

PERSON CONVEYING DEVICE, IN PARTICULAR ESCALATOR OR MOVING SIDEWALK, COMPRISING A HANDRAIL, AND HANDRAIL FOR AN ESCALATOR OR A MOVING WALKWAY

The invention relates to a person conveying device in the form of an escalator or a moving walkway. The person conveying device is equipped with a handrail or two handrails.

By "handrail" there is understood a device at a balustrade arranged at (one or) both sides of the escalator or moving walkway. A handrail strip or grip strip is guided along this balustrade and, in particular, at the same speed at which the escalator or moving walkways moves. The grip strip thereby offers support or a handhold for a person located on the conveying device or getting on or off this.

As essential component of a person conveying device - public facilities such as, for example, railway stations or department stores come to mind - a handrail has to fulfil not only a high level of functional capability, but also high safety demands. Known handrails consist of endless rubber belts in which steel strands or steel wires are vulcanised in place.

A handrail usually comprises traction means with the help of which it is drawn through a guide by a drive. The guide runs along a balustrade arranged at (one or) both sides of the escalator or moving walkway. The traction means, but also the handrail itself, has to be flexible or consist of elements so that circulation, in the manner of an escalator, around the balustrade can be described. This circulation is composed of various curves and semicircles or semi-ellipses as well as looping of drive wheels.

CH 557295, which defines the category, discloses a handrail formed from U-shaped segments which are driven by way of a chain. The chain here forms the traction means constructed as traction carrier. The individual segments of the handrail are merely placed on the chain, wherein in each instance a chain element comes to lie in a corresponding recess of a segment. Guidance is achieved in that a U-shaped carrier profile member, at which a rail or guide rail is arranged, is connected with the balustrade. The transport chain or the chain travels or rolls on this rail or guide rail. This rail consists of a resilient plastics material. Guidance of the segments is thus effected here directly by way of the chain. Pulling of the segments of the handrail off the chain is prevented in that the inner sides of the U-shaped carrier profile member have webs at which lateral guides are fastened.

Provided below the lateral guides are angled ends of the U-shaped segments which enter into a restraining safety position at or into contact with the lateral guides if anybody endeavours to pull off the segments in upward direction.

It is disadvantageous with this handrail arrangement that this special construction of the chain guide as well as the lateral guide has the consequence of a diminished guidance capability. In normal operation, when the U-shaped segments are loaded in downward direction, guidance takes place by way of the chain and the guide rail, but in the converse case, when the segments are loaded in upward direction, by way of the too-small lateral guides and the angled ends of the U-shaped segments themselves. Due to inevitable production tolerances the U-shaped segments can lift off to a substantial degree or move upwardly by clearly perceptible amount, which generates a sense of insecurity in many passengers.

Proceeding from CH 557295 the object is set of creating a person conveying device with a handrail which does not have the described disadvantages. A handrail should be created which is, in addition, of more economic and simpler construction and is improved ergonomically and in terms of gripping. Moreover, the handrail should maintain specific safety demands and surpass new convenience requirements for users.

The inventor recognised that the guide surfaces, which according to CH 557295 are formed between the balustrade upper side and the traction means or traction carrier, make no contribution to running smoothness. Consequently, new guide surfaces, protected against dirt and dust, were incorporated in reverse in the grip strip. In accordance with the invention guidance of the handrail is thereby integrated in the grip strip. Moreover, the handrail is constructed from only two individual parts, namely a grip strip and a traction means, which impart and enable a stable guidance by way thereof.

The grip strip can, for example, be injection-moulded. In this connection it can be injection-moulded or cast from a plastics material, which enables production - in its longitudinal direction - not only from individual segments, but also from a single piece. In this construction the traction means has to be extremely flexible and enable easy deflection. Coming into consideration in this regard is a form of manufacture which is already connected at the factory at its seam position and is delivered as a finished grip-strip ring to the assembly site. However, also coming into consideration is manufacture at

the outset of a ring and not an open grip-strip band having to be later closed to form a grip-strip ring. In addition, however, assembly on site also comes into question, for example by means of an overlapping connection which does not protrude and which ensures a smooth connecting point. The latter is required particularly on the grip-strip upper side so that there is no risk of injury to persons being transported.

The grip strip can - as seen in its cross-section - be made from a single material as a solid or semi-solid or hollow or, however, also partly hollow profile member braced by webs. In this connection, the selected material represents a merging or fusion of advantageous characteristics so as to simultaneously fulfil the required or desired or objective material requirements as satisfactorily as possible.

In the case of a longitudinally integral design variant the material has to be flexible in order to be able to describe the bends and curves of the circulation. At the same time, however, it also has to be supple so that the bends and the alternating loading in bending do not cause cracks. In the case of a roller drive the material has to have a sufficient rubbing strength which withstands the thrust of the driving roller/rollers. The guide surfaces must be wear-resistant, abrasion-resistant and hard and have good sliding properties. The grip surface has to be haptically pleasant and allow secure gripping.

A preferred embodiment of a grip strip according to the invention thus envisages better satisfaction of the partly contradictory material demands in that a grip strip was created which is indeed of integral construction in its cross-section as before, but consists of a material compound with two, three or more materials. This can be, for example, two or three different kinds or variants of plastics material which are so injection-moulded in a common injection-moulding method that, for example, the guide surfaces consist of a highly abrasion-resistant plastics material with very good sliding capability and the remaining cross-sectional profile of the grip strip is formed from a flexible and haptically pleasant plastics material. Suitable as a wear-resistant plastics material compatible with sliding is, inter alia, PAS®-LXY of the company Faigle of Hard, Austria. However, PTFE or Teflon or polytetrafluoroethylene or POM-PTFE 18 Silc2, PA6.6 PTFE 18 Silc2, PA6-PTFE 13 Silc2, PA6.6 PTFE20, PA12 PTFE 18 Silc2, PPS PTFE15 GF30, PAI PTFE20, PPSO PTFE20, PPSU PTFE20, PPE PTFE18, POM-PTFE 18, POM-PTFE 20, POM PTFE25, etc., are also suitable. In general, it is preferred in accordance with the invention to make use of a material having a coefficient of friction in a range of 0.05 to 0.35, preferably 0.10

to 0.15. In general, use is preferably made of Teflon plastics material or polytetrafluoroethylene plastics material and/or NANO slide lacquers or NANO slide synthetic materials or NANO slide parts or NANO slide particles.

A further preferred embodiment of a grip strip according to the invention provides a material compound of three or more different materials. In this regard, the guide surfaces can consist of a Teflon slide material as described above, but the base body region of the grip strip of a material which optimally fulfils the structural demands (reverse bending properties, tensile strength) and the circumferential region or cover region of the grip strip again of a soft and haptically pleasant material. The grip-strip base body region is preferably made of a plastics material having a bending strength in a range of 30 to 185 N/mm², preferably 50 to 95 N/mm², values of 15 to 30 N/mm² also being conceivable.

With respect to the material properties of the cover region of a grip strip according to the invention selection is made of haptically pleasant materials, preferably material with soft-touch surfaces and/or foam skin surfaces. This means on the one hand that the tactile sensation on contact does not generate any excessive stimuli. This concerns, for example, roughness, hand slide characteristics, temperature and thermal conductivity, but, also the capability of absorbing moisture and grease. On the other hand, however, the cover region of the grip strip must satisfy safety demands. Relevant in this connection are, in particular, flame protection characteristics or fire protection characteristics and slip characteristics of the material. If the material is too slippery, then there is too little grip in the inclined part of the escalator. If, thereagainst, it is too slip-resistant, then risks of accident and handling problems are involved, for example with articles of clothing or pieces of luggage sticking thereto. The grip-strip cover layer is preferably made of a different plastics material having a roughness in a range of 0.4 to 8 microns, preferably 2 microns, and/or a specific thermal conductivity λ in a range of 0.05 to 0.5 W/mK, preferably 0.2 to 0.3 W/mK.

In principle, the following materials can be considered for a grip strip according to the invention: plastics materials such as, for example: PA (polyamide), PA6 (Perlon®), POM (polyoxymethylene, e.g. Delrin®), PEEK (polyetheretherketone), PAS (polyarylenesulfide), PE (polyethylene), PUR (polyurethane), PP (polypropylene), PVDF (polyvinylidene fluoride), PTFE (polytetrafluoroethylene); natural fibres or fibre compounds or GRP (glassfibre-reinforced plastic) or CRP (carbonfibre-reinforced plastic) or press

cement or fibre matrix or Polytron or prepregs (pre-impregnated fibres) or injection-moulded ceramic or hemp cement or recycled material or combinations of the listed materials.

Moreover, it is envisaged to construct a grip strip according to the invention, whether it consists of only one material or a material compound, from fireproof or 'self-extinguishing' materials. Coming into consideration is PAS-PVDF of the company Faigle of Hard, Austria, or here, in particular, a plastics material of the name Wytex® of the company Monahan Filaments of Middlebury, Vermont, USA.

The materials of the grip strip - all three materials or, in particular, the material of the cover layer - can additionally in accordance with the invention fulfil the following subsidiary objectives:

- prevention of static electricity,
- noise insulation,
- cold and heat insulation,
- maintenance of hygienic measures or hygiene requirements, with respect to good cleaning and keeping clean, but also the possibility of disinfecting and possible penetration of the material by nano-silver particles, and, in addition, a selective making reflective or chroming or metallisation of the cover material.

The cross-sectional profile of a grip strip according to the invention can be of ergonomically improved construction in that, for example, convexities and depressions adapt better to a resting hand surface and, for example, to the enclosing thumb. A preferred embodiment envisages offering enhanced gripping possibility for children in that a strip of smaller diameter and better grippable from below is integrated in the grip strip.

The surface of the grip strip can be constructed to be rough, smooth, corrugated or knurled. Moreover, it can be coated, painted or coloured or constructed as a PVD surface ('Physical Vapour Deposition' = physical gas-phase deposition), as a metallised (for example, vapour-deposited with chromium) surface, or as a DLC ('Diamond-like Carbon' = diamond-like protective layer of carbon) or plasma surface or nano surface.

In addition, in accordance with a further preferred embodiment of a handrail according to

the invention the surface has guide flutes in the form of grooves into which corresponding mating guides or flanges or lateral guides on the rollers fit. A person conveying device according to the invention thus comprises, in a preferred embodiment, a handrail circulation which is guided at the balustrade upper side by the mechanically positive interengagement of mutually complementary guide surfaces, but the handrail is supported at the underside of the balustrade by rollers. At least one of these rollers is designed as a guiding roller. The drive of the handrail can take place by way of one or more wheels. Apart from guiding rollers or rollers, however, other return guides are also conceivable and in addition not only - as similarly described - at the balustrade underside itself, but also in a base region of the balustrade or thereunder, recessed in the region of the support structure or framework of the escalator or moving walkway.

With regard to guidance of the handrail strip / grip strip at the balustrade upper side, as already mentioned mechanically positively interengaging and complementary guide surfaces are formed in accordance with the invention at the balustrade upper side and at the grip strip. This means that the balustrade upper side itself is, in a minimalistic version, constructed as a rectangle having three guide surfaces. The then - correspondingly - also only three complementary guide surfaces of the grip strip so enclose the balustrade that the grip strip lies on the upper surface of the balustrade and the lateral surfaces give lateral guidance support.

A preferred embodiment of a handrail guide according to the invention, however, provides that the grip strip cannot be laterally displaced by means of application of force (against the flange of the guiding roller or roller). For this purpose, further guide surfaces are provided which interengage in the manner of a groove-and-key connection.

According to the invention it is also possible to provide a handrail guide which has guide surfaces, which are vertically supporting as well, only at the side surfaces of the balustrade. This embodiment has, in particular, the advantage that an intermediate space can be left between the grip-strip lower side and the balustrade upper side, so that the speed of circulation of the handrail cannot reduce if, for example, a person supports themselves firmly or places a heavy item of luggage thereon.

A further preferred embodiment of a handrail guide according to the invention provides, in order to avoid reductions in speed due to increased coefficients of friction, small rollers or

needle bearings or needle-roller flat belts or cylinder-roller flat belts in the guide surfaces.

The afore-described embodiments of handrail strips according to the invention disclosed a construction of the balustrade upper side itself with guide surfaces. However, it is also conceivable to form the balustrade upper side without guide surfaces and to mount a guide rail thereon.

Regardless of whether the balustrade upper side itself is furnished with guide surfaces or a guide rail is mounted thereon the cross-sectional profile of the guide surfaces at the balustrade upper side can be positive or negative. The cross-sectional profile of the guide surfaces at the grip-strip lower side is respectively complementary therewith. The fact that the guide, by contrast to conventional handrail attachments, can also be formed negatively in the balustrade and positively directly in the grip strip opens up the possibility of striving for improved, more secure guides which according to need and the materials employed involve less risk of catching.

A handrail strip according to the invention can, as already explained above, consist longitudinally of one piece or of several segments. In the case of an embodiment with individual segments it is possible to provide the intermediate spaces, which part at the curves or deflection of the handrail strip, with a flexible and reversibly extensible casing. However, a combination of flexible segments together with the flexible and reversibly extensible casing represents a further preferred embodiment. It offers the advantage that the flexibility of the segments does not have to be as high as in the case of the integral grip strip variant without a casing, but at the same time the casing, due to the flexibility of the segments, does not have to cover such widely gaping intermediate spaces.

In accordance with a preferred embodiment of a handrail according to the invention this flexible and reversibly extensible casing is made of a non-combustible material. For this purpose, as already explained above for the grip strip itself (without casing), use is preferably made of the synthetic material Wytex® of the company Monahan Filaments of Middlebury, Vermont, USA. The flame-retardant synthetic materials Wytex® FR-H and Wytex 6, in particular, do not contain any halogens or phosphorous. These synthetic materials have all advantageous stiffness and strength characteristics of Nylon or polyamide and, in addition, the advantage of a very low toxicity, acidity and smoke optical density. Moreover, the material is self-extinguishing and fireproof and fire-retardant. The

inflammability corresponds, in the test of Underwriters Laboratories UL 94, at 0.75 mm thickness with the class V0 (stated as V-zero). This simply means that a sample of the stated material thickness is fixed vertically and after exposure to an open flame self-extinguishes within less than 10 seconds. Self-extinguishing is thus proven and extreme fire-retardation is given.

In addition, these synthetic materials have marked electrical insulation properties whilst maintaining high mechanical strength. The principal features of the basic material are as follows:

- density 1.16 kg/dm³
- impact toughness according to Izod 40 J/m²
- tear/stretch strength 75 N/mm²
- specific elongation 10%
- bending strength 95 N/mm²
- modulus of elasticity 2300 N/mm²
- creep current strength > 600 V
- deformation temperature 190 degrees Celsius
- oxygen index 34%
- inflammability rate according to UL 94 at 0.75 mm corresponds with V0
- toxicity index 38
- smoke optical density 75 (F) / 50 (NF) Dm
- acidity of the smoke 8 pH.

Reference is expressly made to a possible capability of combining the teaching of this application with the teaching of an application filed at the same time by the same applicant (handrail for an escalator or a moving walkway. A handrail with material properties and safety characteristics improved even further or to greater extent, or more or multiply improved, is disclosed there.

Further or advantageous embodiments of the person conveying device according to the invention or the correspondingly designed handrail form the subject matter of the dependent claims.

The invention is explained in more detail symbolically and by way of example on the basis of figures.

The figures are described conjunctively and generally. The same reference numerals signify the same components and reference numerals with different indices indicate functionally equivalent or similar components.

In that case:

Fig. 1 shows a schematic illustration of a person conveying device according to the invention;

Fig. 2 shows a sectional illustration along the section axis A-A of Fig. 1 of a handrail according to the invention as well as the assembly and installation of the handrail;

Fig. 3 shows a guide of the grip strip by means of guide rollers;

Fig. 4 shows further preferred forms of the grip strip and

Fig. 5 shows a schematic illustration of the segment gap change in the curve or handrail curve.

An escalator is shown in Fig. 1 by way of example for a person conveying device 1 from a highly schematic side view. It conveys persons from a level E1 to a level E2 or conversely. For this purpose it has a substructure consisting of a circulation for individual steps 22 and a superstructure formed substantially from a handrail 2 around a balustrade 6. The handrail 2 is thereby in a position of accompanying an upward and downward movement of the steps 22 in that a grip strip 3 runs along a balustrade upper side 7 in a guide 4 or handrail guide 4 by means of guide surfaces 5 formed at a grip-strip lower side 10. The grip strip 3 is deflected at a balustrade lower side 19 by, for example, rollers 20a-20c, 21. The return guide of the grip strip 3 is illustrated here by optional rollers at the balustrade lower side. The roller 21 is constructed as a guiding roller to be adjustable in accordance with an adjusting device 23, which is indicated by means of a double arrow. A drive 8 formed from two opposite rollers, of which at least one is driving, rotates the grip strip 3 in the circulation path, which is formed from the guide 4 and the rollers 20a-20f and 21, respectively in upward or downward transport direction in or against clockwise sense. A section axis A-A is taken through the upper part of the handrail 2 as well as the grip strip

3 and the guide 4 or handrail guide 4.

Fig. 2 schematically shows, as a sectional illustration according to the section axis A-A of Fig. 1, how a guide 4 or handrail guide 4 can be constructed in accordance with the invention, namely in that the balustrade 6c at its balustrade upper side 7 forms a positive cross-sectional profile 15a in the shape of guide surfaces 5a-5e. The grip strip 3 or 3c is drawn by way of traction means 9c in a longitudinal direction 14 into or out of the plane of the sheet. The grip strip 3, 3c forms, by means of guide surfaces 11a-11g, a negative cross-sectional profile 15b. The balustrade can be constructed to be solid, but it can also be hollow or consist only of a vertically disposed plate or sheet or panel or infill panel or panel wall, on the upper edge of which the cross-sectional profile member 15a is seated. The traction means can be of various forms of construction, for example: belt, support belt, chain, aramide belt, cogged belt, poly-V-belt, herringbone-cogged belt, transport chain, etc.

In addition, Fig. 2, or generally described Figures 2a to 2c, shows a handrail 2c or grip strip 3c in cross-section, according to section axis A-A. Arranged on the balustrade 6c is a guide profile member 24 received in the guide 4. The traction means 9c is integrated in the grip strip 3c by means of a receptacle 32 formed for that purpose. The grip strip 3c has optional upper bracing 27a and 27b and lower bracing 28a and 28b and spaces 29a to 29d or cavities. Moreover, two grooves 25a and 25b, the function of which is discussed in the following figure, can be optionally formed at the upper side of the grip strip 3c. The grip strip 3c can be pushed or pulled onto the guide profile member 24 in longitudinal direction 14. Figure 2c illustrates how the traction means 9c can be easily and simply accommodated in the grip strip 3c. The receptacles 32 receive the traction means 9c and accommodate it permanently.

Fig. 3 shows, or Figures 3a and 3b show, the purpose for which the upper side of the grip strip 3c has two longitudinally extending grooves 25a and 25b. In the return guidance of the handrail, thus along the lower side of the balustrade (the grip strip 3c is illustrated in mirror image or turned through 180 degrees 'on its head') a handrail according to the invention can be guided by, in particular, guide rollers 20 or guiding rollers 20 and/or also driven. Corresponding flanges or lateral guides 26a and 26b engage in the grooves 25a and 25b for better lateral guidance and stability, but also for increasing the contact area.

Fig. 4 shows, or Figures 4a and 4b show, additional optional forms of a handrail 2d or 2e, the grip strips 3d and 3e having special, differently usable cross-sectional profiles. Shown in Fig. 4a is a grip strip 3d which also has in cross-section the upper bracing 27a and 27b and lower bracing 28a and 28b or the spaces 29a to 29d or cavities illustrated in Fig. 2, but in addition in the upper region a doubly-reinforced structure and/or double-walled structure with supplementary compartments 30. This embodiment according to the invention brings advantages with respect to stability and material pairings, but also with respect to insulation and damping as well as improved haptics and enhanced grippability. Fig. 4b shows, by way of example, a bulge 31 or convexity 31 or child handgrip 31 which is preferably arranged at the inner side of the balustrade 6c and which shall, for example, make it possible for children to find a more secure and better grip or hold or holding knob on the hand strip or grip strip.

Fig. 5 shows the tilt change of the individual handrail segments of the grip strip 3c of the handrail 2c in the handrail deflection region or in the handrail curve. The deviation in angle over the deflection curve of the handrail segments allows a movement change or change in spacing of at most 1.5 mm to 2 mm, i.e. the segment gap change is at most 1.5 mm to 2 mm and the overlap region of the segments is sufficiently dimensioned at 3 mm to 5 mm. Moreover, no form of air gap or opening gap arises, so that there is no risk of being caught or pinched. The traction means 9c is of such flexible or resilient or articulated construction that a change in angle or spacing in the curve region or deflection region is possible easily, readily and simply. The necessary fixing or fastening of the individual handrail segments of the grip strip 3c on or with the traction means 9c is very satisfactorily provided by the receptacle 32. An additional securing of the handrail segments would be possible and conceivable, but can be omitted.

Patent claims

1. Person conveying device (1), particularly an escalator or a moving walkway, comprising a drivable handrail (2), a grip strip (3), a guide (4) with guide surfaces (5) at a balustrade upper side (7), and a drive (8) which moves the handrail (2) along the guide (4) by a traction means (9), wherein the traction means (9, 9a, 9b) comprises at least one traction carrier (12) exchangeably arranged in the grip strip (3), characterised in that guide surfaces (11a-11g) complementary with the guide surfaces (5a-5e) at the balustrade upper side (7) are formed in the interior of the grip strip (3) and that the traction carrier (12) is mechanically positively fitted in place and/or pressed into place and/or glued in place and/or screwed in place and/or integrated in place in a corresponding recess (13) of the grip strip (3).
2. Person conveying device (1) according to claim 1, characterised in that the grip strip (3) is of integral construction along its rolling circumference in a longitudinal direction (14).
3. Person conveying device (1) according to one of claims 1 and 2, characterised in that the grip strip (3) is of multi-piece and/or multi-part construction in the longitudinal direction (14) and/or consists of individual segments.
4. Person conveying device (1) according to any one of the preceding claims, characterised in that a cross-sectional profile (15c) of the guide surfaces (5f-5m) at the balustrade upper side (7) is of negative form and a cross-sectional profile (15d) of the complementary guide surfaces (11h-11n) at the grip-strip lower side (10) is of positive form.
5. Person conveying device (1) according to claim 4, characterised in that rollers and/or needle bearings and/or needle-roller flat belts and/or cylinder-roller flat belts are arranged at the guide surfaces (5f-5m) at the balustrade upper side (7).

6. Person conveying device (1) according to any one of the preceding claims 1 to 5, characterised in that the grip strip (3) consists of a two-material compound, wherein a grip-strip guide part (16) is formed from a plastics material having a coefficient of friction in a range of 0.05 to 0.35, preferably 0.10 to 0.15, and a grip-strip base region (17) is formed from a plastics material having a bending strength in a range of 30 to 185 N/mm², preferably 50 to 95 N/mm².

7. Person conveying device (1) according to any one of the preceding claims, characterised in that the grip strip (3) consists of a multi-material compound,
 - wherein the grip-strip guide part (16) is formed from a plastics material having a coefficient of friction in a range of 0.05 to 0.35, preferably 0.10 to 0.15,
 - the grip-strip circumferential region (17) is formed from a plastics material having a bending strength in a range of 30 to 185 N/mm², preferably 50 to 95 N/mm², and
 - preferably a grip-strip cover layer (18) is formed from a plastics material having a roughness in a range of 0.4 to 8 µm, preferably 2 µm, and a specific thermal conductivity λ in a range of 0.05 to 0.5 W/mK, preferably 0.2 to 0.3 W/mK.

8. Handrail (2) for an escalator or a moving walkway comprising a grip strip (3), a guide (4) with guide surfaces (5) at a balustrade upper side (7), and a drive (8) which pulls and/or moves the handrail (2) along the guide (4) by a traction means (9), wherein the traction means (9, 9a, 9b) comprises at least one traction carrier (12) exchangeably arranged in the grip strip (3), characterised in that guide surfaces (11a-11g) complementary with the guide surfaces (5a-5e) at the balustrade upper side (7) are formed in the interior of the grip strip (3) and that the traction carrier (12) is mechanically positively fitted in place and/or pressed in place and/or glued in place and/or screwed in place and/or integrated in place in a corresponding recess (13) of a grip strip (3).

9. Handrail (2) according to claim 8, characterised in that the grip strip (3) is of integral construction along its rolling circumference in its longitudinal direction (14).