Title of the Invention: Improved handrail
Abstract Title: Hand rail having LED lights

The rail includes a plurality of light emitting diodes (LEDs) to provide a light source. The LEDs may be mounted on a substrate in a groove, recess or channel formed in the rail body at an angle of between 10 and 30 degrees to the vertical. The rail may provide an emergency lighting system wherein an integral source of electrical power such as a battery and a control board are provided in a support for the rail. A flight of stairs to which the rail is attached, a method of making the rail and a method of installing a lighting system on the interior or exterior of a building by installing the rail are also claimed.
Fig. 1

Angled at 20° to illuminate Staircase Treads.
**Improved Handrail**
This invention relates to an improved hand rail, especially a hand rail for stairs, and to a method of making the same.

**Background of the Invention**
Hand rails in general, and in particular handrails for stairs, have of course been known for centuries.

Much more recently, lighting systems have been developed which utilise LEDs as a light source. These are especially useful for providing emergency back-up lighting.

**Summary of the Invention**
In a first aspect, the invention provides a handrail which incorporates a plurality of LEDs to provide a light source. More especially the handrail is for use on a flight of stairs. Such a handrail is referred to herein as a “stair rail”.

Conveniently the plurality of LEDs are mounted on a support, which may be flexible or rigid. Typical supports comprise polycarbonate or other synthetic plastics substance. It is preferred that the handrail or stair rail is provided with a recess, groove, channel or the like, which can accommodate the plurality of LEDs, and any associated support, along the length thereof.

Incorporation of the LEDs into such a recess, groove, channel or the like confers a number of advantages. The LEDs are provided with shelter by the hand rail, which protects them from mechanical damage. In addition, the location of the LEDs within the recess or groove etc. provides a smooth finish to the handrail, which is desirable for the comfort of people grasping the rail, and provides an aesthetically pleasing appearance.

The hand rail or stair rail incorporating the plurality of LEDs may be of any material including, but not limited to, wood, synthetic moulded plastics materials, stainless steel, power-coated steel, aluminium or other metal. Conveniently the hand rail is essentially hollow, so that the
LEDs and associated cabling can readily be accommodated in a recess or the like formed in the hand rail.

The colour of the LEDs is not critical, and any colour may be chosen. However white or blue LEDs will generally be preferred.

The LEDs can be used to provide routine lighting to walkways, corridors or stairs, in which the LEDs are illuminated constantly during the hours in which lighting is normally required. Alternatively the LEDs may be primarily for decorative purposes. More typically, the LEDs will be used to provide emergency lighting in the event that a primary lighting system fails e.g. due to an interruption in power supply. Such an emergency lighting function may be in addition to a routine normal lighting function.

The hand rail may be intended for interior use or for exterior use. An example of the latter is a stair rail on a fire escape route from a building. The present invention is especially beneficial for exterior use, as there is often no suitable surface on which to mount emergency lighting luminaries and so suitable wiring. The present invention overcomes these problems without causing unsightly extra wiring.

For convenience, the plurality of LEDs are surface mounted on a strip of solid support, such as circuit board. The LEDs will desirably be provided in a substantially linear array, and a plurality of such arrays may be used, either in a side by side arrangement (if there is sufficient space within the hand rail) or, more usually in a longitudinal arrangement along the length of the rail (which is not to be interpreted as requiring that the arrays actually touch one another). The spacing of the individual LEDs in the array may be irregular or, more preferably, regular. Equally, if a plurality of arrays are employed in the hand rail, the spacing of the arrays may be irregular or, more preferably, regular. In one example, an array of LEDs comprises a solid PCB support with LEDs regularly spaced in a row, with a 10mm spacing between adjacent LEDs. However the spacing can readily be made higher or lower as desired.

The LEDs will preferably be protected behind a transparent or translucent cover, which may desirably also act as a lens, to focus and/or direct the light from the LEDs to a desired location. Suitable materials for the cover include polycarbonate, acrylic or other thermoplastics
materials. The cover may also include a reflective material at the sides thereof to help direct the light.

In a preferred embodiment, the handrail is one which is DDA (Disability Discrimination Act) – compliant, which imposes a certain acceptable range on the dimensions of the hand rail. Another requirement for compliance with the DDA is that hand rails are not cold to the touch. Thus, another advantage of the invention is that incorporating LEDs into the handrail provides a small heating effect which allows handrails, which migh otherwise be “cold to the touch” to become DDA-compliant.

In a preferred embodiment, the LEDs incorporated into the handrail form part of an emergency lighting system. In such an emergency system, the lights are able to be operated by an integral power source, such as a battery. The lights may also be operable by a conventional external power source, such as an AC mains supply, or an extra low voltage i.e. less than 25 volts (e.g. 9 or 12 volt).

Accordingly, in the preferred embodiment, the handrail of the invention is also provided with drive gear e.g. necessary to operate the LEDs in the event that the primary lighting has failed. Typically the drive gear will comprise a printed circuit board substrate, a battery, and a sensor which senses any failure in external power supply and/or failure of a primary lighting system, and causes the LEDs to illuminate using power drawn from the battery. The battery may be, for instance, a nickel/metal hydride or a lithium battery.

In a preferred embodiment, the drive gear will comprise a self-test facility.

In a preferred embodiment, the drive gear for the LEDs is not provided in the main body of the handrail but is instead provided in one or more of the supports, on which the hand rail is mounted. Typically the support is a floor- or stair-mounted upright, but the support could alternatively be a wall-mounted support. In any event, physically separating the drive gear from the LEDs in this way is preferable as it keeps the battery cooler (and therefore more efficient), and also allows for longer unbroken runs of LEDs in the main body of the handrail.
The desired density of LEDs per unit length of handrail will depend on a number of factors. If the LEDs are intended to provide a primary lighting system as well as an emergency battery-powered lighting system, a higher LED density may be required. In a stairwell, it may be possible to have a stair rail in accordance with the invention on both sides of the stairs, in which case the density of LEDs in each rail can be less than if a single stair rail is provided on one side of the stairs, and the same intensity of illumination still achieved.

In preferred embodiments the LEDs are arranged so as to provide downward illumination and illuminate the floor or stairs generally beneath the hand rail and/or to one side thereof. Accordingly, a strongly preferred feature of the present invention is that a recess, groove, channel or the like is provided on the underside of the hand rail and, more especially is provided on the underside the hand rail and, more especially is provided at an angle to the vertical.

Typically the channel is such that the LEDs are at an angle in the range 10-30° to the vertically downward direction, more preferably in the range 15-25°. In one particular example, a DDA-compliant staircase (1200mm wide) is provided on each side with a handrail in accordance with the invention, in which the LEDs are angled inwards and downwards towards the stairs at an angle of about 20° from vertical. This provides good illumination across the full width of the stairs, with intensity of illumination well above the minimum emergency lighting requirement of 1 Lux.

It will be apparent to those skilled in the art that the handrail of the invention may conveniently comprise a main body, which accommodates the plurality of LEDs, and also one or more supports for attaching the handrail to a wall, floor, or flight of stairs, and that the drive gear for the LEDs is preferably not in the main body, so as to be separate from the LEDs to keep the battery cool. Providing the drive gear in one or more of the supports confers the desired degree of separation whilst, as the same timing, retaining essentially all the necessary elements of the lighting system as being integral to the handrail.

The handrail of the invention can readily be retro-fitted to existing hallways, corridors, stairwells etc. and may replace or supplement pre-existing handrails.
Conveniently, the LEDs may be removed from the hand rail, and replaced therein, to allow for routine maintenance, cleaning, replacement of faulty LEDs etc. To facilitate this, it is desirable that a plurality of LEDs are mounted in a substrate which is removable and replaceable within the handrail, preferably a plurality of times. Conveniently a resiliently deformable member is used to provide a frictional engagement between the substrate and the recess, groove or channel in the main body of the rail. Alternatively, a snap fit member may be provided, which releasably snaps into the hand rail. The snap fit member or resiliently deformable member may be formed on the substrate itself or an intervening member may be used. In one embodiment, the substrate is gripped in place by an intervening grip member, comprising a natural or synthetic rubber compound or other resiliently deformable material. The grip member has a plurality of projections on its outer surface which provide a frictional engagement with the walls of the recess, groove or channel in the hand rail body. The grip member also has a plurality of thin ridges on the inner surface of its side walls, which ridges are upward or rearward pointing and which grip the substrate or an LED holder.

By way of explanation, in a preferred embodiment the LED substrate is itself held by an LED holder. The LED holder may conveniently be generally C-shaped in transverse section. Desirably each arm of the holder has at least one longitudinal groove therein, the grooves on respective arms being aligned. The edges of the LED substrate may be retained within the aligned grooves. Preferably the respective arms of the LED holder comprise a further groove, again aligned with a groove in the opposite arm, which aligned grooves can be used to retain the edges of a transparent or translucent lens or cover.

The grip member, and/or the LED holder, if present, may define a cavity within which electrical and/or computer network cabling may be deployed, so that the cabling may conveniently be accessed and removed from the hand rail when the LEDs are extracted. Alternatively, cabling may simply be run along the recess, groove or channel in the hand rail, or clipped to the outer surface of the grip member or LED holder.

If desired, the handrail may be provided a part of a pre-fabricated flight of stairs. Thus, in a second aspect the invention provides a flight of stairs to which is attached a handrail in accordance with the first aspect of the invention.
In a third aspect the invention provides a method of making a handrail, the method comprising the step of providing in a handrail a plurality of LEDs. Performance of the method will lead to manufacture of a handrail in accordance with the first aspect defined above, and desirably having one or more, in any combination, of the preferred features described above.

In particular, the method will preferably comprise the locating of the plurality of LEDs within a recess, groove or channel provided on the underside of the handrail. The method will preferably comprise the step of providing drive gear for the LEDs, which drive gear is preferably provided in a support for the main body of the handrail.

In a fourth aspect, the invention provides a method of installing a lighting system on the interior or exterior of a building, the method comprising the step of installing a handrail in accordance with the first aspect of the invention. The method of the fourth aspect may be performed as part of the process of constructing a new building, or may be performed as a retrofit activity, installing the handrail on an already completed building and, typically, replacing a pre-existing (e.g. non-DDA-compliant) handrail. The method of the fourth aspect may optionally additionally comprise the step of providing the LEDs with an external electrical power supply, such as a low voltage AC or DC supply or a mains AC supply. The installed handrail may have any one or more of the preferred features detailed and described in relation to the first aspect of the invention.

The various aspects of the invention will now be described by way of illustrative example and with reference to the accompanying drawings, in which: 

Figure 1 shows a transverse sectional view through one embodiment of a hand rail in accordance with the invention; and

Figure 2 shows, to a different scale, a longitudinal sectional view through part of the handrail illustrated in Figure 1 together with part of an upright support to which the hand rail body is attached.
Referring to Figure 1, a hand rail in accordance with the invention comprises a DDA-compliant stair rail for use with a 1200mm wide DDA-compliant staircase. One stair rail in accordance with the invention is positioned on each side of the stairs.

Each hand rail comprises a main body (2), which is an essentially cylindrical section length of stainless steel, with a relatively deep rectangular-section recess (4) formed along the longitudinal axis thereof. The recess is formed on the underside of the main body (2) and at an angle of about 20° to the vertical. When *in situ*, the hand rail is attached to a plurality of stainless steel upright supports (not shown in Figure 1), which are bolted, screwed or otherwise firmly fixed to the treads of the staircase.

As shown in Figure 1, within the recess (4) is provided a plurality of LEDs, a representative one of which is denoted by reference numeral (6). The LEDs are surface mounted on a strip of PCB substrate (8).

The substrate (8) is retained in an LED holder (10), which is a generally C-shaped moulded or extruded component formed of synthetic plastics material. The substrate (8) is retained in a groove (12) provided in each arm of the LED holder (10). Below the substrate (8) is a transparent or translucent strip of lens material (15), such as polycarbonate, which is similarly retained in a pair of aligned grooves (14), one groove (14) being formed in each arm of the LED holder (10). Above the substrate (8), within the space formed between the two arms of the LED holder (10) is a dual core electric cable (16) providing electrical power to the LEDs.

The LED holder itself is retained within a larger grip member (18), which grip member is generally C-shaped in transverse section and fits within the recess (4) in the main body (2) of the hand rail. The grip member (18) is formed of a natural or synthetic rubber compound. On the outside of each arm of the grip member are a series of six ridges (20) running along the length of the grip member (18), which provide a frictional engagement with the sides of the recess (4). At the ends of the arms of the grip member (18) are widened flange sections (22), which facilitate extraction of the grip member (18) from the recess (4) and which also serve to provide a smooth surface to the edges of the recess and prevent the ingress of dirt.
On the inside of each arm of the grip member (18) are three resiliently deformable projections (23). The projections are angled upwards, away from the LED holder (10) when it is inserted into the grip member (18). This facilitates insertion of the LED holder but tends to resist extraction thereof, thereby keeping the LED holder (10) in place. In the illustrated embodiment, at least two of the three projections on each arm are flattened against the side of the inserted LED holder (10) and provide a frictional engagement with the holder (10) so that it is held in place but can nevertheless be extracted for repair, maintenance, cleaning or the like.

At the upper end of the space between the arms of the grip member is the main cabling run (24). This may comprise an AC mains or other external electrical supply to the apparatus, and cabling for networking of the drive gear and to facilitate automated testing etc. of the LED lighting.

Referring to Figure 2, the drive gear for the LEDs is situated within a hollow metallic upright (30) used to support the hand rail. The drive gear comprises a battery (32) and a drive gear (34) which comprises the necessary electrical components to, for example, detect any interruption or failure in external power supply or to detect a control signal demanding illumination of the LEDs, and to draw power from the integral battery (32) to illuminate the LEDs. The battery may be a nickel/metal hydride or a lithium battery. The drive gear (34) may also comprise components to allow automated self-testing of the LEDs.
Claims

1. A hand rail which incorporates a plurality of LEDs to provide a light source.

2. A hand rail according to claim 1, wherein the plurality of LEDs are provided in a recess, groove, channel or the like formed in the hand rail.

3. A hand rail according to claim 2, wherein the recess, groove or channel is provided on the underside of the hand rail at an angle to the vertical in the range of 10-30°.

4. A hand rail according to claim 3, wherein the recess, groove or channel is provided at an angle to the vertical in the range of 15-25°

5. A hand rail according to any one of the preceding claims, wherein the LEDs form part of an emergency lighting system, which includes an integral source of electrical power for the LEDs.

6. A hand rail according to any one of the preceding claims, additionally comprising at least one support on which the hand rail is mounted, the support having a cavity which accommodates an integral source of electrical power for the LEDs and a control board.

7. A hand rail according to claim 5 or 6, wherein the integral source of electrical power comprises a battery.

8. A hand rail according to any one of the preceding claims, wherein the LEDs are mounted on a substrate.

9. A flight of stairs, to which is attached one or more hand rails in accordance with any one of the preceding claims.

10. A method of making a hand rail, the method comprising the steps of forming or providing a hand rail having a recess, groove or channel therein; and locating a plurality of LEDs within said recess, groove or channel.
11. A method according to claim 10, performance of which results in a hand rail in accordance with any one of claims 3-8.

12. A method of installing a lighting system on the interior or exterior of a building, the method comprising the step of installing a hand rail in accordance with any of claims 1-8.
Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

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<th>Category</th>
<th>Relevant to claims</th>
<th>Identity of document and passage or figure of particular relevance</th>
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<td>X</td>
<td>1-2, 5 and 7-12</td>
<td>GB2404929 A (PIXIE) See whole document.</td>
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<tr>
<td>X</td>
<td>1-2, 5 and 7-12</td>
<td>JP2005336895 A (NAKA) See Abstract and all Figures.</td>
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<td>DE20107645 U (THIEME) See Abstract and Figure.</td>
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<td>JP2003293543 A (DAIWA) See Abstract and Figures 1 and 3.</td>
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<tr>
<td>X</td>
<td>1, 5-9 and 12</td>
<td>JP2007162373 A (SEIWA) See Abstract, all Figures and paragraphs 0025-0026.</td>
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Categories:

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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC:

- Worldwide search of patent documents classified in the following areas of the IPC
- E04F; F21S; F21V

The following online and other databases have been used in the preparation of this search report

ONLINE: EPDOC, WPI

International Classification:

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