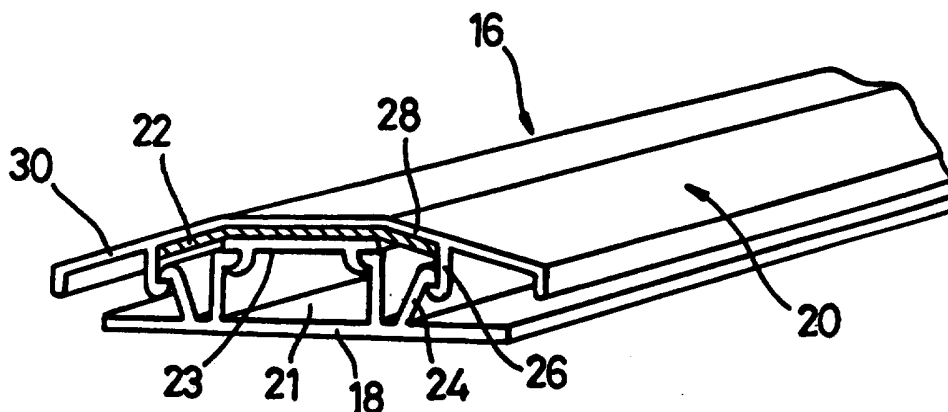


PCTWORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : B64D 25/00, G09F 13/20	A1	(11) International Publication Number: WO 96/33093 (43) International Publication Date: 24 October 1996 (24.10.96)
(21) International Application Number: PCT/GB96/00936 (22) International Filing Date: 19 April 1996 (19.04.96) (30) Priority Data: 9508065.1 20 April 1995 (20.04.95) GB 9604994.5 8 March 1996 (08.03.96) GB (71) Applicant (for all designated States except US): SAF-T-GLO AEROSPACE LIMITED [GB/GB]; The Old Coach House, The Maltings, Narborough, Norfolk PE32 1TE (GB). (72) Inventor; and (75) Inventor/Applicant (for US only): BODLE, Peter, Winstanley [GB/GB]; 6 Eastfields, Narborough, Norfolk PE32 1SS (GB). (74) Agent: BARKER, BRETTELL & DUNCAN; 138 Hagley Road, Edgbaston, Birmingham B16 9PW (GB).	(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	

(54) Title: EMERGENCY LIGHTING**(57) Abstract**

An emergency lighting system for an aircraft has photoluminescent strips (16) mounted on the floor rather than a string of electrical lights. This is a better fail-safe since there is no possibility of a failure in power supply. A channel extrusion is secured to the floor of the aircraft and a photoluminescent strip (22) is held between the channel and a transparent cover member (20). The photoluminescent strip has two thin layers of photoluminescent material rather than on a base layer, rather than being a calendered product. This increases the light output.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	KZ	Kazakhstan	SG	Singapore
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovakia
CM	Cameroon	LR	Liberia	SN	Senegal
CN	China	LT	Lithuania	SZ	Swaziland
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

EMERGENCY LIGHTING

This invention relates to emergency lighting, typically for the interior of vehicles, and especially, but not exclusively, to emergency exit floor path lighting for aircraft.

It is well known in aircraft to have strips of electrical lights mounted at floor level to guide passengers to the emergency exit doors of the aircraft. The strips of electric lights are powered by an emergency battery. Such systems work well, but they have some problems.

One problem is that they need regular servicing. The electricians need checking periodically and bulbs need replacing. Maintenance of the floor-level emergency exit lights adds significantly to the cost of maintaining an aircraft. Also the power drain caused by running the lights adds to fuel costs.

A further problem is that if the emergency battery fails there is no guide lighting for the passengers leading them to the exits.

Another problem is that in the event of a crash the electrical wires connecting some or all of the floor level emergency lights can be broken, again meaning that some or all of the floor-level emergency lights are inoperative at just the time that they are most needed.

It is an aim of one embodiment of the present invention to alleviate at least some of these problems.

According to a first aspect of the invention we provide an emergency exit path lighting system comprising photoluminescent guide means adapted to indicate to a user a path for movement by emitting light photoluminescently.

Thus there is no external power supply to fail and thus the system may be fail safe. The system requires little or no special maintenance, and may simply require wiping or other similar cleaning. The system may be significantly lighter, cheaper and simpler to install than previous systems.

Preferably the guide means is on the floor, but may be elsewhere (eg on the side of seats).

Preferably the guide means is an elongate member.

Preferably the guide means comprises at least one, and preferably two elongate photoluminescent tracks mounted on or near the floor. The two photoluminescent tracks are preferably spaced apart so as to define a path within which the user should move. Each track preferably comprises a substantially continuous, or effectively continuous, strip of photoluminescent material. Alternatively a guide track may have photoluminescent regions, and non-photoluminescent regions which alternate. In a further alternative the photoluminescent track may comprise a row of photoluminescent dots, circles or the like.

Preferably the substantially continuous track provides a substantially continuous path of light from any point to an emergency exit. An advantage of this is that a person will never be lost as they will always

have a path, to an exit, to follow. This "continuous cuing" concept is applicable to other situations.

Alternatively the substantially continuous track may provide a substantially continuous path of light from any point to the region of the emergency exit and electrical lighting means may provide lighting in the region of the emergency exit.

Preferably the system has a track which has a transparent or translucent cover which overlays a photoluminescent guide member. The photoluminescent guide member is preferably a relatively thin strip of material that is supported on a support member. The track may comprise a base member adapted to be secured to the floor, a cover member adapted to be releasably secured to the base member, and a photoluminescent member adapted to be sandwiched between the base member and the cover member. Preferably the photoluminescent member is a flexible strip. In one embodiment the support member supports the photoluminescent strip so that it can withstand being trodden upon. The support member preferably extends across substantially the full width of the photoluminescent strip. The photoluminescent member is preferably removable from the track and is replaceable. A track may be made of adjacent discrete lengths of profiled extrusion. The photoluminescent strip may also be provided in discrete lengths.

Alternatively the photoluminescent strip may be permanently secured, for example with glue, to either, the cover or the support member. In a further embodiment the photoluminescent strip may be co-extruded with either, or both, the cover, or the support member.

The cover member may have a ramped, or sloping, upper surface to facilitate the passage of wheeled vehicles such as trolleys.

Alternatively the cover member may have a low profile so that it provides only a minimal obstruction for wheeled vehicles, such as trolleys.

Preferably the track is laid in short sections. This has several advantages over using a continuous run of track. One advantage is that short runs are not as awkward to handle, another is that they are more resilient in the event of a crash of the vehicle in which the tracks are mounted. A continuous run may tend to be dragged away from the body of the vehicle in such a crash.

Alternatively the track may be laid in a continuous section.

Preferably the cover member of one section may overlap the base member of a neighbouring section. An advantage of this is that neighbouring sections are loosely coupled. A clip may be provided over the joints between the sections of the covering members. Alternatively the sections of the covering members may have no clip and simply butt against a neighbouring section.

Preferably at each end of the track run there are provided end caps. The end caps may be used between the short sections of track.

Preferably to form angled joints the tracks are laid against each other. The sections may be mitred to form an angled joint.

Preferably a layer which is impervious to UV light is used to protect the photoluminescent layer. The UV protecting layer may be a strip mounted on top of the photoluminescent strip or may be a coating on the photoluminescent strip. An advantage of this is that UV light is prevented from reaching the photoluminescent strip, and thus the photoluminescent strip is not degraded by UV light. Also such a layer might additionally, or alternatively, prevent UV light from being emitted from the photoluminescent layer.

Preferably the layer impervious to UV light is made from a PVC based material or resin, but may be from any other suitable material. Preferably the layer impervious to UV light is translucent to light, or other electromagnetic radiation, other than UV light.

The transparent or translucent cover may have portions which are stained, painted, dyed or otherwise modified to change the light transmission properties of the cover. Preferably these portions are opaque. An advantage of such opaque portions is that they can be used to cover or mask poor cutting of the carpet. Alternatively the portions may not be opaque and may be used to change the colour of the light emitted from the photoluminescent strip. The method of modifying the light transmission properties may include inserting a coloured filter underneath the cover or may include using a UV protective layer which modifies the colour of the light passing through it.

According to a second aspect of the invention we provide a photoluminescent member comprising a base and a layer of photoluminescent material.

The layer may be cast onto the base. Alternatively, we may calender a thin layer, and apply that to the base.

Previously photoluminescent members have been made by mixing photoluminescent material with structural material and producing a calendered product. This has the photoluminescent material spread out throughout the depth of the member, when it is only needed at the surface. We have appreciated that by casting a photoluminescent layer on top of a base (or by having a thin calendered layer on top of a base) we can achieve better results.

Furthermore, we preferably provide (eg cast) two layers, or more, of photoluminescent material onto a base. This has been found to increase the light emitted, and is easier and cheaper than casting one thick layer. We can control the application of a thin layer better than the application of a thick layer, and so would prefer to provide (eg cast) a plurality of thin layers until we have the thickness (or light-emitting properties) we want.

The photoluminescent layer, or layers, is preferably a vinyl layer. The base preferably contains titanium dioxide but may contain other whitening agents. This is believed to capture light to energise the photoluminescent material.

The layers may be co-extruded instead of being cast together. We may co-extrude a base and a photoluminescent layer.

According to a third aspect of the invention we provide a method of manufacturing a photoluminescent

article comprising applying (eg casting) a photoluminescent layer onto a base.

According to a fourth aspect of the invention we provide an aircraft having an emergency exit floor path lighting system in accordance with the first aspect of the invention.

Preferably the aircraft has a substantially continuous track mounted on or at the floor, the track comprising the photoluminescent guide means. Alternatively the photoluminescent guide means may be provided on the seats of the aircraft.

Preferably there is one track to one side of an aisle, for example an aisle between seats, and another track to the other side of the aisle. This doubles the light output in a very simple manner and defines a path in which the user may move. Alternatively only a single track may be provided.

Preferably there is one, or most preferably a pair, of branch tracks leading from an aisle track to an emergency door. Most preferably the emergency door, or the region of the doorway, is also marked (preferably bounded) by photoluminescent areas. Alternatively there may be no tracking in the region of the emergency door. The guide means in the region of the emergency door may comprise an electrical or other guide means.

The photoluminescent floor-level emergency exit lighting system may be provided as original equipment, or it may be retro-fitted to existing aircraft.

According to a fifth aspect of the invention we provide a method of reducing the cost of maintaining an aircraft's emergency exit floor path lighting system comprising having a photoluminescent emergency exit floor path lighting system instead of an electrically powered system.

Thus the maintenance required may simply be cleaning.

According to a sixth aspect of the invention we provide a method of reducing the cost of maintaining an aircraft's emergency exit floor path lighting system comprising removing an existing electrically powered floor path system and replacing it with a photoluminescent system.

Preferably when the electrical system comprises a line of lights in a channel track we remove the lights, introduce a support member into the channel, and introduce a photoluminescent strip on top of the support member. Preferably a cover is applied over the strip and is secured to the existing channel track.

The photoluminescent strip may be attached to the carpet of the aircraft. Preferably the photoluminescent strip is attached to the carpet using ultrasonic welding, but may be attached using gluing or other method.

Preferably the photoluminescent strip is covered in a protective see-through material. Preferably the protective material is poly-carbonate, but may be any other suitable see through material, as appreciated by a man skilled in the art.

According to a seventh aspect of the invention we provide a method of reducing the cost of installing, or modifying the layout of, an aircraft's emergency exit floor path lighting system comprising securing the aircraft's emergency floor lighting system to the floor of the aircraft through the carpet on the floor (instead of cutting the carpet around the lighting).

This reduces the amount of cutting of the carpet that is required to match it to the floor path lighting system, which makes it quicker and cheaper to install the carpet. It also means that if the layout of the floor path lighting is changed the existing carpet can still be retained since it does not have great big holes in it at the old location of the lighting system.

It will be appreciated that the carpet extends under the floor path lighting system.

Preferably a backing member (eg a strip or plate) is secured to the floor of the aircraft where the lighting is to be positioned.

Preferably the carpet is laid on top of the backing member.

Preferably locating means is provided on the backing member to locate the lighting. The locating means may be holes or studs which co-operate with studs or holes, respectively, on the lighting.

Such a system has an advantage that cutting of the covering carpet is reduced, resulting in a lower wastage of the carpet, and making it quicker to replace the carpet, and thus the cost of refitting the aircraft is reduced.

The lighting may be provided with a means to temporarily attach it to the floor of the aircraft. The means may comprise velcro % (or the like) attached to the lighting strip or may comprise clamps secured at intervals to the cabin floor through holes in the carpet.

According to another aspect of the invention we provide a way of reducing the cost of fitting out an aircraft with floor-mounted emergency exit path lighting system comprising attaching the exit path lighting above the carpet of the aircraft. This may be achieved by studs entering through the carpet, or by velcro %, or in any other way.

The aircraft's emergency exit floor path lighting system may be of the known electrical system or alternatively the emergency exit floor path lighting system may be of the photoluminescent type disclosed in this application.

In any of the inventions disclosed it will be appreciated that the photoluminescent strips may be substantially continuous elongate lines, or they may be interrupted. Or circles or discs of photoluminescent material spaced at intervals may be used as an alternative to strips of photoluminescent material.

We have also made an interesting discovery which is useful in photoluminescent emergency exit pathways, and more widely in photoluminescent signs or displays generally. Up until now if we wanted to have an arrow, or the word EXIT or other words or pictograms, in a photoluminescent sign, or in the exit path line, we can do it by applying an opaque layer above the photoluminescent material, masking out the emitted

light. This leaves essentially black markings on a light-emitting background (or vice-versa - we can blank out the background and let the markings glow in the dark).

We have now discovered that some dyes/stains/inks can, when applied over a photoluminescent layer, glow in the dark with a different colour to that of the photoluminescent layer. Thus the sign can have both the background and the markings emitting light. This makes the markings easier to see, and means that more light, overall, is given off by the sign.

According to an eighth aspect of the invention we provide a photoluminescent sign or display comprising a photoluminescent layer of a first colour, and markings of a second colour overlying the photoluminescent layer, the markings being made with a dye or ink (or the like) that, in use, when overlaid, glows in the dark with a different colour from that of the photoluminescent layer.

The colour that the markings emit in the dark may not be the same colour as they reflect in daylight.

The dye or ink may simply filter out some wavelengths of light emitted by the photoluminescent layer, allowing others to pass. Alternatively the dye or ink may be excited by the light emitted by the underlying photoluminescent material and may emit its own light as a response to that excitation.

The dye or ink may itself be photoluminescent with a different colour light from that of the layer beneath it.

Preferably the base photoluminescent layer is yellow more specifically yellow/green. Preferably the pigment has a red colour but may be another colour. The pigment may be a dye, such as POLYVIN MATT FLUORESCENT RED PM 1256 which can be obtained from GIBBON inks and coatings of 25 Deer Park Road, Wimbledon.

The pigment may have incorporated in it a compound which is impervious to UV light. Blocking UV light may have the advantages disclosed hereinbefore.

According to a ninth aspect of the invention we provide a photoluminescent sign or markings having a photoluminescent layer and a dye, or other colouring, overlaid above the photoluminescent layer, the dye being such that photoluminescent light is transmitted through it, but with a changed wavelength spectrum to give a photoluminescent light of a different colour to that of the photoluminescent layer.

Instead of transmitting some wavelengths of light emitted by the photoluminescent layer the dye could emit light of its own.

Preferably the sign or markings has a first region in which the photoluminescent layer is overlaid by the dye which modifies the light emitted to produce light of a different colour, and a second region in which the photoluminescent layer is not covered by the dye and emits light of its natural colour.

There may be more than one layer of photoluminescent material provided with the dye, or other colouring, being provided between the different photoluminescent layers. An advantage of this is that

the intensity of the light is increased but a different colour portion is still provided.

Preferably the first or second regions define letters, or a word, or an information - giving graphic symbol.

The dye, or other colouring, may contain mixed Xylenes, 2-Butoxyethanol and Cyolohexanone as active ingredients.

The active ingredients may be provided in the proportions Xylenes <10%, 2-Butoxyethanol <5% and Cyolohexanone <15%.

According to a tenth aspect of the invention we provide a photoluminescent material or member which is also reflective.

Preferably the material or member is retro reflective.

The member or material may be provided in the form of a sheet of material.

Preferably a layer of reflective material is provided on top of a layer of photoluminescent material. An advantage of such a composite is that it will act as a light source and also reflect light, making it highly visible. Such a material may have uses in high visibility clothing, life boats, life belts, guidance out of buildings as well as for the emergency floor lighting of vehicles. Such items incorporating this material are explicitly disclosed and we may seek protection for the items per se.

Preferably the layer of reflective material is transparent in addition to being reflective. This may allow light emitted from the photoluminescent material to pass through the reflective layer.

Preferably the layer of reflective material is made from micro-prism reflective material.

Preferably the reflective layer is attached to the photoluminescent layer, using high frequency welding. Preferably the layers are welded together using a lattice work grid pattern. This pattern of welding may prevent the egress of dirt or water into cells created by the welding pattern. The presence of such dirt or water in the cells may prevent the photoluminescent material from working.

Embodiments of the invention will now be described by way of example only, with reference to the accompanying drawings of which:-

Figure 1 shows a perspective view of a retro-fitted aircraft emergency exit floor path lighting track using existing track;

Figure 2 shows a plan view of an original equipment aircraft exit floor path lighting track;

Figure 3 is a cross-section of the track of Figure 2;

Figure 4 shows the general arrangement of an emergency exit floor path lighting track in an aircraft;

Figure 5 shows detail of the track arrangement near an emergency exit;

Figure 6 shows detail of a track near a galley;

Figure 7 shows an impression of what an aircraft emergency exit floor path system according to the invention will look like in use;

Figure 8 is a cross section of a further embodiment of the lighting track;

Figure 9 is a cross section through a further, co-extruded, embodiment of the lighting track; and

Figure 10 is a cross section through still a further, co-extruded, embodiment of the lighting track.

A general view of a system in accordance with the invention is given in Figure 4. This shows an aircraft 10 having emergency exits 12a, 12b, 12c, 12d, 12e, and 12f, and a floor mounted emergency exit pathway indicating system 14. The system 14 comprises a track 16 having a base member 18, a cover 20, and a photoluminescent strip 22 held between the cover and the base member. Figures 1 to 3 show this best. Figure 4 shows that there are two tracks 16 associated with the aisle, and with each emergency exit route: one to either side of the floor path.

Referring to Figure 1, this shows a moulded plastics guide track 16 that has been retro-fitted to an aircraft that originally had an electric emergency floor path lighting system. The original plastics material base section 18 is retained. In an electrical

lighting system wires and lights are retained in a channel 21, but in the retro-fitted photoluminescent system they have been removed and the top of the channel 21 has been closed by a plastics material support formation 23 which is releasably snap-fitted to hook formations at the top of the side walls of the channel 21. The photoluminescent strip 22 is a flexible strip of about a millimetre thick. It has a vinyl base which contains titanium dioxide or other whitening agent and has two thin-film layers of photoluminescent material - containing vinyl cast on top of the vinyl base. The photoluminescent material is overlaid by a UV protective top layer (not shown). The strip 22 has the following glow properties:

Typical Glow Duration:	Initial	1300	mcd/m^2
	1 minute	445	mcd/m^2
	10 mins	30	mcd/m^2
	30 mins	8	mcd/m^2
	60 mins	3.8	mcd/m^2

The photoluminescent material emits a yellow light, tinged with green.

In a different embodiment a whitening agent other than titanium dioxide may be used.

The cover 20 is made of a transparent plastics material. The cover 20 releasably clips on to the base section via co-operating fingers 24 and 26 provided on the base section and cover respectively. The cover has ramped, or sloping portions 28 and 30 which make it easier to roll a trolley over the track, and reduce the chance of someone tripping over the track.

We have also tested two other photoluminescent materials to see how the luminance level from a photoluminescent guide strip decays with time (after the light source has been switched off). The results are given below in Tables 1 and 2.

Table 1

Table of luminance level (in mcd/m²) over time for photoluminescent composition SG115 ULTRABRITE, for different illumination levels. Test at 23°C.

Duration of Charge 20 mins

Luminance Level	38Lux	100 Lux	150 lux	200 Lux	1000 Lux
1 Initial	154	560	720	985	1400+
2 Secs	73.4	146	189	216	305
3 1 min	53	96	119	133	173
4 1 min 10 secs	42.3	72.7	88.2	97	122
5 2 min	35.7	58.8	70.4	77.2	94
6 2 min 30 secs	31.1	49.5	58.7	64.1	76.4
7 3 min	27.7	43.1	50.5	54.6	64.1
8 3 min 30 secs	24.8	38	44.4	47.6	55.8
9 4 min	22.5	34	39.5	42.4	48.9
10 4 min 30 secs	20.3	30.9	35.6	38.2	43.6
11 5 min	19.2	28.3	32.5	34.6	39.4
12 6 min	16.7	24.1	27.5	29.1	33
13 7 min	14.8	21.2	23.5	25.5	28.1
14 8 min	13.5	18.8	21.2	22.5	24.9
15 9 min	12.5	17	18.9	20	22.1
16 10 min	11.4	15.4	17.1	18.1	19.9
17 20 min	6.3	7.9	8.7	9.1	10.1
18 30 min	4.2	5.4	5.6	5.9	6.2
19 60 min	2.1	2.6	2.8	2.9	3.1
20 120 min					

Test Procedure conformed to DIN standard 67 510 part 1.

Table 2

Table of Luminance level in (mcd/m²) over time for photoluminescent composition SG605 SUPRABRITE, for illumination level of 1000 Lux. Test at 23°C.

Luminance Level 1000 Lux SUPRABRITE					
1	Initial	5000			
2	30 Secs	1568			
3	1 min	1225			
4	1 min 30 secs	1004			
5	2 min	860			
6	2 min 30 secs	746			
7	3 min	673			
8	3 min 30 sec	605			
9	4 min	551			
10	4 min 30 sec	505			
11	5 min	465			
12	6 min	404			
13	7 min	356			
14	8 min	317			
15	9 min	285			
16	10 min	259			
17	20 min	131			
18	30 min	85.7			
19	60 min	38.9			
20	120 min				

Test Procedure conformed to DIN standard 67 510 part 1.

Figures 2 and 3 show a track that is similar to that of Figure 1 except that instead of being retro-fitted to an existing electrical track it is original equipment. Instead of having a separate support formation 21, the plastics material base section 18 of the embodiment of Figures 2 and 3 has a box-section support formation 21 integrally moulded with it.

In a different embodiment the track of Figures 2 and 3 may be retro-fitted.

In both of the arrangements of Figure 1 and Figures 2 and 3 the support formation supports the centre of the cover 20, and the strip 22, so that they do not collapse when someone treads on them.

Figure 5 shows detail of the tracks 16 at the region of an emergency exit. The tracks referenced 51,52, are the main aisle tracks extending longitudinally of the aircraft. Branch tracks 53,54,55,56, extend, in pairs, to each emergency door, referenced as 57 and 58. This gives the passengers a lead right up to the emergency exit. It will also be noted from Figure 4 that all of the aisles of the aircraft are bounded by photoluminescent track 16. This means that if a passenger follows a track 16 in any direction he will come to an emergency exit.

We may put arrows, or other indicia, in the track to indicate the direction to the nearest emergency exit. We may also put words in the track, for example "Emergency Exit".

It we do put markings on the photoluminescent tracks we prefer to make them with the dye POLYVIN MATT FLUORESCENT RED PM 1256 or an equivalent colorant that also glows with light of its own colour in the dark.

Figure 6 shows another arrangement for installing a photoluminescent strip, referenced 60, in the flooring of an aircraft. The flooring is a non-slip plastics material flooring that has raised sections 61. These make it difficult to mount a strip to the flooring. We remove a channel of flooring, for example by abrading, or milling, possibly in situ in the aircraft, to produce a flat based channel 62. The strip 60 is laid in the channel and a transparent covering 63, for example an acetate strip, is glued over the photoluminescent strip 60. The channel 62 is wider than the strip 60 to give a surface area to which the cover 63 can be glued. The glue is also preferably transparent. In the embodiment shown in Figure 6 the surface of the transparent cover strip 63 that overlays the photoluminescent strip 60 is at about the same height as the raised sections 61.

In a different embodiment the cover 63 may be of polycarbonate.

In a further embodiment the photoluminescent strip may be precut and vacuum sealed between two covering strips. A self adhesive may be applied to the bottom surface of one of the covering strips so that the complete assembly can be easily laid into a channel corresponding to channel 62 in the flooring of the aircraft.

Figure 7 has a right hand portion showing the interior of an aircraft and floor-mounted

photoluminescent guide tracks, with the lights of the aircraft on, and a left hand portion showing what a passenger would see with the lights off. A clear path between the parallel photoluminescent tracks of the aisle, and the emergency exit gangways, is defined, and illuminated, for the passenger to escape. The photoluminescence of the pair of tracks is bright enough, at floor level, for reading.

Figure 8 shows a further embodiment for mounting the photoluminescent strip 80. The housing 82 is low profile, presenting a minimum obstruction for trolleys and the like. The housing 82 has the dimensions: height 3.0mm, and width 43mm.

The strip 80 is removable from the housing 82. The gap 84 in the lower portion of the housing 82 facilitating the removal of the strip 80.

Some detailed features of possible alternative systems which are not shown in the drawings and/or described in detail above are:-

A method of joining tracking together is preferred not to be, continuous runs of strip. This is preferably not used because a) it is unwieldy, and b) on impact it may drag away from the fuselage.

Instead we prefer to use short runs. We use 2m lengths placed butt to butt, with the top cover of one slightly overlapping the base section of the next. We could seal using a small strip clip over the joint of the adjacent butting sections, but at present we do not find it necessary.

We have developed and do intend to use end-caps. These are placed at the beginning and end of track runs. We could use the end caps between the 2 metre runs, but this would break the concept of continuous cuing. This may be acceptable.

For right-angle joins as in cross-aisle, we just put the track against each other. Proper mitring of the joint into right-angles or T-junctions could be performed if appropriate.

One way of attaching the lighting strips to the aircraft floor is to ultrasonically weld the PLM tracking into carpeting. The results of our secret tests so far have been successful. This invention would include welding in the strips as they are shown in the drawings, and alternatively welding strips covered or sealed in poly carbonate or other protective see-through material. Instead of welding we may prefer to glue or otherwise inserting or attaching photoluminescent material to the floor covering.

Another variation of this theme is that we may "black" (make opaque) the flange or edge performs of the otherwise transparent top cover to cover up poor cutting of the carpet/floor covering. Furthermore, changing the colour of the light given off by either colouring the top cover by inserting pigment into the plastic mix or by inserting a coloured filter member between the photoluminescent material (PLM) and the top cover or by putting the pigment or filter in the UV protective layer or below the UV protective layer of the PLM is possible.

As discussed in the introduction, we have developed yet another concept for the utilization of

the floor mounted emergency exit path strips. A major cost in putting in lighting strips is the cost and wastage associated with cutting up the aircraft carpet/floor covering. This means that the carpet is thrown away each time there is a change of layout. Consequently we have invented the idea of a system which does not require the carpet to be cut. A backing plate is secured to the floor of the cabin where the tracking is required to run. This plate either has locator holes or studs, it can work either way, along its length. The carpet is laid on top of it and the photoluminescent tracking (it will have to be a lower profile than the present one) is married up and pressed home attaching to the backing plate. Although the attachment could work male to female, or female to male, we feel that the studs should be on the back plate as it would be far easier to locate.

This concept of a backing member beneath the carpet to which floor path lighting is secured, through the carpet that is between them, also applies to standard electrical floor lighting.

In addition we feel that as an alternative we may provide a quick release/no damage to the carpet system. This might include some sort of velcro concept for surface mount, or additionally or alternatively clamps for the lighting system secured at regular intervals on the cabin floor. The clamps might be cut into the carpet, and when PLM is used would secure the PLM strip.

We have also invented a method of combining reflective material with photoluminescent material (PLM) vinyl such that the PLM beneath absorbs light through the surface mounted reflective material whilst

shining through the reflective material to give off light. This combination is a great break through as it is unique to be both reflective as well as PLM charged. Its uses will be for high visibility clothing, life boats, lift belts, and for signs in general. It will also be useful on way guidance in buildings as well as vehicles such as cars and lorries.

It will be appreciated that we could mount the photoluminescent safety strips on the seats (eg the sides of the seats, with or without breaks in the PL material). We could mount the strips on the legs of the seats. Seat side mounting has the advantage that we do not have to cut the carpet to install the system, or to reorganise the layout of the photoluminescent (PL) safety strips within the aircraft.

We could clip the strips to the seat/or carpet, use studs (or releasable mechanical fasteners) use hook and fibre fasteners (velcro TM). We could weld the strips to the carpet and/or seat sides. We could glue the strips down.

In an effort to reduce the manufacturing costs or running costs of any of the systems outlined in this specification the steps outlined hereinafter may be taken.

Of course any of the techniques described hereinafter (which aim to reduce the manufacturing steps and/or cost of a photoluminescent guide means) are not just applicable to aircraft. The techniques may be used in any situation in which photoluminescent material finds use for instance the production of flexible or rigid sheeting to be used in other applications.

A single continuous strip of photoluminescent guide means may be secured along a centre portion of an aircraft's aisle, with intermittent strips along portions of the aisle in the region of the aircraft's seats. Such an arrangement possibly increases the flexibility of the system and reduces the cost of re-arranging the seating plan of the aircraft fitted with photoluminescent guide means. For instance it is known that narrow bodied aircraft may be fitted so that there are two seats on both sides of the aisle, or with three seats on both sides of the aisle or with three seats on one side of the aisle and the two seats on the other. (These seating configurations are only by way of example and are not intended to be limiting). The seating plan of an aircraft may be altered from time to time, changing the configuration of the seats and of the number of seats on each side of the aisle. A consequence of the refit is that the width and centre position of the aisle may be changed. If more than one strip of photoluminescent guide means had been placed along an aisle (for instance a strip along both edge portions of the aisle) then there is a good chance that some of the newly configured seats would overlap the strip requiring the strip to be removed. However, if only a single strip is positioned near to one side, or the centre portion of the aisle then it is unlikely to be overlapped by the seats. The intermittent strips may be placed along parts of the seats (for example the brackets which attach to the floor) and as such the intermittent strips may be fitted, with the seats, in the correct position. Alternatively the intermittent strips may be attached to the floor before or after the seats have been fitted. It is noted that the fitting of intermittent strips is probably cheaper and simpler than the repositioning of continuous strips of photoluminescent guide means.

The advantage of having at least some of the PLM supported on the seats is also applicable to convertible seats in aircraft. Convertible seats are capable of concertinaring out from 2 to 3 seats wide, or in from 3 to 2 seats wide (they can alter their width without having to unbolt seat mountings). This can be used to give a choice between 2 wide seats or three narrow seats. In this case the use of two fixed PL lines on the cabin floor is not ideal since with the convertible seats in different configurations it can be more or less difficult to see at least one of the PL strips on the floor. By providing PL strips on the seats themselves we provide a PL guide-line bounding the aisle whatever seat arrangement is used.

The photoluminescent material may have its base material incorporating strontium aluminate SrAl_2O_3 instead of Zinc Sulphide. A second, strontium aluminate based, example of material available from commercial sources has an initial glow of 4700 mcd/m^2 falling to 300 mcd/m^2 at 60 minutes.

It has also been realised that crystals of the photoluminescent material give an increased performance when compared to other forms of the material, such as perhaps the calendered product. It may be possible to increase the system performance by attaching crystals to an adhesively backed tape and then securing the tape to the area requiring the photoluminescent material. Also it may be possible to embed the crystals in a (possibly clear) clear resin/polymer etc, to form a strip of the crystal containing resin/polymer and then attach the strip as described elsewhere in this specification.

It will be appreciated that reducing the number of manufacturing steps required to produce an item should reduce the cost of that item. Accordingly, we can now suggest various different techniques, to reduce the number of manufacturing steps, which may result in producing a cheaper photoluminescent strip.

For instance we have proposed mounting a strip of material with photoluminescent properties between a base layer and a covering layer. The covering layer may be clear plastic and the base layer covered in a reflective, or whitening, agent (eg TiO_2) to enhance the amount of light emitted from the system. If the number of components in this arrangement can be reduced then the system should be cheaper to manufacture. Accordingly it may be possible to mix the pigment, which exhibits the photoluminescent properties, with the material used for the cover member. This would remove the need for three separate components.

It may be possible to embed photoluminescent powder or crystals or the previously used strip of photoluminescent material into the material of the cover member. Such constructions would of course realise the aim of providing a photoluminescent strip in which the photoluminescent strip is protected from its environment and as indeed do all of the constructions outlined hereinafter.

Another embodiment we envisage to be possible would be to coat, for example by spraying or painting the underside of the cover member with paint (paint is used merely to indicate a medium which may be applied as a covering) which exhibits photoluminescent properties.

Also the base member may be coated, in a similar manner to the cover member, with a TiO_2 layer. This TiO_2 layer is desirable to enhance the light output as discussed elsewhere in the specification.

We may coat the base member with photoluminescent material, possibly after applying a reflective layer.

The TiO_2 may be incorporated into the material of the base unit.

Alternatively a layer of material (eg paint) exhibiting photoluminescent properties may be applied to the underside of the cover member and then a layer of TiO_2 (or other such material) may be applied to the layer exhibiting photoluminescent properties. Thus, the photoluminescent layer is sandwiched between the cover member and the TiO_2 layer.

Of course any method which may be used to reduce the number of components of the strip is desirable.

The need for using a TiO_2 layer may be removed if the base member is formed from a white plastics material. The white plastic may or may not contain TiO_2 .

It may be possible to reduce the number of manufacturing steps by co-extruding a strip of photoluminescent material 90 with a cover member 92. The photoluminescent material may be encapsulated within the cover member 92, or a protective sheath. The cover member or sheath is preferably transparent, or translucent. Figure 9 shows a cross section of such a co-extruded lighting track. The material 90 showing

photoluminescent properties is completely surrounded by the cover member 92.

It may also be cost effective to encapsulate, within a covering member both a photoluminescent strip 100, and a white (or TiO_2 containing) strip 104, by co-extruding with a transparent material. A self contained unit would then be provided. Figure 10 shows a cross section of a co-extruded lighting track in which material 100 showing photoluminescent properties, and a white plastic (TiO_2 containing) strip 104 contained within a cover member 102.

To make the final product easier to use it may be desired to have the thickness of the photoluminescent guide means equal to that of the carpet used in an aircraft. The guide means would then offer a minimum resistance to trollies (such as used to serve refreshments) and reduce the risk of tripping persons passing over the guide means.

CLAIMS

1. An aircraft (10) having an emergency exit path lighting system (14) comprising photoluminescent guide means (16) adapted to indicate to a user a path for movement by emitting light photoluminescently.
2. An aircraft (10) according to claim 1, wherein said guide means is mounted at the floor.
3. An aircraft (10) according to claim 1 or claim 2, wherein said guide means is an elongate member.
4. An aircraft (10) according to any preceding claim, wherein said guide means comprises two elongate photoluminescent tracks (51,52) mounted at said floor and spaced apart so as to define a path within which the user should move, each track (51,52) comprising a substantially continuous track of photoluminescent material, said substantially continuous track providing a substantially continuous path of light from any point in the passenger-holding area of the aircraft to an emergency exit (12a,12b,12c,12d,12e,12f).
5. An aircraft (10) according to any preceding claim, wherein said system has a track which has a transparent or translucent cover (20,63,82) which overlays a photoluminescent guide member.
6. An aircraft (10) according to claim 5, wherein said guide member is a relatively thin strip (22) of material that is supported on a support member (23).
7. An aircraft (10) according to claim 5 or claim 6, wherein said track (16) comprises a base member (21) secured to the floor, a cover member (20,63) releasably

secured to the base member (21), and said photoluminescent guide member (22) sandwiched between the base member (21) and the cover member (20,63), and wherein said support member supports said photoluminescent strip (22) so that it can withstand being trodden upon.

8. An aircraft (10) according to any of claim 5, claim 6 or claim 7, wherein said cover member (20,63) has a sloping (28,30), upper surface to facilitate the passage of wheeled vehicles such as trolleys.

9. An aircraft (10) according to claim 1, wherein said lighting system comprises a track laid in sections, said sections comprising a base member (21) secured to the floor of said aircraft (10) and a cover member (20,63) secured to said base member (21), said cover member (20,63) of one section overlapping the base member of a neighbouring section.

10. An aircraft (10) according to claim 9 in which said guide means is provided with clips over the joints between the sections of the covering members.

11. An aircraft (10) according to any preceding claim, wherein said guide means comprises a photoluminescent layer (100) and a UV impermeable layer, said UV impermeable layer being adapted to protect the photoluminescent layer (100) from UV.

12. An aircraft (10) according to any preceding claim in which said u.v. impermeable layer is translucent to light.

13. An aircraft (10) according to any preceding claim in which said guide means provides a substantially

continuous path of light from any point to an emergency exit.

14. An aircraft (10) according to claim 1 or claim 2 in which said guide means comprises a row of photoluminescent dots, circles or the like.

15. An aircraft (10) according to any preceding claim in which portions of said covers (20,63) are stained, painted, dyed or otherwise modified to change the light transmission properties of the cover.

16. An aircraft (10) emergency exit lighting photoluminescent member comprising a base (21) and a photoluminescent layer (100) applied to said base.

17. A member according to claim 16, wherein a plurality of photoluminescent layers (100) are laid onto said base.

18. A member according to claims 16 or 17, wherein said photoluminescent layer (100) is a vinyl layer, and said base contains titanium dioxide.

19. A method of manufacturing a photoluminescent article comprising applying (e.g. casting) a photoluminescent layer (100) onto a base.

20. A method of reducing the cost of maintaining an aircraft's (10) emergency exit floor path lighting system comprising having a photoluminescent emergency exit floor path lighting system (14) instead of an electrically powered system.

21. A method of reducing the cost of maintaining an aircraft's (10) emergency exit floor path lighting

system comprising removing an existing electrically powered floor path system and replacing it with a photoluminescent system (14).

22. A method of reducing the cost of maintaining an aircraft's (10) emergency exit floor path lighting system according to claims 20 or 21 in which a single continuous strip of photoluminescent guide means is secured along a centre portion of the aircrafts aisle.

23. A method of reducing the cost of maintaining an aircraft's (10) emergency exit floor path lighting system according to claim 22 which comprises leaving the single continuous strip in place during reconfigurations of the aircraft strips.

24. A method of reducing the cost of installing, and time for installing, or modifying the layout of, an aircraft's (10) emergency exit floor path lighting system comprising securing the aircraft's (10) emergency floor lighting system (14) to the floor of the aircraft through the carpet on the floor (instead of cutting the carpet around the lighting).

25. A method of reducing the cost of fitting out an aircraft (10) with floor-mounted emergency exit path lighting system (14) comprising attaching the exit path lighting above the carpet of the aircraft.

26. A photoluminescent sign or display comprising a photoluminescent layer (100) of a first colour, and markings of a second colour overlying the photoluminescent layer, the markings being made with a dye or ink (or the like) that, in use, when overlaid, glows in the dark with a different colour from that of the photoluminescent layer.

27. A photoluminescent sign or markings having a photoluminescent layer and a dye, or other colouring, overlaid above the photoluminescent layer, the dye being such that photoluminescent light is transmitted through it, but with a changed wavelength spectrum to give a photoluminescent light of a different colour to that of the photoluminescent layer.

28. A photoluminescent material or member which has a reflective layer above or below a photoluminescent layer.

29. A photoluminescent material or member according to claim 26 in which the reflective layer is retro reflective.

30. A photoluminescent material or member according to claim 26 or claim 27 in which the reflective layer is transparent in addition to being reflective.

1/5

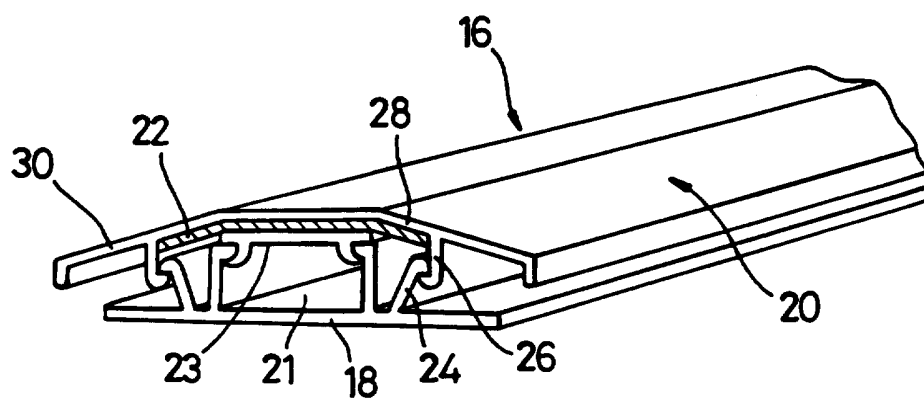


Fig. 1

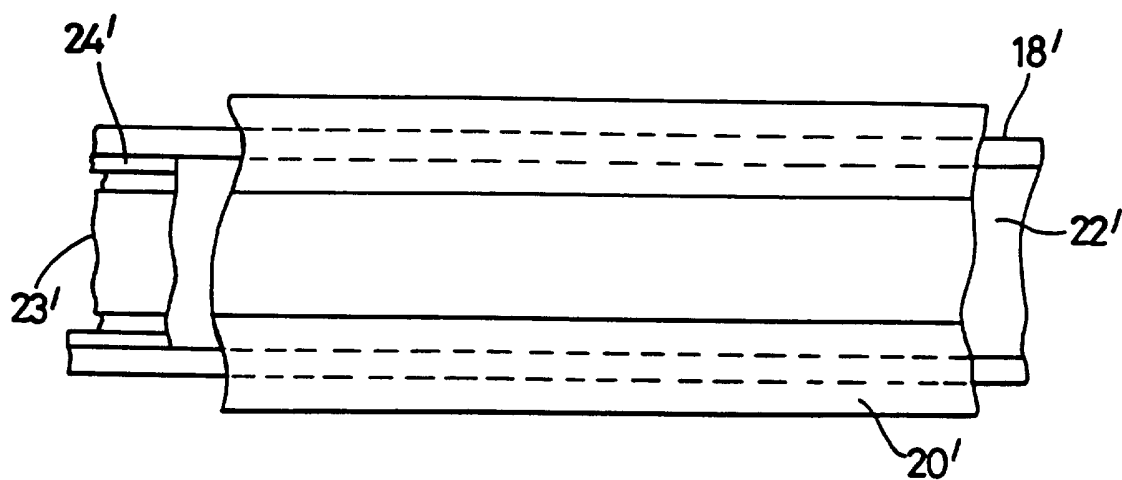


Fig. 2

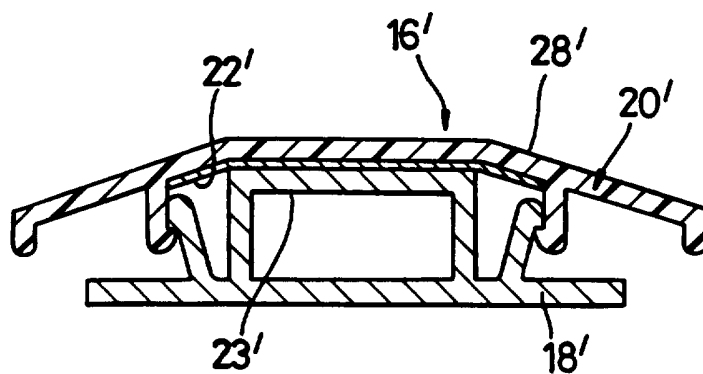


Fig. 3

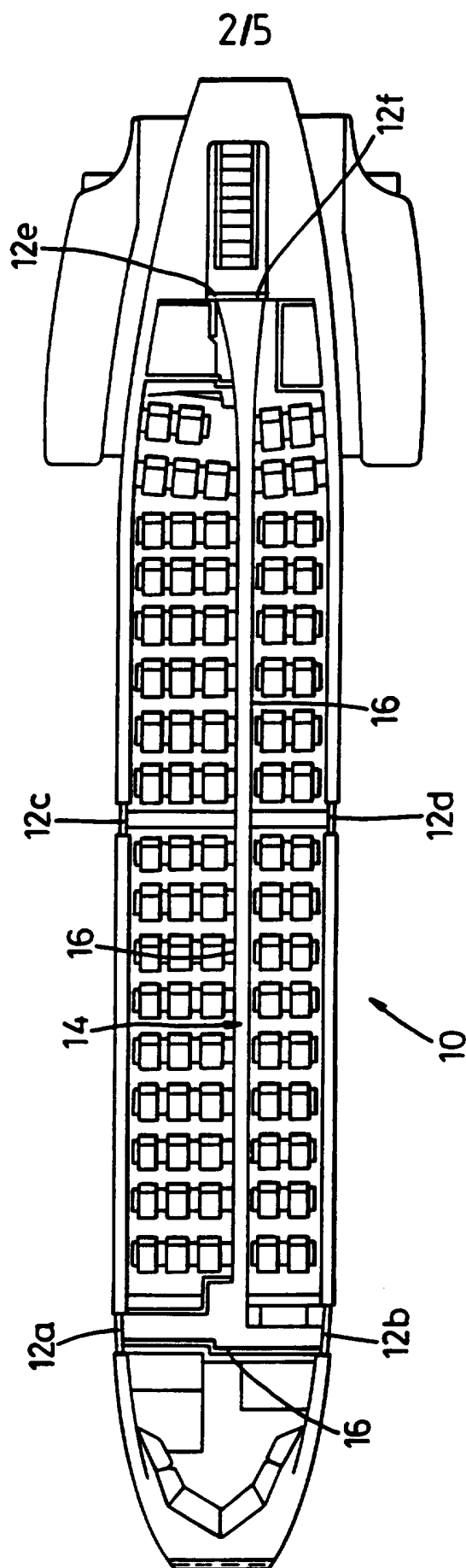


Fig. 4

3/5

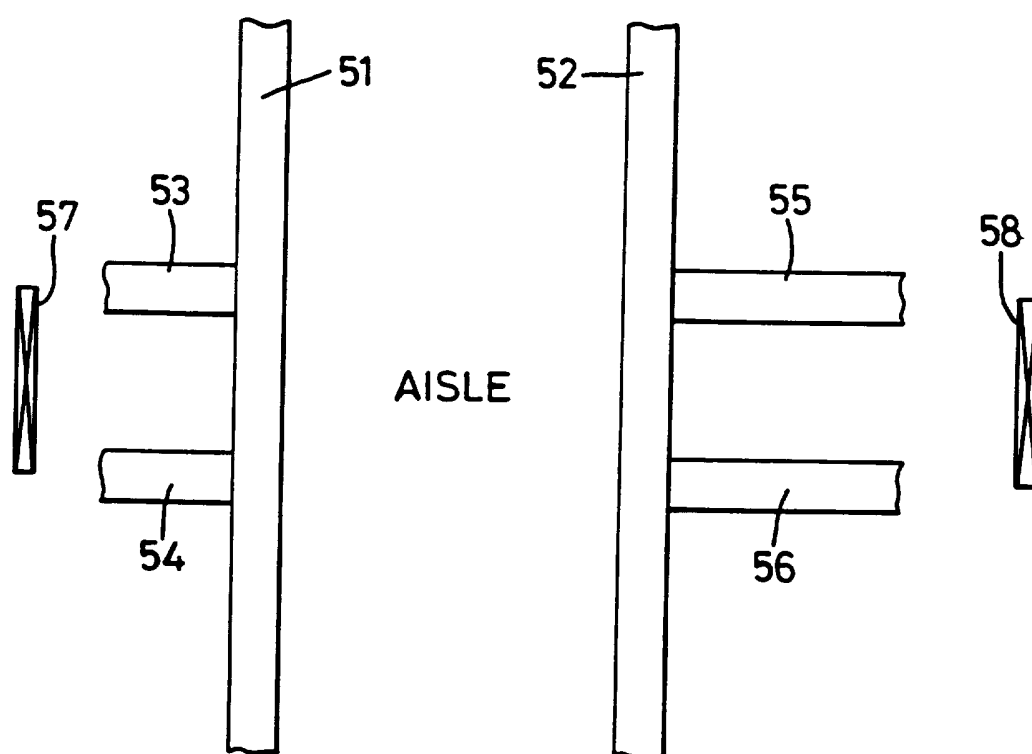


Fig. 5

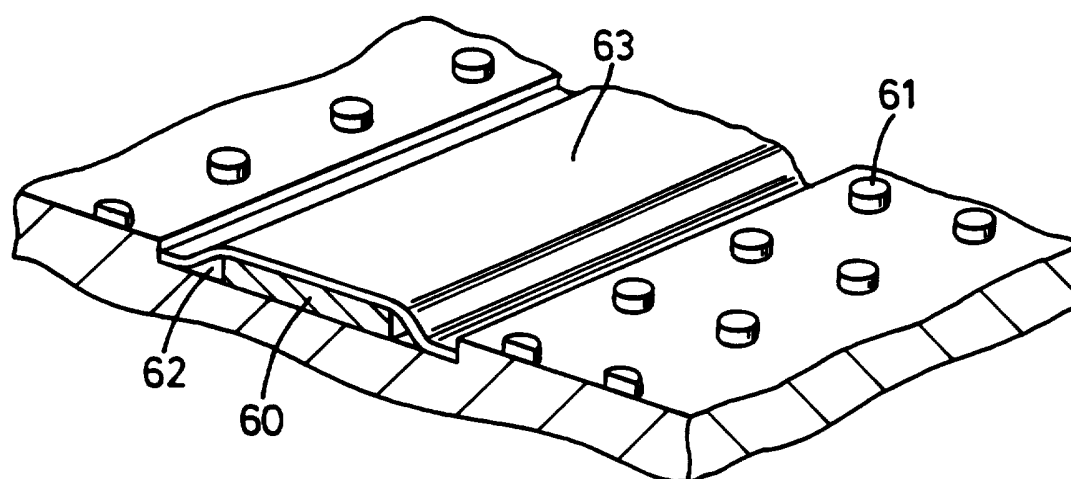


Fig. 6

4/5



Fig. 7

5/5

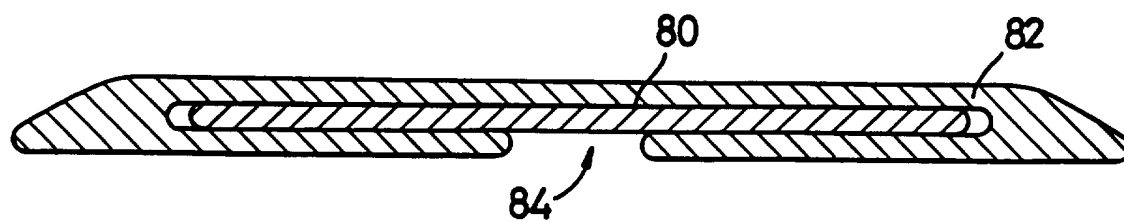


Fig. 8

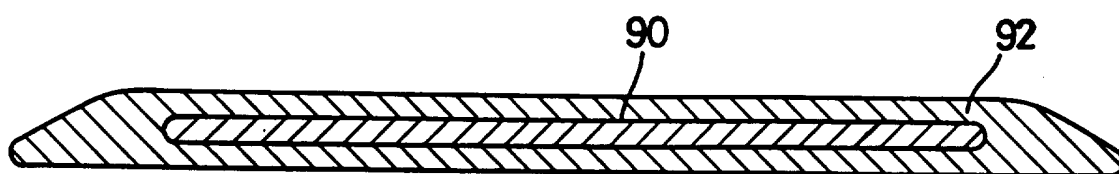


Fig. 9

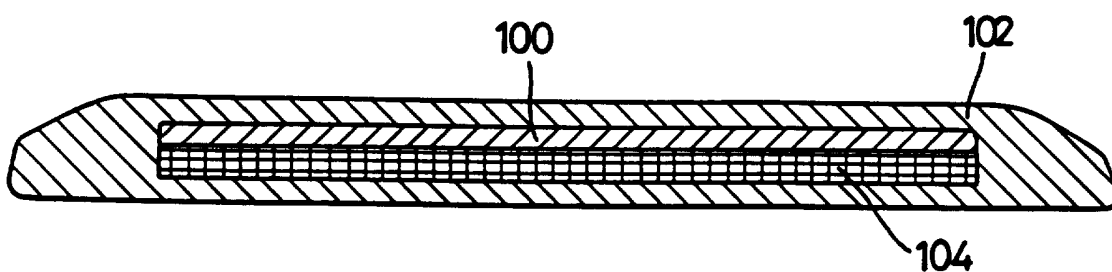


Fig. 10

INTERNATIONAL SEARCH REPORT

Int. l. Application No

PCT/GB 96/00936

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B64D25/00 G09F13/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B64D G09F G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO,A,94 17766 (STIMSONITE CORP) 18 August 1994 see page 1, line 6 - line 22 see page 9, line 10 - line 25 ---	1,5,25, 28-30
X	US,A,4 401 050 (BRITT LAURENCE D ET AL) 30 August 1983 see column 2, line 4 - line 35 see column 4, line 4 - line 41 ---	1,3,6,7, 12,16, 19,20
A	WO,A,87 02813 (HOLMAN ASSOCIATES) 7 May 1987 see claims 1-3 ---	1-3,20, 22,24,27
A	WO,A,94 16287 (HONIGSBAUM RICHARD F) 21 July 1994 see page 17, line 2 - line 9 ---	1-3,13
-/-		

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

A document member of the same patent family

Date of the actual completion of the international search

6 August 1996

Date of mailing of the international search report

13.08.96

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax (+31-70) 340-3016

Authorized officer

Hauglustaine, H

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 96/00936

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP,A,0 489 561 (MINNESOTA MINING & MFG) 10 June 1992 see page 2, line 31 - line 44 ---	11,12
A	WO,A,93 14422 (STIMSONITE CORP) 22 July 1993 see claim 1 ---	1
A	FR,A,2 308 155 (AEROSPATIALE) 12 November 1976 see claim 1 ---	1
A	FR,A,964 348 (MILLET) 10 August 1950 see page 1, line 61 - page 2, line 22 -----	24,25

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 96/00936

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A-9417766	18-08-94	US-A- 5415911	16-05-95
		AU-B- 6235894	29-08-94
		CA-A- 2155738	18-08-94
		CN-A- 1120309	10-04-96
		ZA-A- 9400838	16-09-94

US-A-4401050	30-08-83	GB-A- 2110864	22-06-83
		JP-A- 58116577	11-07-83

WO-A-8702813	07-05-87	NL-A- 8503017	01-06-87
		AU-B- 6622086	19-05-87
		EP-A- 0250478	07-01-88

WO-A-9416287	21-07-94	US-A- 5331918	26-07-94
		CA-A- 2152950	21-07-94
		EP-A- 0679242	02-11-95

EP-A-0489561	10-06-92	AT-T- 134947	15-03-96
		AU-B- 645626	20-01-94
		AU-B- 8779591	11-06-92
		CA-A- 2055194	07-06-92
		DE-D- 69117686	11-04-96
		ES-T- 2084123	01-05-96
		JP-A- 4292940	16-10-92
		US-A- 5387458	07-02-95

WO-A-9314422	22-07-93	AU-B- 3436393	03-08-93
		CA-A- 2128113	22-07-93
		CN-A- 1075374	18-08-93
		EP-A- 0631670	04-01-95
		US-A- 5415911	16-05-95
		ZA-A- 9300314	19-08-93

FR-A-2308155	12-11-76	DE-A- 2615926	28-10-76

FR-A-964348	10-08-50	NONE	
