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Taher et al.

[11] **3,779,360**

[45] **Dec. 18, 1973**

[54] **TRANSPORTATION DEVICE HAVING MOVABLE HANDRAILS**

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[21] Appl. No.: **283,262**

[52] **U.S. Cl.** ..... **198/16 R,** 198/203

[51] **Int. Cl.** **B66b 9/12**

[58] **Field of Search** 198/16-18, 160, 162, 167, 198/165; 226/108, 171, 172; 271/51

[56] **References Cited**

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3,414,109 12/1968 Clark 198/18

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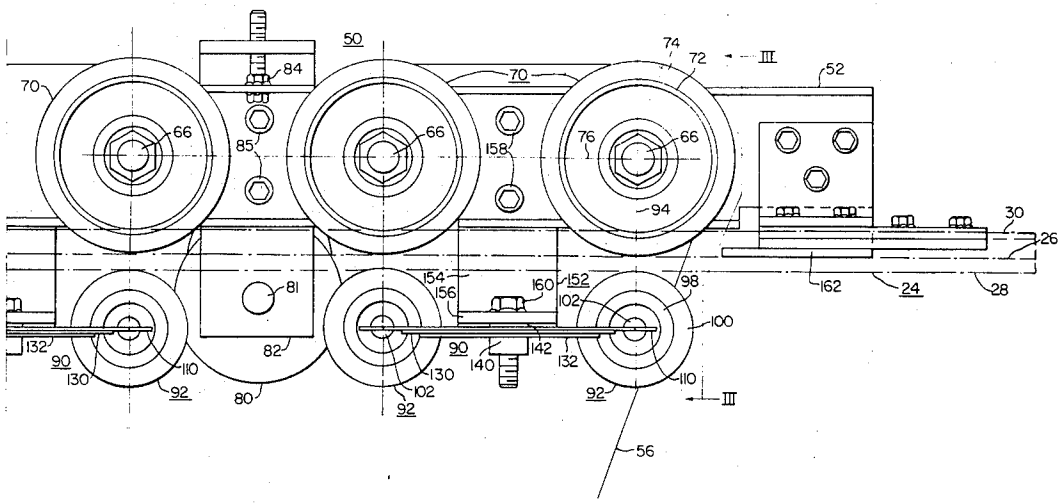
Primary Examiner—Richard E. Aegerter

Attorney—A. T. Stratton et al.

[57] **ABSTRACT**

A transportation device having an endless handrail driven about a closed loop by drive means which include traction and pressure rollers. The pressure rollers are biased against the handrail, opposite the traction rollers, by biasing means which includes at least one main leaf spring member. The leaf spring member is stressed from a predetermined unstressed curved configuration to a flat configuration when the handrail is disposed between the traction and pressure rollers.

21 Claims, 11 Drawing Figures



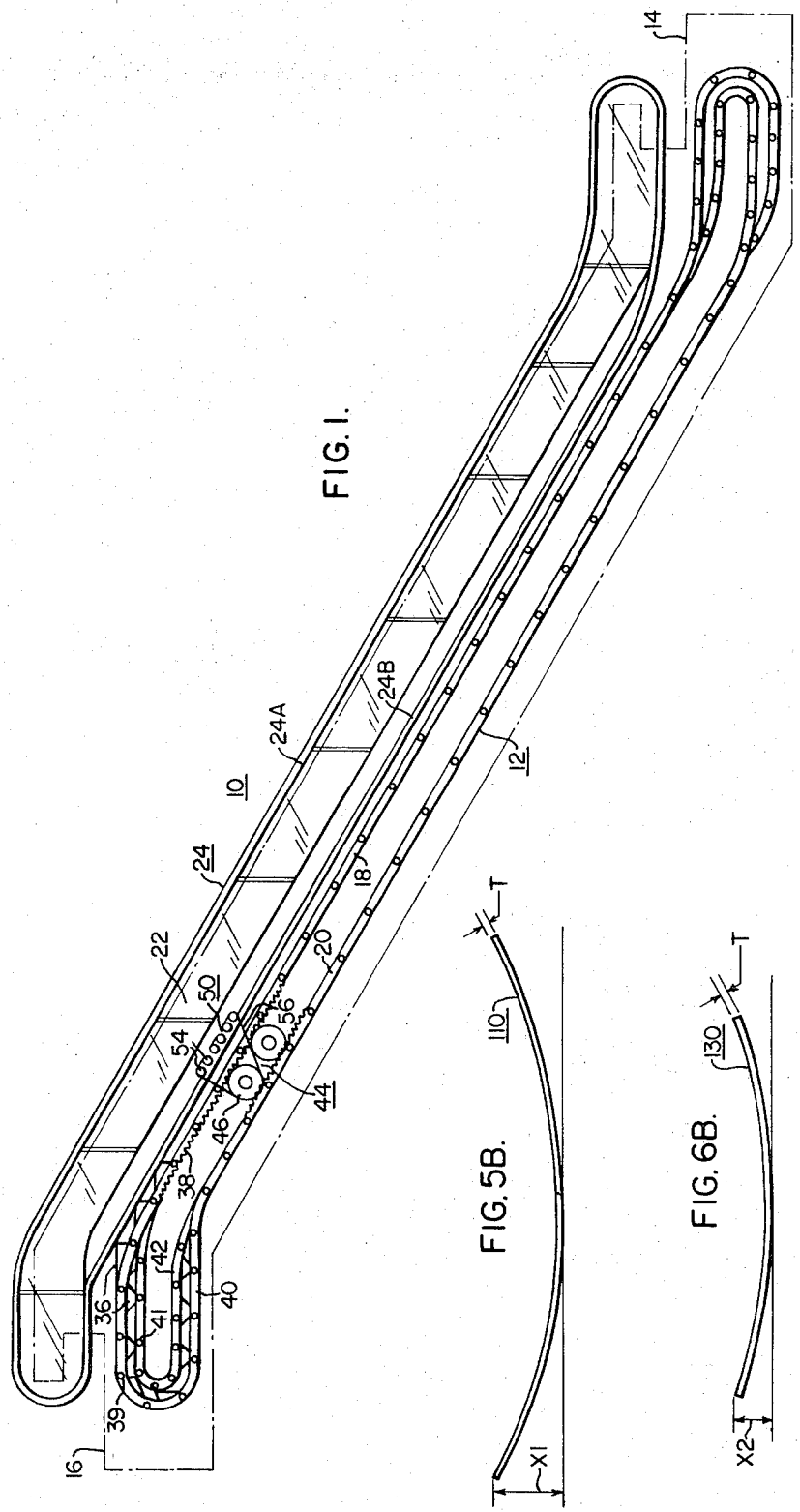


FIG. 1.

FIG. 5B.

FIG. 6B.

FIG. 7B.

FIG. 2.

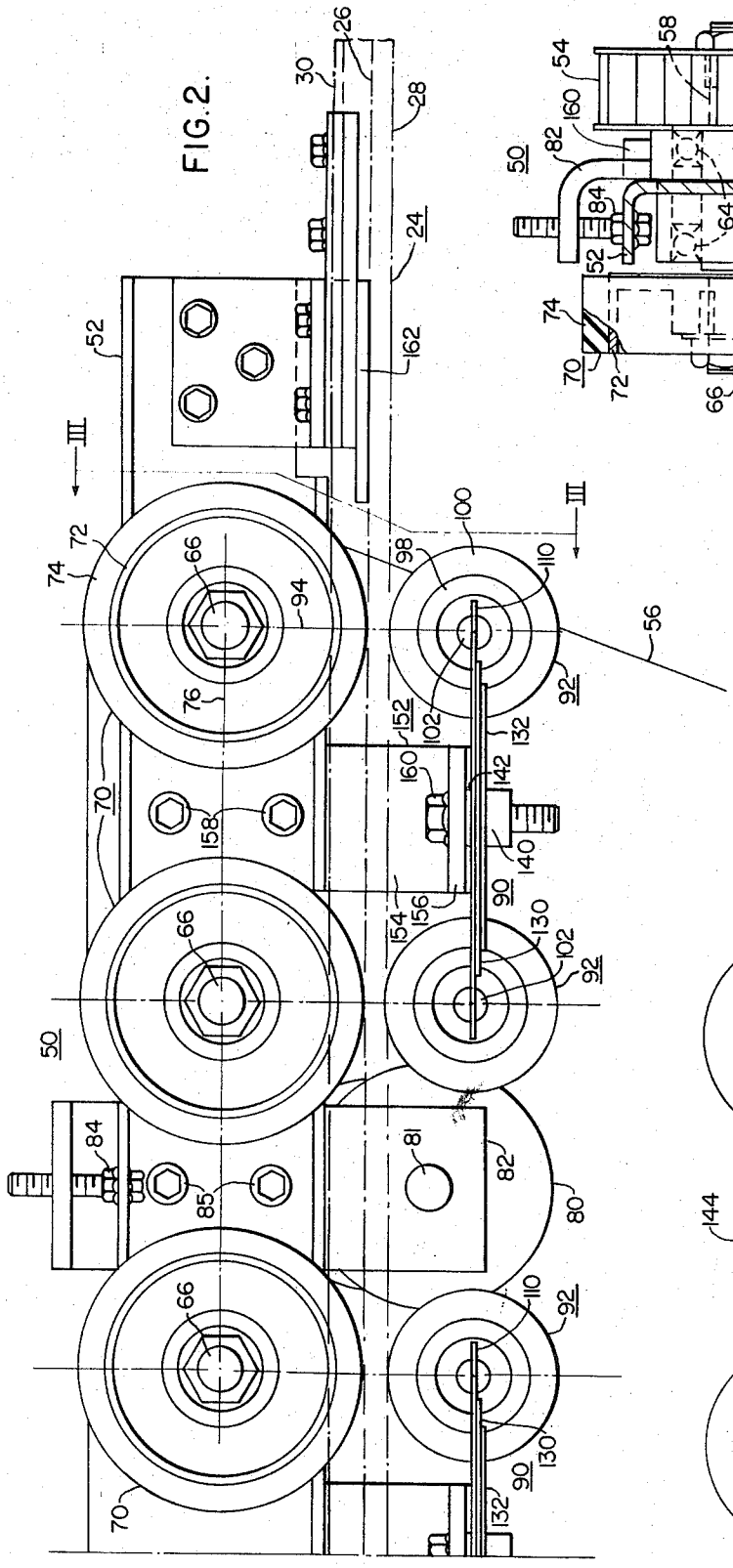


FIG. 3.

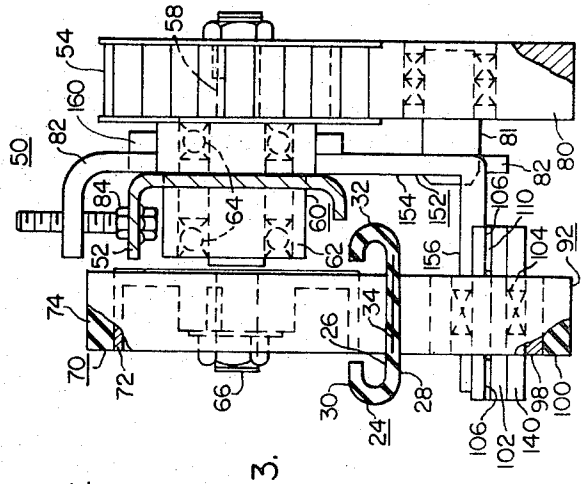
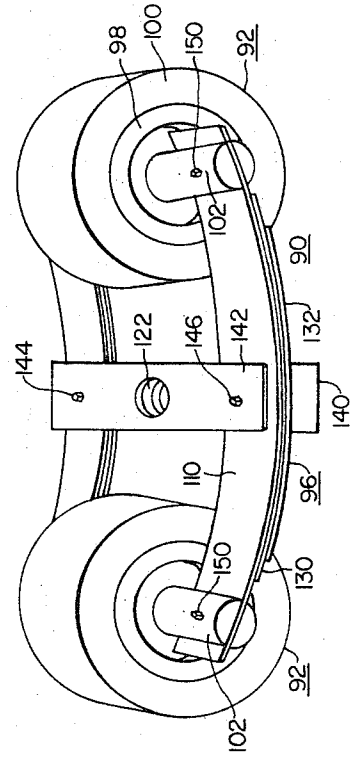


FIG. 4.



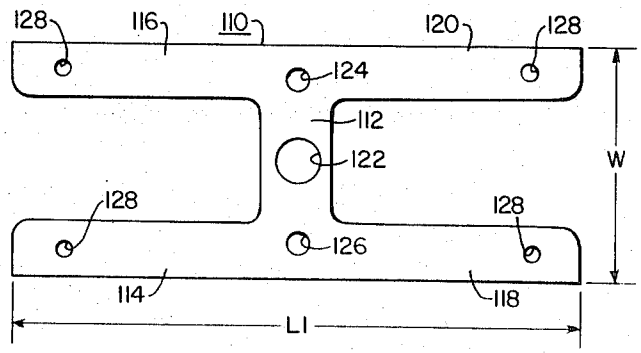


FIG. 5A.

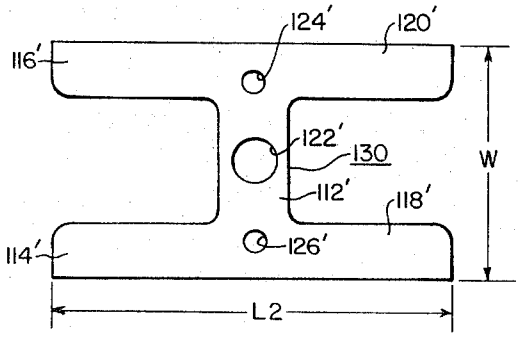


FIG. 6A.

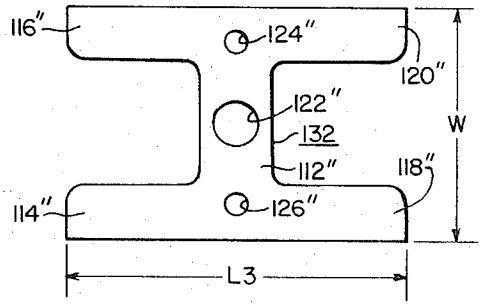


FIG. 7A.

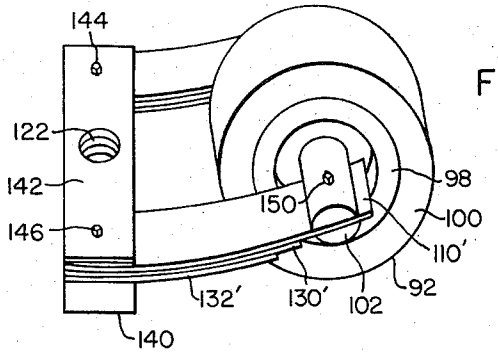


FIG. 8.

TRANSPORTATION DEVICE HAVING MOVABLE HANDRAILS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates in general to transportation devices having movable handrails, and more specifically to transportation devices for transporting people from one landing to another, such as movable walks and electric stairways.

2. Description of the Prior Art

U.S. Pat. No. 3,414,109, which is assigned to the same assignee as the present application, discloses a new and improved transportation device having a movable handrail, in which the handrail drive includes a plurality of traction rollers, and associated pressure rollers, spaced in pairs on opposite sides of the handrail along the direction of handrail movement. This arrangement provides a plurality of driving forces, advantageously reducing the driving force required at any single point. The pressure rollers are disposed in a single cage, with each pressure roller being mounted on a subframe disposed within the cage, and the subframe is biased by a coil spring, pivoting about two pins projecting inwardly from opposite sides of the cage. Thus, the pins function as a fulcrum for the subframe. While this arrangement has provided satisfactory results, the assembly must be very accurately manufactured and assembled in order to achieve the desired operation. The pins upon which the subframe rock must be accurately aligned, or the pressure rollers will not uniformly contact the handrail, riding on one edge or the other of the pressure roller.

The single cage for the plurality of pressure rollers also may have the disadvantage of tending to sag slightly in the middle during service, removing pressure from some of the middle pressure rollers. Thus, the major portion of the driving force may be provided by the end two sets of traction and pressure rollers, defeating the object of trying to evenly divide the driving force into a large plurality of spaced locations.

The coil springs of the cage and subframe assembly must be individually adjusted to provide the desired pressure of the plurality of pressure rollers against the handrail, with this coil spring construction permitting tampering with the pressure. The coil springs permit maintenance personnel to provide extreme pressure, well beyond the designed pressure, which quickly destroy the handrail, as well as bending the cage to a point where the ends of the cage may scrape the handrail.

It would be desirable to provide a new and improved transportation device with a movable handrail which preserves the concept of dividing the handrail driving forces into a plurality of equal, spaced forces along the handrail run, but without the hereinbefore mentioned disadvantages of prior art arrangements.

SUMMARY OF THE INVENTION

Briefly, the present invention is new and improved transportation apparatus having a movable handrail, such as a movable walk or electric stairway, which includes a handrail drive which distributes the driving forces among a plurality of spaced pairs of traction and pressure rollers. The pressure rollers are biased against one side of the handrail by a main leaf spring assembly which accommodates a maximum of two pressure rollers. The main leaf spring is designed with a predetermined curvature therein when unstressed, with the desired bias of each pressure roller against the handrail being achieved when the main leaf spring is stressed to remove the predetermined curvature therefrom. The major opposed surfaces of the main leaf spring are flat and parallel with the surface of the handrail which is engaged by the pressure rollers. Each leaf spring-pressure roller assembly, including one or two pressure rollers, may be easily mounted by a single bolt, which when tightened with the handrail in position between the drive and pressure rollers automatically flattens the main leaf spring to provide a tamper proof predetermined setting for the magnitude of the pressure provided by the pressure rollers. This leaf spring arrangement automatically self-aligns the pressure rollers, resulting in uniform pressure across the width of the pressure rollers; it cannot accidentally overload the handrail through misadjustment; it provides good performance regardless of which direction the handrail is running due to the flat running configuration of the main leaf spring; and, it is less costly to manufacture and assemble than prior art arrangements due to the fewer parts required and absence of close tolerances in hard to control manufacturing operations. Further, any number of pressure roller assemblies may be used without danger of sag, as a maximum of two pressure rollers are assembled together, making each pair of pressure rollers independent of all the other pressure rollers.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be better understood, and further advantages and uses thereof more readily apparent, when considered in view of the following detailed description of exemplary embodiments, taken with the accompanying drawings, in which:

FIG. 1 is a schematic view in side elevation of a transportation device of the type which may embody the teachings of the invention;

FIG. 2 is a fragmentary, side elevational view of a handrail drive assembly constructed according to the teachings of the invention;

FIG. 3 is an end elevation of the handrail drive assembly shown in FIG. 2;

FIG. 4 is a perspective view of a pressure roller assembly employed in the handrail drive unit shown in FIGS. 2 and 3;

FIGS. 5A and 5B are plan and side views of the main leaf spring utilized in the pressure roller assembly shown in FIG. 4;

FIGS. 6A and 6B are plan and side views of a first auxiliary leaf spring member utilized in the pressure roller assembly shown in FIG. 4;

FIGS. 7A and 7B are plan and side views, respectively, of a second auxiliary leaf spring member utilized in the pressure roller assembly shown in FIG. 4; and

FIG. 8 is a perspective view of a pressure roller assembly constructed according to another embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, and FIG. 1 in particular, there is shown a transportation device 10 of the type which may utilize the teachings of the invention. Device 10 employs a conveyor 12 for transporting passengers between a first landing 14 and a second landing 16. The conveyor 12 is preferably of the endless type

conventionally used in moving walks and electric stairways. If the conveyor **12** is a moving walk, it may have a belt-type treadway or a pallet-type. For purposes of example, it will be assumed that the conveyor **12** is in the form of a moving stairway.

Conveyor **12** includes an upper load run **18** on which passengers stand while being transported between the landings, and a lower return run **20.**

A balustrade **22** is disposed above the conveyor **12** for guiding a continuous, flexible handrail **24.** A balustrade guides the handrail **24** as it moves about a closed loop which includes an upper run **24A** during which a surface of the handrail **24** may be grasped by passengers as they are transported along the conveyor **12,** and a lower return run **24B.**

The handrail **24,** shown in section in FIG. **3,** has a substantially c-shaped cross section, having first and second substantially flat, parallel major opposed surfaces **26** and **28,** respectively, which define the major body portion of the handrail. Legs **30** and **32** project upwardly from the sides of the handrail and then curve inwardly parallel to major side **26.** Major side **26** is thus the inner side of the handrail, which rides on the support structure of the balustrade **22,** and major side **28** is the outer side, which is grasped by persons on the conveyor **12** during the upper run **24A** of the handrail. Handrail **24** may be of any suitable construction, conventionally being formed of an elastomer, such as rubber, in which reinforcing materials, such as canvas, are embedded. Inextensible members, shown generally at **34,** such as steel ribbon or wire, are embedded in the elastomer to minimize stretching of the handrail **24** during use. The handrail **24** is constructed as an elongated strip and after it is cut to length, the ends are spliced and vulcanized to produce an endless or closed loop.

The balustrade **22** may be transparent, as indicated, or opaque, as desired. The handrail **24** is guided around the balustrade by suitable guide means, such as a T-shaped guide which is located within the cross section of the handrail **24.** The guide means may be conventional, or it may be continuous to the extent that any gaps are bridged by the handrail **24** without lateral movement of the handrail, permitting the handrail to be pushed as well as pulled by the handrail drive means around the guide loop. This "continuous" guide concept of handrail operation is disclosed in co-pending application Ser. No. 116,264, filed Feb. 17, 1971, now U.S. Pat. No. 3,712,447, which is assigned to the same assignee as the present application.

Conveyor **12** includes a plurality of steps **36,** only a few of which are shown in FIG. **1.** The steps **36** move in a closed path, with the conveyor **12** being driven in the conventional manner, such as illustrated in the hereinbefore mentioned U.S. Pat. No. 3,414,109. Or, the conveyor **12** may be driven by a modular drive arrangement, as disclosed in U.S. Pat. No. 3,677,388, which is assigned to the same assignee as the present application. As disclosed in U.S. Pat. No. 3,677,388 the conveyor **12** includes an endless belt formed of toothed links **38,** to which the steps **36** are connected. The steps **36** are supported by main and trailer rollers **39** and **41,** respectively, which cooperate with main and trailer tracks **40** and **42,** respectively, to guide the steps in the endless path.

The steps are driven by a modular drive unit **44** which includes sprocket wheels and a drive chain for engaging the toothed links. The modular drive unit **44** includes a handrail drive pulley **46** on each side of the conveyor, which drives the handrail drive units **50** disposed on both sides of the conveyor **12.** Since the handrail drive units **50** on each side of the conveyor **12** are of similar construction, and since additional handrail drive units provided when additional modular drive units are required on longer runs would also be similar, only one handrail drive unit **50** is shown in the drawings.

Handrail drive unit **50** is shown in greater detail in FIG. **2,** which is an elevation thereof of the side which is opposite to the side which faces outwardly in FIG. **1.** This side is selected for illustration in order to best illustrate the drive components. FIG. **3** is an end view of the drive unit **50,** taken approximately along a line between arrows III—III of FIG. **2.** Handrail drive unit **50** includes a channel member **52** to which the components of the drive unit **50** are fixed, and the channel member **52** is secured to the supporting structure or truss of the transportation device **10,** in any suitable manner.

Drive unit **50** includes a plurality of auxiliary drive pulleys or sprocket wheels **54,** which are driven by the sprocket wheel **46** via a drive belt or sprocket chain **56.** Six auxiliary drive pulleys **54** are illustrated in FIG. **1,** with the actual number used depending upon design parameters. However, since the invention may be adequately described with fewer auxiliary drive pulleys, only three are illustrated in FIG. **2.**

Auxiliary handrail drive pulley **54** may be toothed as best illustrated in FIG. **3,** which illustrates an auxiliary handrail drive pulley **54** without the sprocket chain **56.** The sprocket chain **56** has cooperative teeth formed thereon of any suitable form. The sprocket chain may be a timing belt formed of metal, or of an elastomeric material having a metallic embedment which makes the belt substantially inextensible. The auxiliary handrail drive pulleys **54** are each secured to one side of channel **52** via individual bearing and shaft assemblies **60.** Each bearing and shaft assembly **60** includes a bearing housing **62,** bearings **64** and a shaft member **66.** The bearing housing **62** is fixed to channel member **52,** being mounted through a suitable opening therein, such that the axis of shaft member **66** extends perpendicularly outward from both major opposed surfaces of the channel member **52.** The auxiliary handrail drive pulley **54** is keyed to one end of shaft member **66,** and a traction or drive roller **70** is keyed to the other end of shaft member **66,** on the opposite side of the channel member. Thus, when auxiliary drive pulley **54** is rotated by the drive belt **56,** a traction roller **70** on the same shaft is also driven.

Traction roller **70** is disposed such that a portion of its perphery or rim engages the inner surface **26** of the handrail **24.** Traction roller **70** may be constructed of a rigid material, such as steel coated with a high friction material on its periphery, or, as illustrated, it may have a metallic hub **72** provided with an elastomeric or rubber tire **74.**

A plurality of pairs of auxiliary drive pulleys **54** and traction rollers **70** are provided at spaced intervals along channel **52,** with the center lines of the shafts **66** falling on a common plane, the edge of which is indicated generally by dashed line **76.** Thus, the peripheries of the plurality of traction rollers **70** all fall on a line which coincides with the return run of the handrail **24,**

contacting the inner surface 26 of handrail 24 when the handrail 24 is in a straight, flat configuration.

After the drive belt 56 passes over the upper surfaces of a predetermined number of adjacent auxiliary drive pulleys 70, it may pass under a take-up pulley 80 before passing over the upper surfaces of the next group of auxiliary drive pulleys. Take-up pulley 80 is rotatably mounted on a shaft 81 which is fixed to a bracket member 82. Bracket member 82 is adjusted vertically relative to channel member 52 by bolt and jam nut arrangement 84, and then fixed to channel member 52 such as by bolts 85 which extend through slotted openings in the channel member into a tapped keeper plate.

A plurality of pressure roller assemblies 90 are provided, each of which include a maximum of two pressure rollers, which assemblies urge or bias the handrail 24 towards the traction rollers 70. The pressure roller assemblies 90 will first be described with the maximum of two pressure rollers, and then an embodiment of the invention will be described which utilizes a single pressure roller.

More specifically, pressure roller assembly 90, which is shown detached from the handrail drive unit 50 in a perspective view in FIG. 4, includes two similar pressure rollers 92, and a leaf spring assembly 96. Each pressure roller 92 must be constructed such that it does not scratch or mark the outer surface 28 of the handrail, which it contacts as it presses or biases the handrail 24 firmly against a traction roller 70 disposed on the opposite side of the handrail. An imaginary line 94 perpendicular to the surfaces 26 and 28 of the handrail, which passes through the center line of shaft 66 of a traction roller, will also pass through the center line of a pressure roller 92, as traction and pressure rollers are provided in cooperative pairs, each pair providing a driving point for squeezing and propelling the handrail 24 around the closed guide loop. The pressure roller may be formed of a rigid material, such as stainless steel, but it is preferably constructed with a metallic hub 98 which is provided with an elastomeric tire 100. Polyurethane has been found to be excellent for the tire 100, as it is non-marking and non-scratching, while providing the desired coefficient of friction, but other elastomeric materials may also be used.

Each pressure roller is rotatably mounted on a shaft member 102 via a bearing 104. Shaft 102 extends outwardly from the sides of pressure roller 92 for a predetermined distance, with both outwardly extending ends of shaft 102 being provided with a slot 106 of predetermined width and length, which starts at the extreme end and cuts through the center line of the shaft, extending inwardly towards the pressure roller 92. An opening transverse to the longitudinal axis of the shaft is provided near each end of the shaft, which opening extends perpendicularly through the slot 106.

The leaf spring assembly 96 includes a main leaf spring member 110 formed of spring steel of predetermined thickness. In the two pressure roller embodiment of the invention, this main leaf spring member 110 is H-shaped, as illustrated most clearly in FIGS. 5A and 5B, which are plan and edge views, respectively, of the main leaf spring member 110. Main leaf spring member 110 includes a central, rectangular portion or section 112, first and second spaced, parallel rectangularly shaped extensions or projections 114 and 116, respectively, which extend outwardly from one side or edge of the central section 112, and third and fourth spaced, parallel rectangularly shaped extensions 118 and 120, respectively, which extend outwardly from the opposite side or edge of the central section 112.

Central section 112 of main leaf spring 110 has an opening 122 centered therein, which extends between the major opposed surfaces of the spring, and two smaller openings 124 and 126 which are equally spaced from and on opposite sides of the central opening 122. Each of the four extensions 114, 116, 118 and 120 have an opening 128 disposed therein, near the extreme end of each projection.

The main leaf spring member 110, when unstressed, has a predetermined curvature therein, which is clearly illustrated in FIG. 5B. When the pressure roller assembly is installed, the concave side of the predetermined curvature faces the handrail.

While the leaf spring assembly 96 may consist of a single leaf spring member, i.e., the main leaf spring 110, in practice, it has been found desirable to construct the leaf spring assembly 96 with one or more auxiliary leaf spring members. For purposes of example, two auxiliary leaf spring members 130 and 132 are illustrated in the Figures, but any number may be used.

FIGS. 6A and 6B are plan and edge views, respectively, of the first auxiliary leaf spring member 130. Auxiliary leaf spring member 130 has an H-shaped plan configuration, with a central portion 112' and extensions 114', 116', 118' and 120'. The length L2 of the auxiliary leaf spring member 130 is less than the length L1 of the main leaf spring member 110, but its other dimensions, such as its width W and thickness T may be the same as the main leaf spring member 110. Similar to the main leaf spring member 110, auxiliary leaf spring member 130 has openings 122', 124' and 126' disposed in its central portion 112', which correspond in size and location to the openings with the same reference numerals, except for the prime mark, in the main leaf spring member 10. Unlike the main leaf spring member 110, however, the extensions of the auxiliary leaf spring member 130 do not have an opening formed therein. The auxiliary leaf spring member 130 has an unstressed radius or curvature selected such that its concave surface will nest with the convex surface of the main leaf spring 110.

FIGS. 7A and 7B are plan and edge views, respectively, of the second auxiliary leaf spring member 132. Auxiliary leaf spring member 132 also has an H-shaped plan configuration, including a central portion 112'' and extensions 114'', 116'', 118'' and 120''. The length L3 of auxiliary leaf spring member 132 is less than the length L2 of the first auxiliary leaf spring member 130, but its other dimensions, such as its width W and thickness T may be the same as the main and first auxiliary leaf spring members. Similar to the main and first auxiliary leaf spring members, the second auxiliary leaf spring member 132 has openings 122'', 124'' and 126'' disposed in its central portion 112'', which correspond in size and location to the openings having the same reference numerals, except for the prime marks, in the main leaf spring. Unlike the main leaf spring 110, the extensions of the second auxiliary leaf spring do not have openings formed therein. The second auxiliary leaf spring member 132 has an unstressed radius of curvature which is selected such that its concave surface will nest with the convex surface of the first auxiliary leaf spring member 130.

The main leaf spring member **110,** and any auxiliary leaf spring members which are utilized, such as auxiliary leaf spring members **130** and **132,** are disposed in nested relation with their openings having like reference numerals being in alignment. The stacked leaf spring members are sandwiched between a base member **140** and a spacer member **142,** and the base and spacer members are also provided with openings aligned with the openings having the reference numerals **124** and **126.** The spacer member **142** has an opening aligned with the openings having the reference numeral **122.** The base member **140** has an opening aligned with the openings having the reference numeral **122,** but this opening is slightly smaller than the openings in the spacer and leaf springs, and it is tapped to receive a bolt. The spacer **142,** base **140** and sandwiched leaf spring members are then consolidated to provide leaf spring assembly **96,** by driving roll pins **144** and **146** through the aligned **124** and **126** openings, respectively.

A pressure roller **92,** along with the shaft member **102,** is then positioned between the extensions **114** and **116,** with the slots **106** in the ends of the shaft **102** being aligned with the flat cross-sectional configuration of the projections **114** and **116.** These projections are pressed into the slots **106** of the shaft **102,** until the transverse openings through the ends of the shaft **102** are aligned wtih the openings **128** disposed in the projections **114** and **116.** Roll pins **150** are then driven through the aligned openings to secure the pressure roller **92** and shaft **102** to the leaf spring assembly **96.** Mounting the pressure roller between two extensions of the main leaf spring makes the pressure rollers self-aligning as they contact the handrail.

The flat, stressed configuration of the main leaf spring member **110** is not only a convenient checkpoint for determining if the handrail drive pressure rollers **92** are providing the desired pressure, but it is essential to the proper performance of the pressure roller assembly **90.** If the leaf springs were flat when unstressed, and then stressed to a curved configuration during use, the roller on the inlet side of the assembly, i.e., the direction from which the handrail is coming, would tend to increase pressure, while the pressure roller on the outlet side would decrease pressure, resulting in uneven driving forces at the two locations. The flat stressed configuration of the main leaf spring **110** also makes it immaterial as to which way the handrail is driven. Thus, the transportation device **10** may be used to transport people from the first to the second terminal during a certain portion of the day, and from the second to the first terminal during another portion on the day, achieving optimum handrail drive performance during each transporting direction.

For purposes of example, the actual construction of a pressure roller assembly designed to provide a force of 120 pounds plus or minus 12 pounds, will now be described. Three leaf spring members were used, a main leaf spring, and two auxiliary leaf spring members, all of which were constructed of 0.062 inch thick spring steel. The main leaf spring **110** had an 8.75 inches radius of curvature on its concave side, a length dimension L1 of 8 inches, providing an X1 dimension of 0.93 inch, which dimension is indicated in FIG . 5B. The first auxiliary leaf spring **130** had an 8.63 inches radius of curvature on its concave side, and a length dimension L2 of 5.63 inches, providing a dimension X2 of 0.47 inch. The second auxiliary leaf spring member **132** had an 8.5 inches radius of curvature on its concave side,

same bias or force against the handrail without complicated adjustment. The pressure rollers apply the substantially equal bias without danger of riding on only one edge of the pressure roller, as the rollers of the pressure roller assembly are self-aligning due to the spring steel extensions of the leaf spring assembly which support the shaft **102**. Further, the design pressure is achieved and maintained in a manner which prevents tampering with the pressure magnitude. Once the single main bolt of a pressure roller assembly is tightened, flattening the main leaf spring, no further pressure can be produced. Further, these advantages are achieved while providing a structure which is more simple, easier to manufacture, easier to assemble and install, than transportation arrangements of the prior art. All moving parts, other than the pressure rollers, have been eliminated from the pressure roller function.

We claim as our invention:

1. Transportation apparatus for transporting persons between spaced landings, comprising:

an endless handrail having first and second major opposed surfaces, and a substantially C-shaped cross section,

a supporting structure for guiding said handrail in a closed loop which includes a run during which a surface of the handrail may be grasped by persons to operate as a balustrade, and a return run,

and driving means for moving said handrail about the closed loop defined by said supporting structure,

said driving means including driven traction rollers and pressure rollers, means mounting said traction rollers for rotation on different axes transverse to the direction of movement of the handrail, with the traction rollers each having a portion of their periphery positioned to engage the first surface of said handrail, and biasing means biasing said pressure rollers against the second surface of said handrail, opposite said traction rollers, such that said pressure rollers are free to rotate on different axes transverse to the direction of movement of said handrail, said biasing means including at least one main leaf spring which supports and biases first and second of said pressure rollers spaced in the direction of movement of the handrail, said at least one main leaf spring having a predetermined curvature therein when unstressed which extends between said first and second pressure rollers, said main leaf spring being stressed to a substantially flat configuration in which its major surfaces are parallel with the second surface of said handrail when said handrail is disposed between said traction and pressure rollers to provide substantially the same pressure between the first pressure roller and its opposing traction roller as between the second pressure roller and its opposing traction roller.

2. The transportation apparatus of claim **1** including at least one auxiliary leaf spring member disposed to aid the at least one main leaf spring member, said at least one auxiliary leaf spring member having an unstressed curvature which is stressed to a substantially flat configuration in which its major surfaces are substantially parallel to the second surface of the handrail when the handrail is disposed between said traction and pressure rollers.

3. The transportation apparatus of claim **2** in which the auxiliary leaf spring member is sandwiched against the main leaf spring member, on the side of the main leaf spring member which is opposite the handrail, and the dimension of the auxiliary leaf spring in the direction of movement of the handrail is less than this dimension of the main leaf spring.

4. The transportation apparatus of claim **1** including a plurality of auxiliary leaf spring members disposed to aid the at least one main leaf spring member said plurality of auxiliary leaf spring members each having an unstressed curvature which is stressed to a substantially flat configuration when the handrail is disposed between said traction and pressure rollers.

5. The transportation apparatus of claim **4** in which the plurality of auxiliary leaf spring members are sandwiched against the main leaf spring member, on the side of the main leaf spring member which is opposite the handrail, and the dimensions of the auxiliary spring members in the direction of movement of the handrail are progressively less than this dimension of the main leaf spring member.

6. The transportation apparatus of claim **1** including a plurality of main leaf springs, and wherein the pressure rollers are divided into pairs, with each pair including a main leaf spring for biasing the pair of pressure rollers against the second surface of the handrail, independent of the remaining pairs.

7. The transportation apparatus of claim **6** wherein the number of pressure rollers is an odd number, with the single remaining pressure roller after the pressure rollers are paired being biased by a main leaf spring against the second surface of the handrail, independent of the pairs of pressure rollers.

8. Transportation apparatus for transporting persons between spaced landings, comprising:

an endless handrail having first and second major opposed surfaces, and a substantially C-shaped cross section,

a supporting structure for guiding said handrail in a closed loop which includes a run during which a surface of the handrail may be grasped by persons to operate as a balustrade, and a return run,

and driving means for moving said handrail about the closed loop defined by said supporting structure,

said driving means including driven traction rollers and pressure rollers, means mounting said traction rollers for rotation on different axes transverse to the direction of movement of the handrail, with the traction rollers each having a portion of their periphery positioned to engage the first surface of said handrail, and biasing means biasing said pressure rollers against the second surface of said handrail, opposite said traction rollers, such that said pressure rollers are free to rotate on different axes transverse to the direction of movement of said handrail, said biasing means including at least one main leaf spring, said at least one main leaf spring supporting and biasing first and second pressure rollers, said at least one main leaf spring having a predetermined curvature therein when unstressed, said main leaf spring being stressed to a substantially flat configuration in which its major surfaces are parallel with the second surface of said handrail when said handrail is disposed between said traction and pressure rollers.

9. The transportation apparatus of claim **8** wherein the at least one main leaf spring has an H-shaped configuration, including first and second spaced parallel extensions on one end which support the first pressure

roller and third and fourth spaced parallel extensions on the opposite end which support the second pressure roller.

10. Transportation apparatus for transporting persons between spaced landings, comprising:

an endless handrail having first and second major opposed surfaces, and a substantially C-shaped cross section,

a supporting structure for guiding said handrail in a closed loop which includes a run during which a surface of the handrail may be grasped by persons to operate as a balustrade, and a return run,

and driving means for moving said handrail about the closed loop defined by said supporting structure,

said driving means including driven traction rollers and pressure rollers, means mounting said traction rollers for rotation on different axes transverse to the direction of movement of the handrail, with the traction rollers each having a portion of their periphery positioned to engage the first surface of said handrail, and biasing means biasing said pressure rollers against the second surface of said handrail, opposite said traction rollers, such that said pressure rollers are free to rotate on different axes transverse to the direction of movement of said handrail, said biasing means including at least one main leaf spring, said at least one main leaf spring supporting and biasing a single pressure roller, said at least one main leaf spring having a U-shaped configuration, including first and second spaced parallel extensions which support said single pressure roller, said at least one main leaf spring having a predetermined curvature therein when unstressed, said main leaf spring being stressed to a substantially flat configuration in which its major surfaces are parallel with the second surface of said handrail when said handrail is disposed between said traction and pressure rollers.

11. Transportation apparatus for transporting persons between spaced landings, comprising:

An endless handrail having first and second major opposed surfaces, and a substantially C-shaped cross section,

a supporting structure for guiding said handrail in a closed loop which includes a run during which a surface of the handrail may be grasped by persons to operate as a balustrade, and a return run,

and driving means for moving said handrail about the closed loop defined by said supporting structure,

said driving means including driven traction rollers and pressure rollers, means mounting said traction rollers for rotation on different axes transverse to the direction of movement of the handrail, with the traction rollers each having a portion of their periphery positioned to engage the first surface of said handrail, and biasing means biasing said pressure rollers against the second surface of said handrail, opposite said traction rollers, such that said pressure rollers are free to rotate on different axes transverse to the direction of movement of said handrail, said biasing means including at least one main leaf spring, which biases at least one pressure roller against the second surface of said handrail, said at least one main leaf spring including extensions between which the at least one pressure roller is mounted, automatically aligning the pressure roller against said handrail.

12. The transportation apparatus of claim **11** wherein the at least one main leaf spring supports and biases first and second pressure rollers.

13. The transportation apparatus of claim **12** wherein the at least one main leaf spring has an H-shaped configuration, including first and second spaced parallel extensions on one end which support the first pressure roller and third and fourth spaced parallel extensions on the opposite end which support the second pressure roller.

14. The transportation apparatus of claim **11** wherein the at least one main leaf spring supports and biases a single pressure roller.

15. The transportation apparatus of claim **14** wherein the at least one main leaf spring has a U-shaped configuration, including first and second spaced parallel extensions which support the single pressure roller.

16. The transportation apparatus of claim **11** including at least one auxiliary leaf spring member disposed to aid the at least one main leaf spring member.

17. The transportation apparatus of claim **16** in which the auxiliary leaf spring member is sandwiched against the main leaf spring member, on the side of the main leaf spring member which is opposite the handrail, and the dimension of the auxiliary leaf spring in the direction of movement of the handrail is less than this dimension of the main leaf spring.

18. The transportation apparatus of claim **11** including a plurality of auxiliary leaf spring members disposed to aid the at least one main leaf sping member.

19. The transportation apparatus of claim **18** in which the plurality of auxiliary leaf spring members are sandwiched against the main leaf spring member, on the side of the main leaf spring member which is opposite the handrail, and the dimensions of the auxiliary spring members in the direction of movement of the handrail are progressively less than this dimension of the main leaf spring member.

20. The transportation apparatus of claim **11** wherein the pressure rollers are divided into pairs, with each pair including a single main leaf spring for biasing the pair of pressure rollers against the second surface of the handrail, independent of the remaining pairs.

21. The transportation apparatus of claim **20** wherein the number of pressure rollers is an odd number, with the single remaining pressure roller after the pressure rollers are paired being biased by a single main leaf spring against the second surface of the handrail, independent of the pairs of measure rollers.

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