(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 421 258 A1**

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **90118460.6**

(51) Int. Cl.5: **A47L 23/26**

(22) Date of filing: **26.09.90**

(30) Priority: **02.10.89 US 415652**

(43) Date of publication of application:
10.04.91 Bulletin 91/15

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI NL SE

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(54) **Floor mat with rigid rails joined by living hinges.**

(57) A floor mat is composed of a multiplicity of rigid elongated rails (10) arranged parallel to each other, each rail having a body portion (12) adapted to receive a tread member (13) and a coupling portion (14) by which it is joined to an adjacent rail. The body and coupling portions are found by extrusion of a rigid high-impact strength thermoplastic polymeric material and are joined by a living hinge in the form of a thin strand (38) of a highly flexible thermoplastic elastomer formed by coextrusion with the body and coupling portions and constituting a distinct bending line between the body and the coupling portion. Each rail includes at least two ribs (34) along its underside laterally spaced apart from each other and adapted to support the rail on a surface, each rib being formed by coextrusion with the body and coupling portions and the living hinge of a soft, compressible thermoplastic polymeric material and serving as a cushion and an anti-slip element of the mat. A tread surface (32) of the rail body portion on either side of the tread member has myriad protuberances (40 or 46) imparting a non-slip characteristic that is highly effective in all directions.

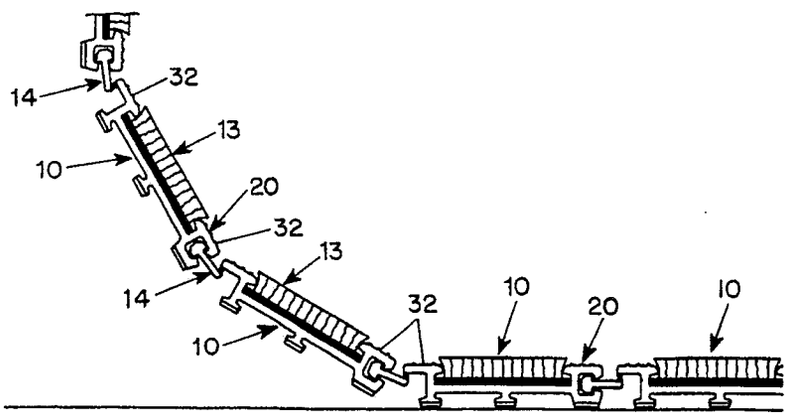

FIG. 2

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FLOOR MAT WITH RIGID RAILS JOINED BV LIVING HINGES

Background of the Invention

It is a highly advisable and almost universal practice to provide floor mats at the entrances to buildings to remove dirt from the footwear of persons entering the building. One form of entrance floor mat widely used in commercial and industrial buildings is based on rigid, elongated rails arranged parallel to each other and joined in closely spaced relation by hinge-type couplings that enable the mat to be rolled up so that the floor or walk under it can be cleaned. The rails have tread surfaces, which may be ribbed or toothed metal or plastic elements, grit materials or carpet pieces, that assist in cleaning dirt from footwear. The dirt removed by the tread surfaces tends to fall or be scraped into the gaps between the rails. Floor mats of the type described above are disclosed in U.S. Patents Nos. 3,808,628 (Betts, 1974); 4,029,834 (Bartlett, 1977); 4,568,587 (Balzer, 1986); Re. 32,061 (Ellingson, Jr., 1986); and 4,633,903 (Ellsingson, Jr., 1987); and in European Patent No. 0,067,024 (Parsons, 1986).

Construction Specialties, Inc., the assignee of the present invention, ("CS") has marketed a floor mat very similar to the one described in the Bartlett '834 patent under the trademark "Turfmat." The CS "Turfmat" product has rails produced by extrusion from a rigid polyvinyl chloride (PVC) and having, therefore, rigid ball and socket type couplings. The CS "Turfmat" product also has integral ribs on each rail that are formed of a softer vinyl than the rest of the rail by coextrusion with the rigid vinyl of the rail bodies and coupling portions. The softer ribs provide a cushioning effect and also impart a non-slip property. While the "Turfmat" PVC mats have given reasonably good service and are less expensive than mats having aluminum rails, they are less durable than the aluminum mats.

The floor mats described in the Balzer U.S. '587 patent are currently marketed by Balco, Inc., of Wichita, Kansas, U.S.A. (the assignee). The Balco mats have aluminum rails and "hinge members" formed of a relatively highly plasticized PVC, a flexible thermoplastic. The hinge members allow the mat to be rolled up by flexing throughout the extent of the transverse span between the aluminum rails and also by articulation at the ball and socket joints by which the hinge members are linked to the rails. Because the hinge members of the Balco mats have, like most mats of the rail type, holes to allow dirt and water to fall to the floor or other surface under the mat, the flexure of the PVC hinge members is concentrated at the segments that are aligned with the holes. The concentrated flexure is accompanied by increased stress. Under repeated flexure the highly stressed regions begin to fail. Eventually, an entire hinge member breaks apart, and the mat must be repaired or replaced.

The floor mats of the Ellingson, Jr., '903 patent are similar to the CS "Turfmat" in that the rails are made of plastic. Each rail has a main body portion that receives a carpet strip or other tread material and is formed by extrusion of a rigid PVC plastic. In addition, however, each rail has a coupling portion along one edge of the body portion that is formed by co-extrusion with the body portion of a flexible PVC plastic. The flexible coupling portion bends when the mat is rolled up. Because of the slots in the coupling portions in which dirt is allowed to fall to the floor below the tread surface, the flexible coupling portion is subject to concentrated stresses (stress risers) that produce rupture. Moreover, flexible PVC has a relatively limited endurance to flexure. Because of the slots and the limited durability of the material, the mats proposed in the '903 patent are not likely to be durable and long-lived.

The mats of the Parsons European patent have hinge members much like those of the Balco mats except that it is proposed that they be made of rubber. Stress concentration and fatigue failure are likewise a potential, though rubber should have greater durability than flexible PVC. However, rubber is generally more elastic than flexible PVC, and mats made according to the Parsons patent would probably be prone to transverse dimensional instability due to creaping of the rails toward or away from each other because of the elasticity of the rubber hinge members.

Assembly of the Balco and Parsons mats is tedious, because the hinge members are separate from the rails. For a given number of rails there are twice as many parts to be assembled by endwise sliding than in a mat in which the rail bodies are integral with the connector elements, such as the CS "Turfmat" and the CS "Pedimat" aluminum mats made according to the Bartlett '834 patent. Also, each rail has to be locked endwise to each hinge member, such as by rivets, and twice as many connections are required in the Balco mats as in the CS mats.

In most mats of the type described in the patents referred to above, the body portions of the rails have tread surfaces along both sides of the tread element. It is well-known to include in the extruded members forming the rails small, continuous lengthwise ribs to impart a non-slip characteris-

tic. Because the ribs extend lengthwise, the non-slip characteristic is largely unidirectional in that the ribs are effective only when one walks along the mat in a direction transverse to the lengthwise direction of the rails. In this regard, the mats are placed on the walk or floor with the rails transverse to the usual path of persons entering the building, because the cleaning effectiveness is maximized. When one walks in the direction of the rails, the lengthwise ribs on tread surfaces of the rails provide little resistance to slipping.

Summary of the Invention

An object of the present invention is to provide a floor mat composed of rails in which the bodies and connectors are unitary and which is more durable than the "Turfmat," less costly than the aluminum rail mats, light in weight, highly attractive in appearance and easy to assemble. Another object is to provide a floor mat in which the rails are not as stiff as the PVC and aluminum rails of currently available mats and thus more readily conform to irregularities in the floor or walk on which they are placed. Yet another object is to provide cushioning and non-slip properties for the mat with respect to the floor or walk by integrally formed elements of the rails. A further object is to provide an anti-slip characteristic on the tread surfaces of the rails that is effective in preventing slipping in all directions.

The foregoing and other objects are attained, according to the present invention, by a floor mat having a multiplicity of rigid elongated rails, each rail being a monolithic formation produced by extrusion from a thermoplastic material and having a body portion that includes a recess opening upwardly and adapted to receive a tread member and a tread surface on either side of the recess, and means joining the rails together in closely adjacent parallel relation for articulation so that the mat can be rolled up. The present invention is characterized in that both tread surfaces have myriad small protuberances imparting an anti-slip property.

In one embodiment, the protuberances are beads of the polymeric material of the rail formed by heat-branding the tread surfaces. For example, the beads may be vestigial segments of longitudinally continuous ribs, the ribs being formed by extrusion, and the segments being defined by a myriad of transverse heat brands in the ribs.

In another embodiment, the protuberances are grains of a grit material bonded to the thermoplastic polymeric material by a bonding substance. The grit material may be garnet or carborundum and preferably has a particle size in the range of from about 0.010 to 0.015 inch (0.254 to 0.381 mm). The bonding substance may be a hot-melt adhesive or an adhesive settable by exposure to ultraviolet radiation. Each tread surface may have a trough adapted to receive and contain the grit material and bonding substance.

For a better understanding of the invention, reference may be made to the following description of exemplary embodiments, taken in conjunction with the accompanying drawings.

Description of the Drawings

Fig. 1 is a top plan view of a section of one embodiment of a floor mat according to the invention;

Fig. 2 is an end elevational view of a section of the mat of Fig. 1 and shows on the left side how the adjacent rails articulate when the mat is rolled up;

Fig. 3 is an end cross-sectional view of a rail of the mat shown in Figs. 1 and 2;

Fig. 4 is a side elevational view of a section of a

Fig. 5 is a top plan view of a portion of a mat according to a second embodiment; and

Fig. 6 is an end cross-sectional view of a rail of the mat of Fig. 5.

Description of the Embodiment

The embodiment shown in Figs. 1 to 4 closely resembles the floor mat described and shown in the Bartlett '834 patent, which is incorporated by reference into the present specification. In particular, it comprises side-by-side, parallel rails 10, each of which has a body portion 12 adapted to receive a tread element 13 (see Fig. 2) and an integral coupling portion 14 by which it is joined to an adjacent rail through a ball and socket arrangement. Each rail is of uniform cross-section along its length and is produced by extrusion. The body has a recess 16 opening upwardly and defined on either side by an overhanging lip 18. The lips retain a carpet strip or some other form of tread element 13 in the recess, as is well known per se .

On one edge of the rail member body 12 is a flange portion 20 of generally C-shaped cross-section that defines a socket 22. A connector formation 24 on the coupling portion 14 in the general shape in crosssection of a ball fits into the socket 22 of the adjacent rail. The opening slot 26 of the socket 22 is wider than the web part 28 of the coupling portion 14 of the rail, which allows each rail to articulate about the longitudinal axis of the ball and socket coupling when the mat is rolled up. The web part 28 has elongated holes 30 uniformly spaced along its length for passage of dirt and water removed by the treads of the mat to the floor

or other surface on which the mat is placed in use. Longitudinal tread surfaces 32 on the marginal upper surfaces of the rail body on either side of the recess 16 assist the tread elements in removing dirt. As described thus far, the embodiment employs well-known features of floor mats that have enjoyed considerable commercial success and have met a need for a durable, attractive, economical and easy-to-use entrance mat.

The rails 10 are made by coextrusion of different thermoplastic polymeric materials, the differently cross-hatched regions of Fig. 3 representing those different materials. The body portion 12 and connector portion 14 are both formed of a rigid high-impact strength thermoplastic polymeric material. A polymeric material having an Izod impact strength, 1/8th inch notch, of not less than 16 ft./lb./in., a Shore D hardness of about 80 and a tensile yield strength of at least 6000 psi is preferred. Acrylic-modified polyvinyl chloride polymers with these properties are commercially available.

The lower extremities 34 of the three ribs or feet 36 of the rail, which support the rail on the floor, are made of a soft, compressible thermoplastic polymeric material to provide a cushioning effect and impart a non-slip characteristic. A polymeric material having a modulus of rigidity less than 16,000 psi at -49° F, a percent elongation of more than 300% and a Shore A hardness of between 60 and 80 is preferred. Commercially available acrylic-modified polyvinyl chlorides with these properties are suitable.

The coupling portion 14 of the rail is joined to the body portion 12 by a living hinge portion 38, which is in the form of a longitudinally continuous thin strand of a soft, flexible thermoplastic elastomer compound that exhibits high endurance to flexural fatigue. Thermoplastic elastomers suitable for living hinges, such as polyurethane elastomers, are commercially available. It is preferred that the elastomer have an elongation of at least 500%, a modulus of rigidity at -45° F of less than 1750 psi and a Shore A hardness in the range of 60 to 80. The tensile strength should be as high as possible, say at least 3000 psi at yield. Of course, the flexural endurance to withstand many hundreds of cycles of rolling and unrolling of the mat is essential.

As is known per se, the living hinge portion 38 is of hour-glass shape, which creates a zone of bending without stress risers and comparatively large areas of joinder to the adjacent rigid parts. The configuration of the embodiment, in which the rigid portions joined by the living hinge portion are offset vertically, is merely exemplary. The living hinge may be interposed anywhere in the transverse gap between the rail body 12 and the rigid coupling ball portion 24. For example it may be located immediately adjacent the ball portion 24 or interposed in the web portion 28. More than one living hinge could be provided in the gap between the coupling portions. It is preferred, however, that the living hinge not be in line with the holes 30 (which, incidentally, are punched out of the extruded member) because they would then be segmental and more prone to failure. Finally, the compound used for the living hinge may be transparent, in which case it is desirable that it be largely invisible, lest it be perceived as a gap (though it is very small and not likely to be observed in use, no matter where it is located).

Except for the living hinge portion, the rails can be pigmented or dyed in any desired color. The color extends throughout the material, so scratches and other surface damage will hardly show. For outdoor use, UV inhibitors should be incorporated.

Each of the tread surfaces 32 of the rail body has myriad small protuberances 40 imparting an anti-slip property. The protuberances are beads of the rigid polymeric material of the rail formed by "heat-branding" the tread surfaces, that is, by embossing the surfaces using a heated roller to soften and deform the material to create protuberances. In the illustrated embodiment, the rails are extruded with longitudinally continuous ribs, and the protuberances 40 are the vestigial segments of the ribs created by heat-brands in the form of closely spaced indentations 44 extending into and transversely to the ribs formed using a heated roll having closely spaced-apart ribs extending parallel to the axis of the roll. Preferably, the indentations 44 extend the full heights of the ribs (see Fig. 4). The heat brands are best made on-line with the extruder. Good results are obtained with protuberances 40 about 0.015 inch (0.381 mm) in height with the heat-branded transverse indentations 44 spaced at 0.150 inch (3.81 mm) center-to-center.

The mat is assembled by sliding successive rails endwise onto the last rail of the partly assembled mat. One or more fusion joints (not shown) is made between the ball and-socket elements of each juncture between rails to join them against lengthwise relative movement. In regions near the fusion joints, the balls and sockets cannot articulate, and rolling up of the mat is permitted by flexure of the living hinge. In regions of the junctures remote from the fusion joints, rolling up of the mat is afforded by a combination of flexure of the living hinges and articulation of the ball and socket joints. The moderate flexibility of the polymeric materials of the mat affords moderate deformation of the coupling portions of the rails, which in turn progressively diminishes the effect of the rotational restraints of the fusion joints, the greater the distance from the fusion joint. The moderate flexibility of the polymeric materials also allows the rails to

conform somewhat by flexure to irregular surfaces in the lengthwise direction. The living hinges and ball and socket joints readily allow conformity to the supporting surface in the transverse direction. The soft thermoplastic on the feet of the rails also provides local compliance with slightly rough or uneven surfaces. The protuberances 40 on the tread surfaces 32 of the rail body provide an excellent anti-slip charcteristic in all directions.

The embodiment of Figs. 5 and 6 is identical in most respects to that shown in Figs. 1 to 4, and corresponding elements are, therefore, designated by the same reference numerals but with prime (′) superscripts. The above description of the first embodiment is fully applicable to most of the elements of the embodiment of Figs. 5 and 6 and is not repeated.

Instead of a non-slip characteristic provided by protuberances in the material of the rail itself, the tread surfaces 32′ of the rail body 12′ have a non-slip characteristic provided by myriad protuberances in the form of particles 46 of a grit material. The rails 10′ are extruded with a shallow, longitudinally continuous groove or trough 48, say 0.015 inch (0.381 mm) deep, extending across nearly the entire width of each tread surface 32′. Each trough 48 is bounded laterally on both sides by shoulders 50. The particles of grit material are dispersed in a settable, fluent, liquid resinous bonding substance. The dispersion is deposited continuously along each trough to a depth such that the surface of the particle-bonding material dispersion is above the upper edges of the shoulders 50. Suitable grit materials are garnet and carborundum in a particle size range of about 0.010 to 0.015 inch (0.254 to 0.381 mm). The bonding material may be a hot melt adhesive or an adhesive set by exposure to ultraviolet radiation. The particle-bonding material dispersion may be applied and set on line with the extruder. While Fig. 5 shows separate particles 46 diagrammatically in spaced-apart relation for clarity, in practice the particles form a continuous layer in each trough. In addition to providing a non-slip characteristic on each tread surface 32 that is highly effective in all directions, the grit material is very resistant to wear.

Claims

1. A floor mat having a multiplicity of rigid elongated rails (10), each rail being a monolithic formation produced by extrusion from a thermoplastic material and having a body portion (12) that includes a recess (16) opening upwardly and adapted to receive a tread member (13) and a tread surface (32) on either side of the recess, and means (22, 24) for joining the rails together in closely adjacent parallel relation for articulation so that the mat can be rolled up, characterized in that both tread surfaces (32) have myriad small protuberances (40 or 46) imparting an anti-slip property.

2. A floor mat according to claim 1 and further characterized in that the protuberances are beads (40) of the polymeric material of the rail formed by heat-branding the tread surfaces.

3. A floor mat according to claim 2 and further characterized in that the beads (40) are vestigial segments of longitudinally continuous ribs, the ribs being formed by extrusion, and the segments being defined by a myriad of transverse heat brands (44) in the ribs.

4. A floor mat according to claim 1 and further characterized in that the protuberances are grains (46) of a grit material bonded to the thermoplastic polymeric material by a bonding substance.

5. A floor mat according to claim 4 and further characterized in that the grit material is selected from the group consisting of garnet, carborundum and combinations thereof.

6. A floor mat according to claim 4 and further characterized in that the grit material has a particle size in the range of from about 0.010 to 0.015 inch (0.254 to 0.381 mm).

7. A floor mat according to claim 4 and further characterized in that the bonding substance is a hot-melt adhesive.

8. A floor mat according to claim 4 and further characterized in that the bonding substance is an adhesive settable by exposure to ultraviolet radiation.

9. A floor mat according to claim 4 and further characterized in that each tread surface has formed in the rail body portion a trough (48) adapted to receive and contain the grid material and bonding substance.

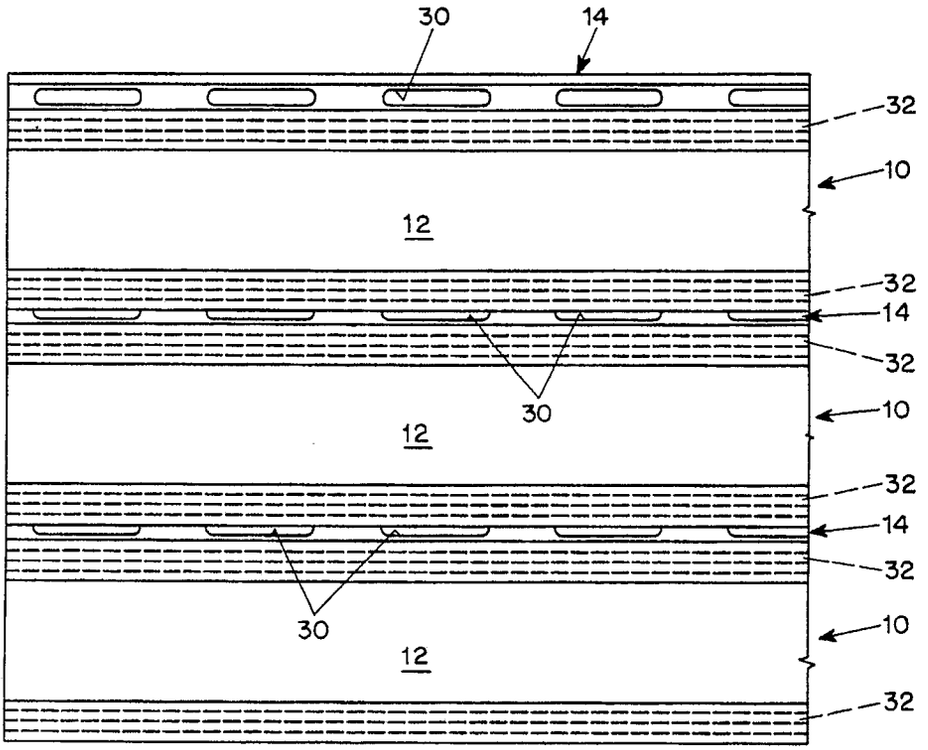
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FIG. 1

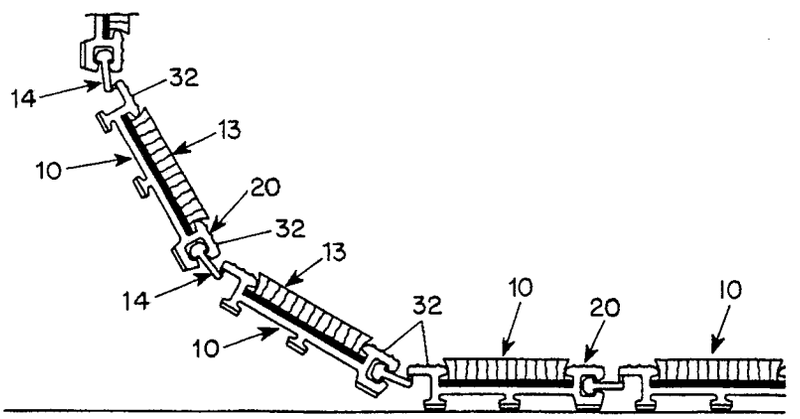
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FIG. 2

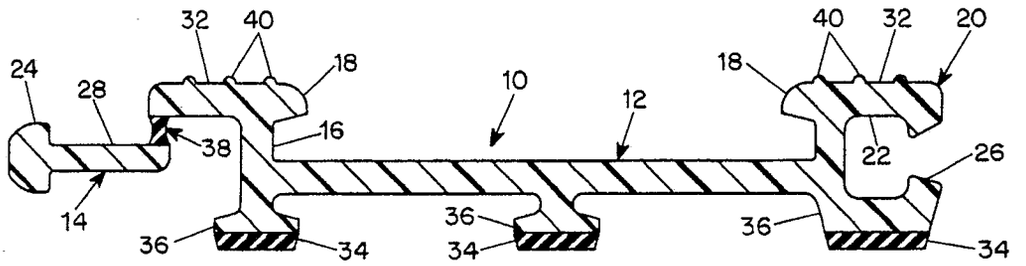

FIG. 3

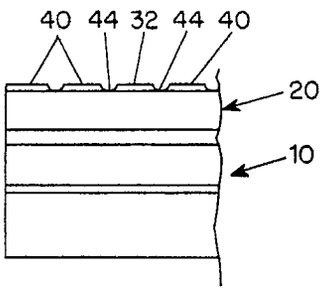

FIG. 4

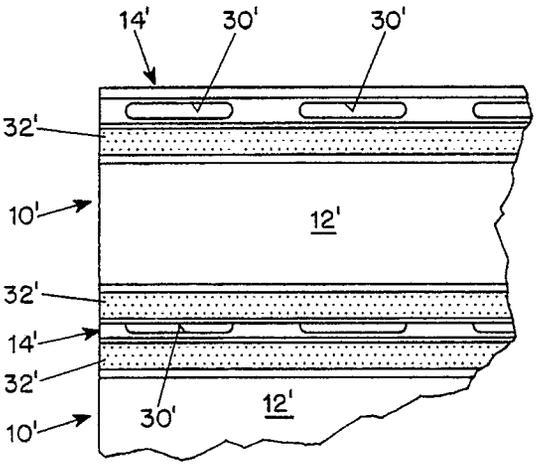

FIG. 5

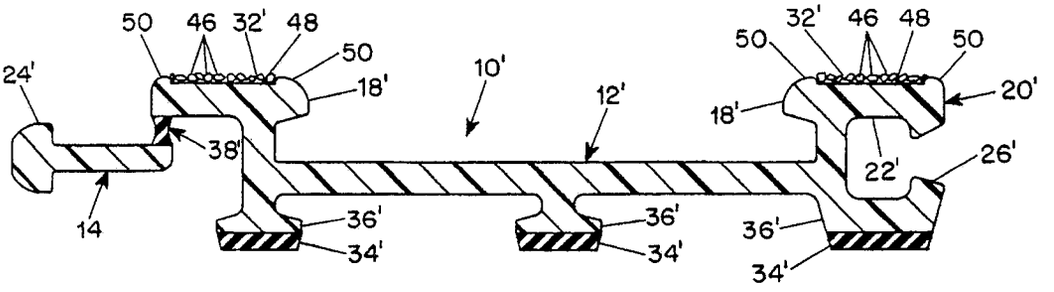

FIG. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 11 8460

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
P,X,A	US-A-4 877 672 (T.A. SHREINER) * column 3, lines 18 - 21; figure 2 *	1,2-7,9	A 47 L 23/26
Y,A	US-A-3 913 291 (F.D. DULIEN & AL) * column 2, line 53 - column 65; figure 2 *	1-3,4-7,9	
D,Y	US-A-3 206 1 (C.W. ELLINGTON JR) * column 2, lines 34 - 37; figure 3 *	1-3	
Y	FR-A-2 251 433 (SA AUTOMOBILES CITROEN) * page 3, line 30 - page 5, line 4 *	2,3	
A	PATENT ABSTRACTS OF JAPAN vol. 9, no. 184 (C-294)(1907) 30 July 85, & JP-A-60 052681 (FUSOU GOUSEI KK) 25 March 85, * the whole document *	1,4-7	
A	US-A-2 793 136 (A.A. ROOT) * column 1, line 56 - column 2, line 34; figures 1-4, 10 *	1,4-7	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

A 47 L
A 47 G
B 29 D
B 29 C

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	19 December 90	VANMOL M.A.J.G.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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