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(54) **STEP FOR AN ESCALATOR AND ESCALATOR WITH AT LEAST ON SUCH STEP**

(57) The invention refers to a step (1) for an escalator, comprising a tread (2) with a tread front edge (2.1), a tread rear edge (2.2) and two tread side edges (2.3, 2.4), a riser (3) extending downwards from the tread front edge (2.1), having at least a curved area (3.1) and a riser lower edge (3.2), two side frames (4) forming a step roller axle (6) and a c-hole (5) for connecting the step (1) to a step chain, a first rib (8.1) extending between the c-holes (5) and at least one second rib (8.2) extending between the first rib (8.1) and the tread front edge (2.1) or the riser lower edge (3.2) and third ribs (8.3), wherein the side frames (4) are formed from an arm (4.1), a pillar (4.2) and a rib connection (4.3). The invention further refers to an Escalator with at least one such step (1).

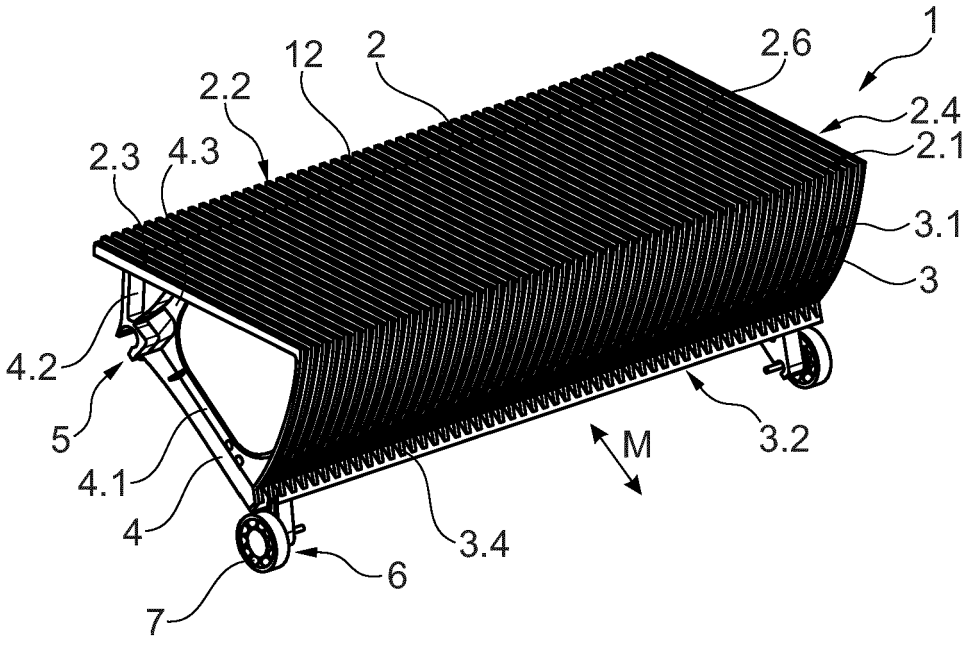

Fig. 1

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Description

Field of the invention

[0001] The present disclosure generally relates to a step for an escalator, comprising a tread with a tread front edge, a tread rear edge and two tread side edges adverse each other, a riser extending downwards from the tread front edge, having at least a curved area and a riser lower edge and side frames below each tread side edge forming a step roller axle below the riser lower edge and a c-hole for connecting the step to a step chain below the tread rear edge. The present disclosure further relates to an escalator with at least one such step.

Background of the invention

[0002] Such escalators, which are moving staircases for carrying people e.g. between floors of a building or structure, are well known from the state of the art and typically comprises a lower transition area at the lower end of the escalator, an upper transition area at the upper end of the escalator and a transporting area in between the lower and the upper transition area. Steps of the escalator are running through those areas, form stairs on an upper side of the transporting area and are turned around in the transition areas. The steps are typically guided on rails by a step chain and two step rollers. In this case, the step is connected to the step chain of the escalator in the area of a step chain roller and is also guided laterally there. Typically, the step rollers run on flat rails without additional lateral guidance.

[0003] Said steps, which are mostly produced by casting processes, have a complex geometry and are therefore of rather high cost in production, wherein costs for production of the steps are critical to the costs of production of the escalator due to the number of steps installed in the escalator. Therefore a high need exists to reduce costs for production of the steps and to thus design the steps in a way which allows low cost production at high quality standards. In particular for a step produced by casting, costs may be reduced by a design which is easy to cast and needs non or at least as little as possible further machining after the casting process like e.g. drilling, boring, deburring, reaming, milling, cutting or the like.

[0004] Further, said steps need to fulfil high mechanical needs, e.g. run in the escalator without any deformation due to the weight of passengers or luggage of any kind and/or by being moved in the escalator. They also need to fulfill high needs regarding precision to assure smooth running and also further need regarding safety, in particular regarding safety regulations.

Description of the invention

[0005] Thus, an object of the invention is to provide a step for an escalator, which is of a low cost design, in particular needs as little machining after casting as possible and fulfills mechanical, precision and safety needs.

[0006] This object is solved by the features of the independent claims. Advantageous embodiments are indicated in the dependent claims. Where technically possible, the features of the dependent claims may be combined as desired with the features of the independent claims and/or other dependent claims.

[0007] In particular, the object is solved by a step for an escalator, comprising a tread with a tread front edge, a tread rear edge and two tread side edges adverse each other, a riser extending downwards from the tread front edge, having at least a curved area and a riser lower edge, two side frames below each tread side edge forming a step roller axle below the riser lower edge and a c-hole for connecting the step to a step chain below the tread rear edge, a first rib extending between the c-holes of the two side frames and protruding downwards from a lower tread surface, at least one second rib extending between the first rib and the tread front edge or the riser lower edge and protruding downwards from the lower tread surface and/or backwards from a back surface of the riser and third ribs extending between the tread rear edge and the first rib and protruding downwards from the lower tread surface, wherein the side frames are each formed from an arm connecting the c-hole to the step roller axle, a pillar connecting the c-hole to the tread rear edge and a rib connection connecting the c-hole to the first rib.

[0008] As elements are designated with the aid of numbering, for example "first element", "second element" and "third element", this numbering is provided purely for differentiation in the designation and does not represent any dependence of the elements on one another or any mandatory sequence of the elements. In particular, this means that a device need not have a "first element" in order to have a "second element". Also, the device may comprise a "first element", as well as a "third element", but without necessarily having a "second element". Multiple units of an element of a single numbering may also be provided, for example multiple "first elements".

[0009] An escalator generally refers to a device for transporting people or luggage from an lower area to an upper area or vice versa. Escalators are used e.g. in highly frequented buildings like office buildings, administration buildings or in public transport, e.g. at a subway station. For transportation of people or luggage, an escalator has a lower transition area at the lower end of the escalator, an upper transition area at the upper end of the escalator and a transporting area in between the lower and the upper transition area, wherein the steps of the escalator are running through those areas, form stairs on an upper side of the transporting area and are transformed into a flat arrangement with each other in the transition areas before being turned around in the transition areas. People enter the escalator on a step in the lower or upper transition area and stand on the step during transportation, while the step transforms into the stairs and back into a flat arrangement with other steps in the

transition areas for the passenger to leave.

[0010] A tread is formed by a flat part of the step having an upper surface to receive one or more passengers, luggage or anything to be transported by the escalator. The tread is formed preferably rectangular and with an upper surface which provides slip-prove contact for the passenger and/or the luggage. The trad is oriented horizontally and is held in such an horizontal position during the entire area of the escalator, in which persons may be transported, while the tread may leave horizontal orientation by being turned around in the transition area.

[0011] A riser provides guidance for a neighboring step during transition of the steps between flat arrangement with each other and stair arrangement with each other in the transition area. The riser therefore forms a curved area, which corresponded to a trajectory of the neighboring step during transition, which occurs due to the fact that the steps move below each other. The riser may provide guidance means such as rails, recesses or protrusions for engagement with the other step, grooves or the like. The raiser may also comprise a limit stop for the neighboring step to be stopped on in any direction, in particular in a vertical direction.

[0012] A side frame is formed on the step to provide good mechanical properties, in particular sufficient stiffness, thus to provide support between the tread and the riser. The side frame further provides means for contacting/receiving the step chain and means for contacting/receiving the step roller and to provide support between these means and the tread and the riser. Preferably, the side frame is formed as a framework with a number of struts.

[0013] A rib may be configured as a flat part abutting perpendicular on a part which the rib is meant to stiffen. Preferably, the rib may abut perpendicular to more than one parts, wherein the parts are arranged angular to each other, e.g. perpendicular to each other, so that the rib stiffens the parts in themselves and against each other. Preferably, at least two second ribs, at least three second ribs or at least four second ribs are provided distributed over the tread width.

[0014] Preferably, at least two third ribs, at least three third ribs or at least four third ribs are provided distributed over the tread width. Most preferred, the at least one third rib aligns with the at least one second rib. With the at least one third rib, the step is further stiffened, in particular in an area below the tread rear edge and thus provided equally good mechanical properties over the entire tread. In particular, the number of second ribs and/or thirds ribs may be chosen according to a width of the step and may be arranged in symmetry with a middle of the step.

[0015] With the features of the step described before, a step is provided which fulfills all mechanical needs. In particular, the step is of a sufficiently stiff design, wherein the tread is sufficiently supported against the step chain and the step roller, and wherein, by the ribs, sufficient stiffness is provided for the tread itself. Further, the step can be produced cost efficient, this is at low costs for each unit, by a casting process with no or little need for further machining after the casting and with a sufficient precision for smooth running in the escalator.

[0016] In one embodiment of the step, an upper tread surface comprises tread grooves in the direction of movement, wherein a recess is formed in the tread grooves receiving an highlighting insert and wherein the highlighting insert forms insert grooves in alignment with the tread grooves. As the recess is formed in the grooves, upstanding ribs forming the grooves may be interrupted by the recess and further, a massive part of the tread under the ribs may be interrupted or not. The upper tread surface and the highlighting insert thus form an uniform surface with each other without any tripping hazard, wherein the tread grooves and the insert grooves merge with each other and provide for slip-prove contact of a passenger or luggage on the tread. The highlighting insert may be of a color, e.g. yellow or red and is provided for highlighting an area for a person not to stand or a luggage not to be placed on so that the passenger or luggage does not get too close to an edge of the step. Thus, potentially dangerous contact with moving parts, e.g. at a gap between two stairs during transition between the stair arrangement and the flat arrangement or contact of the passenger or luggage to a side of the escalator, e.g. a skirt located next to the step, is avoided. With the recess and the highlighting insert, no need exists to apply a highlighting on the step after casting e.g. by paint or the same, thus the respective work step is avoided, while the insert may be produced simple and at low costs and may be simple to attach in the recess, e.g. by clamping means, clips, bolts or the like.

[0017] Preferably, the recess and the highlighting insert extend along at least one edge of the tread, preferably along three edges of the tread. Thus, the highlighting insert may highlight the respective edge for a hazard existing at this edge like a hazard for a passenger to contact moving parts of the escalator. Further, by extending along the edge/s, the insert is of smallest possible size for highlighting the respective edge or the area to stand on/ not stand on and thus, the upper surface of the tread is mostly of a solid and unitary structure. Preferred, the recess and the highlighting insert at least extend along the tread rear edge and more preferred along the tread rear edge and both tread side edges.

[0018] In a further configuration of the embodiment named before, the highlighting insert is formed from a non-metallic material, preferably from plastic. Thus, by the highlighting insert, conduction of any electrostatic loads may be interrupted. Further, in particular for a plastic material, the highlighting insert may be of a colored material and is therefore not only colored on a surface, thus unlike a paint or the same, the color does not fade due to abrasion and thus must not be refreshed during maintenance work. Further, an highlighting insert from plastic may be mass produced by injection molding at very low costs per unit.

[0019] In a further configuration of the embodiment

named before, the highlighting insert is connected to the tread by form fit and/or force fit. Such fit may be configures for fast and easy attachment of the highlighting insert to the recess and therefore the effort due to installation of the highlighting insert in the recess is minimizes and cost efficient. Such form-fit may be provided by clamping means, clips, bolts or the like. In a preferred example, the tread comprises a through-hole in a bottom of the recess and the highlighting insert comprises a bolt to engage through the through-hole and forms a respective fit with the through-hole, e.g. by a spring element or in the manner of a clip or clamping. Most preferred, the bolt is an integral part of the insert. Alternatively, fastening means may be attached to the bolt, when it engages with the through-hole, e.g. from the side of the lower tread surface, such as a nut, a spring or a retainment ring.

[0020] In a preferred embodiment, the riser comprises riser grooves, wherein the riser grooves pitch is preferably twice as much as the tread grooves pitch. Riser grooves extend along the curved area of the riser and provide guidance for a neighboring step, which is guided along the curved area of the riser during transition from a flat arrangement to a stair arrangement of the steps. In particular, due to guidance steps cannot move against each other sideways. The neighboring step may engage into the grooves with ribs forming the tread grooves at the tread rear edge of the neighboring step, wherein e.g. every second rib forming the tread groove protrudes outwards to engage with the riser grooves of a neighboring step.

[0021] In another preferred embodiment of the step, the riser comprises a vertical part extending downwards as a vertical limit stop for a neighboring step, wherein the vertical part is forming the riser lower edge. By providing a vertical stop, the positioning of two neighboring steps to each other is a stair arrangement in the transporting area is defined and thus, the steps form uniform stairs, which are comfortable to walk on. Most preferred, the vertical stop is defined by an end of the riser grooves, to which the protruding ribs of the tread grooves move against. The end of the riser grooves may be positioned at a lower end of the vertical part and thus next to the riser lower edge. Alternatively, the end of the riser grooves may be positioned at an upper end of the vertical part or slightly above the vertical part on the riser.

[0022] In another preferred embodiment, the upper tread surface comprises at least one highlighting groove perpendicular to the tread grooves. Such highlighting grooves may in particular be located along an edge, along which no highlighting insert extends and may be of a dimension which allows visibility without being a trapping hazard to a passenger. The highlighting grooves allow for differentiate one step from another step, when the steps are in a flat arrangement in the transition area and therefore allow a passenger to avoid staying on an edge and loose step, when the steps transform to the stair arrangement.

[0023] In one embodiment of the step, the first ribs protrusion is at a maximum in a middle between the two tread side edges and at minimums at the side frames, wherein the main rib forms a radius with the rib connection. In this way, the first rib is layout according to the force distribution of the tread introduced by different passenger/luggage positions to provide equal stiffness along the tread extension, wherein a smooth force transition between the tread and the rib connection is provided. In particular, by the radius the force in the transition between the first rib and the rib connection is well distributed and absorbed.

[0024] At least one third rib may have a height substantially lower than the first rib and thus, a lower edge of the third ribs may abut the first rib close to the lower tread surface. At least one third rib may however have substantially the same height than the first rib, and thus the third rib extends between the tread rear edge and a lower edge of the first rib. That is, the lower edge of the third rib abuts the first rib at the first rib's lower edge. In a preferred embodiment, a c-hole opening width is smaller than the diameter of the c-hole, wherein the c-hole opening is tampered towards the c-hole. Thus, the opening of the c-hole spans less than 180° of the c-hole diameter so that the c-hole is configured for engagement with a step chain or a step chain roller by engagement of an axle or a bearing of the step chain / step chain roller in the c-hole in such a manner, that the axle or bearing is retained in the c-hole due to the size of the c-hole opening. For engagement, the opening is widened, e.g. by the axle or bearing itself under pressure in the direction of the opening, wherein the tapering provides for easy engagement of the opening on the axle or bearing.

[0025] In another preferred embodiment, the side frames form flat surfaces on sides of the c-hole. In particular, these surfaces are parallel to each other and thus provide for axial retainment between retaining elements of the step chain. This is, the c-hole can engage with an axle or bearing by putting the c-hole over such an axle or bearing, wherein at the same time the flat surfaces engage behind said retainment elements, wherein the retaining elements are provided with a gap corresponding to the distance of the flat surfaces.

[0026] In yet another embodiment of the step, the side frames form a rotation stop at the c-hole, in particular a non-round surface around the c-hole. Such a rotation stop can abut with a stop at the step chain for limiting the rotation and/or define the angle position of the c-hole around the axle or the bearing and thus provides for a strictly horizontal tread for a passenger to stand on or a luggage to be placed on during transportation. A corresponding stop at the step chain may be positioned to provide for the right rotation angle of the c-hole in respect to the position of the step roller axle.

[0027] In one embodiment of the step, the arm, the pillar and/or the rib connection are formed at least partially as a profile, in particular a U-, Z- or L-profile. Such a profile provides high stiffness, in particular buckling stiffness and high moment of inertia against rotation

around the length dimension of the profile. Thus, the arm, the pillar and/or the rib connection are provided for absorbing and/or transmitting forces, in particular not only in their axial extension but also transversely, and moments and the step is provided at high mechanical strength and stiffness.

[0028] Most preferred, the arm comprises no ribs extending transverse to its main extension along its extension, thus no ribs which serve for stiffening the arm itself over the profile configuration, while the arm however may abut ribs, e.g. the first rib. Still preferred, the arm comprises exactly one fourth rib transverse to its main extension for stiffening of the arm. Any transverse ribs comprised by the arm make the geometry of the step respectively the side frames more complex and therefore more complicated and costly to produce. As only one or none fourth rib is provided, the arm respectively the side frame is of a simple and cost efficient design. With the arm being formed as a profile, the arm may provide sufficient mechanical properties to fulfill all mechanical needs without or with only one fourth rib.

[0029] In one embodiment, the step roller axle is formed on a step roller support protruding from the riser lower edge, wherein the step roller support comprises at least one fifth rib in prolongation of the riser. With such a design, forces are properly transmitted from the riser respectively from the entire step to the step axle without any risk of buckling or bending of the step roller support or the riser. As the fifth rib is arranged in prolongation of the riser, in forms a unitary design with the riser to absorb/transmit forces along the riser.

[0030] In a preferred configuration of the embodiment named before, the step roller support comprises at least three fifth ribs forming a star arrangement with each other and forming triangular intermediate spaces. Preferred, the fifth ribs merge in the point where the step roller support abuts the riser. In this way, the contact force between the step roller respectively the step roller axle and a guide of the escalator, which the step roller rolls on is absorbed and/or transmitted in the step roller support along at least one of the fifth ribs no matter which angle the step forms with the guide, as such angle is different in the transporting area and the transmission area. The fifth ribs may be provided on an outer side of the step roller support.

[0031] In a further preferred configuration of the embodiment named before, all fifth ribs are arranged between a prolongation of the rise and the step roller axle. As the step may be designed so that at any angle between the step roller and the guide, the force direction is not behind this prolongation, no further fifth ribs are provided behind this prolongation so that the step respectively the step roller support is designed simple and cost efficient.

[0032] In one embodiment, at a lower surface of the arm, a first stop and a second stop are formed for engagement of the first stop with a second stop of another step and of the second stop with a first stop of the other step during stacking of two steps. Thus, steps may be stacked in a defined and safe manner, wherein one step is turned around so that the lower arm surface points obliquely upwards and another step is stacked on the upwards pointing lower arm surface with its oblique downwards pointing lower arm surface. In this manner, the upper tread surface of the lower step is horizontally lying on an underground, while the upper tread surface of the upper step is parallel to it and thus is horizontally oriented to allow more steps to be stacked on it. This defined position of the steps to each other in the stacked state is provided by the stops in an easy manner, wherein the stops do not interfere with/during the installation and the operation of the escalator. As steps can be stacked easily and in a space saving manner, costs regarding storage work and storage space are reduced and the handling of the step is more cost efficient.

[0033] In one configuration of the before named embodiment, the first stop and/or the second stop are formed to receive the second stop or first stop of the other step in a form fit manner. Thus, the steps are retained in the stacked state and a hazard for the steps to fall or slip off is avoided. Due to the form fit, this advantage is reached while the processes of stacking and unstacking are still simple and cost efficient. Most preferred, one stop is configured in a L- or U-shape.

[0034] In yet another configuration of the before named embodiment, the first stop is positioned at the step roller axle and also preferred, the second stop is positioned at the fourth rib. This is, the stops are positioned relatively far from each other to provide mechanically well determined connection between the stacked steps and allow the steps to be stacked or unstacked only along the direction of the arms. Further, stops are provided at relatively stiff points of the step for safe stacking of the steps without potential for damage to the steps.

[0035] In another embodiment of the step, the arm comprises a sixth rib extending between the c-hole and the step roller axle and protruding downwards from the lower surface of the arm. The sixth rib may have its highest protrusion next to the c-hole. With the sixth rib, the arm itself may be of a lighter configuration while being stiffened by the sixth rib resulting in an overall lighter arm.

[0036] Another advantage of the step described before assigned to symmetry in the width direction. As the design of the tread and the riser is uniform along the width of the step and side frames are positioned below side edges, steps of different length may be casted with only one casting coquille, wherein the coquille may comprise different parts, which can be slide against each other to set the width or may comprise different parts which are merged together to form a coquille of the correct width. The design of the fist rib may comprise side sections with a variable protrusion and a middle section with a constant protrusion, wherein differences in width for different steps may be assigned to the middle section. Advantageously, with the casting of different step widths with one coquille, costs for casting are reduced and thus, the costs of the step and the escalator are reduced.

[0037] The object of the invention is also solved by an

escalator with at least one step as described before. With such an escalator, the same advantages are to be reached as described in regards of the step. In particular, such an escalator is of low costs while providing sufficient mechanical, precision and safety needs.

Brief description of the figures

[0038] In the following, the invention is explained in more detail with reference to the accompanying figures using preferred examples of embodiments. The formulation figure is abbreviated in the drawings as Fig.

Fig. 1 is a perspective top view of a step according to an aspect of the invention;
Fig. 2 is a perspective bottom view of half the step according to fig. 1;
Fig. 3a is a detail view of the tread front edge, the upper tread surface and a highlighting insert therein of the step according to fig. 1;
Fig. 3b is a cross-section view of the highlighting insert and the tread of the step according to fig. 1;
Fig. 4 is a detail view of the upper tread surface of the step according to fig. 1;
Fig. 5 is a detail view of the vertical part of the riser of the step according to fig. 1;
Fig. 6 is a side view of the step according to fig. 1;
Fig. 7a is a detail view of a c-hole of the step according to fig. 1 from a first side;
Fig. 7b is a detail view of the c-hole of the step according to fig. 1 from a second side;
Fig. 8 is a detail view of a step roller axle and an arm of the step according to fig. 1;
Fig. 9 is a detail view of an arm and a c-hole of the step according to fig. 1;
Fig. 10a is a bottom view of an arm of the step according to fig. 1; and
Fig. 10b is a perspective view of two steps according to fig. 1 forming a stack with each other.

Detailed description of the embodiments

[0039] The described embodiments are merely examples that can be modified and/or supplemented in a variety of ways within the scope of the claims. Any feature described for a particular embodiment example may be used independently or in combination with other features in any other embodiment example. Any feature described for an embodiment example of a particular claim category may also be used in a corresponding manner in an embodiment example of another claim category.

[0040] Referring to figures 1 and 2, a step 1 comprises a tread 2, a riser 3 and two side frames 4. The tread 2 comprises a tread front edge 2.1, a tread rear edge 2.2 and two tread side edges 2.3, 2.4 adverse each other. The riser 3 extends downwards from the tread front edge 2.1 and comprises a curved area 3.1 and a riser lower edge 3.2. The side frames 4 are connected to / do form a c-hole 5 for connecting the step 1 to a step chain below the tread rear edge 2.2 and a step roller axle 6, which is visible e.g. in figures 6 and 8 and receives a step roller 7. Further, the step 1 comprises a first rib 8.1 extending between the two tread side edges 2.3, 2.4 and protruding downwards from a lower tread surface 2.5 and second ribs 8.2 extending between the first rib 8.1 and the tread front edge 2.1 and/or the riser lower edge 3.2 and protruding downwards from the lower tread surface 2.5 and backwards from a back surface 3.3 of the riser 3. The side frames 4 are formed from an arm 4.1 connecting the c-hole 5 to the step roller axle 6, a pillar 4.2 connecting the c-hole 5 to the tread rear edge 2.2 and a rib connection 4.3 connecting the c-hole 5 to the first rib 8.1. The first rib 8.1 is formed according to the static properties of the step 1 and the expected dynamic load on the step 1 and thus, the first ribs 8.1 protrusion is at a maximum in a middle between the two tread side edges 2.3, 2.4 and at minimums at the side frames 4, wherein the first rib 8.1 forms a radius R with the rib connection 4.3. The step 1 further comprises third ribs 8.3 extending between the tread rear edge 2.2 and the first rib 8.1 and protruding downwards from the lower tread surface 2.5.

[0041] Now referring to figures 1 to 5, an upper tread surface 2.6 comprises tread grooves 10 in the direction of movement M, which are formed by upstanding ribs 10.1. Within the tread grooves 10, a recess 11 is formed receiving an highlighting insert 12 and the highlighting insert 12 forms insert grooves 12.1 in alignment with the tread grooves 10. The insert grooves 12.1 are formed by upstanding ribs 12.2 parallel to the upstanding ribs 10.1. The tread grooves 10 and the insert grooves 12.1 have the same pitch P.1. The tread grooves 10 further comprise / do form a highlighting groove 16 extending perpendicular to the tread grooves 10 and parallel to the tread front edge 2.1 for distinguishing of two steps 1 being neighbors in a flat arrangement of the steps 1 in a transition area of an escalator.

[0042] Further, the riser 3 comprises riser grooves 13, wherein the riser grooves 13 have a pitch P.2, which is twice as much as the tread grooves 10 pitch P. 1, as best visible in Fig. 3a. Every second rib 10.1 of the tread grooves 10 forms an extension 10.2 on the tread rear edge 2.2 as best pictured in Fig. 4 to engage with the riser grooves 13 of a neighboring step 1. The riser 3 comprises a vertical part 3.4 extending downwards as a vertical limit stop 3.5 for a neighboring step 1, wherein the vertical part 3.4 is forming the riser lower edge 3.2. As the riser grooves 13 form limit stops 3.5 on the vertical part 3.4, the extensions 10.2 are stopped at the limit stops 3.5 of the riser grooves 13 in a vertical direction V.

[0043] The highlighting insert 12 is formed from a colored plastic material and extends along the tread rear edge 2.2 and the tread side edges 2.3, 2.4. For retaining the highlighting insert 12 in the recess 11, the tread 2 comprises through-holes 14 in a bottom 11.1 of the recess 11 and the highlighting insert 12 comprises bolts 12.3

integral to the highlighting insert 12 to engage through the through-holes 14. The bolts 12.3 are retained in the through-holes 14 by spring elements 15, which are clamped on the bolts 12.3 and build a form-fit with the tread 2.

[0044] Now referring to figures 6, 7a, 7b and 9, the c-hole 5 is formed as a merge point of the arm 4.1, the pillar 4.2 and the rib connection 4.3 and thus, forces on the c-hole 5 due to contact to the step chain are divided on the tread rear edge 2.2, the riser lower edge 3.2 and the first rib 8.1, the second ribs 8.2 and the third ribs 8.3.

[0045] A c-hole 5 opening width W is smaller than the diameter D of the c-hole 5 and the c-hole 5 opening is tampered towards the c-hole 5. Further, the side frames 4 form flat surfaces 19.1, 19.2 on sides of the c-hole 5, wherein the flat surfaces 19.1, 19.2 are parallel to each other. This is, the c-hole 5 may be clamped on an axle or bearing of the step chain, wherein the c-hole 5 opening is widened during attachment of the c-hole 5 on the axle or bearing under favor of the tampering and the side frame 4 may be retained on the step chain in an axial direction of the step chain by limit stops for the flat surfaces 19.1, 19.2. Thus, flat surfaces 19.1, 19.2 engage between such limit stops during attachment of the c-hole 5 on the axle or bearing. Further, the side frames 4 form a non-round surface 20, namely a rectangular surface, around the c-hole 5 which serves as a rotation stop at the c-hole 5 and might interact with the step chain to define the angle position of the step 1 against the step chain.

[0046] Further referring to figure 6, the step roller axle 6 is formed on a step roller support 21 protruding from the riser lower edge 3.2, wherein the step roller support 21 comprises at least one fifth rib 8.5 in prolongation of the riser 3. Further fifth ribs 8.6 extend in front of a prolongation of the riser 3 and form a star arrangement with the fifth rib 8.5 and each other, merging at the point, where the step roller support 21 meets the riser 3. Thus, the fifth ribs 8.5, 8.6 form triangular intermediate spaces 22. By this arrangement of the fifth ribs 8.5, 8.6, a force introduced into the step 1 at the step roller axle 6 is well distributed into the arm 4.1 and the riser 3 at any angle of the step 1 against an guide for the step roller 7.

[0047] Referring to figures 6 and 8, the arm 4.1, the pillar 4.2 and the rib connection 4.3 are all formed as a L-profile to receive, absorb and distribute forces and momentum at a sufficient stiffness. Referring to figures 6 and 9, the arm 4.1 comprises a fourth rib 8.4 for stiffening the arm 4.1.

[0048] Referring to figures 2, 6, 8, 9, 10a and 10b, on a lower surface 23 of the arm 4.1, a first stop 24.1, which is positioned at the step roller axle 6, and a second stop 24.2, which is positioned at the fourth rib 8.4, are formed for engagement of the first stop 24.1 with a second stop 24.2 of another step 1 and of the second stop 24.2 with a first stop 24.1 of the other step 1 during stacking of two steps 1. Two steps 1 stacked with each other accordingly are pictures in figure 10. In the stack, the treads 2 of the steps 1 are each horizontal and thus parallel to each other, while the arms 4.1 of the steps 1 are in contact with each other. For retaining the first stop 24.1 of the other step 1, the second stop 24.2 is formed in a L-shape as best visible in figure 10a, Thus, the steps 1 are retained at each other in the side direction and are positioned against each other in a defined manner. On the tread 2 of the upper step 1, another stack of two steps 1 may be stacked. As the second stop 24.2 is located neighboring to the fourth rib 8.4, a high stiffness is given at the second stop 24.2, e.g. for the case, where any load is placed on top of a stack of steps 1.

Reference list

[0049]

1	step
2	tread
2.1	tread front edge
2.2	tread rear edge
2.3	tread side edge
2.4	tread side edge
2.5	lower tread surface
2.6	upper tread surface
3	riser
3.1	curved area of the riser
3.2	riser lower edge
3.3	back surface of the riser
3.4	vertical part of the riser
3.5	limit stop at the vertical part of the riser
4	side frames
4.1	arm of a side frame
4.2	pillar of a side frame
4.3	rib connection of a side frame
5	c-hole
6	step roller axle
7	step roller
8.1	first rib
8.2	second rib
8.3	third rib
8.4	fourth rib
8.5	fifth rib
8.6	fifth rib
10	tread grooves
10.1	upstanding rib forming the tread grooves
10.2	extension of the upstanding rib
11	recess in the tread grooves
11.1	bottom of the recess
12	highlighting insert
12.1	insert grooves
12.2	upstanding ribs forming the insert grooves
12.3	bolt of the highlighting insert
13	riser grooves
14	through-hole in the bottom of the recess
15	spring element
16	highlighting groove
19.1	flat surface of the c-hole

19.2 flat surface of the c-hole
20 non-round surface around the c-hole
21 step roller support
22 triangular intermediate space
23 lower surface of the arm
24.1 first stop
24.2 second stop

M direction of movement
P. 1 pitch of the tread grooves
P.2 pitch of the riser grooves
R radius of the first rib
V vertical direction

Claims

1. Step (1) for an escalator, comprising

a tread (2) with a tread front edge (2.1), a tread rear edge (2.2) and two tread side edges (2.3, 2.4) adverse each other;
a riser (3) extending downwards from the tread front edge (2.1), having at least a curved area (3.1) and a riser lower edge (3.2);
two side frames (4) below each tread side edge (2.3, 2.4) forming a step roller axle (6) below the riser lower edge (3.2) and a c-hole (5) for connecting the step (1) to a step chain below the tread rear edge (2.2);
a first rib (8.1) extending between the c-holes (5) of the two side frames (4) and protruding downwards from a lower tread surface (2.5);
at least one second rib (8.2) extending between the first rib (8.1) and the tread front edge (2.1) or the riser lower edge (3.2) and protruding downwards from the lower tread surface (2.5) and/or backwards from a back surface (3.3) of the riser (3); and third ribs (8.3) extending between the tread rear edge (2.2) and the first rib (8.1) and protruding downwards from the lower tread surface (2.5);
wherein the side frames (4) are each formed from an arm (4.1) connecting the c-hole (5) to the step roller axle (6), a pillar (4.2) connecting the c-hole (5) to the tread rear edge (2.2) and a rib connection (4.3) connecting the c-hole (5) to the first rib (8.1).

2. Step (1) according to claim 1, wherein an upper tread surface (2.6) comprises tread grooves (10) in the direction of movement (M), wherein a recess (11) is formed in the tread grooves (10) receiving an highlighting insert (12) and wherein the highlighting insert (12) forms insert grooves (12) in alignment with the tread grooves (10).

3. Step (1) according to claim 2, wherein the recess (11) and the highlighting insert (12) extend along at least one edge (2.1, 2.2, 2.3, 2.4) of the tread (2), preferably along three edges (2.1, 2.2, 2.3, 2.4) of the tread (2).

4. Step (1) according to claim 2 or 3, wherein the highlighting insert (12) is formed from a non-metallic material, preferably from plastic.

5. Step (1) according to any of claims 2 to 4, wherein the highlighting insert (12) is connected to the tread (2) by form fit and/or force fit.

6. Step (1) according to claim 5, wherein the tread (2) comprises a through-hole (14) in a bottom (11.1) of the recess (11) and the highlighting insert (12) comprises a bolt (12.3) to engage through the through-hole (14).

7. Step (1) according to any of the preceding claims, wherein the riser (3) comprises riser grooves (13), wherein the riser grooves (13) pitch (P.2) is preferably twice as much as the tread grooves (10) pitch (P.1).

8. Step (1) according to any of the preceding claims, wherein the riser (3) comprises a vertical part (3.4) extending downwards as a vertical limit stop (3.5) for a neighboring step (1), wherein the vertical part (3.4) is forming the riser lower edge (3.2).

9. Step (1) according to any of the preceding claims, wherein the upper tread surface (2.6) comprises at least one highlighting groove (16) perpendicular to the tread grooves (10).

10. Step (1) according to any of the preceding claims, wherein the first ribs (8.1) protrusion is at a maximum in a middle between the two tread side edges (2.3, 2.4) and at minimums at the side frames (4), wherein the first rib (8.1) forms a radius (R) with the rib connection (4.3).

11. Step (1) according to any of the preceding claims, wherein at least one third rib (8.3) extends between the tread rear edge (2.2) and a lower edge of the first rib (8.1).

12. Step (1) according to any of the preceding claims, wherein a c-hole (5) opening width (W) is smaller than the diameter (D) of the c-hole (5) and wherein the c-hole (5) opening is tampered towards the c-hole (5).

13. Step (1) according to any of the preceding claims, wherein the side frames (4) form flat surfaces (19.1, 19.2) on sides of the c-hole (5).

14. Step (1) according to any of the preceding claims, wherein the side frames (4) form a rotation stop at the c-hole (5), in particular a non-round surface (20) around the c-hole (5).

15. Step (1) according to any of the preceding claims, wherein the arm (4.1), the pillar (4.2) and/or the rib connection (4.3) are formed at least partially as a profile, in particular a U-, Z- or L-profile.

16. Step (1) according to claim 15, wherein the arm (4.1) comprises one or less fourth rib (8.4) transverse to its main extension for stiffening of the arm (4.1).

17. Step (1) according to any of the preceding claims, wherein the step roller axle (6) is formed on a step roller support (21) protruding from the riser lower edge (3.2), wherein the step roller support (21) comprises at least one fifth rib (8.5) in prolongation of the riser (3).

18. Step (1) according to claim 17, wherein the step roller support (21) comprises at least three fifth ribs (8.5, 8.6) forming a star arrangement with each other and forming triangular intermediate spaces (22).

19. Step (1) according to claim 18, wherein all fifth ribs (8.5, 8.6) are arranged between a prolongation of the riser (3) and the step roller axle (6).

20. Step (1) according to any of the preceding claims, wherein at a lower surface (23) of the arm (4.1), a first stop (24.1) and a second stop (24.2) are formed for engagement of the first stop (24.1) with a second stop (24.2) of another step (1) and of the second stop (24.2) with a first stop (24.1) of the other step (1) during stacking of two steps (1).

21. Step (1) according to claim 20, wherein the first stop (24.1) and/or the second stop (24.2) are formed to receive the second stop (24.2) or first stop (24.1) of the other step (1) in a form fit manner.

22. Step (1) according to claim 20 or 21, wherein the first stop (24.1) is positioned at the step roller axle (6).

23. Step (1) according to any of claims 20 to 22, wherein the second stop (24.2) is positioned at the fourth rib (8.4).

24. Step (1) according to any of the preceding claims, wherein the arm (4.1) comprises a sixth rib extending between the c-hole (5) and the step roller axle (6) and protruding downwards from the lower surface (23) of the arm (4.1).

25. Escalator with at least one step (1) according to any of the preceding claims.

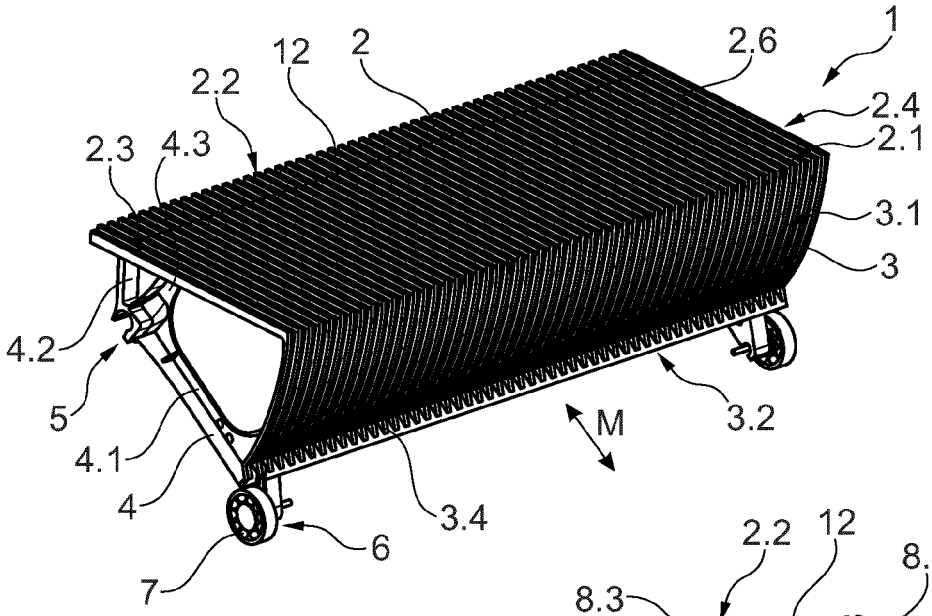

Fig. 1

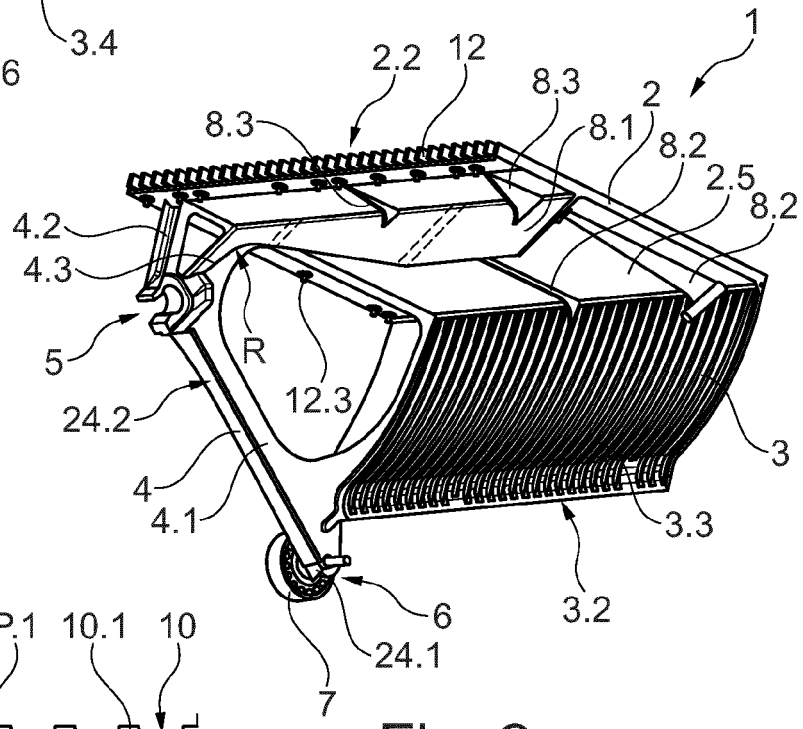

Fig. 2

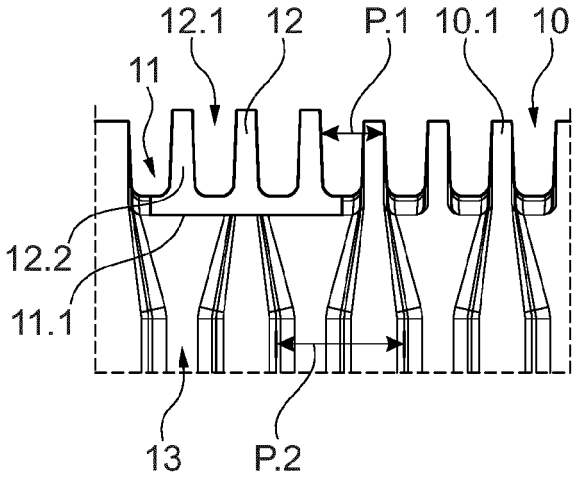

Fig. 3a

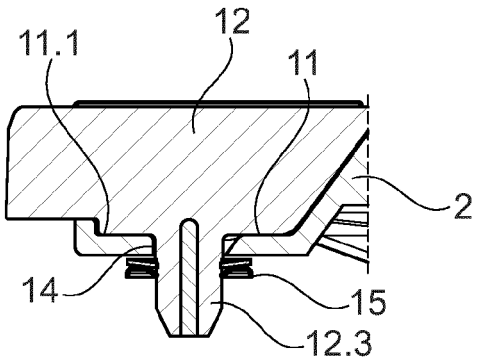

Fig. 3b

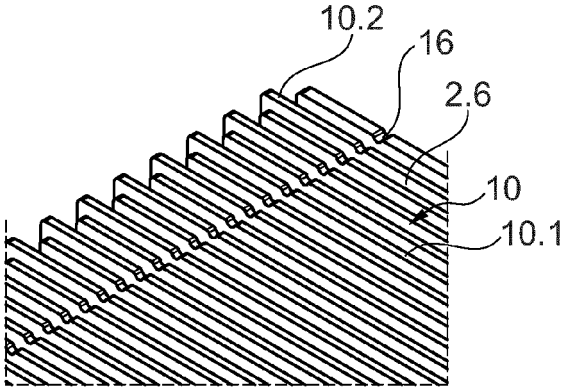

Fig. 4

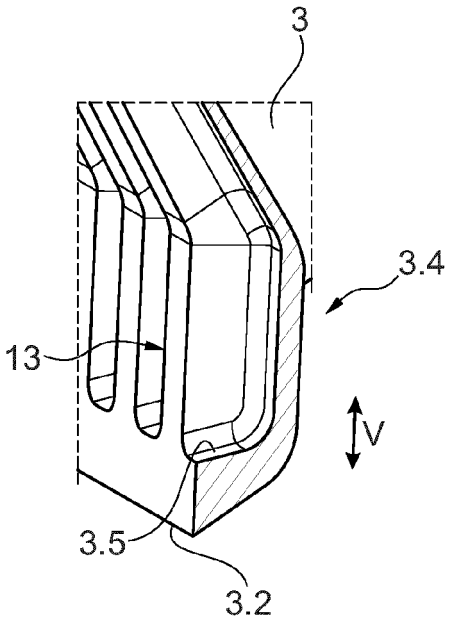

Fig. 5

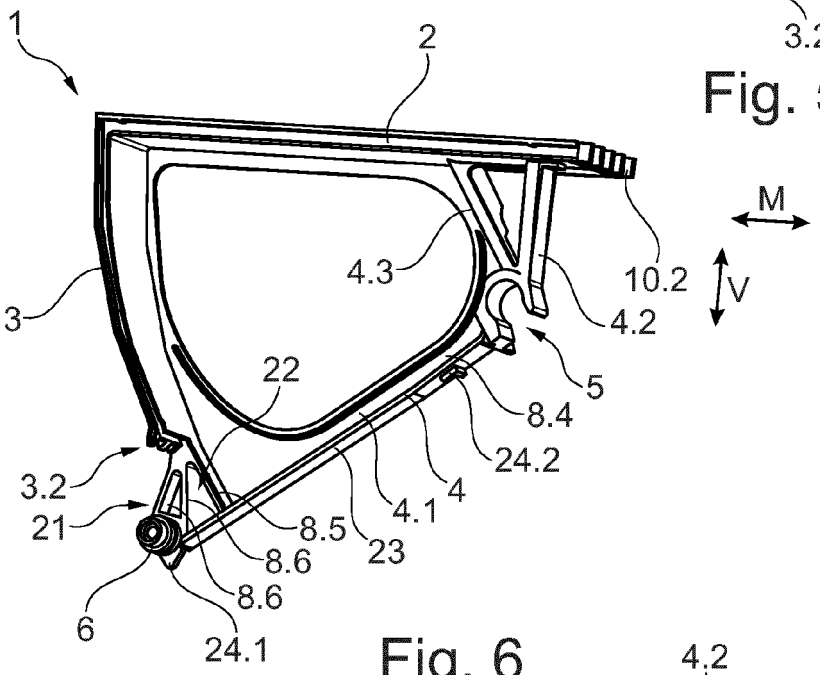

Fig. 6

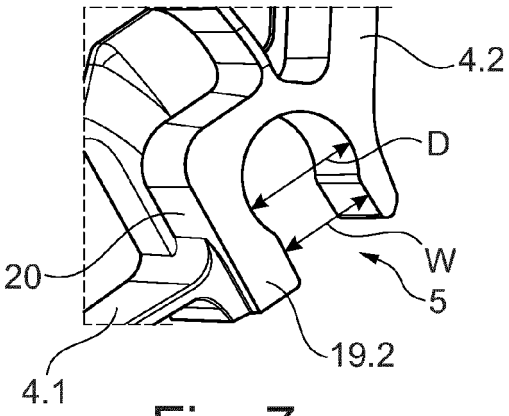

Fig. 7a

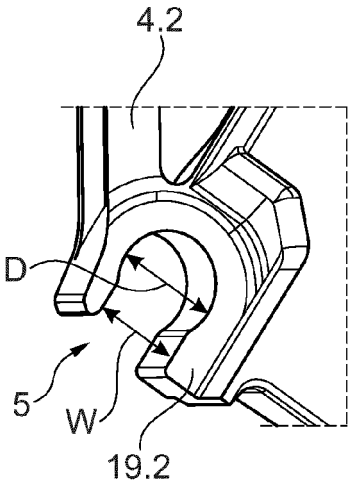

Fig. 7b

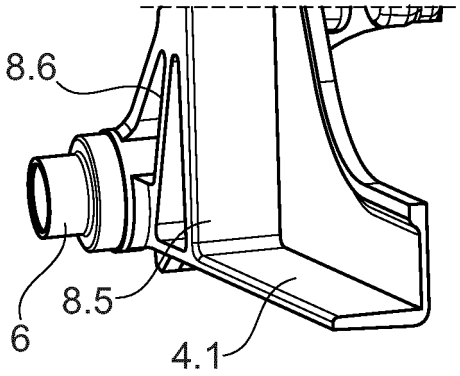

Fig. 8

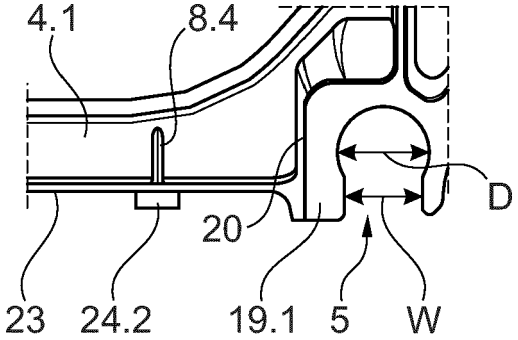

Fig. 9

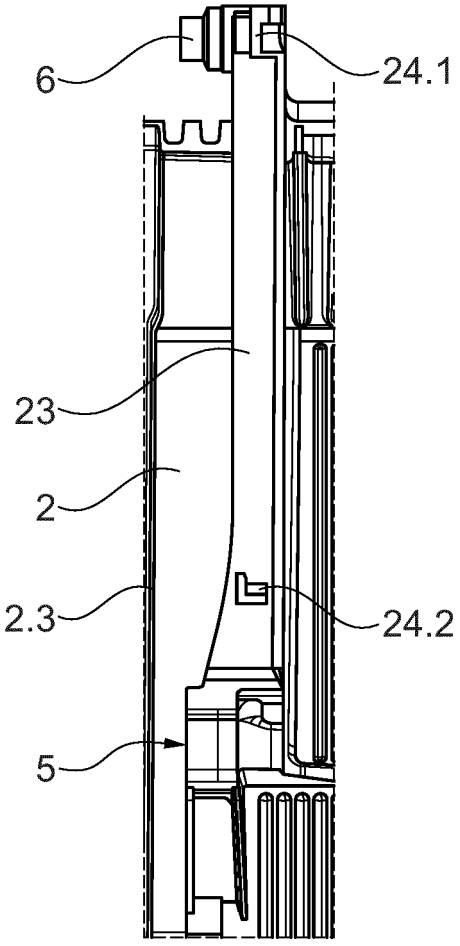

Fig. 10a

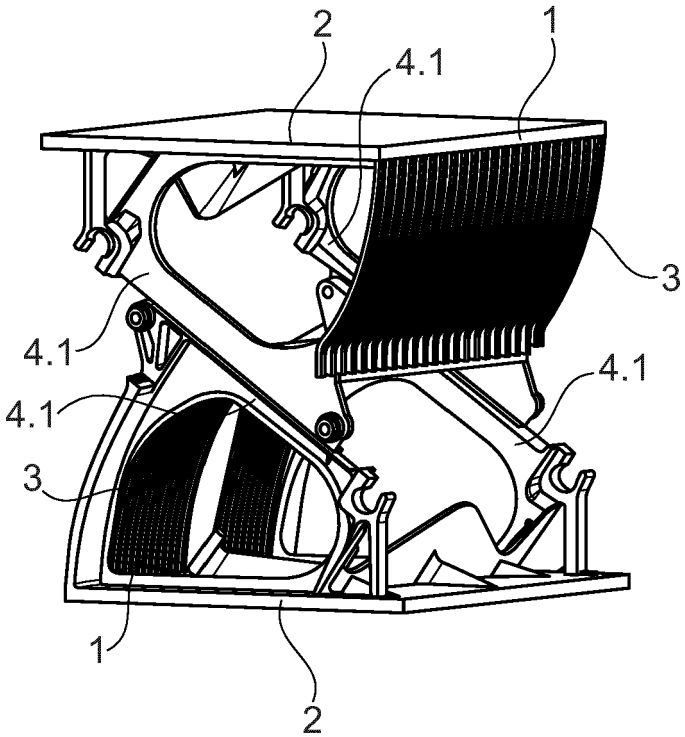

Fig. 10b

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EUROPEAN SEARCH REPORT

Application Number
EP 23 38 2195

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 358 089 A (RIEDEL HANS-DIETER [DE]) 25 October 1994 (1994-10-25) * column 3, line 37 - column 4, line 31; figures 1-6 *	1-25	INV. B66B23/12
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A	US 5 560 468 A (INOUE TAKAO [US]) 1 October 1996 (1996-10-01) * abstract; figures 3-10 *	1-25	
			TECHNICAL FIELDS SEARCHED (IPC)
			B66B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 August 2023	Nelis, Yves

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 38 2195

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