

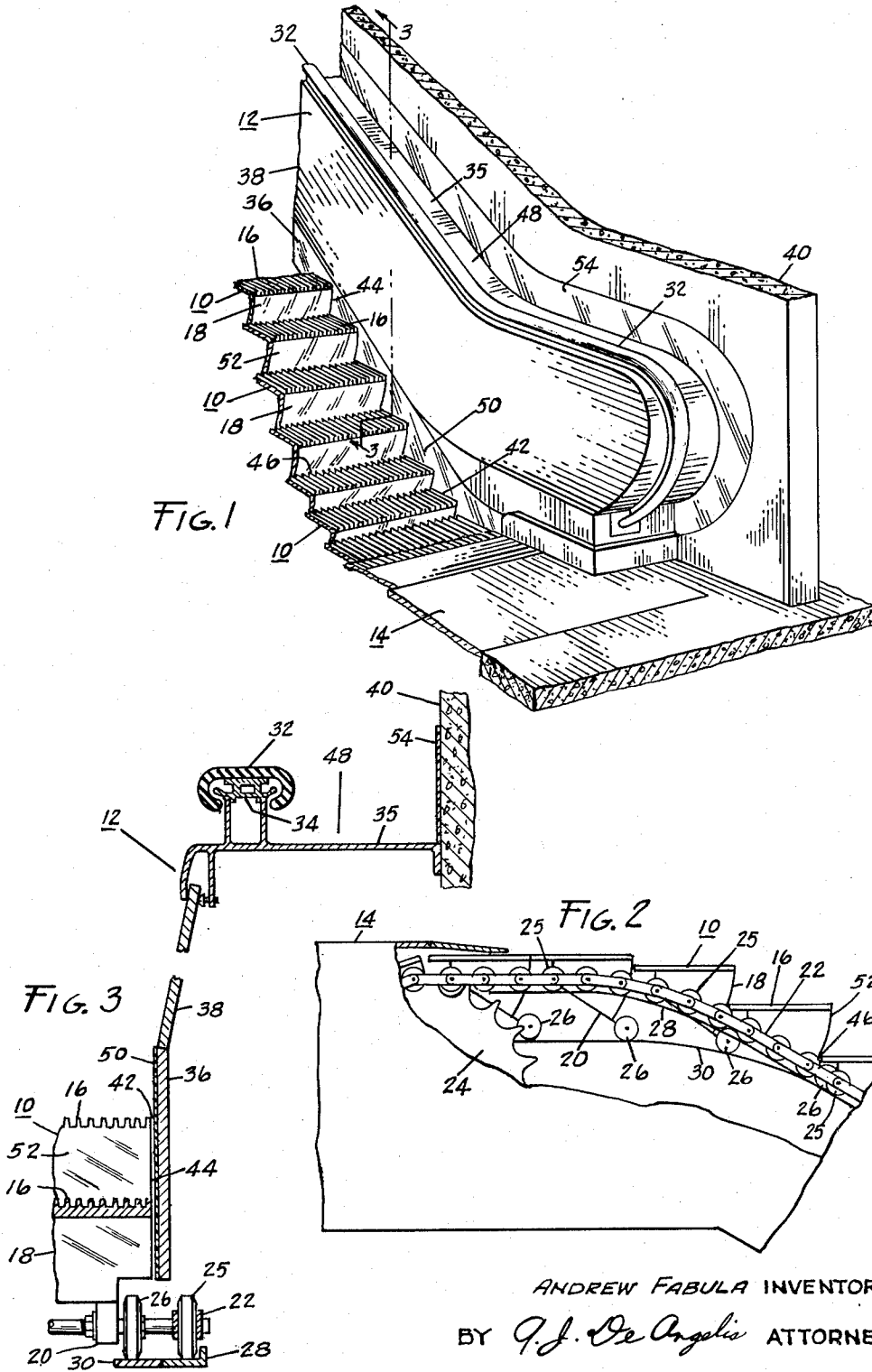
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COATED SURFACES FOR MOVING STAIRWAYS

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COATED SURFACES FOR MOVING STAIRWAYS
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The invention relates to moving stairways and more particularly to the arrangement of such structures as to enhance the safety of users of them.

This application is a continuation-in-part of my copending application Serial No. 753,439, filed August 6, 1958, now abandoned.

Moving stairways comprise an endless series of steps which are moved between balustrades from one landing to another for the purpose of conveying passengers. Each step includes a tread plate, disposed substantially horizontally for carrying passengers, and a vertically disposed riser. The steps emerge from underneath the landing at the entrance of the stairway in platform formation, transfer to step formation on the incline of the stairway and change back again to platform formation to pass underneath the landing at the exit end of the stairway. An endless handrail is supported by the balustrade on each side of the stairway and is driven in synchronism with the steps.

Passengers through misuse of the moving stairway sometimes create a hazard to themselves and their clothing. Such a hazard is created when, while the stairway is in operation, a high frictional object is improperly placed in simultaneous contact with opposing surfaces of relatively moving adjacent stairway parts, between which a common operating clearance space is necessarily provided. This is especially true of rubber overshoes and sneakers, since both are made of flexible material having a relatively high coefficient of friction, which material may be readily pinched and drawn into a common clearance space. However, the relative motion between such adjacent parts to be dangerous, must be in a direction which effectively tends to draw such objects into the operating clearance space common to such adjacent parts. Such relative motion occurs between the side edges of the tread plate and riser of each step and the stationary adjacent sides of the balustrades, and, as the steps change from step formation to platform formation at their exit end, between the outer surface of the riser of each step and the adjacent edge of the tread plate of the adjacent step.

As an example of such dangerous misuse of a moving stairway, it has happened that a child, wearing sneakers and riding a descending stairway, improperly has faced backwards and placed the toe of one sneaker into the corner formed by the riser of the succeeding, descending step and the stationary side of the adjacent balustrade. Since the toe and that riser move downward along the incline relative to the adjacent balustrade surface, frictional engagement between the balustrade surface and the sneaker is sometimes sufficient to draw the sneaker upward into the clearance space necessarily provided between the edge of the riser and the adjacent balustrade. In such a case, the sneaker is pinched and wedged into that space and damaged. Unhappily, sometimes the child's toes are also injured, being mashed or bruised by the relatively moving parts. The injury is usually more severe when, with the sneaker thus caught between the riser edge and the adjacent balustrade, the stairway changes from step to platform formation at its exit end. This is so, since at that point the riser moves downward relative to the step tread upon which the child is standing, thereby intensifying the pinching and wedging of the captive sneaker toe. In extreme cases, the captive sneaker

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and foot are carried along to the point where the stairway disappears underneath the landing platform and are there amputated.

Attempts to remove such hazards have been made in the past, such as, for example, by minimizing the width of these clearance spaces. Such attempts have been effective to prevent relatively large objects from being wedged into the clearance spaces but have not had the desired effect of preventing high frictional and flexible objects from being pinched and wedged into such crevices.

Also, in some installations, a handrail is positioned relatively close to a stair well wall and objects may become wedged between the side edge of the moving handrail and the adjacent stair well wall and be damaged by relative motion between the two. The handrail surfaces are purposely made of a material having a relatively high coefficient of friction (such as rubber, so that a passenger may easily maintain a grip on the handrail) and the adjacent wall surface is also usually of "rough" material. In such installations, as the handrail moves relative to the adjoining stair well wall, an object which is touching that wall and also resting against the handrail side edge which faces that wall may, under certain circumstances, become frictionally engaged sufficiently by both surfaces to be wedged in between the two and crushed. This occasionally happens to packages improperly placed on the handrail by passengers or to the forearms of small children who, while riding on the moving stairway, foolishly attempt to slide their hands along the adjoining wall surface in advance of the handrail travel or place their forearms between the wall and handrail. In these latter instances the child's small arm becomes wedged between the relatively rough surface of the wall and the handrail. The moving handrail, which tends to move the arm forward, causes it to be so twisted as to fracture it in the area of the wrist.

An object of the invention is to make moving stairways safer for passengers, their clothing and objects carried by them.

It is another object of the invention to minimize the effective frictional forces tending to draw objects into the operating clearance spaces provided between passenger carrying components of moving stairways and adjacent parts which are in relative motion with respect to such passenger carrying components.

The invention involves eliminating potential hazards to moving stairway passengers, their clothing and objects carried by them under conditions where such hazards are due to relative motion between two stairway components with which a passenger, his clothing or an object being carried is improperly in simultaneous contact with. This is accomplished by substantially reducing the coefficient of friction of the contacting surface of one of the cooperating components without reducing the frictional engagement between the passenger and the moving stairway necessary for safe passenger transfer from one landing to another.

Features and advantages of the invention will be seen from the above and from the following description of the preferred embodiment when considered in conjunction with the drawings and appended claims.

In the drawings:

FIGURE 1 is a perspective partial view of the lower end of a moving stairway installation embodying the invention;

FIGURE 2 is a simplified diagrammatic representation in side elevation of the upper end of a moving stairway embodying the invention; and

FIGURE 3 is a simplified fragmentary cross-sectional view taken along line 3—3 of FIGURE 1.

For the sake of brevity, the moving stairway structure illustrated in the drawings has been greatly simplified.

However, the moving stairway may be considered to be present day commercial construction, as described in Patent No. 2,686,585, issued to S. G. Margles et al.

The moving stairway comprises an endless series of steps 10, adapted to be moved in either direction between balustrades 12 from one to another landing, each landing being generally designated 14. Each step 10 includes a horizontally disposed tread plate 16 and a vertically disposed curved riser 18, both secured to a pair of step yokes 20. The steps 10 are driven by running gear chains 22, one on each side of the stairway.

These chains are driven by sprocket wheels 24 at the upper end of the stairway, which sprocket wheels are in turn driven by a reversible driving machine (not shown). Each running gear chain 22 includes a plurality of chain wheels 25. Each step 10 is attached on each side to a chain wheel 25 and a trailer wheel 26. The chain wheels 25 are arranged for rolling engagement along one pair of tracks 28, while the trailer wheels are arranged for rolling engagement along a second pair of tracks 30. The curvature of track pairs 28 and 30 is such that the steps emerge in platform formation from underneath landing 14 at the entrance of the stairway, transfer to step formation on the incline and change back again to platform formation to pass underneath landing 14 at the exit end of the stairway.

An endless handrail 32 is provided on each side of the stairway and is driven in synchronism with the steps 10 by the reversible driving machine. Each handrail 32 is supported at a convenient height above the steps by the balustrade 12 which extends the length of the stairway.

Each balustrade 12 includes a handrail guide 34 for guiding handrail 32, a deck member 35 upon which guide 34 is mounted, a skirt panel 36 adjacent the side edges of steps 10, and a side panel 38 positioned intermediate skirt panel 36 and deck member 35. The aforementioned handrail guide balustrade panels and deck member may be secured to each other and to the building structure by any suitable means, as by screws (not shown).

The stair well wall is generally designated 40.

Operating clearance space is provided between relatively moving parts. Such clearance spaces include the space 42 provided between the side edges of tread plate 16 of the steps 10 and skirt panel 36, which skirt panel is positioned on either side of the steps along their entire length of travel from entrance landing to exit landing; the space 44 provided between the side edges of riser 18 of steps 10 and skirt panel 36; the space 46 provided between the exterior surface of the curved riser 18 of each step and the adjacent edge of the tread plate 16 of the adjacent step. In addition, there is the space 48 provided between the side edge of the handrail 32 and the adjacent wall structure 40.

As has been previously stated, relative motion between the foregoing stairway components, between which a common space exists, is sometimes in a direction which creates a hazard for objects improperly placed into simultaneous frictional engagement with adjacent component surfaces. In order to remove this hazard, the frictional forces which tend to draw passengers, their clothing and objects carried by them into the aforementioned spaces are minimized, but without decreasing the desirably high frictional engagement between the passenger carrying stairway components and the passengers being carried. To accomplish this, the surfaces of non-load carrying components of such relatively moving parts (between which the aforementioned common spaces exist) are coated with a material which substantially reduces their coefficient of friction, while the surfaces of the load carrying components (such as tread plate 16 and handrail 32) are made of a high friction, non-slippery material. In present day installations, such non-load bearing surfaces are usually either of steel or enameled metals, having a

static coefficient of friction in the range of .15 against dry polished steel. In the subject invention their static coefficient of friction is materially reduced to substantially one-fourth that value, to the order of .04, thereby minimizing the frictional forces, acting upon a contacting object, to the point where all hazard to that object, due to relative motion, is removed.

For example, such non-load bearing surfaces are covered, preferably but not necessarily, with polytetrafluoroethylene, which is a fluorocarbon resin commercially available under the trademark Teflon. It will hereinafter be referred to as Teflon resin in this specification. Teflon resin has the lowest static coefficient of friction of any solid substance presently known, being approximately .04 for a 20 pound load against polished steel, ASTM method (Du Pont booklet #A-7756, 8-58). Its coefficient of friction is substantially independent of load, the speed of frictionally engaged surfaces moving relative to each other and temperature variations. It is non-soiling and self-lubricating.

Teflon resin may be applied as a sheet attached with an adhesive or as a sprayed powder which is then heated to about 700 degrees Fahrenheit to form a smooth surface. However, a preferred method of producing a satisfactory coating is to cover the surface with a colloidal suspension of the resin in a liquefied thermosetting plastic. As the thermosetting plastic cools and solidifies, the resin rises to the surface to form a smooth, slick coating.

Coated with Teflon resin are: the surface of each skirt panel 36 which is adjacent the steps 10 to form a substantially non-frictional surface 50; the outer surface of each riser 18 to form a substantially non-frictional surface 52, and the surface area of building wall 40 adjacent to handrail 32 to form a substantially non-frictional surface 54.

Referring to FIGURES 1 and 3, while the stairway is moving in an ascending direction, an object being carried upward on a tread plate 16 and coming into contact with the surface 50 of an adjacent skirt panel 36 (such as the overshoe of a passenger standing on the tread plate, which overshoe is improperly also placed in contact with the surface of the adjacent skirt panel) has frictional forces exerted on it which, due to the relative motion between the object and the skirt panel, tend to draw that object downward into operating clearance space 42. The resin coating forming the slippery surface 50 of skirt panel 36 minimizes such frictional forces to the extent that they are of insufficient magnitude to draw an object into clearance space 42. While the stairway is moving in the descending direction, the aforementioned frictional forces are in an opposite direction and therefore tend to keep objects out of clearance space 42.

However, while the stairway is moving in a descending direction, an object carried by tread plate 16 and improperly coming into contact with skirt panel 36 has frictional forces exerted on it which tend to draw that object upward into clearance space 44. Due to the substantially non-frictional surface 50 of skirt panel 36, such frictional forces are ineffective to do so. While the stairway is ascending, the frictional forces acting upon such a contacting object are in an opposite direction.

At the exit end of the moving stairway in either the ascending or descending directions as the steps change from step formation to platform formation, relative motion in a vertical direction takes place between the riser 18 and the adjacent edge of tread plate 16 of the adjacent step. That is, at the exit end of an ascending stairway the riser 18 of a step moves downward relative to the adjacent edge of the tread plate 16 of the succeeding step, while at the exit end of a descending stairway the riser 18 moves downward relative to the adjacent edge of the tread plate 16 of the preceding step. If, as riser 18 moves downward vertically relative to that adjacent edge, there is in contact with its surface a fairly flexible object of high frictional material, the frictional forces that are developed tend to draw the object carried by tread plate

16 downward into clearance space 46. The Teflon resin coating forming the outer surface 52 of each riser 18 provides a substantially non-frictional surface which minimizes such frictional forces to the point where they are insufficient in magnitude to draw an object into clearance space 46.

While the stairway is either ascending or descending, an object (for example, a forearm), coming into simultaneous contact with the side edge of handrail 32 and that portion of the surface of the wall 40 which is in advance of the direction of handrail travel can, if frictionally engaged sufficiently by both relatively moving surfaces, be caught crosswise between the two and fractured. Since the wall surface adjacent to the handrail is coated with Teflon resin to provide a substantially non-frictional surface 54, the frictional forces exerted on such an object are minimized to the point where that object is prevented from being frictionally engaged sufficiently by the wall surface and injury or damage is avoided. The object instead tends to slide along the adjoining resin coated wall surface 54.

It may be noted that the subject arrangement effectively minimizes frictional forces tending to draw portions of passengers, their clothing and objects carried by them into operating clearance spaces without in any way reducing the secure footing and gripping provided for the passengers.

Optionally, polytetrafluoroethylene adulterated with an additive and commercially sold under the trademark "Rulon" may be used to coat the aforementioned stairway components in lieu of Teflon "TFE" resin.

As many changes can be made in the above described construction and many apparently different embodiments of this invention can be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown on the accompanying drawings be interpreted as illustrative only and not in a limiting sense.

What is claimed is:

1. A moving stairway comprising, an endless series of steps adapted for carrying passengers from one landing to another in ascending and descending directions, each of said steps including a tread portion and a riser portion and each running on tracks arranged between balustrading, said tracks being arranged so that said steps emerge from under the landing at the stairway entrance in platform formation, change to step formation on the incline and back to platform formation at their exit end, said balustrading including a skirt panel adjacent the right and left edges of said steps, characterized in that the surface of the skirt panels adjacent said step edges and the outer surface of said riser of each step are coated with a solid material having a static coefficient of friction of substantially .04 for a 20 pound load against polished steel, ASTM method.

2. A moving stairway comprising, an endless series of steps adapted for carrying passengers from one landing to another in ascending and descending directions, each of said steps including a tread portion and a riser portion and each running on tracks arranged between balustrading, said tracks being arranged so that said steps emerge from under the landing at the stairway entrance in platform formation, change to step formation on the incline and back to platform formation at their exit end, said balustrading including a skirt panel adjacent the right and left edges of said steps, characterized in that the surface of the skirt panels adjacent said step edges and the outer surface of said riser of each step are coated with a non-soiling, self-lubricating material having a static coefficient of friction of substantially

.04 for a 20 pound load against polished steel, ASTM method.

3. A moving stairway comprising, an endless series of steps, each including a passenger carrying portion disposed in a horizontal direction and a riser portion disposed in a vertical direction; means for driving said steps in ascending and descending directions; a set of tracks for supporting said steps and adapted for causing said steps to emerge in platform formation at their entrance end, change to step formation on the stairway incline and back to platform formation at their exit end, whereby the passenger carrying portion of each of said steps moves upward vertically relative to the adjacent riser portion of the step adjacent it as said steps convert from step to platform formation at their exit end, characterized in that the outer surface of each of said riser portions is composed of polytetrafluoroethylene, whereby an object which is in simultaneous contact with the passenger carrying portion of one step and the adjacent riser portion of the adjacent step as the steps convert from step to platform formation has frictional forces acting upon it which are insufficient in magnitude to draw that object downward between the two relatively moving stairway components.

4. A moving stairway comprising an endless series of steps, each including a tread portion, and each running on tracks arranged between balustrading, said balustrading including a skirt board adjacent the right and left edges of said steps, each of said skirt boards having its surface contiguous to said steps composed of a continuous coating of polytetrafluoroethylene, and each of said step tread portions having as its upper surface a material having a large coefficient of friction relative to said polytetrafluoroethylene.

5. A moving stairway installation wherein are provided an endless series of steps adapted for carrying passengers in a stair well from one landing to another, an endless handrail driven in synchronism with said steps, said stair well including a wall surface positioned adjacent said handrail, characterized in that said adjacent wall surface is composed of a material having a static coefficient of friction of substantially .04 for a 20 pound load against polished steel, ASTM method, whereby an object in simultaneous contact with said handrail and said adjacent wall surface slides along said wall surface in the direction of handrail travel.

6. A moving stairway installation wherein are provided an endless series of steps adapted for carrying passengers in a stairwell from one landing to another, an endless handrail driven in synchronism with said steps, said stair well including a wall surface positioned adjacent said handrail, characterized in that said adjacent wall surface is composed of polytetrafluoroethylene, whereby an object in simultaneous contact with said handrail and said adjacent wall surface slides along said wall surface in the direction of handrail travel.

7. A moving stairway in which an endless series of steps run from one platform to another between skirt panels, one on each side, and in which each step has a step riser characterized in that each skirt panel surface facing the steps is provided with a surface of polytetrafluoroethylene, and in that each step riser is provided with an outer surface of polytetrafluoroethylene.

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