US006866125B2

(12) **United States Patent**
Ball et al.

(10) **Patent No.: US 6,866,125 B2**
(45) **Date of Patent: Mar. 15, 2005**

(54) **ILLUMINATION SYSTEM FOR ESCALATOR HANDRAILS**

(75) Inventors: **Ronald Ball**, Oshawa (CA); **George Yan**, North Augusta (CA)

(73) Assignee: **Ronald H. Ball**, Oshawa (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/948,622**

(22) Filed: **Sep. 10, 2001**

(65) **Prior Publication Data**

US 2002/0036121 A1 Mar. 28, 2002

Related U.S. Application Data

(60) Provisional application No. 60/231,302, filed on Sep. 8, 2000.

(51) **Int. Cl.**[7] **B66B 7/00**

(52) **U.S. Cl.** **187/391**; 187/413; 198/335

(58) **Field of Search** 187/391, 413, 187/353, 414; 362/551, 553, 555, 146; 198/335–338, 324

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,479,500 A	*	8/1949	Longberg	362/146
3,740,541 A	*	6/1973	Conradt	362/146
4,896,759 A	*	1/1990	Badstuebner et al.	198/324
5,020,256 A	*	6/1991	French	40/584
5,067,062 A	*	11/1991	Rulke	198/337
5,099,402 A	*	3/1992	Starniri	362/146
5,339,228 A	*	8/1994	Baethge et al.	198/337
5,613,758 A	*	3/1997	Kamschal et al.	362/146
6,030,108 A	*	2/2000	Ishiharada et al.	362/101
6,129,442 A	*	10/2000	Hoefling et al.	362/146

FOREIGN PATENT DOCUMENTS

CA	2312041	6/2000	
DE	4209505 C1	* 7/1993	B66B/23/22
JP	62-157876	10/1987	
JP	2000 103585	4/2000	
JP	2000 103585	9/2000	
WO	WO-97 15520	5/1997	

OTHER PUBLICATIONS

PCT International Search Report, PCT/CA01/01282 filed Sep. 7, 2001

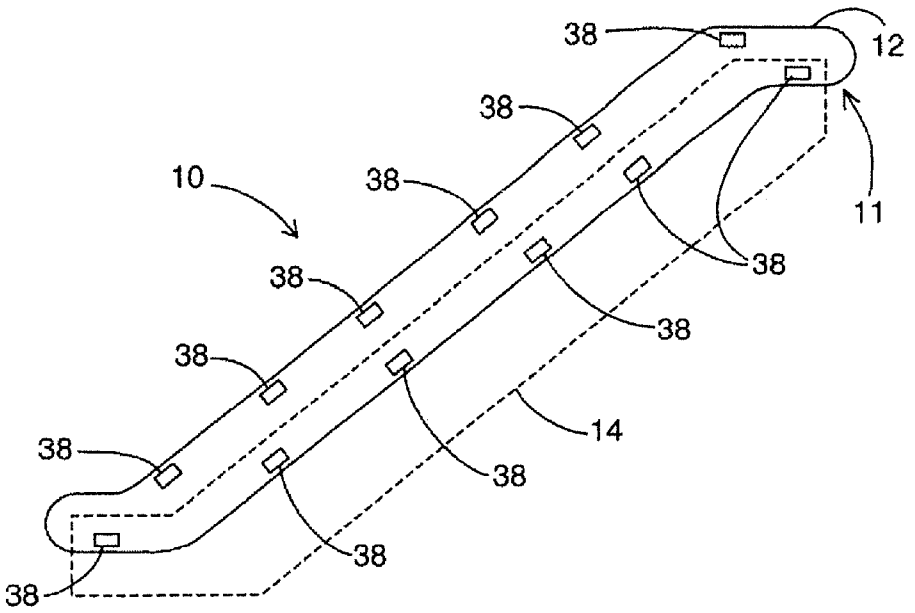
* cited by examiner

Primary Examiner—Jonathan Salata
(74) *Attorney, Agent, or Firm*—Bereskin & Parr

(57) **ABSTRACT**

An illumination system for an escalator handrail has a rechargeable power source and a light source. The rechargeable power source is recharged by a charging circuit which receives power from one or more magnetically coupled charging stations. The light source emits light into an optic fiber or another light carrying and dispersing element. The optic fiber is selected to disperse light from its sides and thereby appears to be illuminated.

27 Claims, 6 Drawing Sheets



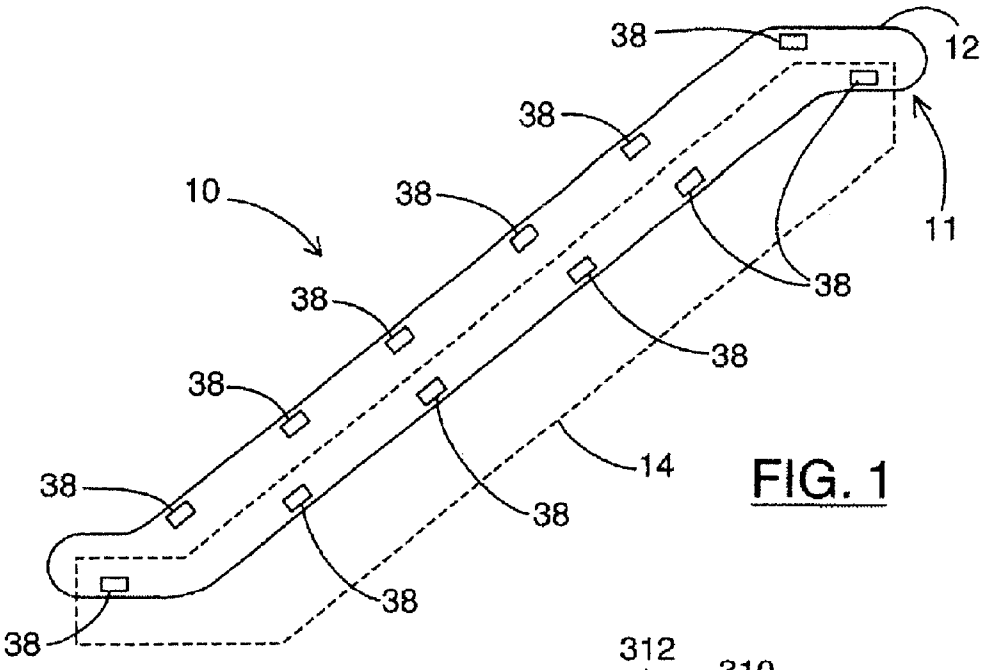


FIG. 1

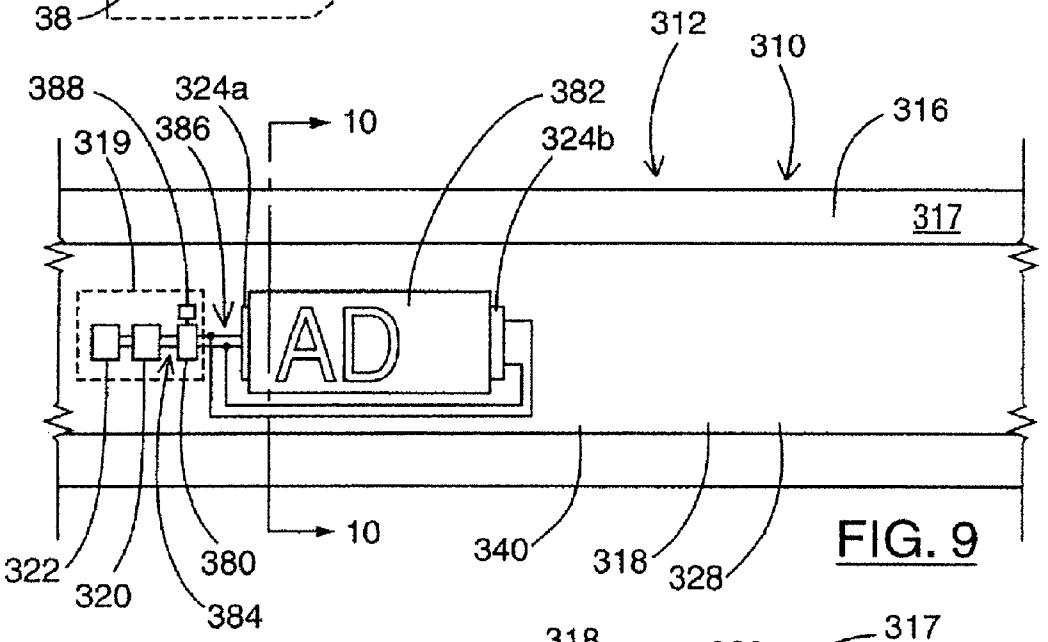


FIG. 9

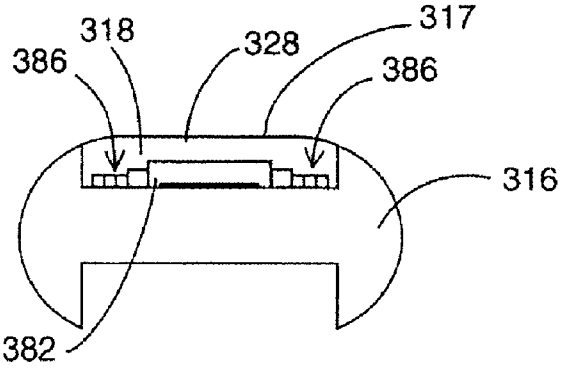


FIG. 10

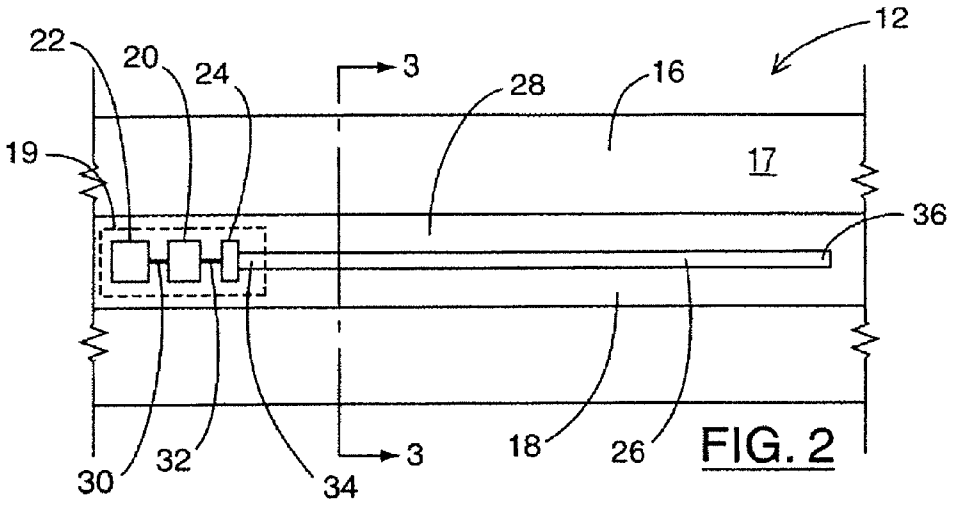


FIG. 2

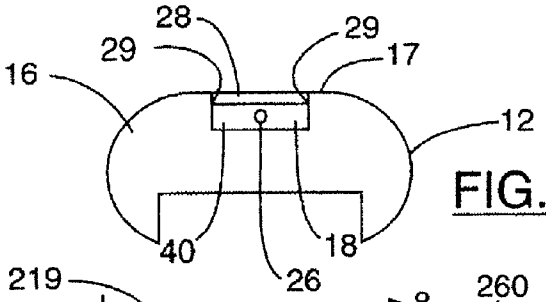


FIG. 3

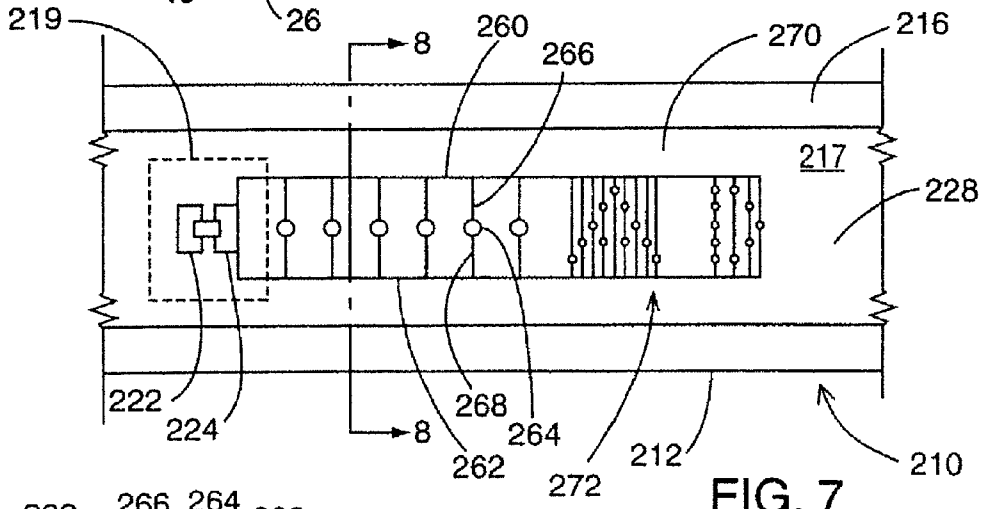


FIG. 7

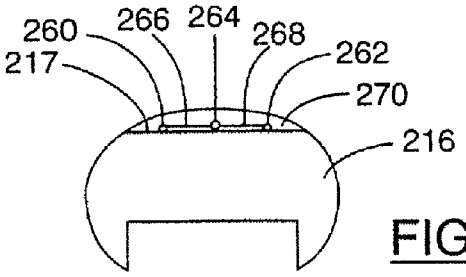


FIG. 8

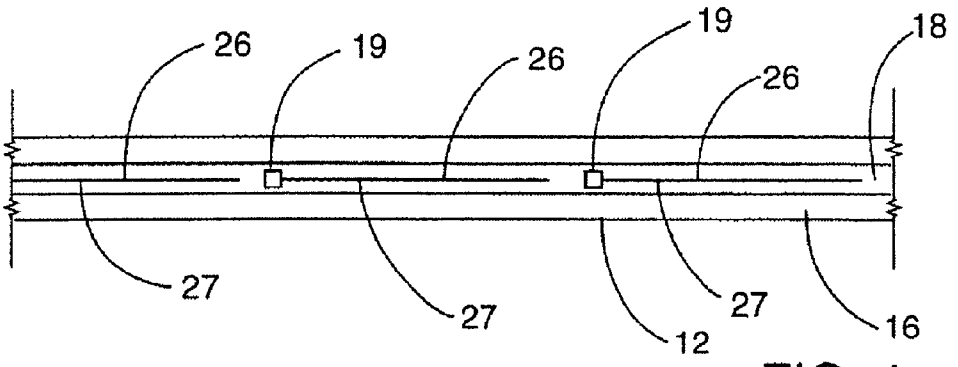


FIG. 4

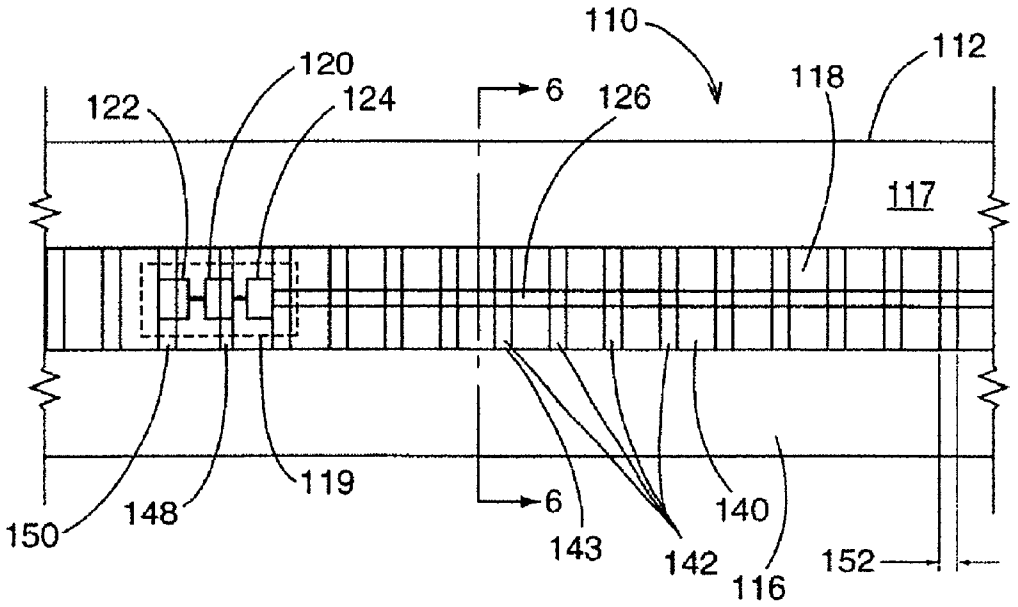


FIG. 5

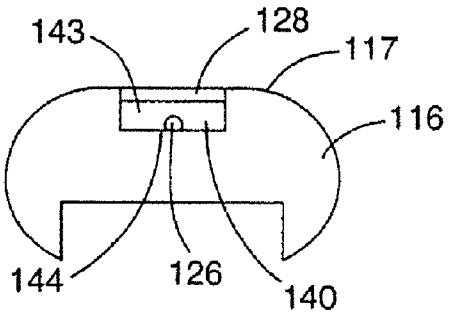


FIG. 6

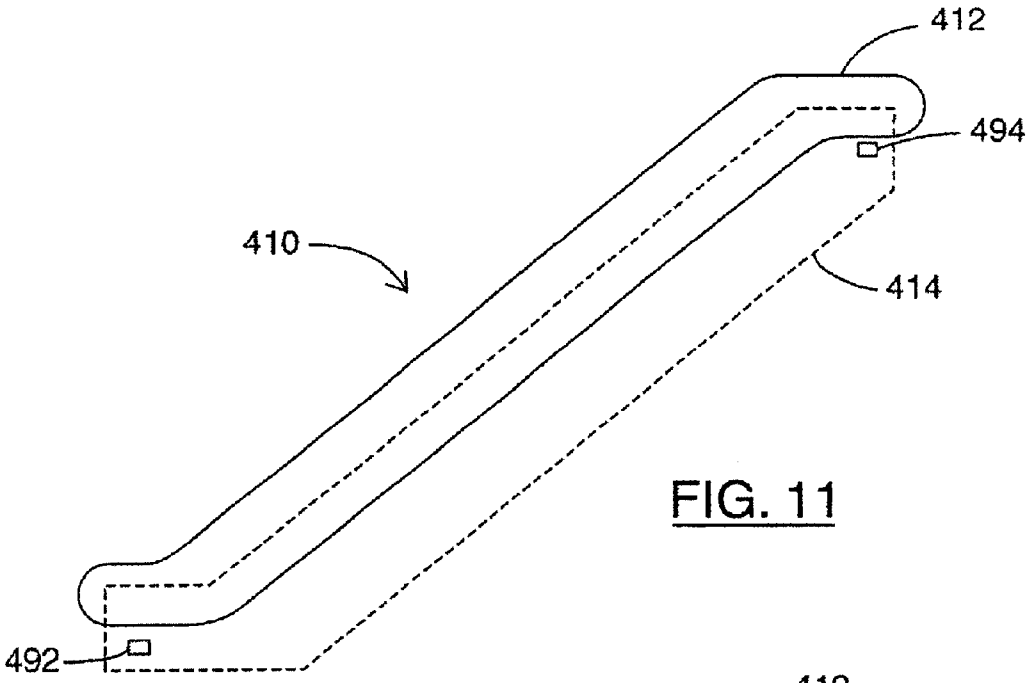


FIG. 11

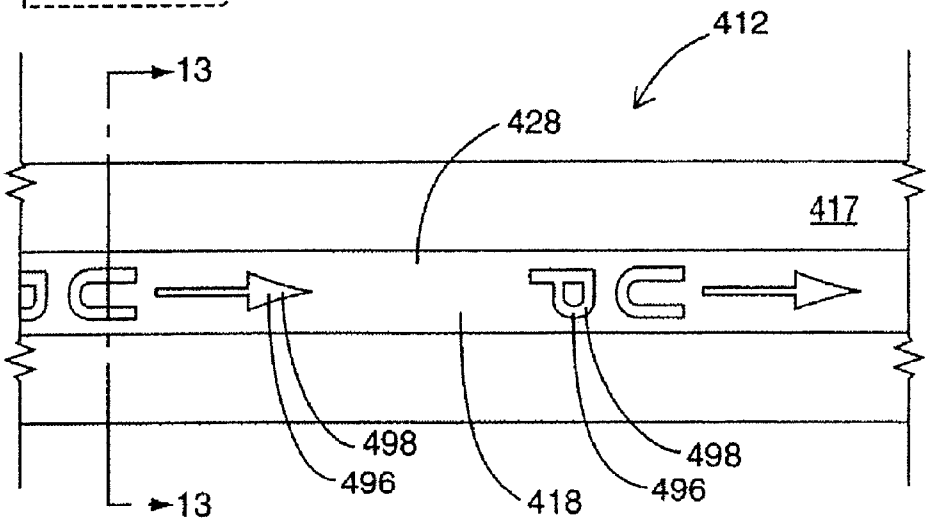


FIG. 12

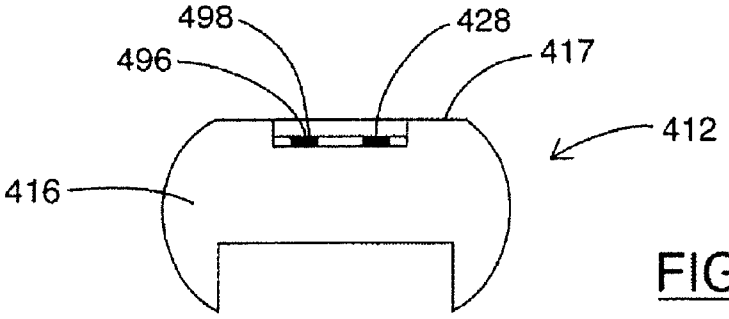


FIG. 13

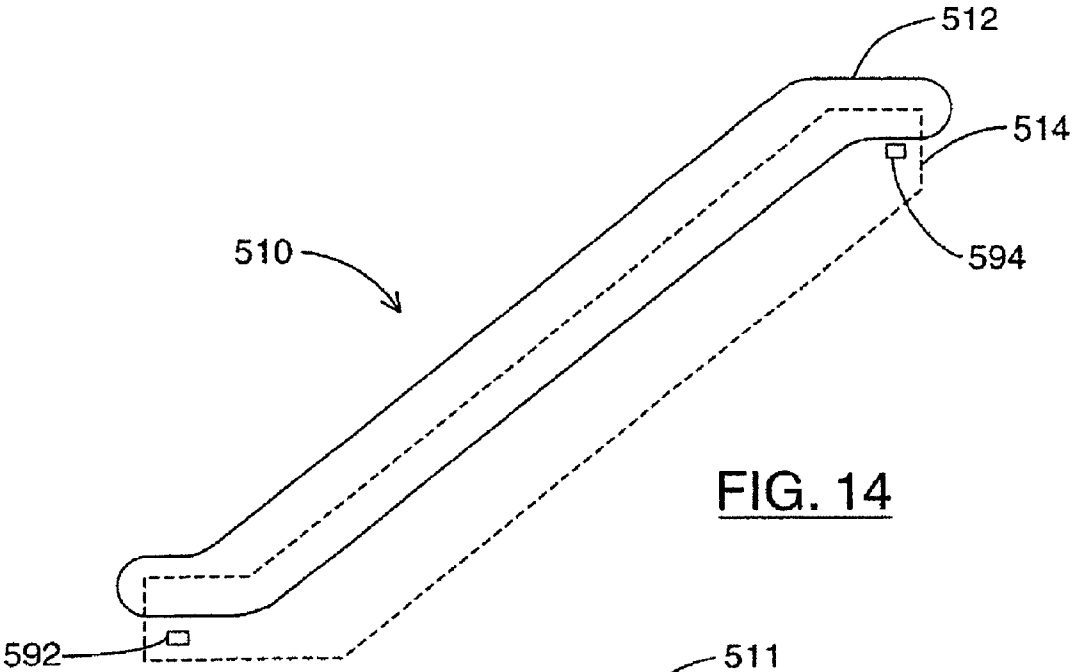


FIG. 14

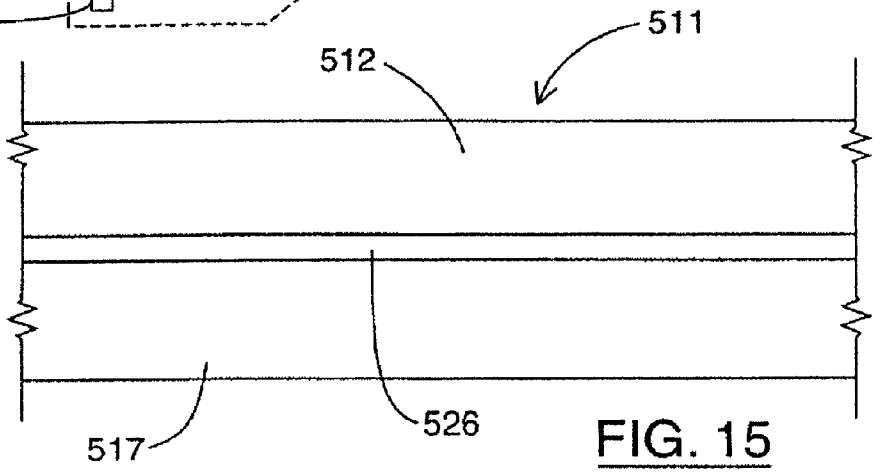


FIG. 15

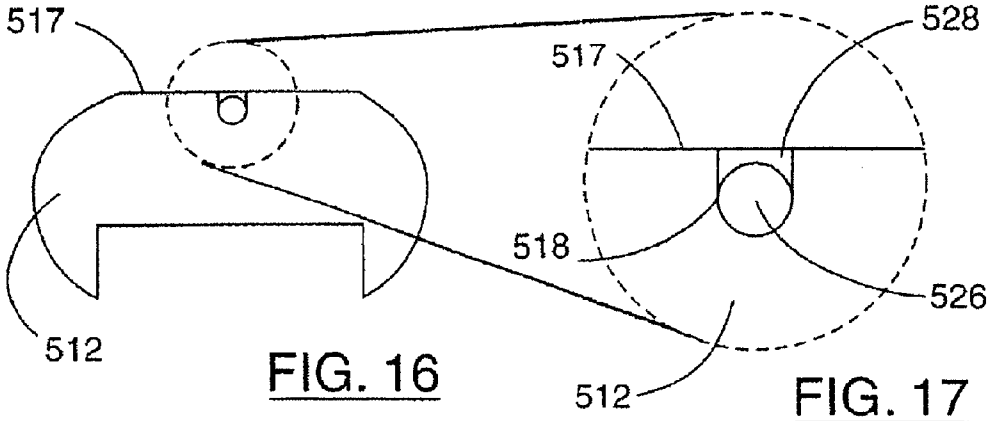


FIG. 16

FIG. 17

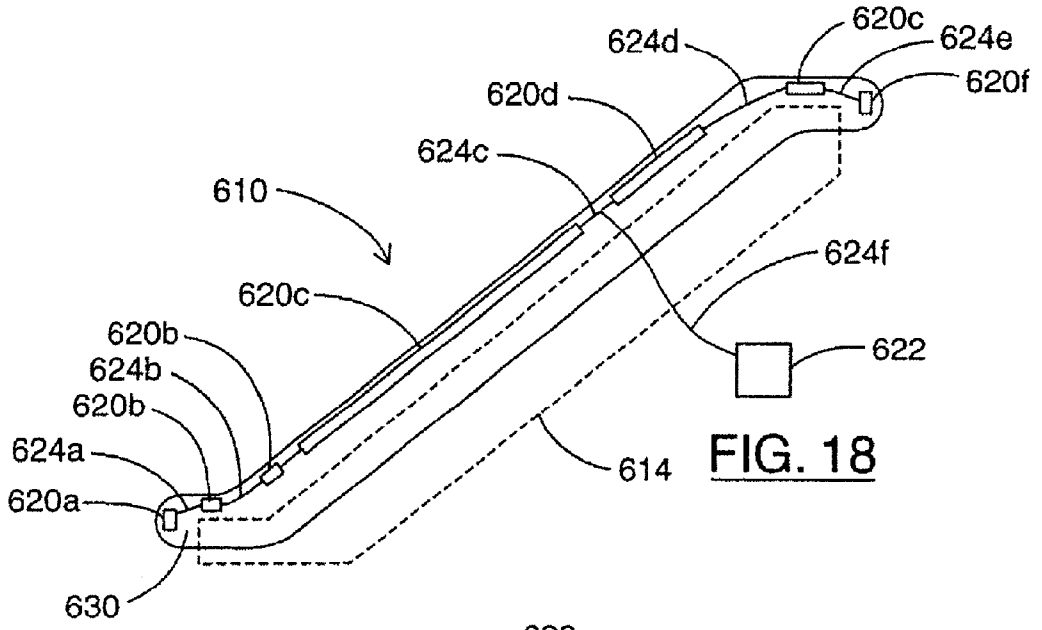


FIG. 18

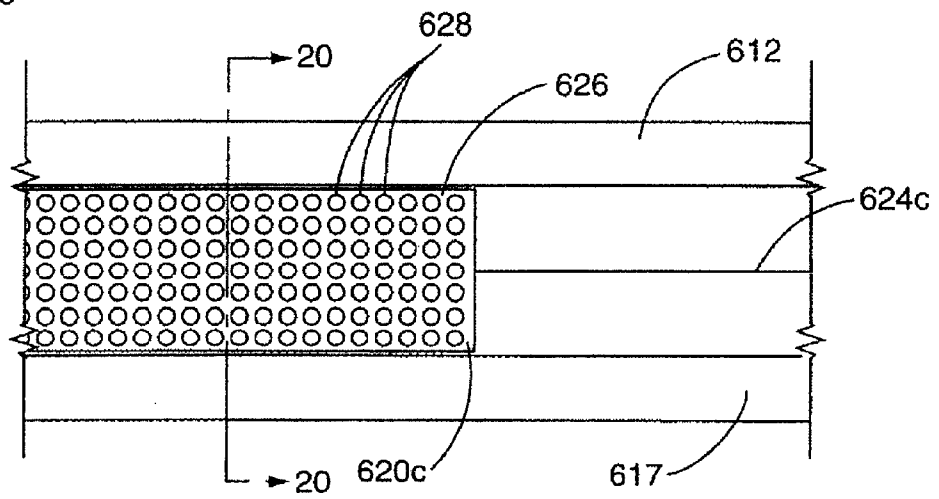


FIG. 19

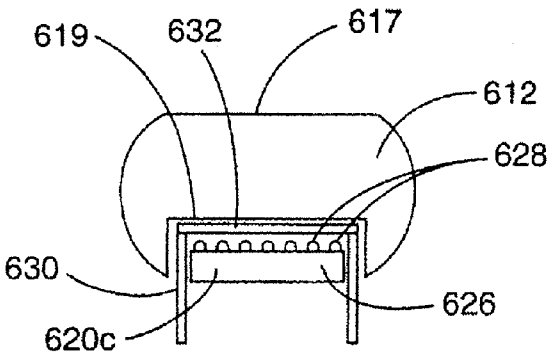


FIG. 20

ILLUMINATION SYSTEM FOR ESCALATOR HANDRAILS

FIELD OF THE INVENTION

This invention relates to handrails for escalators. More particularly, the invention relates to escalator handrails that are illuminated.

BACKGROUND OF THE INVENTION

Escalator systems with moving handrails are well known. In many of these systems, the handrail is a rubberized or thermoplastic element which travels at an appropriate height above and adjacent to a moving escalator. Typically, the handrail is solid black or another monochromatic color.

Such monochromatic handrails may be difficult for some persons to see, particularly when ambient lighting conditions are poor. Furthermore, the surface of such handrails presents a potential surface for advertising, for the presentation of safety information, or for the presentation of a graphic design.

It is accordingly desirable to provide an illuminated handrail for an escalator. Such a handrail will be more visible to persons with visual impairments. Preferably, although not necessarily, the illumination system may be adapted to present a safety or advertising message or a graphic design to users of the escalator.

SUMMARY OF THE INVENTION

In one embodiment, the present invention provides an illumination system for an escalator handrail. The illumination system comprises a light source powered by a power source which may be a rechargeable battery. The light source may directly provide the illumination for the system or it may emit light into a light dispersing element such as an optical fiber or a plastic sheet. If the power source is a rechargeable battery, a charging circuit may be coupled to it to maintain the battery's charge. The charging circuit is magnetically coupled to one or more charging stations as the handrail travels around its loop and at each charging station, the charging circuit will receive an electromagnetic power signal from the charging station. The charging circuit converts this electromagnetic power signal into a charging signal which is used to charge the battery.

In another embodiment of an illumination system according to the present invention, an escalator handrail includes an optic fiber embedded into it adjacent its surface. A light source positioned adjacent the optic fiber injects light into the optic fiber. This injected light travels along the length of the fiber and is emitted from the side of the fiber, causing the fiber to appear illuminated.

In another embodiment of the present invention, one or more light sources are mounted beneath a handrail. The handrail may be transparent, allowing the light from the light sources to be seen from a top surface of the handrail. The light sources may be oriented to display text messages or graphics, which may be either static or moving. If the messages are moving, their motion may be synchronized to the motion of the handrail or the steps of the escalator. Alternatively, the handrail may be translucent so that it absorbs, diffuses and emits light incident upon it. Such a translucent handrail appears to be lit up internally, although, in fact, the light sources are external to the handrail.

In one aspect, the present invention provides an illumination system for a handrail, said illumination system comprising: a light source mounted onto or within said handrail; and a power source coupled to said light source.

In another aspect, the present invention provides an illumination system for a handrail comprising: an optic fiber mounted to said handrail; and a light source for injecting light into said handrail.

In yet another aspect, the present invention provides an illumination system for a handrail comprising a light source oriented to direct light onto a bottom surface of said handrail. In this aspect, the handrail may be transparent or translucent.

BRIEF DESCRIPTION OF THE DRAWINGS

Several exemplary embodiments of the present invention will now be described with reference to the drawings, in which:

FIG. **1** is a side elevational view of a first illumination system according to the present invention;

FIG. **2** is a top view of a handrail which forms part of the illumination system of FIG. **1**;

FIG. **3** is a sectional view of the handrail of FIG. **2**;

FIG. **4** is another top view of the handrail of FIG. **2**;

FIG. **5** is a top view of a handrail of a second illumination system according to the present invention;

FIG. **6** is a sectional view of the handrail of FIG. **5**;

FIG. **7** is a top view of a handrail of a third illumination system according to the present invention;

FIG. **8** is a sectional view of the handrail of FIG. **7**;

FIG. **9** is a top view of a handrail of a fourth illumination system according to the present invention;

FIG. **10** is a sectional view of the handrail of FIG. **9**;

FIG. **11** is a side elevational view of a fifth illumination system according to the present invention;

FIG. **12** is a top view of a handrail which forms part of the illumination system of FIG. **11**;

FIG. **13** is a sectional view of the handrail of FIG. **12**;

FIG. **14** is a side elevational view of a sixth illumination system according to the present invention;

FIG. **15** is a top view of a handrail which forms part of the illumination system of FIG. **14**;

FIG. **16** is a sectional view of the handrail of FIG. **15**;

FIG. **17** is an enlargement of a portion of FIG. **16**;

FIG. **18** is a side elevational view of a seventh illumination system according to the present invention;

FIG. **19** is a top view of a handrail and a frame which form parts of the illumination system of FIG. **18**; and

FIG. **20** is a sectional view of the handrail and frame of FIG. **19**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference is first made to FIG. **1** which illustrates a handrail illumination system **11** for an escalator **10**. Handrail illumination system **11** comprises a handrail **12** and plurality of charging stations **38**. Handrail **12** forms a closed loop and moves along the closed path illustrated in FIG. **1** in conjunction with a set of steps (not shown) of escalator **10**. During its travel, handrail **12** is enclosed within the body of escalator **10** when it is in the portion of the path enclosed within dotted outline **14**. As handrail **12** moves along the closed path, each point of handrail **12** passes every charging station **38**.

Reference is next made to FIGS. **2** and **3**, which illustrate handrail **12** in greater detail. Handrail **12** comprises a base **16**, a channel **18**, a power/lighting block **19**, an optic fiber **26** and a protective cover **28**. Power/lighting block **19** comprises a power source **20**, a charging circuit **22** and a light emitter **24**.

Base **16** may be formed from any elastomeric material suitable for an escalator handrail. For example, base **16** may be formed of rubber or a thermoplastic material. During the fabrication of base **16**, channel **18** is formed in a top surface **17** of handrail **12**. Power source **20** may be a battery or rechargeable battery. In the preferred embodiment of handrail **12**, power source **20** is a rechargeable battery. Power source **20** is coupled to a charging circuit **22** by means of a coupling **30**, which may be one or more wires. Charging circuit **22** maintains the charge of power source **20** as described below. Power source **20** is coupled to light emitter **24** by means of a coupling **32** which may be one or more wires. Light emitter **24** may be a small laser device or one or more diodes or any other light source which emits visible light. Light emitter **24** is coupled to optic fiber **26** such that the visible light emitted by light emitter **24** is projected into a proximal end **34** of optic fiber **26**. Light emitter **26** transmits this light signal down its length to its distal end **36**. Optic fiber **26** is selected so that light transmitted by light emitter **24** from the proximal end **34** to the distal end **36** of optic fiber **26** will be dispersed from the sides of optic fiber **26** along its length, and in particular will be dispersed through the top **17** of handrail **12**. For example, optic fiber **26** may be comprised of a homogenous material along its length or may comprise an inner core and a cladding having different refractive indexes selected so that light transmitted down the core of optic fiber **26** will be refracted out of optic fiber **26**.

Protective cover **28** is transparent or is at least translucent and covers the length of channel **18**. Protective cover **28** is sealed at its edges **29** to base **16** forming a cavity **40** defined by the walls of channel **18** and protective cover **28**. Charging circuit **22**, power source **20**, light emitter **24** and optic fiber **26** are contained within cavity **40**.

The length of optic fiber **26** will be dependent on the distance over which it appears to be illuminated when light source **24** is operational. This in turn will depend on the intensity of light emitted by light source **24** and the light dispersing characteristics of optic fiber **26**. A person skilled in the art will be capable of selecting an appropriate optic fiber **26** (or other material) for use in conjunction with the selected light source **24** and will be capable of determining an appropriate length for optic fiber **26**.

Referring again to FIG. **1**, charging stations **38** are spaced along and adjacent to the path of handrail **12**. Each charging station **38** is a circuit (not shown) configured to provide an electromagnetic power signal to charging circuit **22** as charging circuit **22** passes the particular charging station **38**. Charging circuit **22** receives this electromagnetic power signal and converts it into an electric power signal which it uses to then charge power source **20** via power coupling **30**. Charging circuit **22** will be electromagnetically coupled to each charging station **38** as it travels along its path. Both charging circuit **22** and charging stations **38** may include a coil (not shown). The coils of the charging circuit **22** and charging stations **38** may be shaped to increase the electromagnetic coupling between the charging circuit **22** and a charging station in order to increase the power transfer between them.

The power received by charging circuit **22** and the power stored in power source **20** by charging circuit **22** will depend on the strength of the electromagnetic coupling and on the amount of power transferred during the effective period of coupling. The spacing of charging stations **38** and the power transferred during each coupling between charging circuit **22** and a charging station **38** will be selected so that power source **20** is kept sufficiently charged to power light source **24**.

Reference is made to FIG. **2**. Charging circuit **22**, power source **20** and light source **24** are shown as distinct units coupled together by couplings **30** and **32**. In an alternative embodiment of an illumination system according to the present invention, charging circuit **22** and power source **20** and light source **24** may be combined so that a single integrated unit comprises all three elements. Such an integrated unit may appear smaller than three distinct units and may present a more attractive appearance from the top of handrail **12**.

Reference is next made to FIG. **4**. The length of optic fiber **26** will be selected as described above. Typically, to illuminate the entire length of handrail **12**, a number of optic fibers **26** may be positioned end to end. FIG. **4** illustrates a longer section of handrail **12** than was illustrated in FIG. **2** and shows a number of illumination units **27** comprising an optic fiber **26** and a power/light block **19**. Each of the illumination units operates separately and each of them receives power from the charging stations **38** (FIG. **1**) as the charging circuits **22** of the power/light blocks **19** pass by the respective charging station. As shown, a plurality of illumination blocks may be positioned in a linear arrangement to provide illumination of all or substantially all of the handrail.

Optic fiber **26** need not be positioned in a straight line but may be configured to show a graphic design or may be configured to display an alphanumeric message. Furthermore, sections of optic fiber **26** may be covered by an opaque material so as to create a more complex pattern or to separate letters in an alphanumeric message. In addition, two or more optic fibers **26** may receive light from a single light source **24** and may be combined to form a longer or more complex message or design. Furthermore, power source **20** may be used to power two or more light sources **24**, possibly of different colors. Each light source **20** may provide light to one or more optic fibers **26**, which may be combined to form a design or alphanumeric message.

Reference is again made to FIG. **3**. Cavity **40** may be left empty or may be filled with a flexible and transparent gel or other material which allows light emitted by optic fiber **26** to be seen from the top of handrail **12**.

Reference is next made to FIGS. **5** and **6** which illustrate a second embodiment of an escalator handrail **112** which is part of a second illumination system **111** according to the present invention. Illumination system **111** includes charging stations **138** (not shown) which are identical to charging stations **38**. Elements of escalator handrail **112** which correspond to escalator handrail **12** are given the same reference numerals increased by 100. As is known, the movement of an escalator handrail is generally controlled by mechanical devices such as pinch rollers and motors which can exert substantial forces on the handrail. If in a particular embodiment of an escalator handrail according to the present invention, such pinch rollers and other mechanical devices would exert too great a mechanical compression force so as to cause cover **28**, optic fiber or power/light block **19** to become damaged, then protective elements may be installed in cavity **40**.

Escalator handrail **112** is identical to escalator handrail **12** except for the use of protective shells **142**. Protective shells

142 are spaced apart longitudinally in channel 118 within cavity 140. Cover 128 is affixed above protective shells 142. When handrail 112 is subjected to mechanical forces of pinch rollers and other mechanical components of an escalator, protective shells 142 will prevent cover 128 from being forced into cavity 140 and from separating from base 116 or from compressing and damaging optic fiber 126.

A particular protective shell 143 may correspond to the shape of cavity 140 and may have a notch 144 to accommodate optic fibers 126. Protective shells 148 and 150 which are positioned over power source 120 and charging circuit 122 will have appropriately shaped notches to accommodate those elements inside cavity 140.

Protective shells 142 are shown spaced along channel 118. In another embodiment of a handrail according to the present invention, protective shells 142 may be placed alongside one another so that they provide a continuous protective support for optic fiber 126 and the components of power/light block 119. The width 152 of protective shells 142 is selected so that handrail 112 remains flexible along its path as part of escalator 110 (not shown). Any spaces between protective shells 142 may be filled with an optically transparent gel or other material which renders the edges between protective shells 142 transparent or more difficult to view through the top 117 of handrail 112.

Reference is next made to FIG. 7 which illustrates a third embodiment of a handrail 212 which is part of an illumination system 211 according to the present invention. Illumination system 211 includes charging stations 238 (not shown) which are identical to charging stations 38. Elements of handrail 212 which correspond to elements of handrail 12 are given similar reference numerals increased by 200. Handrail 212 comprises a base 216, a power block 219, power rails 260 and 262 and a plurality of light sources 264 and a cover 270.

Base 216 does not have a channel like channel 18 of handrail 12. Power block 219 comprises a charging circuit 222 and a power source 224, which operate in the same manner as charging circuit 22 and power source 24. Charging circuit 222 receives power from charging stations (not shown) identical to charging station 38. Charging circuit 222 and power source 224 are mounted on the top 217 of base 216. Power source 224 is coupled to power rail 260 and 262 which respectively carry positive and negative (or power and ground) power signals from power source 224. Each light source 264 is coupled between power rails 260 and 262 by means of conductors 266 and 268 to receive power from power rails 260 and 262. A cover 270 is mounted over power block 219, power rails 260, 262 and light sources 264 to protect them during usage of handrail 212. Cover 270 is sealed to top 217 of base 216. If necessary, protective shells similar to protective shells 142 may be mounted between cover 270 and base 216 to protect power block 219 and/or light sources 224.

Light sources 264 are selected to emit visible light and may be selected to emit visible light of different colors. More than one light source may be coupled in parallel between power rails 260, 262 and the spacing between adjacent light sources 264 may be varied to form letters or another pattern, as shown at 272, where a plurality of light sources are arranged to display the word "AD".

In this way, handrail illumination system 211 provides an embedded signboard which may be used to display advertising, safety information or a graphic design on handrail 212.

Reference is next made to FIG. 9, which illustrates a fourth embodiment of a handrail 312 which is part of an illumination system 311 according to the present invention. Illumination system 311 includes charging stations 338 (not shown) which may be identical to charging stations 38. Elements of handrail 312 which correspond to elements of handrail 12 are given similar reference numerals increased by 300. Handrail 312 comprises a base 316, a power/lighting control block 319 and a display board 382. Power/lighting control block 319 includes power source 320, charging circuit 322, a pair of light sources 324*a* and 324*b*, a microcontroller 380 and a position detector 388. Microcontroller 380 is coupled to power source 320 through a coupling 384, which may be one or more wires, to receive power and is coupled to light sources 324*a* and 324*b* through coupling 386, which may be one or more wires, to control their operation. Microcontroller 380 is coupled to position detector 388 through a coupling 390, which may be one or more wires.

Display board 382 may be a flexible plastic sheet which has been scored or etched on one or both sides. Display board 382 is selected so that light transmitted into a side of display board 382 is dispersed through the top 317 of handrail 312 at the location of the scores or etchings on display board 382. In this exemplary embodiment, display board 382 has been etched on its bottom surface with the letters "AD".

Light sources 324*a* and 324*b*, which may include one or more LEDs, are mounted on either side of display board 382. Light sources 324*a* and 324*b* transmit light into the edges of display board 382 and this light is dispersed through the top 317 of handrail 312 when it strikes the etched portions of display board 382.

In an alternative embodiment of a handrail according to the present invention, the etched portions of display board 382 may be painted with photo-luminescent paint to enhance to the dispersion of light. Alternatively, display board 382 may not be etched at all and a design or message may be painted onto its top or bottom surface using photo-luminescent paint. This may be particularly desirable where display board 382 is a thin plastic sheet or film and is not suitable for etching or scoring.

Microcontroller 380 controls the power supply to light sources 324*a* and 324*b* to controllably switch them on or off. Microcontroller 380 is also coupled to a position detector 388. Position detector 388 provides a signal to microcontroller 380 indicating whether it is within the enclosed portion 314 of escalator 310 (not shown, but see element 14 on FIG. 1). Microcontroller 380 is responsive to this signal and may switch light sources 324*a* and 324*b* off when they are not visible from the exterior of escalator 310, thereby reducing the power requirements of illumination system 311, and possibly reducing the required number of charging stations 338 (not shown). Position detector 388 may be a photo-diode which is sensitive to the presence or absence of ambient light to determine its position.

The use of two light sources 324*a* and 324*b* at opposite sides of display board 382 is only exemplary. In alternative embodiment, only a single light source may be used, or two or more light sources may be mounted one any side or edge of display board 382, which may not be rectangular.

Microcontroller 380 and position detector 388 may be adapted for use with illumination system 11, 111 or 211. In particular, such a microcontroller may be advantageously used with illumination system 211 to selectively turn on different light sources 224 to provide a dynamic (i.e. time-varying) message or graphic image.

Reference is next made to FIGS. 11, 12 and 13, which illustrates a fifth embodiment of a handrail 412 which is part

of an illumination system **411** according to the present invention. Elements of illumination system **411** which correspond to elements of illumination system **11** are given similar reference numerals increased by **400**. Illumination system **411** differs from illumination systems **11** in that illumination system **411** does not require charging stations **38** (FIG. **1**) or a power light block **19** (FIG. **2**).

Illumination system **411** includes a handrail **412** and two light sources **492** and **494**. Light sources **492** and **493** are positioned at the upper and lower ends of enclosed region **414**. Handrail **412** comprises a base **416**, a cover **428** and a luminescent message **496**. Handrail **412** has a channel **418** which may be formed during manufacturing of handrail **412**.

Luminescent message **496** is formed within channel **418**. Luminescent message **496** is made of a luminescent material **498** which may be made to glow. One such luminescent material is sold by Hirotec Inc. 2470-G South Harbor Blvd, Santa Ana, Calif., USA under the trade mark PERMAGLOW. This material is described on the Internet at www-.permaglow.com. This luminescent material is responsive to an energy input and begins to glow if it receives sufficient energy from an energy source such as a light source. If luminescent material **498** is produced in a paint form, luminescent message **496** may be formed by stenciling, painting or printing luminescent material **498** onto channel **418**. Other methods may be used, depending on the nature of luminescent material **498**. For example, a luminescent material formed into a sheet may be cut into letters or symbols, which may then be fastened (i.e. by glue or other means) onto channel **418**. Luminescent material **498** may include different types of luminescent materials and different colors of luminescent materials.

Cover **428** is affixed to base **416** over channel **418** to protect luminescent message **496**. In an alternative embodiment of a handrail according to this invention, channel **418** may be omitted. In such an embodiment luminescent message **496** may be formed on the top surface **417** of handrail **412** and cover **428** may be omitted or affixed onto top surface **417**. This is similar to the structure of handrail **212**.

Light sources **492** and **494** are selected to individually provide sufficient light energy to luminescent material **498** to cause it to glow. For example, if the PERMAGLOW material described above is used as luminescent material **498**, light sources **492** and **494** may be high intensity (i.e. 300W) mercury vapor lamps. Light sources **492** and **494** may be selected so that they may be operated at a high intensity (i.e. 300 W or higher) and at a low intensity (i.e. a selected fraction of the high intensity).

Handrail **412** may travel around its closed path (shown in FIG. **11**) in either direction, depending on whether escalator **410** is configured to carry riders up or down. When escalator **410** is configured to go up, handrail **412** will exit enclosed region **414** at its bottom, near light source **492**. When escalator **410** is configured to go down, handrail **412** will exit enclosed region **414** at its top, near light source **494**. In either case, the light source **492** or **494** adjacent the end of enclosed region **414** from which handrail **412** will exit enclosed region **414** is energized to provide light energy to luminescent material **498**. The other light source **494** or **492** need not be energized.

Depending on the nature of luminescent material **498**, it may be necessary to initially expose luminescent material **498** to a high power energy source to initiate the luminescence of luminescent material **498**. Subsequently, a lower power energy source may be sufficient to maintain the luminescence of luminescent material **498**. If this is required, light source **492** or **494** may be operated at a high intensity when escalator **410** is initially activated. When luminescent material **498** has received sufficient energy, light source **492** or **494** may be operated at a low intensity. To reduce the time required for luminescent material to receive sufficient energy, both light sources **492** and **494** may be used at high intensity during the initial period. In addition, both light sources **492** and **494** may be used at all times, possibly at a lower intensity, to maintain the luminescence of luminescent material **498**.

Illumination system **411** provides a simple method for printing a luminescent message **496** onto an escalator handrail and using an external energy source (light source **492** and/or **494**) to energize the luminescent message **496**. This embodiment may be particularly appropriate for use with an escalator handrail that should be illuminated in low lighting situations. For example, this system may be appropriate for use in an office tower in the evening or nighttime hours, during which the main lighting of the building may be shut off.

In another embodiment of a handrail illumination system (not shown) according to the present invention, a luminescent material, such as the luminescent material **498** of handrail **411** may be mixed into the rubber or thermoplastic material from which the handrail is formed. This may be done prior to the formation of the handrail to provide a uniform mixture. When the handrail is formed, the luminescent component of the handrail may be made luminescent in the manner described above in relation to illumination system **411**.

Reference is next made to FIGS. **14**, **15**, **16** and **17**, which illustrate another embodiment of a handrail illumination system **511** according to the present invention. Illumination system **511** includes a handrail **512** and light sources **592** and **594**. Handrail **512** has an optical fiber **526** embedded into a channel **518** adjacent its top surface **517**. A cover **528** is affixed over optical fiber **526** to protect optical fiber **526** and to hold it in place within channel **518**. Optical fiber **526** extends around the perimeter of handrail **512**. The ends of optical fiber **526** are spliced together so that it forms a continuous loop. Optical fiber **526** may be comprised of several component fibers which are spliced together.

Light sources **592** and **594** are positioned at the upper and lower ends of enclosed region **514**. Each light source **592**, **594** provides a high intensity light beam which is directed into the portion of optical fiber **526** adjacent that light source. Light received by optic fiber **526** may be said to be "injected" into optic fiber **526**. A least a portion of this injected light travels longitudinally in optic fiber **526**, thereby causing optic fiber **526** to appear illuminated. If optic fiber **526** is selected to disperse light from it sides (as described above in relation to optic fiber **26**), then this appearance of illumination may be enhanced. The use of two light sources **592** and **594** at the upper and lower ends of enclosed region **514** is desirable to increase the intensity of light emitted from optic fiber **526** and to maintain a more even intensity of light emitted along the length of optic fiber **526**. However, one of light source **592** or light source **594** may be omitted.

Illumination system **511** has the advantage that no electronic components are required in handrail **512** and accordingly, there is no need to provide a battery or charging circuit in handrail **512**.

Reference is next made to FIGS. **18**, **19** and **20**, which illustrate another embodiment of a handrail illumination system **611**. System **611** comprises a handrail **612** and a

plurality of sign boards **620***a*–**620***f* and a controller **622**. Sign boards **620***a*–**620***f* and controller **622** are coupled together by couplings **624***a*–**624***f*.

Part of sign board **620***c* is illustrated in FIGS. **19** and **20**. Sign board **620***c* has a housing **626** and a plurality of light sources **628** extending from the housing **626**. Light sources **628** may be single or mulit-color LEDs, light bulbs or any other type of light emitting device. Light sources **628** are controlled by controller **622** through couplings **624**. Controller **622** may be a computer or other type of control device. Typically, each sign board **620** may be an independent unit capable of receiving control instructions from controller **622** and of displaying text or graphic messages using light sources **628**. Sign board **620***c* has its lights source **628** arranged in a matrix that is particularly suitable for displaying text, which may be displayed in a static or moving position.

Light sources **628** may receive power from the electrical system of escalator **610** or from another source (not shown) in a conventional manner. Since sign boards **620** are mounted in fixed positions within the frame **630** of escalator **610**, they be physically coupled to a power source and do not require batteries or charging circuits.

The bottom surface **619** of handrail **312** is supported by a frame **630**, which is part of the body of escalator **610**. Frame **630** has a transparent cover **632**, which permits light from light sources **628** to pass through to the bottom surface **617** of handrail **612**. Each sign board **620** is installed within frame **630** adjacent to handrail **612**, so that the light from the sign board's light sources **628** is directed to the bottom surface **617** of handrail **612**.

Handrail **612** is formed from a transparent material, allowing text or images displayed on sign boards **620** to be viewed through the top surface **617** of handrail **612**. In this way, a text or graphic message displayed using light sources **628** is visible through the top surface **617** of handrail **612**.

Illumination system **611** includes six sign boards **620***a*–**620***f* of various sizes and placed in different parts of frame **630**. In an alternative embodiment, a single sign board that extends the whole or part of the exposed portion of handrail **612** (i.e. the portion of handrail **612** that is not enclosed within the body of escalator **610** at any particular time) may be used. Alternatively, independent light sources may be installed within frame **630**. Such independent light sources may optionally be organized in a matrix like light sources **628** and may optionally be controlled by a common controller like controller **622**. Alternatively, such independent light sources may be controlled by separate controllers or may simply be left on at all times. Any other method of directing light on to the bottom surface **619** of handrail **620** may be used within the scope of the present invention.

Handrail **612** has been described as transparent. Alternatively, handrail **612** may be formed from a translucent colored or colorless material. In a simple embodiment, a translucent handrail **612** that diffuses light may be combined with several constantly powered light sources **628** spaced along the path of handrail **612** to simply illuminate the handrail **612**. Such a system may be used to illuminate the entire exposed part of handrail **612** or may be used to illuminate only the portion of the handrail **612** at the top and/or bottom of the escalator **610**.

Handrail illumination system **611** allows transparent or translucent handrail **612** to be illuminated through its bottom surface. If handrail **612** is transparent and appropriate light sources, such as sign boards **620** are used, a text or graphic message may be displayed through handrail **612**. Handrail illumination system **611** does not require a channel, such as channel **18** to be formed in handrail **612**. In addition, no electronic components are required in handrail **612**, eliminating the need for batteries and charging stations.

Illumination systems **11**, **111**, **211**, **311**, **411**, **511** and **611** have been described in the context of a single handrail. As is well known, most escalators have two distinct handrails and an illumination system may be used on one or both of such handrails. Furthermore, differently configured illumination systems may be used on one or both handrails to increase the amount of safety or advertising information which may be conveyed.

While particular embodiments of illumination systems according to the present invention have been described here, other variations are possible. Such variations fall within the scope of the invention, which is limited only by the appended claims.

We claim:

1. An illumination system for a moving handrail, said illumination system comprising:

(a) a light source attached to said moving handrail; and

(b) a power source comprising a first circuit coupled to said light source, and a second circuit, wherein the light source and the first circuit are mounted to the moving handrail, wherein the second circuit is stationary, and wherein electromagnetic coupling is provided between the first and second circuits for transferring power therebetween.

2. The illumination system of claim **1** wherein a channel is formed in a top surface of said handrail and wherein said light source is mounted within said channel.

3. The illumination system of claim **2** further comprising a cover mounted over said channel.

4. The illumination system of claim **3** further comprising one or more support shells positioned within said channel wherein said shells have a thickness which substantially fills the depth of said channel around said light source and beneath said cover, to support said cover.

5. The illumination system of claim **4** wherein a plurality of said support shells are provided at intervals along said channel, and wherein an optically transparent material is provided between adjacent support shells.

6. The illumination system of claim **1** wherein said light source mounted to an upper surface of said moving handrail from above.

7. The illumination system of claim **1** wherein said light source comprises a light dispersing optic fiber.

8. The illumination system of claim **1** wherein said light source is a light emitting diode.

9. The illumination system of claim **1** wherein said light source is a laser.

10. The illumination system of claim **1** further comprising a light dispersing element and wherein said light source is comprised of a light emitting diode.

11. The illumination system of claim **10** wherein said light dispersing element is a light dispersing optic fiber.

12. The illumination system of claim **10** wherein said light dispersing element is a sheet of flexible plastic.

13. The illumination system of claim **12** wherein said sheet of flexible plastic is engraved or etched with a graphic image or message.

14. The illumination system of claim **12** wherein a graphic image or message is printed onto said sheet of flexible plastic with photo-luminescent paint.

15. The illumination system of claim **1** wherein said power source comprises a rechargeable battery and said rechargeable battery is attached to said moving handrail.

16. The illumination system of claim 15 comprising:

(i) a charging circuit coupled to said battery for charging said battery in response to a charging signal; and

(ii) a power supply circuit for generating said charging signal, wherein said power supply circuit and charging circuit are electromagnetically coupled for transmitting said charging signal from said power supply circuit to said charging circuit.

17. The illumination system of claim 16 including at least two power supply circuits wherein said handrail travels along a closed path and wherein said at least two power supply circuits are positioned adjacent said path and are spaced along said path to allow said charging circuit to be electromagnetically coupled to each said power supply circuit.

18. The illumination system of claim 1 wherein said handrail travels along a closed path and wherein a portion of said path is enclosed and further including a position detection device for de-activating said light source when said light emitting device is in said enclosed portion of said path.

19. An illumination system for a moving handrail comprising:

(a) an optic fiber mounted to said moving handrail; and

(b) a light source for injecting light into said optic fiber,

wherein said optic fiber is configured to absorb at least some of said injected light and to disperse at least some of said absorbed light through a side surface of said optic fiber, and wherein said dispersed light travels through a top surface of said moving handrail.

20. The illumination system of claim 19 wherein said light source is spaced apart from said optic fiber and from said handrail.

21. The illumination system of claim 19 wherein said handrail is moveably mounted on a support frame and wherein said light source is fixedly mounted on said support frame.

22. An illumination system for moving handrail comprising at least one light source oriented to direct light onto a bottom surface of said moving handrail, wherein the handrail includes a light receiving and emitting portion, adapted to receive and absorb light from the light source and to emit light, whereby, in use, light is emitted from the handrail and is visible from a top surface of said handrail.

23. The illumination system of claim 22 wherein said handrail is translucent.

24. The illumination system of claim 22, wherein said handrail is transparent and wherein said at least one light source is mounted adjacent said bottom surface of aid handrail.

25. An illumination system for a moving handrail and having a light source comprising a plurality of individual light sources arranged in a matrix, wherein said matrix defines an electronic signboard directed at the handrail.

26. The illumination system of claim 25 further comprising a controller for controlling the operation said electronic signboard.

27. The illumination system of claim 26 wherein said electronic signboard displays at least one of text and graphics.

* * * * *