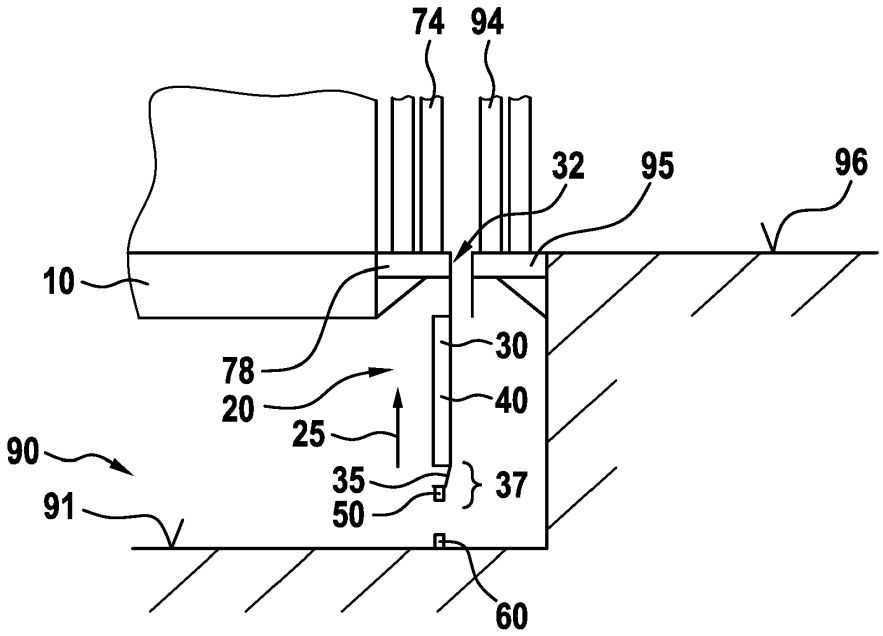
(54) TOE GUARD FOR AN ELEVATOR CAR AND ELEVATOR CAR SYSTEM

(57) A toe guard (20) for an elevator car (10) for moving in an elevator shaft (90) is proposed, wherein the toe guard (20) comprises at least a first element (30) and a second element (35), wherein the first element (30) comprises a mounting section (32) for mounting the first element (30) at the elevator car (10), wherein the second element (35) is movable relative to the first element (30) in a first direction (25) towards the mounting section (32) and opposite to the first direction (25) away from the mounting section (32), characterized in that the second element (35) comprises at least one first magnet (50, 51), wherein the first magnet (50, 51) is disposed at an end section (37) of the second element (35), wherein the end section (37) is distal to the mounting section (32), and wherein the first magnet (50, 51) is adapted to be repelled by a second magnet (60) on a bottom (91) of the elevator shaft (90) such that the second element (35) is moved relative to the first element (30) in the first direction (25) towards the mounting section (32) when the first magnet (50, 51) is closer to the second magnet (60) than a set distance.

Fig. 1



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Description

[0001] The present invention pertains to a toe guard for an elevator car and an elevator car system.

[0002] In the state of the art a toe guard is mounted to an elevator car. When people are rescued from the elevator car, the elevator car can be non-aligned with a floor or a shaft door. Thus, a gap between a lower end of the elevator car and an upper side of a shaft door sill exist. People exiting the elevator car in this situation to a lower shaft door are protected from falling through the gap into an elevator shaft by the toe guard.

[0003] Several types of toe guard are known. For example, DE 10 2008 038 408 A1 discloses such a toe guard. The toe guard is foldable and can be unfolded manually or automatically in the case of an evacuation out of an elevator car which is not aligned with a shaft door. Electromagnets hold the toe guard in a foldable state and let the toe guard free to unfold when the electromagnets are no longer powered, e.g., due to a power outage. The toe guard is folded when the elevator car reaches the lowest floor by a physical contact between the toe guard and the bottom of the shaft or pit.

[0004] One disadvantage is that the toe guard has to be unfolded manually (if there is no power outage). This means that there is no toe guard with an adequate height if the toe guard is not unfolded manually. This can lead to dangerous situations during a rescue of persons out of the elevator car. Furthermore, folding the toe guard by a physical contact between the toe guard and the bottom of the pit creates a lot of noise and wears down the toe guard under unfavorable circumstances.

[0005] There may be the need for a toe guard which is automatically adapted in height and which is technically simple. Also, there may be the need for an elevator car system with a height adaptable toe guard, which is technically simple and which height is automatically adapted.

[0006] Such a need can be met by a toe guard and an elevator car system according to the independent claims. Advantageous embodiments are defined by the dependent claims.

[0007] According to a first aspect, a toe guard for an elevator car for moving in an elevator shaft is proposed, wherein the toe guard comprises at least a first element and a second element, wherein the first element comprises a mounting section for mounting the first element at the elevator car, wherein the second element is movable relative to the first element in a first direction towards the mounting section and opposite to the first direction away from the mounting section, characterized in that the second element comprises at least one first magnet, wherein the first magnet is disposed at an end section of the second element, wherein the end section is distal to the mounting section, and wherein the first magnet is adapted to be repelled by a second magnet on a bottom of the elevator shaft such that the second element is moved relative to the first element in the first direction towards the mounting section when the first magnet is closer to the second magnet than a set distance..

[0008] One advantage hereof is that the toe guard generally automatically changes or adapts its height and is technically simple. Furthermore, the change of height of the toe guard typically happens without physical contact and, thus, quietly without making much noise. Also, since no physical contact between the toe guard and the bottom of the shaft occurs deterioration of the toe guard is minimized, in general. In addition, the toe guard can typically be produced with low costs. Furthermore, no electric and/or manual interface is generally needed for moving the second element relative to the first element, i.e., for changing the height of the toe guard. Also, usually, the toe guard is present below the elevator car at any point of operation of the elevator car without manual intervention. Typically, this increases the safety of operation.

[0009] In particular, the set distance can be a few millimeters (e.g., 1 mm, 2 mm or 5 mm) or a few centimeters (e.g., 1 cm, 2 cm or 5 cm).

[0010] According to a second aspect, an elevator car system is proposed comprising an elevator car and a toe guard as described above, wherein the toe guard is mounted at the elevator car.

[0011] Possible features and advantages of the embodiments of the invention can be based among others and without limiting the invention on the following ideas and insights.

[0012] According to an embodiment, the second element can be moved telescopically out of the first element or the first element can be moved telescopically out of the second element. Generally, by this the toe guard is very compact and saves space.

[0013] According to an embodiment, the toe guard comprises guiding rails for guiding the first element and/or second element during the movement of the second element relative to the first element. One advantage hereof is that typically the moving of the second element relative to the first element is secured. Therefore, canting or jamming between the elements is prevented generally.

[0014] According to an embodiment, the toe guard is adapted such that the second element moves due to its own weight opposite to the first direction away from the mounting section of the first element when the first magnet is in such a distance from the second magnet that the first magnet is essentially not repelled by the second magnet. By this, the extension of the toe guard, i.e., moving the second element away from the mounting section of the first element, is achieved technically easily, in general. Furthermore, typically, the toe guard is especially technically simple and can be produced with low costs. In particular, usually, no manual and/or electric intervention is necessary for increasing or decreasing the height of the toe guard.

[0015] According to an embodiment the toe guard comprises a spring for moving the second element relative to the first element opposite to the first direction away from the mounting section when the first magnet is in such a distance from the second magnet that the first

magnet is essentially not repelled by the second magnet. One advantage hereof is that, usually, the extending of the toe guard, i.e., moving the second element away from mounting section of the first element, is also possible if there is a high friction between the first element and the second element and/or the second element has a very low weight. Typically, this increases the safety.

[0016] According to an embodiment, the toe guard comprises a first detection device for detecting that the second element has moved relative to the first element opposite to the first direction away from the mounting section as far as possible. In general, by this, it can be determined technically easily if the toe guard is extended, i.e., moved away from mounting section of the first element as far as possible. Typically, this increases the safety of operation.

[0017] According to an embodiment, the toe guard comprises a second detection device for detecting that the second element has moved relative to the first element in the first direction towards the mounting section as far as possible. In general, by this, it can be determined technically easily if the toe guard is retracted, i.e., moved towards the first element and the mounting section of the first element as far as possible, when the elevator car is at or near the lowest floor or level.

[0018] According to an embodiment, the toe guard further comprises at least one third element, in particular at least two third elements, which connects the first element with the second element, wherein the third element is movable in the first direction relative to the first element and relative to the second element. Usually, one advantage hereof is that the toe guard can be collapsed to a very short height. Typically, this allows the toe guard to be used for shafts with very small pit depths below the lowest floor or level. The at least one third element can be movable relative to the first element and relative to the second element in the first direction and opposite to the first direction. If there is more than one third element, the third elements can be interconnected. The third element (s) can connect the first element with the second element. The third element(s) can comprise guiding rails for guiding other third elements and/or the second element during movement.

[0019] According to an embodiment, the toe guard further comprises a retaining element for retaining the second element when the second element has moved relative to the first element opposite to the first direction away from the mounting section as far as possible. In general, this ensures that the second element does not detach from the first element when the second element has moved away from the mounting section of the first element as far as possible. Typically, this increases the safety and reliability.

[0020] According to an embodiment, the first magnet is disposed on a side of the second element which faces away from the mounting section. By this, in general, the first magnet can have a low power, since the first magnet comes in close contact with the second magnet when the elevator car is at the lowest level before any other part of the second element comes close to the second magnet. Usually, this reduces the costs of the toe guard.

[0021] According to an embodiment, the first magnet and/or the second magnet is a permanent magnet. Typically, this simplifies the toe guard further. Also, in general, the production costs of the toe guard become lower.

[0022] According to an embodiment, the first magnet and/or the second magnet is a rare-earth magnet, preferably a neodymium magnet. One advantage hereof is that the toe guard has a small weight and has low production costs.

[0023] According to an embodiment of the elevator car system, the first magnet is disposed at a side of the second element which faces away from a shaft door sill of a shaft door which separates the elevator shaft from a level. Typically, this ensures that the first magnet is not attracted by the shaft door sill (which is made of metal typically) when the toe guard passes or stops at a floor or level. Thus, usually, any lateral movement of the second element or the first element due to an attraction between the first magnet and the shaft door sill is prevented. Hence, in general, the first magnet does not alter the movement of the elevator car and toe guard when the elevator car is at or near a floor or level and, thus, at or near a shaft door sill. This increases the safety and reliability of the movement of the elevator car, in general.

[0024] According to an embodiment of the elevator car system, the first magnet has such a fixed distance from the elevator car, when the second element has moved relative to the first element in the first direction towards the mounting section as far as possible, that a weight force of the second element is higher than an attractive force between the first magnet and the elevator car. In general, this ensures that the first magnet does not stick at the bottom of the elevator car. Thus, typically, a movement of the second element away from the mounting section of the first element is ensured as soon as there is no repulsive force (or only a negligible repulsive force) between the first magnet and the second magnet. Generally, this increases the safety of operation of the elevator car system.

[0025] Some of the possible features and advantages of the invention are described herein with reference to different embodiments. A person skilled in the art understands that the features can be combined, adapted or exchanged to achieve further embodiments of the invention.

[0026] In the following, embodiments of the invention are described with reference to the enclosed figures, wherein neither the figures nor the specification should be construed as limiting for the invention.

Fig. 1 shows a schematic side view of an elevator car system with a toe guard according to an embodiment of the invention;

Fig. 2 shows a perspective view of the toe guard of

Fig. 1 wherein the toe guard is extended; and

Fig. 3 shows a perspective view of the toe guard of Fig. 1 wherein the toe guard is retracted.

[0027] The figures are only schematic and not to scale. Same reference numbers in the different figures refer to same or same-acting features.

[0028] Fig. 1 shows a schematic side view of an elevator car system with a toe guard 20 according to an embodiment of the invention. Fig. 2 shows a perspective view of the toe guard 20 of Fig. 1 wherein the toe guard 20 is extended. Fig. 3 shows a perspective view of the toe guard 20 of Fig. 1 wherein the toe guard 20 is retracted.

[0029] The elevator car system comprises an elevator car 10 and a toe guard 20 which is mounted to the elevator car 10. The elevator car 10 can be moved up and down in the elevator shaft 90 and transports people and/or goods. The elevator car 10 can be stopped at different floors or levels, wherein only the lowest floor or lowest level 96 (of the building) is shown. The toe guard 20 is mounted at the elevator car 10 system such that it projects or protrudes in the direction of the weight force of the elevator car 10. In particular, the toe guard 20 is mounted to the sill 78 of the elevator car door 74.

[0030] The toe guard 20 comprises a first element 30 and a second element 35. One or several third elements can be provided between the first element 30 and the second element 35. The third elements are connected with each other and connect the first element 30 with the second element 35. The number of elements (i.e., the sum of the number of third elements plus two for the first element 30 and the second element 35) of the toe guard 20 can be for example two, three, four, five or six. Also more than six elements are possible.

[0031] The first element 30 comprises a mounting section 32 (at the top of the first element 30 in Fig. 2 and Fig. 3) for mounting the first element 30 and, thus, the toe guard 20 to the elevator car 10. The mounting section 32 comprises holes for receiving bolts, pins and/or screws with which the first element 30 is mounted at the elevator car 10.

[0032] The toe guard 20 is variable in height. I.e., the height of the toe guard 20 can be changed. The height runs along the elevator shaft 90. The height runs along the first direction 25. The first direction 25 runs from bottom 91 to top in Fig. 1. Depending on the relative position between the first element 30 and the second element 35, the toe guard 20 has different heights, i.e., lengths along the first direction 25. This way, the toe guard 20 can have a greater height when the elevator car 10 is not at the lowest floor or level 96, i.e., when there is enough space between the bottom of the elevator car 10 and the bottom 91 of the elevator shaft 90. When the elevator car 10 is near or at the lowest floor or level 96, the height of the toe guard 20 is reduced such that the movement of the elevator car 10 is not hindered and such that the toe guard 20 does not come in (direct) physical contact with the bottom 91 of the elevator shaft 90. This reduction of the height of the toe guard 20 is achieved by a repulsive force of a first magnet 50, 51 of the second element and a second magnet 60 on the bottom 91 of the elevator shaft.

[0033] The first element 30 can be or is mounted rigidly at the elevator car 10. The toe guard 20 protrudes over the lower side of the elevator car 10 (in Fig. 1 the bottom side of the elevator car 10).

[0034] The second element 35 can be moved relative to the first element 30 in the first direction 25 and opposite to the first direction 25. The first direction 25 runs from bottom to top in Fig. 1 (as well as in Fig. 2 and Fig. 3). The second element 35 can be moved towards the first element 30 and the mounting section 32 of the first element 30. This way the second element 35 is moved towards the mounting section 32 of the first element 30 and the elevator car 10. I.e., the second element 35 can be moved up and down.

[0035] The first element 30 comprises two guiding rails 40, 41 on opposite lateral sides of the first element 30. The guiding rails 40, 41 together surround the lateral sides of the second element 35 in Fig. 3, i.e., when the toe guard 20 is in its retracted position. The guiding rails 40, 41 provide guidance for the second element 35 while the second element 35 is moved relative to the first element 30.

[0036] In Fig. 2, the toe guard 20 is in an extended position or status. In this extended position the second element 35 has been moved opposite to the first direction 25 away from the mounting section 32 of the first element 30 (and, thus, away from the elevator car 10) as far as possible. In this position, the toe guard 20 has the largest height, i.e., its maximum height.

[0037] In Fig. 3, the toe guard 20 is in a retracted position. The second element 35 has been moved in the first direction 25 towards the first element 30 and, thus, towards the mounting section 32 of the first element 30 (and, thus, towards the elevator car 10) as far as possible. In this retracted position, the toe guard 20 has the shortest/lowest height, i.e., its minimum height.

[0038] The toe guard 20 comprises at least a first magnet 50, 51. In the embodiment shown in Fig. 1-3, the toe guard 20 comprises two first magnets 50, 51. The magnets can be permanent magnets and/or electromagnets.

[0039] The first magnets 50, 51 are disposed at an end section 37 of the second element 35. The end section 37 is the section of the second element 35 which is distal to the first element 30, in particular distal to the mounting section 32 of the first element 30. I.e., the end section 37 is part of the second element 35 which is farthest away from the mounting section 32. The first magnets 50, 51 are disposed on a bottom or lower side of the second element 35. The lower side of the second element 35 faces away from the first element 30 (and, thus, from the elevator car 10). In use, there is no part of the second

element 35 between the first magnet 50, 51 and the second magnet 60. The first magnets 50, 51 are disposed near the lateral ends of this lower side. The first magnets 50, 51 are arranged symmetrically with reference to the lateral ends of the lower side.

[0040] At least one second magnet 60 is disposed on the bottom 91 of the elevator shaft 90. The number of second magnets 60 typically is equal to the number of first magnets 50, 51. Thus, the number of second magnets 60 can be one, two, three, four or more than four magnets. The second magnets 60 are disposed on positions which are directly under the first magnets 50, 51, respectively. I.e., the second magnets 60 are positioned on the bottom 91 of the elevator shaft 90 below the first magnets 50, 51, respectively. This is shown in Fig. 1. The first direction 25 runs opposite to the weight force.

[0041] Each of the first magnets 50, 51 and second magnets 60 are adapted to repel each other, respectively. I.e., one of the first magnets 50, 51 is repelled from one of the second magnets 60. This is typically true for all first magnets 50, 51 and second magnets 60.

[0042] This means that the south pole of the first magnet 50, 51 faces a south pole of the second magnet 60. Alternatively, the north pole of the first magnet 50, 51 faces the north pole of the second magnet 60. This applies to all first and second magnets 60. Hence, same poles of the first magnet 50, 51 and the second magnet 60 face each other.

[0043] An elevator system comprises the elevator shaft 90 with the second magnet 60 and the elevator car 10 with the toe guard 20.

[0044] While the elevator car 10 is away from the lowest level 96, i.e., the level which is closest to the bottom 91 of the elevator shaft 90, the toe guard 20 is in its extended position or status which is shown in Fig. 2. The height of the toe guard 20 is at its maximum.

[0045] When the elevator car 10 is at or near the lowest level 96 or the shaft door sill 95 of the lowest level 96, the first magnet 50, 51 experiences a repulsive force by the second magnet 60 disposed at the bottom 91 of the elevator shaft 90. Theoretically, the first magnet 50, 51 is repelled by the second magnet 60 even when the distance between the first magnet 50, 51 and second magnet 60 is very large (e.g., a few meters). However, this force is negligible (essentially zero), in particular compared to the weight force of the toe guard 20 or the second element 35 of the toe guard 20, until the distance between the first magnet 50, 51 and the second magnet 60 is small, e.g., less than a few centimeters or a few millimeters, for example 1 mm, 5 mm, 1 cm, 5 cm or 10 cm. Only then, the force exerted by the second magnet 60 on the first magnet 50, 51 is non-negligible or significant, in particular compared to the weight force of the second element 35 (or if applicable of the second element 35 and third elements).

[0046] When the toe guard 20 and, thus, the second element 35 approaches the bottom 91 of the elevator shaft 90, the second magnet 60 exerts a force on the first magnet 50, 51 and, hence, on the second element 35 in the first direction 25. This pushes the second element 35 together with the first magnet 50, 51 away from the bottom 91 of the elevator shaft 90 and towards the first element 30 and, thus, towards the elevator car 10. The second element 35 moves relative to the first element 30 in the first direction 25 by this. By this, the height of the toe guard 20 is reduced.

[0047] The set distance at which the second element 35 is moved relative to the first element 30 by the repelling force or repulsion force or repulsive force between the first magnet 50, 51 and the set magnet depends on the weight of the second element 35 (plus, if applicable, the weights of third elements) and on the power of the first magnet 50, 51 and the second magnet 60.

[0048] This movement of the second element 35 relative to the first element 30 in the first direction 25 (upwards in Fig. 1-3) continues as the elevator car 10 approaches the bottom 91 of the elevator shaft 90. The second element 35 can be moved relative to the first element 30 until the position shown in Fig. 3 is achieved. The toe guard 20 is in its (fully) retracted position. The height of the toe guard 20 is at its minimum. Typically, the lowest floor or level 96 is reached by the elevator car 10 before or when the position in Fig. 3 is achieved.

[0049] When the elevator car 10 moves again away from lowest floor or level 96 and the bottom 91 of the elevator shaft 90, the second element 35 moves away from the first element 30 (and the elevator car 10) due to the weight of the second element 35. I.e., the second element 35 moves opposite to the first direction 25 due to the weight force of the second element 35 (or due to the weight force of the second element 35 and third elements).

[0050] This way, the toe guard 20 increases its height gradually and continuously until the extended position (see Fig. 2) is achieved.

[0051] The movements between the position shown in Fig. 3 (retracted position) and the position shown in Fig. 2 (extended position) is not digital, i.e., there are infinite intermediate positions in between.

[0052] The toe guard 20 comprises a first detection device 70 for detecting that the second element 35 has moved relative to the first element 30 opposite to the first direction 25 away from the mounting section 32 and, thus, away from the elevator car 10 as far as possible. I.e., the first detection device 70 detects if the toe guard 20 is in its extended position (shown in Fig. 2).

[0053] The first detection device 70 comprises a first circuit element 71 disposed at the lower end of the first element 30 and a second circuit element 72 disposed at the upper end of the second element 35. When the first circuit element 71 of the first detection device 70 comes in physical contact with the second circuit element 72 of the first detection device 70 (this is shown in Fig. 2), an electrical circuit is closed and an electric signal is generated. This way, it can be detected when the toe guard 20 is in its extended position.

[0054] The toe guard 20 further comprises a second detection device 80 for detecting that the second element 35 has moved relative to the first element 30 in the first direction 25 towards the mounting section 32 of the first element 30 and the elevator car 10 as far as possible. I.e., the second detection device 80 detects if the toe guard 20 is in its retraced position (shown in Fig. 3).

[0055] The second detection device 80 can comprise a first circuit element 81 fixed to lower end or lower side of the first element 30 and a second circuit element 82 fixed to the lower end or lower side of the second element 35. When the first circuit element 81 comes in contact with the second circuit element 82 (this is shown in Fig. 3), an electrical circuit is closed and an electric signal is generated. This way, it can be detected when the toe guard 20 is in its (fully) retracted position.

[0056] The further movement of the second element 35 in the first direction 25 can be prevented by one or several end stops fixed at the first element 30, wherein the end stop or end stops physically hinder the second element 35 from moving further in the first direction 25. The end stops can comprise one or more projections which are in the way of the movement of the second element 35. The toe guard 20 comprises a retaining element which prevents further movement of the second element 35 opposite to the first direction 25 away from the mounting section 32 of the first element 30 when second element 35 has reached the position shown in Fig. 2. The retaining element can comprise one or more projections which are in the way of the movement of the second element 35.

[0057] During the movement of the elevator car 10 above the lowest floor or level 96, the toe guard 20 should be in its fully extended position. If it is detected that that the toe guard 20 has not fully extended, i.e., reached its maximum height, an error signal can be produced. This error signal can trigger a call for maintenance and/or stop the operation of the elevator.

[0058] There can be further elements, so-called third elements, between the first element 30 and the second element 35. Thus, the toe guard 20 can comprise more than two elements. The number of elements can be two, three, four, five or more than five elements. The third elements are movable relative to the first element 30 and relative to the second element 35 in the first direction 25 and opposite to the first direction 25. The third elements are interconnected and connect the first element 30 with the second element 35. The third elements can comprise guiding rails 40, 41 for guiding other third elements and/or the second element 35 during movement. The third elements are movable in the first direction 25 and opposite to the third direction. Thus, the height of the toe guard 20 can change by moving the second element 35 and the third element(s) towards the mounting section 32 of the first element 30 and, thus, towards the elevator car 10. The third elements together with the first element 30 and the second element can be constructed like a multi-sectional extendable ladder. I.e., if there is one third element, the elements would be constructed like a three-sectional extendable ladder. The first element 30 can be moved relative to the third element until first end stops are reached. The second element 35 can be moved relative to the third element until second end stops are reached. This way, the toe guard can be extended to a very large height and can be retracted to a very small height.

[0059] The height of the elements of the toe guard 20 along the first direction 25 can be the same for all elements (i.e., the first element 30, the second element 35 and, if applicable, the third element(s)). Alternatively, the elements can have different heights along the first direction 25.

[0060] It is also possible that the first element 30, the second element 35 and third element(s) can be moved telescopically out of the other element(s).

[0061] The toe guard 20 can comprise a spring (not shown). The spring is adapted to force the second element 35 away from the mounting section 32 of the first element 30 and, thus, away from the elevator car 10. Thus, the spring helps to move the second element 35 away from the mounting section 32 of the first element 30, i.e., the spring supports the movement from the retracted position shown in Fig. 3 to the extended position in Fig. 2. The second element 35 moves away from the mounting section 32 of the first element 30 when the repulsive force between the first magnet 50, 51 and second magnet 60 is lower than the weight force of the second element 35 (and, if applicable, third elements) plus the spring force. The spring exerts a force in the direction of the weight force. Thus, the extending of the toe guard 20 is ensured.

[0062] The second element 35 (the lower element in Fig. 2 and Fig. 3) has a rounded lower end section 37 wherein the end section 37 faces away from the mounting section 32 of the first element 30. The lower end of the second element 35 is bent to the front, i.e., lower left side, in Fig. 2, i.e., away from the shaft door sill 95. The toe guard 20 is mounted to the elevator car 10 such that the back of the second element 35 of Fig. 2 faces the shaft door 94 and, thus, the wall of the elevator shaft 90 with the shaft doors.

[0063] The second magnet 60 or magnets exert(s) a repulsive force on the first magnet(s) 50, 51 of about 200 N (corresponding to a weight of about 20 kg) when the distance between the first magnet 50, 51 and the second magnet 60 is in the range of millimeters, for example. When the second element 35 and the third element(s) of the toe guard 20 have a combined weight of less than about 20 kg, the toe guard 20 is moved in the retracted position or partially retracted position when the elevator car 10 with the toe guard 20 moves to the lowest floor or level 96. The second element 35 and the third element(s) are pushed upwards by the repulsive force between the first magnet(s) 50, 51 and the second magnet(s) 60. The second element 35 pushes the third element(s) upward, when the second element 35 has moved away from the

second magnet 60.

[0064] The first magnet or first magnets 50, 51 can be disposed on a lateral side of the second element 35 which faces away from the shaft door sill 95. I.e., when the toe guard 20 is mounted to the elevator car 10 such that the toe guard 20 projects or protrudes in the direction of the weight force of the elevator car 10, the first magnet(s) 50, 51 does essentially not attract the shaft door sill 95. Thus, the movement of the elevator car 10 and the toe guard 20 is not influenced by the presence of the shaft door sill 95.

[0065] The first element 30 has such a height that the first magnet(s) 50, 51 has/have a fixed distance from the elevator car 10 when the second element 35 has moved relative to the first element 30 in the first direction 25 towards the mounting section 32 of the first element 30 (and the elevator car 10) as far as possible. I.e., when the toe guard 20 is in its retracted position the first magnet 50, 51 has a fixed distance to the lower side of the elevator car 10.

[0066] The fixed distance is set to a value that an attraction force between the first magnet(s) 50, 51 and the elevator car 10 is negligible or at least (much) lower than the weight force of the second (and, if applicable, third elements). The fixed distance typically depends on the height of the first element 30. This way, a sticking of the first magnet(s) 50, 51 on the lower side of the elevator car 10 is prevented. This ensures that the second element 35 is moved away from the mounting section 32 of the first element 30 and, thus, away from the elevator car 10 due to its own weight or weight force.

[0067] The toe guard 20 itself has no parts and no elements which have to be triggered to extend or retract the toe guard, i.e., to change the height of the toe guard. The changing of height of the toe guard 20 occurs automatically when the elevator car is moved closer to the bottom 91 of the elevator shaft 90 or farther away from the bottom 91 of the elevator shaft 90.

[0068] The terms "having", "comprising" etc. do not exclude other elements or steps and terms like "a" or "one" do not exclude a plurality. Further it has to be noted that features and steps described with reference to one of the above-described embodiments can be used in combination with other features or other steps of other embodiments described above. Reference numerals in the claims are to be considered non-limiting.

Claims

1. Toe guard (20) for an elevator car (10) for moving in an elevator shaft (90),
   wherein the toe guard (20) comprises at least a first element (30) and a second element (35), wherein the first element (30) comprises a mounting section (32) for mounting the first element (30) at the elevator car (10),
   wherein the second element (35) is movable relative to the first element (30) in a first direction (25) towards the mounting section (32) and opposite to the first direction (25) away from the mounting section (32),
   characterized in that
   the second element (35) comprises at least one first magnet (50, 51),
   wherein the first magnet (50, 51) is disposed at an end section (37) of the second element (35), wherein the end section (37) is distal to the mounting section (32), and wherein the first magnet (50, 51) is adapted to be repelled by a second magnet (60) on a bottom (91) of the elevator shaft (90) such that the second element (35) is moved relative to the first element (30) in the first direction (25) towards the mounting section (32) when the first magnet (50, 51) is closer to the second magnet (60) than a set distance.

2. Toe guard (20) according to claim 1, wherein
   the second element (35) can be moved telescopically out of the first element (30) or the first element (30) can be moved telescopically out of the second element (35).

3. Toe guard (20) according to claim 1 or 2, wherein
   the toe guard (20) comprises guiding rails (40, 41) for guiding the first element (30) and/or second element (35) during the movement of the second element (35) relative to the first element (30).

4. Toe guard (20) according to one of the preceding claims, wherein
   the toe guard (20) is adapted such that the second element (35) moves due to its own weight opposite to the first direction (25) away from the mounting section (32) of the first element (30) when the first magnet (50, 51) is in such a distance from the second magnet (60) that the first magnet (50, 51) is essentially not repelled by the second magnet (60).

5. Toe guard (20) according to one of the preceding claims, wherein
   the toe guard (20) comprises a spring for moving the second element (35) relative to the first element (30) opposite to the first direction (25) away from the mounting section (32) when the first magnet (50, 51) is in such a distance from the second magnet (60) that the first magnet (50, 51) is essentially not repelled by the second magnet (60).

6. Toe guard (20) according to one of the preceding claims, wherein
   the toe guard (20) comprises a first detection device (80) for detecting that the second element (35) has moved relative to the first element (30) opposite to the first direction (25) away from the mounting section (32) as far as possible

7. Toe guard (20) according to one of the preceding claims, wherein
the toe guard (20) comprises a second detection device (70) for detecting that the second element (35) has moved relative to the first element (30) in the first direction (25) towards the mounting section (32) as far as possible.

8. Toe guard (20) according to one of the preceding claims, wherein
the toe guard (20) further comprises at least one third element, in particular at least two third elements, which connects the first element (30) with the second element (35), wherein the third element is movable in the first direction (25) relative to the first element (30) and relative to the second element (35).

9. Toe guard (20) according to one of the preceding claims, wherein
the toe guard (20) further comprises a retaining element for retaining the second element (35) when the second element (35) has moved relative to the first element (30) opposite to the first direction (25) away from the mounting section (32) as far as possible.

10. Toe guard (20) according to one of the preceding claims, wherein
the first magnet (50, 51) is disposed on a side of the second element (35) which faces away from the mounting section (32).

11. Toe guard (20) according to one of the preceding claims, wherein
the first magnet (50, 51) and/or the second magnet (60) is a permanent magnet.

12. Toe guard (20) according to one of the preceding claims, wherein
the first magnet (50, 51) and/or the second magnet (60) is a rare-earth magnet, preferably a neodymium magnet.

13. Elevator car system comprising an elevator car (10) and a toe guard (20) according to one of the preceding claims, wherein the toe guard (20) is mounted at the elevator car (10).

14. Elevator car system according to claim 13, wherein the first magnet (50, 51) is disposed at a side of the second element (35) which faces away from a shaft door sill (95) of a shaft door (94) which separates the elevator shaft (90) from a level (96).

15. Elevator car system according to claim 13 or 14, wherein
the first magnet (50, 51) has such a fixed distance from the elevator car (10), when the second element (35) has moved relative to the first element (30) in the first direction (25) towards the mounting section (32) as far as possible, that a weight force of the second element (35) is higher than an attractive force between the first magnet (50, 51) and the elevator car.

Fig. 1

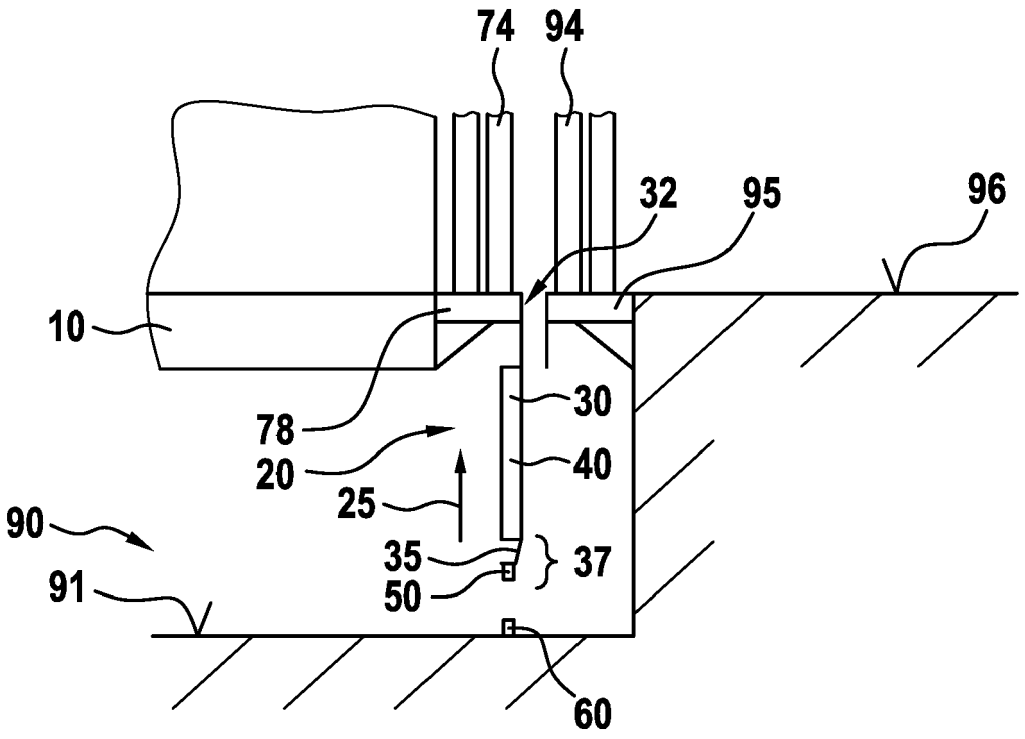


Fig. 2

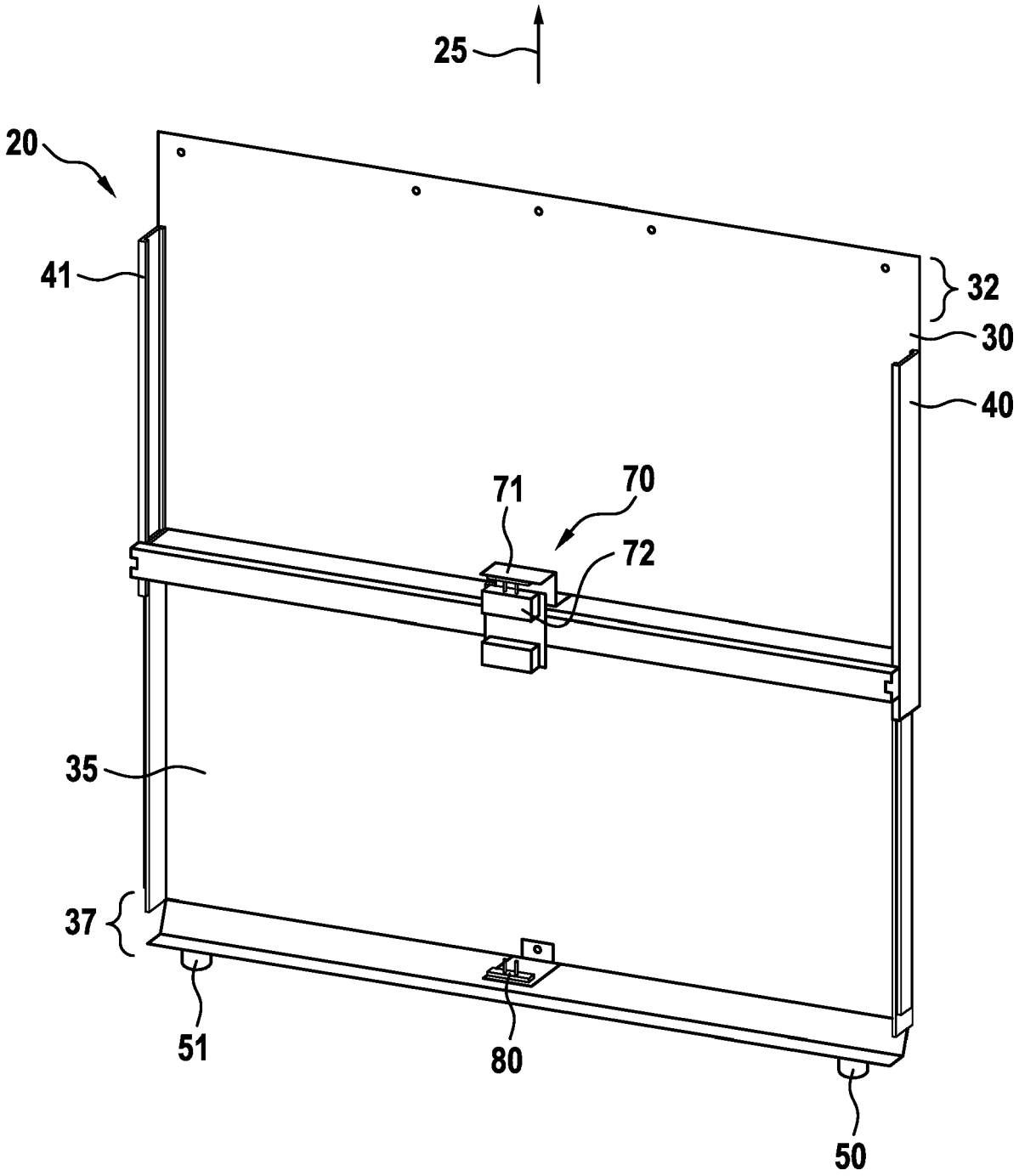
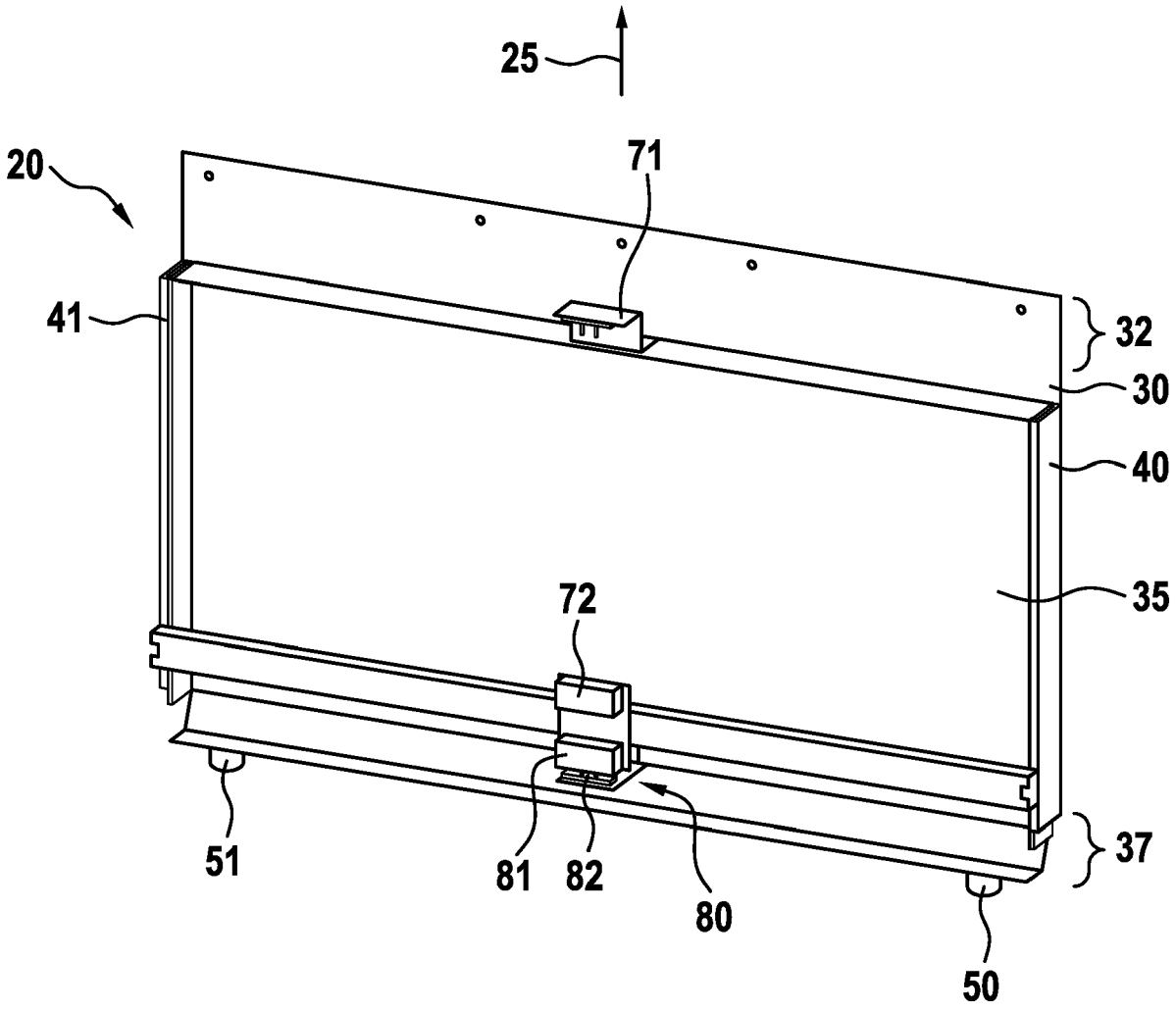


Fig. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 17 17 1048

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