

**Barrier for an escalator or a moving walkway**

The invention relates to a barrier for a transport device. The barrier serves as fall protection for users of the transport device. Furthermore, the invention relates to a transport device with such a barrier, an installation method for the barrier, and a method for modernizing a transport device by means of such a barrier.

In the sense of the present document, transport devices are escalators and moving walkways with a conveyor belt that has a large number of steps or pallets. The steps or pallets form a conveying surface which serves to convey users and/or other loads, such as hand luggage or shopping carts.

Balustrades with handrails that move synchronously with the conveyor belt are usually arranged to the sides of the steps or pallets of the transport device. Below the balustrades is a supporting structure to which the balustrades are attached. The supporting structure is covered at the top by a cover assembly and laterally by side paneling. The cover assembly and side paneling are usually attached to the supporting structure with the aid of fastening means.

For transport devices, building regulations and standards such as EN-115 apply with regard to their balustrade height (starting from the conveying surface of the conveyor belt) or the height at which the handrail is arranged. These building regulations are intended to ensure the safe use of the escalator or moving walkway and must be strictly adhered to by the operators or building owners.

Since the balustrades of conventional transport devices extend only to the height of the handrail, there are certain risks associated with improper use. As a result, users sometimes "surf" on the handrails or deliberately jump over the balustrade, or users are involuntarily pushed over the balustrade. This happens, for example, in soccer stadiums when hooligans jump off a transport device or push other users off a transport device.

Such situations are dangerous for the users of the transport devices and also for the people located under the transport devices and must therefore be avoided at all costs.

For example, WO 2020/114846A1 discloses a balustrade for an escalator in which first panels are arranged below the handrail, and, as an additional barrier, second panels are arranged laterally offset from the handrail and projecting above the handrail. A disadvantage of this solution is that installing the panels in the mounting profile can lead to problems. In particular, the glass paper thereof tends to shift upon the insertion of the panels, and may get crumpled in the process and need to be replaced. Furthermore, it offers little damping at the clamping point, which can lead to an increased risk of breakage in glass panels. A further problem arises from the mass of the barrier and from forces acting upon the barrier due to greater leverage effects, which place additional stress on the balustrade. In most cases, this needs to be significantly reinforced, which increases its intrinsic mass and, in total, places an additional load on the supporting structure. Furthermore, measures to reinforce the balustrade of existing transport devices significantly increase the installation effort and may require extensive modifications to the existing balustrade panels. DE102019207776A1 also discloses such a barrier.

Against this background, it is an object of the present invention to provide an improved means of erecting the aforementioned barrier. In particular, the aim is to create a barrier that is easy and quick to install, visually appealing, and serves as a more effective fall protection. Furthermore, it should be possible to easily retrofit transport devices with such a barrier.

This object is achieved by a barrier to protect users from falling from a transport device that is configured as an escalator or moving walkway. The barrier is configured to be installed on the transport device next to a circulating, movable handrail of the balustrade of the transport device, wherein, in the installed state, the barrier extends parallel to the handrail and projects in height beyond the balustrade or the handrail. The barrier has a clamping profile with a V-shaped groove that extends into the clamping profile in the longitudinal direction thereof, wherein the V-shaped groove is bounded by a groove base and two groove surfaces, and the groove surfaces are arranged at an opening angle to each other from the groove base toward a groove opening. The clamping profile can, for example, be made from an aluminum extrusion profile or extruded plastic profile, the ends of which are covered with an end cap.

Furthermore, the barrier includes a balustrade panel which has two parallel side surfaces and a lower edge, and in the region of its lower edge is arranged in the V-shaped groove.

The balustrade panel can also be configured of multiple parts and comprise a plurality of panel sections. Another component of the barrier is an L-shaped wedge insert with a wedge leg and a base leg. The wedge leg has a wedge-shaped cross-section and is arranged between the first side surface of the balustrade panel and the first groove surface. The base leg is arranged between the lower edge of the balustrade panel and the groove base. In addition, a channel is formed in the base leg and extends parallel to the V-shaped groove. The formation of a channel in the base leg has the advantage that a lighting means and/or a supply line can be laid in the V-shaped groove.

In addition, the barrier has a clamping wedge that is wedge-shaped in cross-section and arranged between the second side surface of the balustrade panel and the second groove surface. It is not necessary in this case for the wedge insert and the clamping wedge to extend continuously in the V-shaped groove or for their length to be matched to the length of the balustrade panel.

For reasons of cost, manufacturing, and installation, the wedge insert and the clamping wedge are configured to be significantly shorter than a balustrade panel so that they can also be used in curved sections of the clamping profile without having to be bent in the longitudinal extension of the clamping profile. To avoid additional bending moments on the balustrade panel as a result of the clamping force generated by the driven-in clamping wedge, the wedge insert and the clamping wedge are preferably arranged opposite each other in the V-shaped groove and not offset from each other in the longitudinal direction. A plurality of wedge inserts and clamping wedges can be provided per balustrade panel, whereby a distance can be provided between two pairs of wedge inserts/clamping wedges that is greater than the length of a wedge insert or a clamping wedge.

The L-shaped wedge insert provides a component that is per se dimensionally stable enough to withstand the forces of the balustrade panel when inserted into the V-shaped groove. Furthermore, the balustrade panel is precisely positioned in the V-shaped groove by the wedge insert so that a plurality of panel sections arranged side-by-side in series of a balustrade panel divided into a plurality of parts can be precisely positioned relative to each other without effort. In addition, the wedge insert, which is preferably made of a polymer material such as acrylonitrile butadiene styrene copolymer (ABS), polyethylene terephthalate (PET), polyamide (PA), and the like, offers very good shock absorption, so

that the risk of breakage of the balustrade panel is significantly reduced, and its thickness can therefore be kept comparatively low.

To further increase the effectiveness of the barrier with regard to its task as fall protection, it has at least one sensor and/or an output device for visual, acoustic, or audiovisual outputs. In addition, at least one connecting line for the sensor and/or the output device is arranged in the V-shaped groove and guided through the channel of the wedge insert.

If the fall protection has a sensor, for example the region between the handrail and the balustrade panel can be monitored thereby. As soon as a body mass larger than a hand is located in this region, a suitable warning can be issued to the user of the transport device via the output device. Naturally, the sensor can also send its sensor signals via the connecting line to an output device independent of the barrier or even the transport device, and thereby warn the user acoustically, visually, or audiovisually. However, the barrier can also be equipped with only a dispensing device. By means of this, for example, announcements (acoustic output) can be periodically issued, or warning signals (visual output) can be displayed, or even film sequences (visual or audiovisual output) can be shown. As described in more detail below, the content output by the output device can also be static.

In one embodiment of the barrier, a receiving structure for a sensor or an output device is formed in the clamping profile. The receiving structure is designed to align an installed sensor or an installed output device with a predetermined region. This region can, for example, be the adjacent space of the handrail and/or the conveyor belt of the transport device. The receiving structure is preferably adapted to the sensor so that said sensor can be easily integrated into the receiving structure. As the receiving structure, a simple bore can serve, which is for example formed in the clamping profile, and whose inner diameter is matched to the outer diameter of the sensor. The clamping profile can have one or more receiving structures.

In another embodiment of the barrier, a sensor is arranged in the receiving structure and connected to the connecting line. For example, a radar sensor, an infrared sensor, a CMOS sensor, a laser scanner, a TOF camera, a LIDAR sensor, and the like can be installed as a sensor. The sensor data generated by the sensor is transmitted to a

processing module via the connecting line or wirelessly. The processing module is described in more detail below. Furthermore, an output device or parts of an output device, e.g., a loudspeaker, can also be installed in the receiving structure and connected to the connecting line.

5

Regarding the connecting line, it can generally be any type of connecting line. In particular, the connecting line can be a power supply line, a signal transmission line, an RS-485 line, an Ethernet line, and the like. The connecting line can be a multi-core cable or comprise several single- or multi-core cables. The connecting line can, for example, serve only to supply the sensor and/or the output device with electrical energy, while signals from the sensor or, if required, control signals for the output device can be transmitted wirelessly. The signals can also be transmitted along with the supply voltage via the same connecting line, as is common with a CAN bus, for example.

10

15

In another embodiment of the barrier, the balustrade panel is equipped with an OLED screen film (organic light-emitting diode) serving as an output device. The OLED screen film is connected to the connecting line to thereby receive image data and electrical power. By means of this output device, both image sequences such as commercials or clips with safety instructions, as well as static content such as images, advertising slogans, or warning symbols can be output to the users of the transport device. Since such displays usually attract attention, users are prevented or at least distracted from thinking about using the transport device improperly. Exploiting this psychological effect, the output device effectively increases the effect of the barrier.

20

25

In a further embodiment of the barrier, the balustrade panel is made of transparent material such as single-pane safety glass, double-pane safety glass, or transparent plastic such as acrylic glass (PMMA), polycarbonate (PC), edge-illuminated acrylic glass that emits light via the side surfaces, and the like. The balustrade panel is also equipped with a semi-transparent coating, such as a print, a film, a vapor deposition, or the like, serving as an output device, and accordingly outputs only static content. The barrier also has a lighting means directed toward the lower edge of the balustrade panel and arranged in the V-shaped groove and guided through the channel of the wedge insert. The lighting means is connected to the connecting line, which can supply it with electrical energy and control it if necessary.

30

35

Although the output device in this embodiment displays purely static images or pictograms, it also utilizes the psychological effect described above. This is particularly the case if the light source is controllable and, for example, the color or wavelength of the emitted light can be varied over time. For example, light colors can be chosen that have a calming effect when a hectic or irritable mood arises on the transport device. On the other hand, more “aggressive” light colors can also be used if the users are behaving too sluggishly.

In another embodiment of the barrier, the balustrade panel is made of transparent edge illuminated acrylic glass that emits light via the side surfaces, and is equipped with a liquid crystal display serving as an output device. Analogously to the previously described embodiment, here, too, a lighting means directed toward the lower edge of the balustrade panel is arranged in the V-shaped groove and guided through the channel of the wedge insert. The light source and the output device are also connected to the connecting line.

As already mentioned, the barrier can have a processing module that is connected to the connecting line and accordingly to the sensor and/or the output device. The processing module is designed to perform at least one of the functions described below. The processing module can receive data. This characteristic is to be understood very broadly. For example, data from the sensor can be received, stored, or forwarded. Data can also be received, processed, and forwarded from a controller of the transport device or from sensors that are installed in the transport device.

Furthermore, data can also be received from an external monitoring system, from an external data storage device (for example, video sequences that are to be played on an output device of the barrier), or from a monitoring room by means of which a plurality of transport devices are centrally monitored. These data can be processed by the processing module - for example, by analyzing and evaluating sensor data and generating appropriate signals in response to the received data. This involves the use of well-known evaluation algorithms and analysis methods from electronic surveillance - for example, a trained artificial intelligence. The processing module can output a signal based upon processed data - for example, an alarm signal to the aforementioned monitoring room or to the controller of the transport device or to an output device independent of the transport device. The processing module can also control a lighting means that is installed in the

barrier in order to create the situation-appropriate ambiance on the transport device mentioned above. The processing module can also control an output device that is installed in the barrier in order to output acoustic or visual or audiovisual content such as warnings, advertising messages, and the like.

5

In principle, all known light-emitting devices such as light-emitting diodes, fluorescent tubes, OLED screen films, and the like can be used as lighting means. Preferably, the light source is a light strip equipped with light-emitting diodes. Light strips of the aforementioned type generally have a flexible base body with a rectangular cross-section and light-emitting diodes arranged in series. Generally, there is also an integrated connecting line with which the individual LED's are supplied with electrical energy. Depending upon the design, these light strips are dimmable and/or the color or wavelength of the emitted light can be adjusted as desired.

10

15

To facilitate the assembly of the barrier, the channel can have a positioning means. The positioning means is configured to match the lighting means and/or the connecting line in such a way that it positions the lighting means or the connecting line perpendicular to the longitudinal direction of the clamping profile in the channel during and after assembly of the barrier. The positioning means can, for example, be a rounding or chamfering of the edges at the opening, facing the balustrade panel or the groove base, of the channel.

20

In a further embodiment of the barrier, the channel is arranged on that side of the base leg which is directed toward the groove base when the wedge insert is placed in the V-shaped groove. This creates a wide support surface for the lower edge of the balustrade panel. In order to ensure that the balustrade panel resting on top can be sufficiently illuminated in the region of the wedge insert by a lighting means arranged in the channel, at least one opening through the base leg is provided. The opening can also be used to run one or more connecting lines.

25

30

In one embodiment of the barrier, the channel is arranged on that side of the base leg which, given a wedge insert inserted in the V-shaped groove and inserted balustrade panel, is directed toward the lower edge of the balustrade panel. This embodiment has the advantage that no opening is required, since a lighting means arranged in the channel can also be arranged in the region of the wedge insert between the base leg and the lower edge of the balustrade panel.

35

In another embodiment of the barrier, fastening structures for an elastic sealing profile are formed on both sides at the groove opening of the V-shaped groove. The sealing profiles arranged on both sides prevent dirt and water from penetrating the V-shaped groove and give the transition from the clamping profile to the balustrade panel an aesthetic appearance.

On one side, facing away from the V-shaped groove, of the clamping profile, a T-shaped groove can also be formed, which is provided to accommodate fastening means. This allows the clamping profile to be attached to suitable structural parts of the transport device or, via adapter parts, to the transport device. Furthermore, clamping profiles divided into a plurality of sections can be firmly connected to each other at the end face by means of connecting tongues inserted into the T-groove.

In another embodiment of the barrier, it has a support which is provided at one end with a foot attachment region and, at the other end, with a head attachment region. The head attachment region is connected to the clamping profile by fastening means. Provided that the previously described T-shaped groove is present in the longitudinal direction of the clamping profile, the position of the support on the clamping profile can be freely selected. The foot attachment region is provided to be attached to a bearing structure of a transport device - for example, to its supporting structure.

The support can have a telescopic device between the head attachment region and the foot attachment region. This allows the distance between the head attachment region and the foot attachment region to be fixably adjusted.

Depending upon its location in a building, the transport device, configured as an escalator or moving walkway, can be equipped with a barrier on one or both sides. Such transport devices typically have a circulating conveyor belt and, on both sides of the conveyor belt, a balustrade with a circulating, movable handrail. The barrier according to the invention is installed next to the circulating, movable handrail on the transport device, wherein the barrier is arranged on the side, facing away from the conveyor belt, of the handrail. In an installed state, the barrier extends parallel to the balustrade and projects in height beyond the balustrade or its handrail.

An existing transport device of the aforementioned type can also be updated by equipping it with at least one barrier according to the invention.

The installation method for the barrier includes at least the steps listed below. At least one  
5 connecting line, possibly also a lighting means, is arranged in the V-shaped groove.

Furthermore, a wedge insert is placed in the V-shaped groove so that the base leg of the wedge insert lies on the groove base of the V-shaped groove. In this case, the connecting line and, if applicable, the lighting means, are guided through the channel of the wedge insert. The balustrade panel or end panel is then inserted into the V-shaped groove so that  
10 its lower edge lies on the base leg of the wedge insert, and the wedge leg is positioned between the first groove surface of the V-shaped groove and the first side surface of the balustrade panel. Then the clamping wedge is positioned and pressed in between the second side surface of the balustrade panel and the second groove surface.

Preferred exemplary embodiments of the barrier according to the invention are explained  
15 in greater detail in the following description with reference to the accompanying drawings; identical elements are provided with the same reference signs in all figures. Neither the drawings nor the description are to be interpreted as limiting the invention. In the figures:

20 Figure 1 shows a three-dimensional view of a transport device configured as an escalator with glass balustrades and two laterally arranged barriers to protect users from falling from the transport device;

25 Figure 2 shows an enlarged view of a cross-section through a clamping profile of the barrier shown in Figure 1;

Figure 3 shows a cross-section through the entire barrier and the glass balustrade of the transport device shown in Figure 1;

30 Figure 4 shows an enlarged view of a partial cross-section through a box-shaped balustrade of a transport device and the barrier with a sensor and an output device attached thereto;

Figure 5 shows a three-dimensional exploded view of a section of the barrier shown in Figure 4 without a balustrade and without brackets;

Figure 6 shows an enlarged view of the cutout B indicated in Fig. 2, also with an acoustic output device; and

Figure 7 shows a possible installation method for a barrier according to the invention.

Figure 1 shows a three-dimensional view of a transport device 1 configured as an escalator, as it is installed in a building 3 (shown with dashed lines). The transport device 1 has a circulating, movable conveyor belt 5 with steps 7. Along each side of the conveyor belt 5 extend two balustrades 9 with glass panels 11. Transport devices 1 with such glass balustrades are used, for example, in department stores and shopping malls. A handrail guide profile 13 (see Figure 3) with a circulating, movable handrail 15 is arranged at the edge of each balustrade 9. The handrails 15 are moved synchronously with the conveyor belt 5. The balustrade height  $H_B$  of the balustrade 9 is adapted in such a way that its handrail 15 can be comfortably grasped by an adult person of average height, but is also easily reachable for smaller children. For example, EN-115 specifies a balustrade height  $H_B$  of 900 cm to 1,100 cm depending upon the location of use.

Since there is no wall on any side of the transport device 1, users could fall over the balustrade and tumble down the side of the transport device 1 during the improper use mentioned above. To avoid this, a barrier 31 is installed on both sides of the handrail 15 on the transport device 1. As can be seen from Figure 1, the barrier 31 extends parallel to the balustrade 9. Its balustrade panel 45 projects in height  $H_A$  beyond the balustrade height  $H_B$  or the handrail 15. To enable users to hold onto the handrail 15, the barrier 31 is arranged on the side, facing away from the conveyor belt 5, of the handrail 15.

In order to show various embodiments of the barrier 31, the balustrade panel 45 installed on the right barrier 31 is made in one piece. As shown by the left barrier 31, the balustrade panel 45 can also be made of a plurality of parts and comprise a plurality of panel sections 46. In this case, the barrier 31 can have panel connectors 145 to connect the individual panel sections 46 together.

Fig. 2 schematically shows an enlarged view of a cross-section through the supporting barrier 31 shown in Fig. 1. The barrier 31 has a clamping profile 33 with a V-shaped groove 35 which extends therein in the longitudinal direction L (see Figure 1) of the clamping profile 33. The V-shaped groove 35 is bounded by a groove base 37 and two groove surfaces 39, 41. In this case, the groove surfaces 39, 41 are arranged opening at an angle to each other, proceeding from the groove base 37 to a groove opening 43. In other words, the width of the V-shaped groove 35 increases toward the groove opening 43. The clamping profile 33 can, for example, be made from an aluminum extrusion profile or an extruded plastic profile, the ends of which can be covered, for example, with an end cap 147 (see Figure 1).

The barrier 31 also has a balustrade panel 45, which has two parallel side surfaces 47, 49 and in the region of its lower edge 51 is arranged in the V-shaped groove 35. The balustrade panel 45 is made of transparent material such as single-pane safety glass, laminated safety glass, a PMMA sheet, a polycarbonate sheet, edge-lit acrylic glass that emits light via the side surfaces, and the like.

Another component of the barrier 31 is an L-shaped wedge insert 53 with a wedge leg 55 and a base leg 57. The wedge leg 55 has a wedge-shaped cross-section and is arranged between the first side surface 47 of the balustrade panel 45 and the first groove surface 39. The base leg 57 of the wedge insert 53 is arranged between the lower edge 51 of the balustrade panel 45 and the groove base 37. In addition, a channel 58 is also formed in the base leg 57 and extends parallel to the V-shaped groove 35. The formation of a channel 58 in the base leg 57 has the advantage that, for example, a lighting means 151 can be laid within the clamping profile 31 or in the V-shaped groove 35 with a constant cross-section without interrupting it.

Furthermore, the balustrade panel 45 is provided with a semi-transparent coating serving as a dispensing device 157. This coating can be a print, a film, a vapor deposition, and the like. In order to “activate” the effect of this output device 157, which outputs static content, it or the barrier 31 has a lighting means 151 directed toward the lower edge 51 of the balustrade panel 45 and arranged in the V-shaped groove 35 and guided through the channel 58 of the wedge insert 55.

All known light-emitting devices such as light-emitting diodes, fluorescent tubes, OLED screen films, and the like can be used as lighting means 151. The channel also allows for easily laying connecting lines 155 in the V-shaped groove 35. In order to ensure that the balustrade panel 45 resting on top can be sufficiently illuminated in the region of the wedge insert 53 by a lighting means 151 arranged in the channel 58, at least one opening 54 through the base leg 57 is provided.

The lighting means 151 is connected to a processing module 161 (shown only in Figure 5) via the connecting line 155. As soon as the lighting means 151 is switched on by the processing module 161, the balustrade panel 45 is flooded with light and backlights the semi-transparent coating of the output device 157. Since the balustrade panel 45 is arranged at eye level for most users of the transport device 1, it attracts their attention and thereby reduces the willingness to use the transport device 1 improperly.

In order to fasten the wedge insert 53 and the balustrade panel 45 in the clamping profile 33, the barrier 31 has a clamping wedge 59 with a wedge-shaped cross-section and arranged between the second side surface 49 of the balustrade panel 45 and the second groove surface 41. To ensure a secure and permanent clamping of the balustrade panel 45 in the V-shaped groove 35, the wedge angle  $\alpha$  of the wedge leg 55 and the wedge angle  $\beta$  of the clamping wedge 59 must be smaller than the angle of a friction cone which is present between the first groove surface 39 and the wedge leg 55 or the second groove surface 41 and the clamping wedge 59. The angle of the friction cone, which is another way of describing the coefficient of friction between these components, depends upon the surface roughness and the materials used for the clamping profile 33, the wedge insert 53, and the clamping wedge 59. In multi-part balustrade panels 45, wedge inserts 53 and clamping wedges 59 are preferably arranged in the clamping profile 33 such that they overlap two adjacent panel sections 46.

The V-shaped groove 35 also has, on the first groove surface 39 provided for the wedge insert 53, a projection 61 narrowing the groove opening 43. This projection 61 gives the wedge insert 53 a better hold in the V-shaped groove 35 so that it does not slip when the balustrade panel 45 is inserted. To further improve this hold, on the wedge leg 55 of the wedge insert 53, an elastic element 63 can be arranged which, when the wedge insert 53 is inserted into the V-shaped groove 35, clamps its wedge leg 55 between the projection 61 and the groove base 37.

To prevent the V-shaped groove 35 from filling with water and dirt, sealing profiles 65, 67 of elastomer material such as rubber, nitrile rubber, and the like are arranged at the groove opening 43 on both sides of the balustrade panel 45. In order to enable the sealing profiles 65, 67 to be mounted, fastening structures 69 are formed on both sides at the groove opening 43 of the V-shaped groove 35. The fastening structures 69 (shown is a tongue-and-groove connection) correspond to corresponding formations on the sealing profile 65, 67. The tongue-and-groove fastening structure 69 shown in Figure 2 is only one of the countless possible designs for fastening the sealing profile 65, 67 in the groove opening 43 and is therefore not to be understood as reduced to this one representation.

In order to be able to attach the barrier 31 to the transport device 1, a T-shaped groove 71 is formed on one side, facing away from the V-shaped groove 35, of the clamping profile 33. Fastening means 73, such as square or hexagonal screw heads, can be arranged therein, wherein their position in the longitudinal direction L of the clamping profile 33 is freely selectable. This simple and robust construction allows the clamping profile 33 to be attached, for example, to a support 75 as also shown in Figures 1 and 3, or to a box-shaped balustrade 91 as shown in Figure 4. Of course, other structures such as bores with internal threads, clampable projections, and the like can also be formed on the clamping profile 33 in order to connect it to the transport device 1.

Figure 3 shows a cross-section through the entire barrier 31 and the balustrade 9 of the transport device 1 shown in Figure 1. The barrier 31 has, in addition to the clamping profile 33, the balustrade panel 45, the wedge insert 53, and the locking wedge 59, a support 75 which is provided at one end with a foot attachment region 77 and at the other end with a head attachment region 79. The head attachment region 79 is connected to the clamping profile 33 by means of attaching elements 73 arranged in the T-shaped groove 71 of the clamping profile 33. The foot attachment region 77 of the support 75 is screwed to a balustrade clamp 103 of the transport device 1, and the balustrade clamp 103 is attached to a supporting structure 101 (only its upper chord is shown) of the transport device 1. The supporting structure 101 is the load-bearing structure that accommodates all components of the transport device 1 and supports the mass thereof and its own mass in the structure 3. A glass panel 11 of the balustrade 9 is clamped in the clamping device of the balustrade clamp 103.

To enable the support 75 to be manufactured in large series rather than for a specific contract, a telescopic device 81 is arranged between the head attachment region 79 and the foot attachment region 77. The telescopic device 81 is realized by a two-part support tube, wherein the two parts of the support tube are connected to each other by a thread 83 and allow an adjustment in axial direction A. By means of the telescopic device 81, a distance X between the head attachment region 79 and the foot attachment region 77 can be fixedly adjusted so that, on the one hand, manufacturing tolerances of the supporting structure 101 can be compensated for, and on the other, the desired height  $H_A$  (see Figure 1) of the balustrade panels 45 can be adjusted.

The barrier 31 also has a connecting element 85, which is connected at one end to the support 75. The other end of the connecting element 85 is attached to the handrail guide profile 13 of the transport device 1 already mentioned above. This stabilizes the support 75 and the balustrade 9 of the transport device 1 against the forces acting transversely to the longitudinal direction L (see also Figure 1) of the barrier 31 upon the balustrade 9 and the barrier 31.

In contrast to Figure 2, the balustrade panel 45 shown in Figure 3 has two transparent plates 165 and an output device 167 (preferably an OLED screen film) arranged between these plates 165. So that the transparent panels 156 are firmly joined together even at edge regions not clamped in the clamping profile 33, the balustrade panel 45 can have an edge protection profile 163. Of course, the transparent plates 165 and the output device 167 can also be glued together with a transparent adhesive applied over the entire surface; the edge protection profile 163 may then be unnecessary. This embodiment has the advantage that the output device 167 is better protected against harsh climatic conditions and acts of vandalism. The output device 167 is connected to a connecting line 155 arranged below the balustrade panel 45 in the clamping profile 33.

Figure 4 shows an enlarged partial cross-section through a box-shaped balustrade 91 of a transport device 1 and the barrier 31 attached thereto. Box-shaped balustrades 91 have an internal metal structure 93 of metal profiles which are covered with paneling sheets 95. Such box-shaped balustrades 91, also called metal balustrades, are usually installed in heavily frequented transport devices 1 in public buildings - for example, in subway stations, train stations, and airports. Since the box-shaped balustrades 91 already have a high inherent stiffness and strength, a support 75 can be dispensed with. Instead, the

clamping profile 33 of the barrier 31 is screwed onto simple brackets 97, which are attached to the inner metal structure 93. The exemplary bracket 97 can be part of the barrier 31 or part of the box-shaped balustrade 91 of the transport device 1.

5 In contrast to the wedge insert 53 shown in Figure 2, the channel 58 of the wedge insert 53 shown in Figure 4 is arranged on the opposite side of the base leg 57. In other words, the channel 58 is arranged on that side of the base leg 57 which, given a wedge insert 53 inserted into the V-shaped groove 35 and an inserted balustrade panel 45, is directed toward the lower edge 51 of the balustrade panel 45. This embodiment has the advantage  
10 that, for example, the connecting line 155 and optionally a lighting means 151 (not shown) can be laid very easily in the V-shaped groove 35. Furthermore, no opening 54 (see Figure 2) is required, since a lighting means 151 arranged in the channel 58 can also be arranged in the region of the wedge insert 53 between the base leg 57 and the lower edge 51 of the balustrade panel 45.

15 In addition, the balustrade panel 45 is provided with a dispensing device 159 on its side facing away from the handrail 15. In the present exemplary embodiment, the output device 159 is an OLED screen film (organic light emitting diode) which is glued to the first side surface 47 of the transparent balustrade panel 45. The connectors 181 from the  
20 output device 159 to the connecting line 155 are shown only in Figure 5 and are described further below.

Furthermore, a receiving structure 171 for a sensor 173 or an output device 169 (see Figure 6) is formed in the clamping profile 33. In the present exemplary embodiment, an  
25 infrared sensor is installed in the receiving structure 171. Of course, other sensors 173 such as a laser scanner, a radar sensor, a TOF camera, a LIDAR sensor, and the like can also be installed. As indicated by the infrared light beam 174 emanating with a dash-dot line and the receiving direction 175 symbolized by the dash-double-dotted line, the receiving structure 171 aligns the installed sensor 173 with a predetermined region 16,  
30 such as the surroundings of the handrail 15. The receiving structure 171 has a passage 177 to the V-shaped groove 35 so that the sensor 173 can be connected to the connecting line 155.

Figure 5 shows a three-dimensional exploded view of a section of the barrier 31 shown in  
35 Figure 4 without the box-shaped balustrade 91 and without brackets 97. The balustrade

panel 45 is divided into panel sections 46. Adjacent panel sections 46 are mechanically tightly connected to each other on the one hand by means of panel connectors 145 and on the other by clamping in the clamping profile 33. OLED screen films that serve as output device 159 are attached to the first side surfaces 47 of the panel sections 46 by means of adhesive. Alternatively, a liquid crystal display (LCD) can also be arranged as output device 159. In this case, the panel sections 46 are preferably made of edge-lit acrylic glass that emits light via the side surfaces and can be illuminated by the lighting means 151, shown with a continuous line, in order to backlight the liquid crystal display. The lighting means 151, directed toward the lower edge 51 of the balustrade panel 45, is arranged in the V-shaped groove 35 of the clamping profile 33 and guided through the channel 58 of the wedge insert 53.

In order to enable the output device 159 to be controlled for the purpose of displaying visually perceptible content, it has connectors 181 which are connected to the connecting line 155 arranged in the V-shaped groove 35. The arrangement of the connectors 181 and the wedge inserts 53 can be matched to each other in such a way that a wedge insert 53 fits between two connectors 181.

As already mentioned, the barrier can have a processing module 161 which is connected to the connecting line 155 and accordingly to the sensor 173 (see Figure 4) and/or the output device 159 and/or the lighting means 151. The processing module 161 is designed to perform at least one of the functions described below. The processing module 161 can, for example, receive data from the sensor 173 shown in Figure 4, process, store, and/or forward it. Data can also be received, processed, and forwarded from a controller (not shown) of the transport device 1 or from sensors (not shown) installed in the transport device 1. Furthermore, data can also be received from an external monitoring system (not shown) and/or from an external data storage device (not shown). Such data are, for example, video sequences that are to be played back on the output device 159 shown in Figures 4 and 5.

The data can be processed by the processing module 161 - for example, by analyzing and evaluating sensor data and generating appropriate signals in response to the received data. This involves the use of well-known evaluation algorithms and analysis methods from the field of electronic surveillance - for example, an artificial intelligence trained through various deliberately staged situations. The processing module 161 can output a signal

based upon processed data - for example, an acoustic alarm signal via the output device 169 (loudspeaker) shown in Figure 6 and/or a visual message via the output device 159 arranged on the balustrade panel 45. The processing module 161 can also control the lighting means 151, which is installed in the barrier 31, in order to create the  
5      aforementioned situation-appropriate ambiance on the transport device 1, or to accomplish the backlighting of a print or liquid crystal display arranged as an output device 157, 159.

Figure 6 shows a larger view of the cutout B shown in Figure 2. In this embodiment, the  
10      channel 58 of the wedge insert 53 is arranged on that side of the base leg 57 which faces the groove base 37 when the wedge insert 53 is inserted into the V-shaped groove 35. This creates a wide support for the lower edge 51 of the balustrade panel 45. As mentioned above, at least one opening 54 through the base leg 57 is provided so that the light 99 emitted by the lighting means 151 can also reach the lower edge 51 of the  
15      balustrade panel 45 in the region of the wedge insert 53. The light strip used as a lighting means 151 has an integrated connecting line 155.

The clamping profile 33 also has a receiving structure 171 (not shown in Figure 2) in which a loudspeaker serving as an output device 196 is installed instead of a sensor. This  
20      is connected to another connecting line 155 arranged in the V-shaped groove 35. The passage 177 is much more clearly visible here than in Figure 4.

To facilitate the assembly of the barrier 31, the channel 58 has a positioning means 153. In the present embodiment, the positioning means 153 forms two chamfers with a  
25      chamfer angle  $\gamma$ , which are configured on the two edges of the opening 158 of the channel 58. The positioning means 153 is adapted with its dimensions to a contour or cross-section 56 of the lighting means 151 and/or the connecting line 155 such that it positions the lighting means 151 transversely to the longitudinal direction L (see Figure 1) of the clamping profile 33 in the channel 58 during and after assembly of the barrier 31. The  
30      shown positioning means 153 represents only one of many different possibilities for positioning the lighting means 151 and/or the connecting line 155 in the channel 58. Noses, projections, grooves, roundings at the opening 158, and the like can also be used as positioning means 153, provided they are matched to the lighting means 151 or the connecting line 155 provided for installation.

Figure 7 shows a possible installation method for a barrier 31, according to the invention, of the aforementioned type. The sequence of steps does not necessarily have to be followed, so that other, sensible sequences of these steps are also included in the scope of protection. Reference is made here in particular to the explanations regarding Figure 5, which may require an adjustment of the step sequence.

In step S1 of the assembly method, the clamping profile 33 is firmly connected to the transport device 1 by supports 75, connecting elements 85, or brackets 97 (see Figures 3 and 4). In addition, a connecting line 155 designed as a flat cable is laid in the V-shaped groove 35. The connecting line 155 has connectors 181 designed as contact fingers.

In a further step S2, the wedge insert 53 or a plurality of wedge inserts 53 are inserted into the V-shaped groove 35 so that the base leg 57 of the respective wedge insert 53 lies on the groove base 37 of the V-shaped groove 35. In so doing, the connecting line 155 is "automatically" positioned and fixed in the channel 58 of the wedge insert 53 by the positioning means 153 described in Figure 7.

In a further step S3, a first sealing profile 65 is attached above the wedge leg 55 of the wedge insert 53 or of the plurality of wedge inserts 53 to the fastening structure 69 provided therefor.

In a further step S4, a balustrade panel 45 or plurality of panel sections 46 are inserted into the V-shaped groove 35 so that its lower edge 51 lies on the base leg 57 of the wedge insert 53, and the wedge leg 55 is arranged between the first groove surface 39 of the V-shaped groove 35 and the first side surface 47 of the balustrade panel 45. The balustrade panel 45, which is designed as described above with reference to Figure 3, has an integrated output device 167. The output device 167 contacts the connectors 181 when inserting the balustrade panel 45. Of course, other variants of connectors 181 can also be used - for example, by connecting the output device 167 to the connecting line 155 before inserting the balustrade panel 45.

In a further step S5, one or more clamping wedges 59 are arranged and pressed in between the second side surface 49 of the balustrade panel 45 and the second groove surface 41.

In a further step S6, a second sealing profile 67 is attached above the clamping wedge 59, or the plurality of clamping wedges 59 are attached to the fastening structure 69 provided for this purpose.

5       The aforementioned steps S1 to S6 can also be part of a method for modernizing an existing transport device 1, in which this transport device 1 is equipped with a barrier 31 according to the invention.

10       Although transport devices 1 configured as escalators are shown in Figure 1, it is obvious that the barrier 31 and the associated method can also be used for moving walkways. In addition, two opposing channels 58 can also be formed in the base leg 57 of the wedge insert 53. Furthermore, it is also possible for a plurality of receiving structures 171 to be arranged in the longitudinal direction L of the clamping profile 33, and for these to be alternately equipped with a sensor 173 or with an output device 169. The output devices  
15       169 installed in the receiving structures 171 do not necessarily have to be loudspeakers, but can also be lighting means or a combination of loudspeakers and lighting means which are activated by the processing module 161 according to the evaluated sensor signals of the sensors 173.

20       Finally, it should be noted that terms such as "having," "comprising," etc., do not preclude other elements or steps, and terms such as "a" or "one" do not preclude a plurality. Furthermore, it should be noted that features or steps which have been described with reference to one of the above exemplary embodiments may also be used in combination with other features or steps of other exemplary embodiments described  
25       above. Reference signs in the claims should not be considered to be limiting.

## Claims

1. A barrier (31) to protect users from falling from a transport device (1) that is configured as an escalator or moving walkway, which barrier (31) is configured to be installed on the transport device (1) next to a circulating, movable handrail (15) on a balustrade (9) of the transport device (1), wherein, in the installed state, the barrier (31) extends parallel to the handrail (15), and projects at a height ( $H_A$ ) beyond the balustrade (9) or the handrail (15), and wherein the barrier (31) has:

- a clamping profile (33) with a V-shaped groove (35) that extends therein in the longitudinal direction (L) of the clamping profile (33), wherein the V-shaped groove (35) is bounded by a groove base (37) and two groove surfaces (39, 41), and the groove surfaces (39, 41) are arranged at an opening angle to each other from the groove base (37) toward a groove opening (43);
- a balustrade panel (45) which has two parallel side surfaces (47, 49) and a lower edge (51), and in the region of its lower edge (51) is arranged in the V-shaped groove (35);
- a clamping wedge (59) designed with a wedge-shaped cross-section and arranged between the second side surface (49) of the balustrade panel (45) and the second groove surface (41),

**characterized in that** the barrier (31) further has:

- an L-shaped wedge insert (53) with a wedge leg (55) and with a base leg (57), wherein the wedge leg (55) has a wedge-shaped cross-section and is arranged between the first side surface (47) of the balustrade panel (45) and the first groove surface (39), and the base leg (57) is arranged between the lower edge (51) of the balustrade panel (45) and the groove base (37), and a channel (58) is formed in the base leg (57) and extends parallel to the V-shaped groove (35); and
- at least one sensor (173) and/or an output device (157, 159, 167, 169) for visual, acoustic, or audiovisual outputs, as well as at least one connecting line (155) for the sensor (173) or the output device (157, 159, 167, 169), wherein the connecting line (155) is arranged in the V-shaped groove (35) and is guided through the channel (58) of the wedge insert (53).

2. The barrier (31) according to claim 1, wherein a receiving structure (171) for the sensor (173) or the output device (169) is formed in the clamping profile (33), and

wherein the receiving structure (171) is designed to align the installed sensor (173) or the installed output device (169) with a predetermined region (16).

3. The barrier (31) according to claim 2, wherein the sensor (173) or the output device (169) is arranged in the receiving structure (171) and is connected to the connecting line (155).

4. The barrier (31) according to any of claims 1 to 3, wherein the balustrade panel (45) is provided with an OLED screen film serving as an output device (159, 167), and the OLED screen film is connected to the connecting line (155).

5. The barrier (31) according to any of claims 1 to 3, wherein the balustrade panel (45) is made of transparent material and is provided with a semi-transparent coating serving as a output device (157), wherein a lighting means (151) directed toward the lower edge of the balustrade panel (45) is arranged in the V-shaped groove (35) and is guided through the channel (58) of the wedge insert (53), and the lighting means (151) is connected to the connecting line (155).

6. The barrier (31) according to any of claims 1 to 3, wherein the balustrade panel (45) is made of transparent, edge-lit acrylic glass that emits light via the side surfaces and is provided with a liquid crystal display serving as an output device (159), wherein a lighting means (151) directed toward the lower edge (51) of the balustrade panel (45) is arranged in the V-shaped groove (35) and is guided through the channel (58) of the wedge insert (53), and the lighting means (151) and the output device (159) are connected to the connecting line (155).

7. The barrier (31) according to any of claims 1 to 6, wherein it has a processing module (161) which is connected to the connecting line (155) and is designed to perform at least one of the following functions: receiving data; processing data; outputting a signal based upon processed data; controlling a lighting means (151); controlling an output device (159, 167, 169).

8. The barrier (31) according to claim 5 or 6, wherein the channel (58) has a positioning means (153) which is matched to the lighting means (151) and/or the connecting line (155) and positions the lighting means (151) or the connecting line (155)

transversely to the longitudinal direction (L) of the clamping profile (33) in the channel (58) during and after assembly of the barrier (31).

9. The barrier (31) according to any of claims 1 to 8, wherein the channel (58) is arranged on the side of the base leg (57) which, when the wedge insert (53) is inserted into the V-shaped groove (35), is directed toward the groove base (37), and wherein at least one opening (54) through the base leg (57) is provided.

10. The barrier (31) according to any of claims 1 to 9, wherein the channel (58) is arranged on the side of the base leg (57) which, when the wedge insert (53) is inserted into the V-shaped groove (35) and the balustrade panel (45) is inserted, is directed toward the lower edge (51) of the balustrade panel (45).

11. The barrier (31) according to any of claims 1 to 10, wherein fastening structures (69) for an elastic sealing profile (65) are formed on both sides at the groove opening (43) of the V-shaped groove (35).

12. The barrier (31) according to any of claims 1 to 11, wherein it has a support (75) which is provided at one end with a foot attachment region (77) and at the other end with a head attachment region (79), wherein the head attachment region (79) is connected to the clamping profile (33) by means of fastening means (73), and the foot attachment region (77) is provided to be attached to a supporting structure (101) of a transport device (1).

13. A transport device (1) that is configured as an escalator or moving walkway, with a circulating conveyor belt (5), **characterized by** at least one barrier (31) according to any of claims 1 to 12, which barrier (31) is installed on the transport device (1) next to a circulating, movable handrail (15) on a balustrade (9) of the transport device (1), wherein, in the installed state, the barrier (31) extends parallel to the balustrade (9), and, at a height ( $H_A$ ), projects beyond the balustrade (9) or the handrail (15), and wherein the barrier (31) is arranged on the side, facing away from the conveyor belt (5), of the handrail (15).

14. A method for modernizing a transport device that is configured as an escalator or moving walkway, **characterized in that** an existing transport device is equipped with a barrier according to any of claims 1 to 12.

15. An installation method for a barrier (31) according to any of claims 1 to 12,  
**characterized in that** the installation method comprises at least the following steps:

- arranging a connecting line (155) and, if provided, a lighting means (151) in the V-shaped groove (35);
- 5       • inserting the wedge insert (53) into the V-shaped groove (35) so that the base leg (57) of the wedge insert (53) rests on the groove base (37) of the V-shaped groove (35), wherein the connecting line (155) and, if provided, a lighting means (151) is guided through the channel (58) of the wedge insert (53);
- 10       • inserting the balustrade panel (45) into the V-shaped groove (35) so that its lower edge (51) lies on the base leg (57) of the wedge insert (53), and the wedge leg (55) is arranged between the first groove surface (39) of the V-shaped groove (35) and the first side surface (47) of the balustrade panel (45); and
- arranging and pressing in the clamping wedge (59) between the second side surface (49) of the balustrade panel (45) and the second groove surface (41).