

Description

The present invention relates to a moving staircase and more particularly to an improvement in the construction of a guide for tread boards in a curved moving staircase which has a curved conveying path in plan view.

Curved moving staircases have been proposed in US-A-2641351. In this document, the treads follow a completely closed loop without being reversed, and dip below floor level at the landings. This escalator has drive rollers which run in dual-section guides, with the lower flange of each guide acting as a drive rail and the upper flange of each guide serving to hold down the drive rollers. Upper and lower rails are further provided for positively locating follower rollers. This curved escalator was not found to be practical.

The applicants have produced a successful curved moving staircase, disclosed in EP-A-103489.

In a conventional moving staircase of this kind, as shown in Figs. 1 to 3 of the attached drawings, a main frame 1 of the moving staircase having a semicircular configuration in plan view is arranged substantially obliquely upwards. Supported in an endless fashion by the main frame 1 is a conveyor passage 2 which includes an inclined upper load run 2a on the upper side of the main frame 1, horizontal deflection portions 2b at both ends of the main frame 1, and an inclined lower return run 2c on the lower side of the main frame 1. The conveyor passage 2 comprises a number of tread boards 3 articulated together, each having generally the shape of a sector in plan view and provided on its underside at the forward end thereof (relative to the direction of movement) with a rotatable horizontal tread board axle 3a in the widthwise direction. The axle 3a fixedly secures a bracket 7a at its outer end portion which rotatably supports a pair of outer drive rollers 3b, while the axle 3a rotatably supports an inner drive roller 3c, the outer and inner drive rollers 3b and 3c being supported on and guided by outer and inner drive rails 4a and 4b, respectively, which are disposed within the main frame 1 along the outer and inner peripheries of the conveyor passage 2 and secured to the main frame 1 at the outer and inner arcuate peripheries thereof, respectively, by any suitable means such as brackets. An outer and inner follower roller 20a and 20b are, as shown in Figs. 5 and 6 to be referred to later, provided on the tread board 3 on its underside at the rear end thereof (relative to the direction of motion), and are adapted to be supported on and guided by outer and inner follower rails 5a and 5b secured to the main frame 1 along the outer and inner peripheries of the conveyor passage 2, respectively, by any suitable means such as brackets. The tread board axles 3a are connected together at their outer and inner ends by endless outer and inner tread board chains 6a and 6b, respectively. Further, each tread board axle 3a is provided at its outer end portion with a side roller 7 rotatably

mounted on the bracket 7a such that the side roller 7 is disposed at right angles to the outer drive rollers 3b, the side roller 7 being adapted to be abutted against a guide rail 8 which is fixedly secured to the main frame 1 through a bracket along the outer periphery of the circular arc of the conveyor passage 2, the side roller 7 serving to carry a load directed to the center of the circular arc of the conveyor passage 2 in cooperation with the guide rail 8; the load being generated as the result of the moving of the tread boards 3. Reference numeral 9 denotes a driving means provided at the upper deflection portion 2b of the conveyor passage 2 and supported by the main frame 1, comprising a driving motor 9b and a pair of sprocket wheels 9a transversely spaced apart and adapted to be driven by the driving motor 9b, receiving thereon the endless tread board chains 6a and 6b, respectively, of the tread boards 3 at the upper deflection portion 2b. 10 denotes a tension wheel means provided at the lower deflection portion 2b of the conveyor passage 2. The tension wheel means 10 is provided with outer and inner sprocket wheels 10a and 10b, respectively, which are spaced apart in the widthwise direction, the sprocket wheels 10a and 10b being adapted to have reeved thereon the outside and inside tread board chains 6a and 6b, respectively. Accordingly, the diameter of the outer sprocket wheel 10a is larger than that of the inner sprocket wheel 10b.

Here the constitution of the outer and inner drive rails 4a and 4b will be more precisely explained taking the inner drive rail 4b as an example. As shown in Fig. 10, the inner drive rail 4b belonging to the upper load run 2a of the conveyor passage 2 switches over at its lower end portion to a horizontal inner drive rail 4b' at the inner end of the lower deflection portion 2b of the conveyor passage 2, the drive rail 4b' terminating in an inclined portion 4b'', the free end of which is bent downward substantially towards the center of the lower deflection portion 2b.

Similarly, the drive rail 4d belonging to the lower return run 2b switches over at its lower end portion to a horizontal inner drive rail 4d' at the inner end of the lower deflection portion 2b, the drive rail 4d terminating in an inclined portion 4d'', the free end of which is bent upwards substantially towards the center of the lower deflection portion 2b. At this point it should be noticed that the other rails shown in Fig. 10 such as those designated by reference numerals 12b and 12d are not provided in the conventional staircase and will be described fully later on in connection with the present invention. This applies also to all of Figs. 8 to 11.

Upon energizing the driving means 9, the sprocket wheels 9a are driven, and the tread boards 3 are driven through the outer and inner tread board chains 6a and 6b which are reeved on the sprocket wheels 9a. Therefore, the outer and inner drive rollers 3b and 3c, the follower rollers 20a and 20b, and the side rollers 7 of the tread boards 3 are guided along the upper load run 2a

(10)

of the conveyor passage 2 by the drive rails 4a and 4b, the follower rails 5a and 5b, and the guide rail 8, respectively, and roll on them so that the tread boards 3 are circulated along the conveyor passage 2. In this case, the tread boards 3 are subjected to a component of force directed towards the center of the circular arc of the conveyor passage 2, the component being carried by the side rollers 7 and by the guide rail 8 guiding them.

However, in the conventional curved moving staircase as shown in Fig. 3, there is nothing to prevent the drive rollers 3b and 3c from being raised up from the drive rails 4a and 4b at the inclined portions 2a and 2c of the conveyor passage 2, except at certain sections such as the deflection portions where the drive rollers 3b and 3c are subjected to forces urging them upwards.

However, with the constitution shown in Figs. 1 to 3, although a force to urge the drive rollers 3b and 3c upwards is not usually applied to them during their normal movement, should the drive rollers 3b and 3c be raised up for some unavoidable reasons, the side rollers 7 can come off the guide rail 8 so that the tread boards 3 may be displaced towards the center of the circular arc of the conveyor passage 2 due to the force applied thereto in that direction or in the direction of the tread board axle 3a. Further, the drive rollers 3b and 3c may also be raised up from the drive rails 4a and 4b, such as during their travel along the upper load run 2a, endangering the passagers.

Moreover, since in the above-described conventional moving staircase, the guide rail 8 for the side rollers 7 is independent of the drive rails 4a and 4b, the number of parts becomes large, necessitating considerable time for manufacture, assembly, and adjustment, of a moving staircase of this kind.

On the other hand, at the lower deflection portion 2b, for instance, as shown in Fig. 10, the inner drive rails 4b and 4d are connected at their lower ends to the horizontal inner drive rails 4b' and 4d', respectively. These rails cause the endless inner tread board chain 6b to smoothly mesh with the sprocket wheel 10b having a smaller diameter than the sprocket wheel 10a, the larger sprocket wheel 10a being adapted to mesh with the outside tread board chain 6a.

As can be easily understood, in the conventional moving staircase of this kind, the rails 4b, 4b', 4b'', 4d, 4d', 4d'', etc. are all fixedly secured to the main frame 1, and the tension wheel means 10 are adapted to be shifted substantially horizontally outwards relative to the conveyor passage 2 as the tread board chains 6a and 6b elongate due to wear, etc., so that any slack in the chains has to be compensated for. In this case, in a usual straight moving staircase such as is shown in Fig. 11, the outer drive rail 4b or the rails which correspond to the rails 4b, 4d, etc. of Fig. 10 have no inclined rails such as

4b'', 4d'' at their lower deflection portion 2b. Therefore, even if the inner sprocket wheel 10b be shifted by an amount W as shown in Fig. 11, it does not cause any problems in the operation of the escalator.

Contrarily, in the curved moving staircase shown in Fig. 10, since the inner drive rails 4a and 4d are provided with the horizontal rail portions 4b', 4d' as well as the inclined rail portions 4b'' and 4d'', if the inner sprocket wheel 10b is shifted outwards by the same distance W as in Fig. 12, it causes several problems. That is, the inner drive rollers 3c are caused to deviate from the rail portions due to the gradual increase in the distance between the tread board chain 6b and the inclined inner rail portions 4b'' and 4d'' as will be readily seen from Fig. 12, with the result that the inner drive rollers 3c are made unstable or can not ride smoothly on the rails, causing oscillations, noise, etc. or even damaging the machine parts.

Summary of the invention

It is a principal object of the present invention to provide a moving staircase with a curved conveyor passage in which the outer and/or inner drive rollers are prevented from being derailed from the outer and/or inner drive rails during the operation of the moving staircase.

It is another object of the present invention to provide a moving staircase with a curved conveyor passage in which the inner sprocket wheel of the tension wheel means provided at the lower deflection portion of the conveyor passage can be horizontally shifted without the fear of derailing the inner drive rollers from the inner drive rail at the time of the adjustment of the tension of the tread board chains.

It is a further object of the present invention to provide a moving staircase with a curved conveyor passage in which the strength and the rigidity of the support members for the side drive rails to guide the side drive rollers are made sufficiently large so that the dimensions of the side drive rails need not be increased.

In accordance with the present invention there is provided a moving staircase with a curved path in plan formed of an upper load run, a lower return run and horizontal upper and lower deflection portions connecting said upper load and lower return runs together at their upper and lower portions, respectively, comprising a main frame, tread boards articulated in an endless fashion and supported by said main frame so as to circulate along said path, tread board axles swingably carrying said tread boards and extending transversely with respect to the circulation direction of said tread boards, outer and inner drive rollers rotatably mounted on each of said tread board axles near its outer and inner ends respectively, upper and lower outer and inner drive rails fixedly secured to said main frame and adapted to carry thereon said outer and inner drive rollers in said upper load and lower return runs, respectively, outer and inner

follower rollers rotatably mounted on each of said tread boards at both sides, upper, outer and inner follower rails and at least one lower follower rail secured to said main frame and adapted to carry thereon said outer and inner follower rollers in said upper load and lower return runs, respectively, outer and inner tread board chains drivingly connecting said tread board axles near their outer and inner ends respectively, and side rollers provided on said tread board axles on at least one end thereof such that their axes are orthogonal to the said tread board axles and such that they bear the load applied to said tread board axles in the direction towards the centre of said curved path, and pressure rails for holding the drive rollers against the drive rails, to prevent said drive rollers from being raised away from said drive rails, and wherein a tension means for said endless outer and inner tread board chains is provided at said lower deflection portion which comprises an axle adapted to be shifted horizontally relative to said main frame, and outer and inner ends thereof, respectively, upper and lower outer rail means secured to said main frame to guide said outer drive rollers along said deflection portion have horizontal parts connected to the lower ends of said upper and lower outer rails, upper and lower inner rail means secured to said main frame to guide said inner drive rollers along said deflection portion have horizontal parts connected to the lower ends of said upper and lower drive rails and inclined rail means between the said horizontal rail parts and the axle slope towards substantially the centre axis of said axle, characterised in that the inclined rail means include horizontal portions which are slidably connected to the said horizontal rail parts and are integral with the inclined portions and that the inclined rail means are mounted on a common movable frame with the chain sprocket axle so as to move with the shaft when the latter is moved to adjust the chain tension, the said side rollers are guided by said drive rails along said upper load run and lower return runs respectively.

It should be noted that US—A—3365051 discloses the provision of tensioning means at reversal points of a moving-walk belt.

In one of the preferred embodiments of the present invention, the upper outer and inner drive rails as well as the upper outer and inner follower rails are supported on a number of radial horizontal crossbeams fixedly secured to the main frame, and the outer drive rail and the outer follower rail are interconnected by a bracket disposed at substantially midway between adjoining crossbeams, increasing the strength and rigidity of these rails.

Preferably, upper and lower outer and/or inner pressure rails are secured to the main frame to prevent the drive rollers from being raised from the drive rails.

In the escalator of the present invention, enhanced safety is provided by presser rails which are provided throughout the length of the drive rails including the main inclined run.

The present invention will be further described with reference to the accompanying drawings, in which:

Fig. 1 is a schematic representation of a conventional moving staircase with an arcuate conveyor passage in plan view;

Fig. 2 is a plan view of the moving staircase shown in Fig. 1;

Fig. 3 is a vertical sectional view of the moving staircase shown in Fig. 1 taken along the line III—III of Fig. 2;

Fig. 4 is a vertical sectional view similar to Fig. 3, but illustrating an embodiment of the present invention;

Fig. 5 is a plan view of the essential portion of the embodiment shown in Fig. 4 on a larger scale;

Fig. 6 is a side elevation of the embodiment shown in Figs. 4 and 5 as viewed in the direction shown by the arrows VI—VI in Fig. 5;

Fig. 7 is a partial plan view of the main frame and the various rail portions of the embodiment shown in Fig. 4 on a larger scale;

Fig. 8 is a partial plan view similar to Fig. 7, but illustrating another embodiment of the present invention;

Fig. 9 is a sectional view of Fig. 8 taken along the line IX—IX in Fig. 8;

Fig. 10 is a partial side elevation of the tension wheel means shown in Fig. 1, but also partially illustrating the presser rails in accordance with the present invention;

Fig. 11 is a partial side elevation similar to Fig. 10, but illustrating partially the state after the tension wheel means is shifted in a conventional moving staircase with a straight conveyor passage;

Fig. 12 is a partial side elevation similar to Fig. 10, but illustrating the state after the tension wheel means is shifted relative to the main frame;

Fig. 13 is a partial side elevation similar to Fig. 11, but illustrating the provision of the inclined rail device in accordance with the present invention;

Fig. 14 is a plan view of the inclined rail device shown in Fig. 13 as viewed in the direction shown by the arrows XIV—XIV of Fig. 13;

Fig. 15 is a vertical sectional view similar to Fig. 4, but illustrating a variant form of the embodiment shown therein; and

Fig. 16 is a schematic exploded side elevation of a moving staircase as a whole to illustrate the state of the tread boards while they move along the upper load and lower return runs.

Description of the preferred embodiments

Reference is now made to Figs. 4 to 6 of the attached drawings wherein is shown a first embodiment of the present invention. In these drawings the components indicated by the reference numerals 1, 3a, 3b, 3c, 4b, 4d, 5a, 5b, 5c, 6a, 6b and 7 are generally identical to those in a conventional curved moving staircase as described above in reference to Figs. 1 to 3.

In Fig. 4, reference numeral 11a denotes an outer drive rail which is adapted to carry thereon

the outer drive rollers 3b for the upper load run 2a and which is rigidly secured to an outer bracket 13a at its upper left corner as viewed in Fig. 4, the bracket 13a being integral with the main frame 1. 12a denotes a presser rail for the outer drive rollers 3b which is adapted to urge them downwards against the outer drive rail 11a for the upper load run 2a and which is rigidly secured to an upper end bracket 14a which is integral with the main frame 1, at its lower right corner as viewed in Fig. 4 so that the presser rail 12a is vertically aligned with the outer drive rail 11a for the upper load run 2a. 11c denotes an outer drive rail which is adapted to carry thereon the outer drive rollers 3b for the lower return run 2b and which is rigidly secured to the main frame 1 through a lower end bracket 14b integral therewith at its upper right corner as viewed in Fig. 4. 12c denotes a presser rail for the outer drive rollers 3b which is adapted to urge them downwards against the outer drive rail 11c for the lower return run 2c and which is rigidly secured to the outer bracket 13a at its lower left corner as viewed in Fig. 4 so that the presser rail 12c is vertically aligned with the outer drive rail 11c for the lower return run 2c.

The side rollers 7 are adapted to be guided by the outer side surface of the outer drive rail 11a and the outer side surface of the presser rail 12c for the upper load run 2b and the lower return run 2c, respectively.

Thus, in this first embodiment, should the outer and/or the inner drive rollers 3b, 3c be subjected to a force urging them upwards the outer drive rollers 3b are prevented from being raised up from the surfaces of the outer drive rails 11a and 11c owing to the existence of the presser rails 12a and 12c, whereby the derailing of the side rollers 7 from the outer drive rail 11a and the presser rail 12c is simultaneously prevented by the presser rail 12a and the outer drive rail 11c for the upper load run 2a and the lower return run 2c, respectively.

Although in the above description the presser rails 12a and 12c are provided at the side of the outer drive rollers 3b, it will be apparent that similar effects can be obtained even if the presser rails be provided at the side of the inner drive rollers 3c.

It is also conceivable that the presser rails be provided at the sides of both and outer and inner drive rollers 3b and 3c.

An additional advantage of the first embodiment resides in the fact that although the presser rails 12a and 12c are provided, since the guide rails for the side rollers 7 are constituted by the outer side surfaces of the drive rail 11a or the presser rail 12c, the number of rails employed is no greater than in a conventional moving staircase.

At this point, for the object of providing a better understanding of the improvement in accordance with the present invention in the support system for the various rails in the embodiment shown in Figs. 4 to 6, the constitution of the main frame 1

together with its associated members will be explained more fully in reference to Figs. 4 to 7.

As shown in these figures, the outer and inner vertical members 10 and 11 constituting the outer and inner strength members of main frame 1, respectively, are rigidly connected together by a number of radial main frame crossbeams 1a which are disposed between the vertical members 10 and 11, the vertical members being disposed at suitable intervals along the conveyor passage 2. The outer and inner brackets 13a and 13b are secured to the main frame crossbeams 1a at positions corresponding to the outer drive rails 11a and the inner drive rails 4b, respectively. The outer bracket 13a also supports the outer follower rails 5a, 5c, and the presser rail 12c, while the inner bracket 13b supports the inner drive rails 4b, 4d and the inner follower rails 5b, 5d. The outer member 10 of the main frame 1 is further provided with the upper end bracket 14a and the lower end bracket 14b at its upper and lower end portions, respectively, and the upper and lower end brackets 14a and 14b rigidly mount the presser rail 12a and the outer drive rail 11c, respectively.

With such a constitution of the main frame 1 together with its associated members, since the outer drive rail 11a and the lower presser rail 12c are subjected to large forces through the side rollers 7 during the operation of the moving staircase, in order to resist the forces, the dimensions of the rails 11a and 12c must be made large, and at the same time the spacing between adjoining main frame crossbeams 1a, and thus the spacing between adjacent outer brackets 13a, inner brackets 13b, upper end brackets 14a, and lower end brackets 14b, as measured along the conveyor passage 2, must be decreased so that the support spans of the rails 11a, 12c, etc. are made small. However, such a measure causes the installation cost of the moving staircase to be high.

The improvement of the present invention to remedy this difficulty resides in as follows.

In the second embodiment of the present invention, as shown in Figs. 8 and 9, a bracket 15 having generally the shape of a hat in cross section is disposed between the outer drive rail 11a and the upper outer follower rail 5a at substantially midway between adjoining outer brackets 13a, the bracket 15 being rigidly secured to the rails 11a and 5a by bolts 16 or the like.

With such a measure the thrust applied to the outer drive rail 11a through the rotating side rollers 7 can be borne also by the outer follower rail 5a through the brackets 15 disposed therebetween. Thus, since the thrust from the side rollers 7 can be carried not only by the outer drive rail 11a but also by the upper outer follower rail 5a, sufficient strength and rigidity of the outer drive rail 11a can be achieved without it being necessary to increase the cross section thereof or to decrease the spacing between adjoining outer brackets 13a.

Although in the improvement just described the

bracket 15 is disposed between the outer drive rail 11a and the upper outer follower rail 5a in the upper load run 2a, a similar bracket may also be provided between the lower presser rail 12c and the lower outer follower rail 5c in the lower return run 2c. Further, if the inner drive rail 4b is designed to have a cross sectional configuration similar to that of the outer drive rail 11a and if the side rollers 7 are provided so as to roll on the outer periphery of the inner drive rail 4b, a similar bracket may be provided between the inner side drive rail 4b and the inner follower rail 5b.

Next the tension wheel means to be provided at the lower deflection portion 2b of the conveyor passage 2 which is constructed in accordance with the present invention will be described in reference to Figs. 10 to 14 as a third embodiment thereof.

As was previously explained in reference to Figs. 10 to 11, in a conventional curved moving staircase, the inner drive rollers 3c tend to derail from the surfaces of the inner drive rails 4b and 4d at the lower deflection portion 2b when the tension wheel means 10, i.e. the inner sprocket wheel 10b is linearly moved longitudinally outwards relative to the conveyor passage 2, because at the lower deflection portion 2b the rails 4b and 4d comprise the horizontal rail portion 4b' and 4d' and the downwardly and upwardly inclined rail portion 4b'' and 4d''.

Therefore, in accordance with the present invention, for the purpose of remedying this phenomenon, as shown in Figs. 12 and 13, at the lower deflection portion 2b there is provided an inclined rail device 21 which is positioned between the horizontal rail portions 4b' and 4d' of the inner drive rails 4a and 4d of the upper load and lower return runs 2a and 2c, respectively, and the inner sprocket wheel 10b, and which is adapted to be horizontally shiftable. The inclined rail device 21 comprises a horizontal upper rail portion 21b' which is slidably connected with the horizontal rail portion 4b' through a sliding joint 22b with their upper surfaces being flush with each other, a horizontal lower rail portion 21d which is slidably connected with the horizontal rail portion 4d' through a similar sliding joint 22d, an upper inclined rail portion 21b'' which is connected to the outer end of the horizontal rail portion 21b', and a lower inclined rail portion 21d''. The upper inclined rail portion 21b'' slopes downwards substantially towards the center of the inner sprocket wheel 10b, whereas the lower inclined rail portion 21d'' slopes upwards substantially towards the center of the inner sprocket wheel 10b. The inclined rail device 21 is rigidly connected to the frame 23 of the inner sprocket wheel 10b by brackets 24 through any suitable fastening means (not shown), the frame 23 being mounted on the main frame 1 so as to be shiftable relative thereto.

With such a constitution of the inclined rail device 21, even if the frame 23 is moved outwards by a distance W relative to the main frame 1 as shown in Fig. 13 in order to compensate for the

elongation of the endless tread board chain 6b due to wear, etc., the inclined rail device 21 is also moved by the same distance W together with the frame 23 through any suitable means, and no relative change in position between the inner tread board chain 6b and the rail portions 4b', 21b', 21b'', 4d', 21d' and 21d'' occurs.

Therefore, it will be apparent that no change in the relative position between the rails 4b, 4d, 4b', 4d', 21b', 21b'', 21d' and 21d'' at the lower deflection portion 2b and the endless inner tread board chain 6b occurs regardless of the shift of the inner sprocket wheel 10b. Thus, the movement of the endless inner tread board chain 6b is always kept stable, overcoming the difficulties in the conventional curved moving staircase as described above.

At this point it should be noted that in Fig. 13 it is assumed that at the inner side of the conveyor passage 2 there are provided presser rails 12b and 12d in addition to or in place of the presser rails 12a and 12c provided at the outer side of the conveyor passage 2, the presser rails 12b and 12d having similar constitutions to those of the presser rails 12a and 12c, respectively, and that although the presser rail 12b terminates in a horizontal rail portion 12b' substantially at the position of the horizontal rail portion 4b' of the inner drive rail 4b, the presser rail 12d connects to a horizontal rail portion 12d' substantially in parallel with the horizontal rail portion 4d', and that the horizontal rail portion 12d' is adapted to be shiftable connected to the horizontal rail portion 21e' of the inclined rail device 21 through a sliding joint 22d' similar to the sliding joint 22b for the horizontal upper rail portion 21b', whereby the horizontal rail portion 21e' is rigidly mounted to the inclined rail device 21 together with an inclined rail portion 21e'' which is integral with the horizontal rail portion 21e' and substantially in parallel with the inclined rail portion 21d''.

Finally, as another embodiment of the present invention a variation of the first embodiment will be explained with reference to Figs. 15 and 16.

As publicly known in the art, in a curved moving staircase of this kind, the upper surfaces of the tread boards 3 are always maintained horizontal while they move along the upper load run 2a of the conveyor passage 2. In this case, the follower rails 5a and 5b in the upper load run 2a function to carry the load of the passengers getting on the tread boards 3 together with the upper and lower outer drive rails 11a and 11c, while the lower outer and inner follower rails 5c and 5d in the lower return run 2c function to maintain the attitude of the tread boards 3. In this case, since the follower rails 5c and 5d in the lower return run 2c do not carry the load of the passengers, the attitude of the tread boards 3 can be maintained just as well even when either one of the follower rollers 20a or 20b is supported by one of the follower rails 5c or 5d, no need being required for the follower rails 5c and 5d to be arranged over the whole moving range of the follower rollers 20a, 20b.

From this point of view, as shown in Figs. 15 and 16, the lower inner follower rail 5d, shown in Fig. 4, is omitted.

At this point it should be noticed that, as shown in Fig. 16, since the tread boards 3 in the upper load run 2a in Section A have passengers thereon, it is necessary that the rollers 3b, 3c, 20a, 20b and 7 be guided by the corresponding rails 11a, 4b, 5a, 5b, and 11a so as to carry the load of the passengers, but, at any section other than Section A, since the tread boards 3 carry no load, the attitude of the tread boards 3 can be maintained even if the lower inside follower rail 5d is omitted, and the same safety level as in the conventional curved moving staircase is maintained.

Although in the above variation the lower inner follower rail 5d is omitted, it is, of course, possible to omit the lower outer follower rail 5c, and further the lower follower rail 5c or 5d need not be arranged over the whole moving range of the follower roller 20a or 20b. Instead they may be partially arranged at several necessary locations so long as they provide a continuous passage for the follower rollers 20a and 20b as a whole.

It is to be understood that although certain forms of the present invention have been illustrated and described it is not to be limited thereto except insofar as such limitations are included in the following claims.

Claims

1. A moving staircase with a curved path in plan formed of an upper load run (2a), a lower return run (2c) and horizontal upper and lower deflection portions (2b) connecting said upper load and lower return runs together at their upper and lower end portions, respectively, comprising a main frame (1), tread boards (3) articulated in an endless fashion and supported by said main frame so as to circulate along said path, tread board axles (3a) swingably carrying said tread boards and extending transversely with respect to the circulation direction of said tread boards, outer and inner drive rollers (3b, 3c) rotatably mounted on each of said tread board axles near its outer and inner ends respectively, upper and lower outer and inner drive rails (4b, 4d, 11a, 11c) fixedly secured to said main frame and adapted to carry thereon said outer and inner drive rollers in said upper load and lower return runs, respectively, outer and inner follower rollers (20a, 20b) rotatably mounted on each of said tread boards at both sides, upper, outer and inner follower rails (5a, 5b) and at least one lower follower rail (5c, 5d) secured to said main frame and adapted to carry thereon said outer and inner follower rollers in said upper load and lower return runs, respectively, outer and inner tread board chains (6a, 6b) drivingly connecting said tread board axles near their outer and inner ends respectively, and side rollers (7) provided on said tread board axles on at least one end thereof such that their axes are orthogonal to the said tread board axles and such that they bear the load applied to said tread board

axles in the direction towards the centre of said curved path, and presser rails (12a, 12c) for holding the drive rollers against the drive rails, to prevent said drive rollers (3b—3c) from being raised away from said drive rails (11a, 11c, 4b, 4d), and wherein a tension means for said endless outer and inner tread board chains is provided at said lower deflection portion which comprises an axle (10) adapted to be shifted horizontally relative to said main frame (1), and outer and inner chain sprocket wheels (10a, 10b) secured to said axle near the outer and inner ends thereof, respectively, upper and lower outer rail means (11, 12) secured to said main frame to guide said outer drive rollers (3b) along said deflection portion (2b) have horizontal parts connected to the lower ends of said upper and lower outer rails, upper and lower inner rail means (4, 12) secured to said main frame to guide said inner drive rollers (3c) along said deflection portion have horizontal parts (4b', 4d', 12b', 12d') connected to the lower ends of said upper and lower drive rails and inclined rail means (21b, 21d, 21e) between the said horizontal rail parts and the axle (10) slope towards substantially the centre axis of said axle, characterised in that the inclined rail means (21b, 21d, 21e) include horizontal portions (21b', 21d', 21e') which are slidably connected to the said horizontal rail parts (4b', 4d', 12b', 12d') and are integral with the inclined portions (21b'', 21d'', 21e''), and that the inclined rail means are mounted on a common movable frame (23) with the chain sprocket axle (10) so as to move with the shaft when the latter is moved to adjust the chain tension, the said side rollers (7) are guided by said drive rails (11a) and said presser rails (12c) along said upper load run (2a) and lower return runs (2c) respectively.

2. A curved moving staircase as claimed in claim 1, characterised in that the side rollers (7) and the drive rollers (3b) bear respectively on vertical and horizontal guide surfaces of a common drive rail (11a).

3. A curved moving staircase as claimed in claim 1 or 2 characterised in that upper and lower outer and/or inner presser rails (12a—12d) are secured to the main frame to prevent the drive rollers (3b) from being raised from the drive rails.

4. A curved moving staircase as claimed in claim 1, 2 or 3 characterised in that said lower outer and inner follower rails (5c, 5d) have either one omitted, or are intermittently provided, but so as to be continuous as a whole.

5. A curved moving staircase as claimed in claim 1, 2, 3 or 4, wherein said main frame comprises an outer frame member (1o) disposed along the outer periphery of said curved path, an inner frame member (1i) disposed along the inner periphery of said path, a number of radial crossbeams (1a) which are disposed at intervals along said path so as to diverge radially from the centre of said path and which rigidly connect said outer and inner frame members, a number of outer brackets (13a) each rigidly connected to said crossbeams, so as to mount thereon said upper

From this point of view, as shown in Figs. 15 and 16, the lower inner follower rail 5d, shown in Fig. 4, is omitted.

At this point it should be noticed that, as shown in Fig. 16, since the tread boards 3 in the upper load run 2a in Section A have passengers thereon, it is necessary that the rollers 3b, 3c, 20a, 20b and 7 be guided by the corresponding rails 11a, 4b, 5a, 5b, and 11a so as to carry the load of the passengers, but, at any section other than Section A, since the tread boards 3 carry no load, the attitude of the tread boards 3 can be maintained even if the lower inside follower rail 5d is omitted, and the same safety level as in the conventional curved moving staircase is maintained.

Although in the above variation the lower inner follower rail 5d is omitted, it is, of course, possible to omit the lower outer follower rail 5c, and further the lower follower rail 5c or 5d need not be arranged over the whole moving range of the follower roller 20a or 20b. Instead they may be partially arranged at several necessary locations so long as they provide a continuous passage for the follower rollers 20a and 20b as a whole.

It is to be understood that although certain forms of the present invention have been illustrated and described it is not to be limited thereto except insofar as such limitations are included in the following claims.

Claims

1. A moving staircase with a curved path in plan formed of an upper load run (2a), a lower return run (2c) and horizontal upper and lower deflection portions (2b) connecting said upper load and lower return runs together at their upper and lower end portions, respectively, comprising a main frame (1), tread boards (3) articulated in an endless fashion and supported by said main frame so as to circulate along said path, tread board axles (3a) swingably carrying said tread boards and extending transversely with respect to the circulation direction of said tread boards, outer and inner drive rollers (3b, 3c) rotatably mounted on each of said tread board axles near its outer and inner ends respectively, upper and lower outer and inner drive rails (4b, 4d, 11a, 11c) fixedly secured to said main frame and adapted to carry thereon said outer and inner drive rollers in said upper load and lower return runs, respectively, outer and inner follower rollers (20a, 20b) rotatably mounted on each of said tread boards at both sides, upper, outer and inner follower rails (5a, 5b) and at least one lower follower rail (5c, 5d) secured to said main frame and adapted to carry thereon said outer and inner follower rollers in said upper load and lower return runs, respectively, outer and inner tread board chains (6a, 6b) drivingly connecting said tread board axles near their outer and inner ends respectively, and side rollers (7) provided on said tread board axles on at least one end thereof such that their axes are orthogonal to the said tread board axles and such that they bear the load applied to said tread board

axles in the direction towards the centre of said curved path, and presser rails (12a, 12c) for holding the drive rollers against the drive rails, to prevent said drive rollers (3b—3c) from being raised away from said drive rails (11a, 11c, 4b, 4d), and wherein a tension means for said endless outer and inner tread board chains is provided at said lower deflection portion which comprises an axle (10) adapted to be shifted horizontally relative to said main frame (1), and outer and inner chain sprocket wheels (10a, 10b) secured to said axle near the outer and inner ends thereof, respectively, upper and lower outer rail means (11, 12) secured to said main frame to guide said outer drive rollers (3b) along said deflection portion (2b) have horizontal parts connected to the lower ends of said upper and lower outer rails, upper and lower inner rail means (4, 12) secured to said main frame to guide said inner drive rollers (3c) along said deflection portion have horizontal parts (4b', 4d', 12b', 12d') connected to the lower ends of said upper and lower drive rails and inclined rail means (21b, 21d, 21e) between the said horizontal rail parts and the axle (10) slope towards substantially the centre axis of said axle, characterised in that the inclined rail means (21b, 21d, 21e) include horizontal portions (21b', 21d', 21e') which are slidably connected to the said horizontal rail parts (4b', 4d', 12b', 12d') and are integral with the inclined portions (21b'', 21d'', 21e''), and that the inclined rail means are mounted on a common movable frame (23) with the chain sprocket axle (10) so as to move with the shaft when the latter is moved to adjust the chain tension, the said side rollers (7) are guided by said drive rails (11a) and said presser rails (12c) along said upper load run (2a) and lower return runs (2c) respectively.

2. A curved moving staircase as claimed in claim 1, characterised in that the side rollers (7) and the drive rollers (3b) bear respectively on vertical and horizontal guide surfaces of a common drive rail (11a).

3. A curved moving staircase as claimed in claim 1 or 2 characterised in that upper and lower outer and/or inner presser rails (12a—12d) are secured to the main frame to prevent the drive rollers (3b) from being raised from the drive rails.

4. A curved moving staircase as claimed in claim 1, 2 or 3 characterised in that said lower outer and inner follower rails (5c, 5d) have either one omitted, or are intermittently provided, but so as to be continuous as a whole.

5. A curved moving staircase as claimed in claim 1, 2, 3 or 4, wherein said main frame comprises an outer frame member (1o) disposed along the outer periphery of said curved path, an inner frame member (1i) disposed along the inner periphery of said path, a number of radial crossbeams (1a) which are disposed at intervals along said path so as to diverge radially from the centre of said path and which rigidly connect said outer and inner frame members, a number of outer brackets (13a) each rigidly connected to said crossbeams, so as to mount thereon said upper



outer drive rail (11a) and said upper outer follower rail (5a), and a number of inner brackets (13b) each rigidly connected to said crossbeams so as to mount thereon said upper inner drive rail (4b) and said upper inner follower rail (5b), characterised by brackets (15) rigidly connecting together said upper outer drive rail (11a) and said upper outer follower rail (5a) substantially midway between adjoining ones of said crossbeams (1a) and/or a number of further brackets each rigidly connecting together said upper inner drive rail (4b) and said upper inner follower rail (5b) substantially midway between adjoining ones of said crossbeams.

Patentansprüche

1. Bogenrolltreppe, bestehend aus einer oberen Lastaufnahmestrecke (2a), einer unteren Rücklaufstrecke (2c) und horizontalen, oberen und unteren Umlenkbereichen (2b), welche die obere Lastaufnahmestrecke und die untere Rücklaufstrecke in ihren oberen bzw. unteren Endbereichen verbinden, umfassend einen Hauptrahmen (1), Trittbretter (3), die in endloser Weise angelenkt und von dem Hauptrahmen gelagert sind, so daß sie längs der bogenförmigen Strecke umlaufen, Trittbrettachsen (3a), die schwenkbar die Trittbretter tragen und sich quer bezüglich der Umlaufrichtung der Trittbretter erstrecken, äußere und innere Antriebsrollen (3b, 3c), die drehbar an jeder der Trittbrettachsen in der Nähe ihrer äußeren bzw. inneren Enden montiert sind, obere und untere, äußere und innere Antriebsrollen (4b, 4d, 11a, 11c), die fest an dem Hauptrahmen befestigt und so ausgelegt sind, daß sie darauf die äußeren und inneren Antriebsrollen in der oberen Lastaufnahmestrecke bzw. der unteren Rücklaufstrecke tragen, äußere und innere Mitläuferrollen (20a, 20b), die drehbar an jedem der Trittbretter an beiden Seiten montiert sind, obere, äußere und innere Mitläuferschienen (5a, 5b) und mindestens eine untere Mitläuferschiene (5c, 5d), die am Hauptrahmen befestigt und so ausgelegt sind, daß sie darauf die äußeren und inneren Mitläuferrollen in der oberen Lastaufnahmestrecke bzw. der unteren Rücklaufstrecke tragen, äußere und innere Trittbrettketten (6a, 6b), die antriebsmäßig die Trittbrettachsen in der Nähe ihrer äußeren bzw. inneren Enden verbinden, und Seitenrollen (7), die an den Trittbrettachsen an mindestens einem ihrer Enden vorgesehen sind, so daß ihre Achsen orthogonal zu den Trittbrettachsen sind und so daß sie die Last, welche die Trittbrettachsen beaufschlagt, in der Richtung zum Zentrum der gebogenen Laufstrecke tragen, und Andruckschienen (12a, 12c), um die Antriebsrollen gegen die Antriebsschienen zu halten, um zu verhindern, daß die Antriebsrollen (3b—3c) von den Antriebsschienen (11a, 11c, 4b, 4d) weg angehoben werden, und wobei eine Spanneinrichtung für die endlosen äußeren und inneren Trittbrettketten im unteren Umlenkbereich vorgesehen ist, die eine Achse (10), welche horizontal relativ zum Hauptrahmen

(1) verschiebbar ist, und äußere und innere Kettenzahnräder (10a, 10b) aufweist, die an der Achse in der Nähe ihrer äußeren bzw. inneren Enden befestigt sind, wobei obere und untere, äußere Schienen (11, 12), die am Hauptrahmen befestigt sind, um die äußeren Antriebsrollen (3b) längs des Umlenkbereiches (2b) zu führen, horizontale Teile haben, die mit den unteren Enden der oberen und unteren, äußeren Schienen verbunden sind, wobei obere und untere, innere Schienen (4, 12), die am Hauptrahmen befestigt sind, um die inneren Antriebsrollen (3c) längs des Umlenkbereiches zu führen, horizontale Teile (4b', 4d', 12b', 12d') haben, die mit den unteren Enden der oberen und unteren Antriebsschienen verbunden sind, und geneigte Schienen (21b, 21d, 21e) zwischen den horizontalen Schienenteilen und der Achse (10) im wesentlichen schräg zur Mittelachse der Achse hin verlaufen, dadurch gekennzeichnet, daß die geneigten Schienen (21b, 21d, 21e) horizontale Teile (21b', 21d', 21e') aufweisen, die gleitend mit den horizontalen Schienenteilen (4b', 4d', 12b', 12d') verbunden und integral mit den geneigten Teilen (21b'', 21d'', 21e'') ausgebildet sind,

und daß die geneigten Schienen an einem gemeinsamen beweglichen Rahmen (23) mit der Kettenzahnradachse (10) montiert sind, um sich mit der Achse zu bewegen, wenn letztere bewegt wird, um die Kettenspannung einzustellen, wobei die Seitenrollen (7) von den Antriebsschienen (11a) und den Andruckschienen (12c) längs der oberen Lastaufnahmestrecke (2a) bzw. der unteren Rücklaufstrecke (2c) geführt sind.

2. Bogenrolltreppe nach Anspruch 1, dadurch gekennzeichnet, daß die Seitenrollen (7) und die Antriebsrollen (3b) jeweils gegen vertikale bzw. horizontale Führungsflächen einer gemeinsamen Antriebsschiene (11a) drücken.

3. Bogenrolltreppe nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die oberen und unteren, äußeren und/oder inneren Andruckschienen (12a—12d) am Hauptrahmen befestigt sind, um zu verhindern, daß die Antriebsrollen (3b) von den Antriebsschienen abgehoben werden.

4. Bogenrolltreppe nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß von den unteren, äußeren und inneren Mitläuferschienen (5c, 5d) eine weggelassen oder diese absatzweise vorgesehen sind, so daß sie aber insgesamt kontinuierlich vorgesehen ist.

5. Bogenrolltreppe nach Anspruch 1, 2, 3 oder 4, wobei der Hauptrahmen folgendes aufweist: Ein äußeres Rahmenteil (10), das längs des Außenumfanges der gebogenen Strecke angeordnet ist, ein inneres Rahmenteil (11), das längs des Innenumfanges der Strecke angeordnet ist, eine Anzahl von radialen Querträgern (1a), die in Abständen längs der Bahn angeordnet sind, so daß sie von dem Zentrum der Strecke radial divergieren, und die die äußeren und inneren Rahmentteile starr verbinden, eine Anzahl von äußeren Trägern (13a), die jeweils starr mit den Querträgern verbunden sind, um darauf die obere, äußere



Antriebschiene (11a) und die obere, äußere Mitläuferschiene (5a) zu montieren, und eine Anzahl von inneren Trägern (13b), die jeweils starr mit den Querträgern verbunden sind, um darauf die obere, innere Antriebschiene (4b) und die obere, innere Mitläuferschiene (5b) zu montieren, gekennzeichnet durch Träger (15), die die obere, äußere Antriebschiene (11a) und die obere, äußere Mitläuferschiene (5a) starr verbinden, im wesentlichen in der Mitte zwischen angrenzenden Querträgern (1a), und/oder eine Anzahl von weiteren Trägern, die jeweils die obere, innere Antriebschiene (4b) und die obere, innere Mitläuferschiene (5b) starr miteinander verbinden, im wesentlichen in der Mitte zwischen angrenzenden Querträgern.

Revendications

1. Un escalier roulant comportant un chemin curviligne, en plan, formé d'une piste de charge supérieure (2a), d'une piste de retour inférieure (2c) et de parties de déflexion horizontales supérieure et inférieure (2b) reliant lesdites pistes supérieure de charge et inférieure de retour, ensemble, à leurs parties d'extrémités supérieure et inférieure, respectivement, comportant une structure principale (1), des girons (3) articulés, sans fin, et supportés par ladite structure principale afin de circuler le long dudit chemin, des axes de giron (3a) supportant de façon pivotante lesdits girons et s'étendant transversalement par rapport à la direction de mouvement desdits girons, des galets d'entraînement extérieurs et intérieurs (3b, 3c), montés de façon rotative sur chacun desdits axes de giron à proximité de ses extrémités extérieure et intérieure, respectivement, des rails d'entraînement supérieurs et inférieurs, extérieurs et intérieurs, (4b, 4d, 11a, 11c), maintenus fixement à ladite structure principale et adaptés à supporter lesdits galets d'entraînement extérieurs et intérieurs dans lesdites pistes supérieure de charge et inférieure de retour, respectivement, des galets suiveurs extérieurs et intérieurs (20a, 20b) montés de façon rotative sur chacun des girons et des deux côtés, des rails suiveurs supérieurs, extérieur et intérieur (5a, 5b) et au moins un rail suiveur inférieur (5c, 5d) fixé à ladite structure principale et adapté à supporter lesdits galets suiveurs extérieurs et intérieurs dans lesdites pistes supérieure de charge et inférieure de retour, respectivement, des chaînes de giron extérieures et intérieures (6a, 6b) reliées de façon entraînée avec les axes de giron à proximité de leurs extrémités extérieure et intérieure, respectivement, et des galets latéraux (7) prévus sur lesdits axes de giron sur au moins une extrémité de ceux-ci, de telle sorte que leurs axes soient perpendiculaires aux axes de giron de telle sorte qu'ils supportent la charge appliquée sur lesdits axes de giron vers le centre dudit chemin curviligne, et des rails presseurs (12a, 12c), pour maintenir les galets d'entraînement contre les rails d'entraînement, pour empêcher lesdits galets d'entraînement (3b—3c) d'être

écartés desdits rails d'entraînement (11a, 11c, 4b, 4d), et dans lequel un moyen de tension desdites chaînes de giron extérieure et intérieure sans fin est prévu à ladite partie de déflexion inférieure, qui comporte un axe (10), adapté à être déplacé horizontalement par rapport à ladite structure principale (1) et des pignons dentés de chaîne extérieur et intérieur (10a, 10b) fixés audit axe à proximité des extrémités extérieure et intérieure de celui-ci, respectivement, des moyens formant rails extérieurs, supérieur et inférieur, (11, 12) fixés à ladite structure principale pour guider lesdits galets d'entraînement extérieurs (3b) le long de la partie de déflexion (2b) ayant des parties horizontales reliées aux extrémités inférieures desdits rails supérieur et inférieur extérieurs, des moyens formant rails intérieurs, supérieur et inférieur (4, 12) fixés à ladite structure principale pour guider lesdits galets d'entraînement intérieurs (3c) le long de ladite partie de déflexion ayant des parties horizontales (4b', 4d', 12b', 12d') connectées aux extrémités inférieures desdits rails d'entraînement supérieurs et inférieurs et des moyens formant rails inclinés (21b, 21d, 21e) entre lesdites parties de rail horizontales et l'axe (10) essentiellement courbé vers l'axe centrale dudit axe, caractérisé en ce que les moyens formant rails inclinés (21b, 21d, 21e) comportent des parties horizontales (21b', 21d', 21e') qui sont montées de façon coulissante sur lesdites parties horizontales (4b', 4d', 12b', 12d') et qui font partie intégrante avec les parties inclinées (21b'', 21d'', 21e''), et en ce que les moyens formant rails inclinés sont montés sur une structure déplaçable commune (23) comportant l'axe de chaîne denté (10) de sorte de se déplacer avec l'axe quand ce dernier est déplacé pour ajuster la tension de la chaîne, lesdits galets latéraux (7) étant guidés par lesdits rails d'entraînement (11a) et par lesdits rails presseurs (12c) le long de ladite piste supérieure de charge (2a) et de ladite piste inférieure de retour (2c) respectivement.

2. Un escalier roulant curviligne selon la revendication 1, caractérisé en ce que les galets latéraux (7) et les galets d'entraînement (3b) sont supportés respectivement sur des surfaces verticales horizontales d'un rail d'entraînement commun (11a).

3. Un escalier roulant curviligne selon la revendication 1 ou 2, caractérisé en ce que les rails presseurs supérieurs et inférieurs, extérieurs et/ou intérieurs (12a—12d) sont fixés à la structure principale pour empêcher les galets d'entraînement (3b) d'être écartés des rails d'entraînement.

4. Un escalier roulant curviligne selon l'une des revendications 1 à 3, caractérisé en ce que lesdits rails suiveurs inférieurs, extérieur et intérieur, sont soit pour l'un omis; ou sont prévus de façon intermittente, mais de sorte qu'ils soient continus en général.

5. Un escalier roulant curviligne selon l'une des revendications 1 à 4, dans lequel ladite structure principale comprend un élément de structure extérieur (10) disposé le long de la périphérie



extérieure dudit chemin curviligne, un élément de structure intérieur (1i) disposé le long de la périphérie intérieure dudit chemin, plusieurs traverses radiales (1a) qui sont disposées à des intervalles le long dudit chemin de sorte de diverger radialement du centre dudit chemin et qui relient rigidement lesdits éléments de structure extérieur et intérieur, plusieurs supports extérieurs (13a), chacun étant relié rigidement auxdites traverses, de sorte de monter sur celles-ci ledit rail d'entraînement extérieur supérieur (11a) et ledit rail suiveur extérieur supérieur (5a), et plusieurs supports intérieurs (13b), chacun relié

de façon rigide auxdites traverses pour recevoir ledit rail d'entraînement intérieur supérieur (4b) et ledit rail suiveur intérieur supérieur (5b), caractérisé par des supports (15) reliant de façon rigide ensemble ledit rail d'entraînement extérieur supérieur (11a) et ledit rail suiveur extérieur supérieur (5a) essentiellement à mi-chemin entre une desdites traverses avoisinantes (1a) et/ou plusieurs supports reliant chacun de façon rigide ledit rail d'entraînement intérieur supérieur (4b) et ledit rail suiveur intérieur supérieur (5b), essentiellement à mi-chemin entre une desdites traverses avoisinantes.

5

10

15

20

25

30

35

40

45

50

55

60

65

10



* C L M S *