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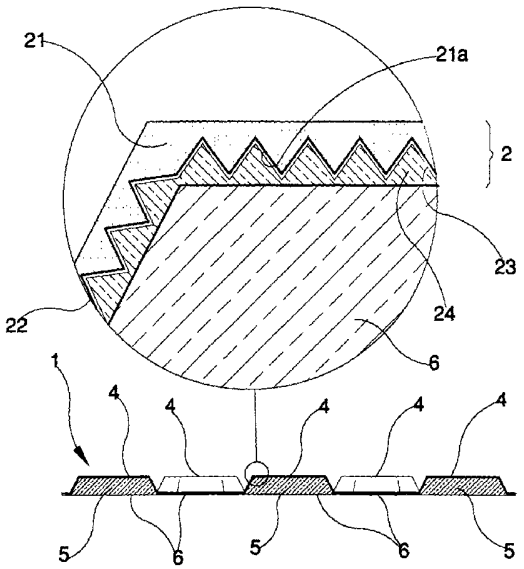
(54) Title: REFLECTOR LAMINATE WITH MICRO-PRISMS AND PROCESS FOR MANUFACTURING IT



(57) Abstract: A multilayer film (2) is heat-formed to obtain a distribution of macroscopic projections (4) from an outer side of the multilayerfilm (2). On the bottom side of the multilayerfilm (2) there are cells (5) corresponding to the reliefs (4) on the upper side. A filler base layer (6) of material filing the cell covers the whole bottom side of the multilayer film (2). The multilayer film (2) comprises a upper layer (21) made of a transparent heat-formable material, a lower structured surface (21a) exhibiting microprisms having reflective properties, and other layers made of a protective material underlying a reflective layer (22). The laminate has a high reflective power and exhibits luminous qualities, a colour scheme and reflective properties which satisfy legal requirements.

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Description

REFLECTOR LAMINATE WITH MICRO-PRISMS AND PROCESS FOR MANUFACTURING IT

Technical Field

The invention relates to a reflector laminate with micro-prisms and a process for manufacturing it. Specifically, though not exclusively, the reflector laminate can be usefully applied in the field of horizontal road signals.

Background Art

The prior art teaches various types of reflector laminates with micro-prisms, for example US patents 5376431, 5657162, 6083607, 6139158.

The present invention concerns a laminate with micro-prisms having a high reflecting power.

An advantage of the invention is to provide a reflector laminate having characteristics of brightness, colour precision and high reflecting qualities, responding to norms and standards in the field of road signals.

A further advantage consists in the fact that the laminate is resistant to wear and has a long working lifetime.

The invention also proposes a simple reliable, economical and high-production process for manufacturing a reflector laminate.

These aims and advantages and more besides are all attained by the present invention as it is characterised in the claims that follow.

Disclosure of Invention

Further characteristics and advantages of the present invention will better emerge from the detailed description that follows, of a preferred but non-

exclusive embodiment of the invention, illustrated purely by way of example in the figures of the drawings, in which:

figure 1 is a plan view from above of a laminate made according to the invention;

figure 2 is section II-II of figure 1.

With reference to the figures of the drawings, 1 denotes in its entirety a reflector laminate, used in particular to make horizontal road signals, which comprises a multi-layer film 2 comprising in turn an upper layer 21 made of heat-formable plastic material, either transparent or coloured transparent, for example a methacrylate such as ethyl methacrylate, which on a bottom side exhibits a structured surface 21a having a distribution of micro-prisms in relief, a layer 22 of reflector material underlying the structured surface 21a with the micro-prisms, and one or more layers 23 and 24 of protective material underlying the reflector layer 22.

In the preferred embodiment the reflector layer 22 is metallic (for example, aluminium) and is inferiorly covered with a thin layer 23 of protective material constituted by a preferably polyurethane-based metal primer, which has the function of improving grip with a layer 24 of material for filling the micro-prisms. The layer 24 is made for example with a high-weight polyurethane resin and fills the "valleys" of the structured surface 21a and covers the "peaks" thereof so as to protect the micro-prisms, and especially to avoid the risk that the micro-prisms deform (damaging their reflective properties) during the heat-forming stage of manufacture of the reliefs 4 and the cells 5, as will be better explained herein below.

A thin light-coloured opaque (preferably white) outline 3 is printed on the structured surface 21a of the transparent or coloured transparent layer 21. The outline can be designed as a wording or a figure (perhaps a trade mark, or a geometric figure), and is distributed over the surface 21a of the transparent layer

21 in such a way as to form a sort of lattice which in part (to a predetermined percentage of the layer 21) covers the underlying reflector layer 22, with the aim of modifying the colour characteristics and luminosity of the laminate without excessively reducing its reflective qualities. Preferably the outline 3 covers a total area percentage of about 15% of the total area of the structured surface 21a. The percentage is in accordance with the colour and luminosity characteristics required, especially the characteristics required by law in relation to visibility of the laminate by day during normal light conditions.

The multi-layer film 2 is shaped to form a distribution of macroscopic reliefs 4 on the upper side of the film 2. The macroscopic reliefs 4 are accompanied, on the bottom layer of the film 2, by cells 5. The height of the macroscopic reliefs 4 is about 1-4 mm. , i.e. at least twice as big as the size of the micro-prisms, so that the lateral surface of each relief 4 exhibits a multiplicity of micro-prisms. This is due to the fact that the lateral surface of the reliefs 4 is the most responsible part for the reflective effect when the laminate is used as a horizontal signal. The reliefs 4 (and the cells 5 on the other side), seen in plan view (figure 1), preferably exhibit a hexagonal shape and are distributed in a regular and ordered fashion. In the illustrated embodiment they are trunco-pyramidal with a hexagonal base. It would however be possible to have other shapes, though it is preferable that the reliefs 4 each exhibit a top surface which is flat and parallel to the laminate, as well as an inclined lateral surface with respect to the laminate. At least a part of the micro-prisms is situated on the inclined lateral surface of the reliefs (4). These micro-prisms are protected against wear (by traffic passing over the laminates) and are also the most exposed to light beams coming from the headlights of vehicles, so that reflective capacity is optimised, as is visibility of the horizontal road surface, in all atmospheric and road surface conditions and for all possible angles of incidence of the light beam emitted by the headlights of a

vehicle.

The laminate also comprises a filler base layer 6 which fills the cells 5 and also functions as a covering for the bottom side of the shaped multi-layer film 2. The base layer 6 is thicker than the depth of the cells 5, so as to obtain a total covering and form a continuous base surface over the whole of the bottom side of the laminate opposite the upper reflecting surface. The material used for the base layer 6 is preferably a plastic spreadable layer, for example a polyurethane resin or synthetic rubber. The material can contain additives, such as a percentage of pigments, for example white or variously coloured according to needs. The material can also contain a percentage (for example, about 0.5%) of a bleach (preferably of the type used in the textile or paper industries) for improving visibility of the film when used as a road signal. The material also preferably contains particles of relatively hard abrasive material, which particles give the base layer 6 high resistance to both mechanical and atmospheric wear, thanks to which the reliefs on the external reflector side keep their shape over a long period of time even where subjected to high wear situations. The abrasive particles can be granular or sharp scales having a very irregular structure, of the type normally used for making glass-paper, mills, emery paper and so on; in the illustrated embodiment, the particles are mostly constituted by grains or scales of corundum or other abrasive substances having a hardness of about the same or even greater than corundum (i.e. 9 in the Mohs scale), such as for example carborundum, boron carbide, aluminium sesquioxide, diamond, etc. Less hard substances than corundum can be used, however, although they should preferably be above 8 in the Mohs scale, i.e. harder than topaz. It has been noted however that laminates for high-quality horizontal signals can be made with abrasive particles having a hardness of less than 8 in the Mohs scale, but preferably harder than silica glass (which is between 6 and 7 in the Mohs scale) such as for example garnet or

quartz in very fine grains. Other usable abrasive materials are, for example, the following: pumice, sepia, tripoli powder, fossil powder, tantalum carbide, tungsten carbide, sandstone, very fine glass powder, granular and powder emery, iron oxide and/or chrome oxide in powder form. A mixture of powders can also be used, made of various abrasive materials, reduced to granular or powder form and having different hardnesses and granulometries. The abrasive particles can be mixed up together with the other ingredients of the base layer 6 (for example polyurethane resin, white pigment and bleach), after which the mixture obtained can be spread on the side exhibiting the cells, advancing the laminate towards a base layer 4 forming device, comprising a feeder which distributes the mixture and a doctor which fills the cells and scrapes and smooths the mixture.

The process for manufacturing the reflector laminates comprises the following stages:

a) printing on a lower side of a heat-formable material, either transparent or coloured transparent, an thin outline 3 of a wording or repeated design, in white or coloured opaque material, according to the desired characteristics or colour scheme and the desired luminosity of the laminate;

b) forming (for example by embossing) on the lower printed side a structured surface 21a exhibiting a distribution of micro-prisms in relief. The micro-prisms are conformed in a known way to provide reflecting characteristics;

c) treating the structured surface 21a in order to increase the ability thereof to grip and anchor to the next-applied layer of material, for example using a treatment increasing the surface tension and roughness of the structured surface 21a;

d) distributing a layer 22 of reflecting material on the treated structured surface with the micro-prisms; the reflecting material is preferably metallic (for example, aluminium) and is applied using a known metallizing process under vacuum;

e) distributing on the reflecting material at least one thin layer 23 of material, preferably constituted by a metal primer, for example a bicomponent polyurethane, which enables a firm anchoring of the following layer 24 of covering and protective material. Alternatively to the primer layer 23, the metallized surface can be surface-treated to improve its gripping capacity on the next covering and protective layer 24. Then a second, filler layer 24 of protective material is laid on the primer layer 23 (or surface-treated layer). This second, filler layer 24 can be for example a high-weight polyurethane resin which flattens the bottom side of the film 2, filling the "valleys" and covering the "peaks" of the micro-prisms in relief on the structured surface 21a; the filler layer 24 is thicker than the depth of the valleys on the structured surface, so that the micro-prisms are fully protected;

f). Heat-forming the film 2 to obtain a distribution of macroscopic reliefs 4 to which an equal number of cells 5 corresponds. During this stage the filler layer 24 has the function of protecting the micro-prisms so that they keep their conformation and reflective properties. The reliefs 4 project on the upper side of the film 2, i.e. the side bearing the transparent material, while the cells 5 are on the lower side, i.e. the side filled by the filler layer 24. The film is heat-formed by being passed between two opposed embossing cylinders (not illustrated) which are peripherally provided with two matrices (one male, one female) which cooperate to obtain the reliefs 4 on one side of the film and the cells 5 on the other side. Preferably one of the two matrices (preferably the male matrix) is made of an elastically-deformable material, or in any case more deformable than the material of the other matrix. For example, the male matrix can be made of silicone rubber while the female matrix can be made of a metal (e.g. steel, nickel, etc). Before the heat-forming operation the film 2 is pre-heated, for example by batteries of infra-red rays and/or heating rollers; then the heat-forming is

performed by the two embossing rollers (cooled) which operate synchronously to produce a film 2 in which each relief (male) on one side corresponds to a cell (female) on the other side. The heat-formable layer 21 guarantees good-quality heat-forming;

g). Distributing, as previously described, a filler layer 6 of material to fill the cells 5 and cover the bottom side of the film, 2, the same side as the protective layer 24.

A layer of adhesive or self-adhesive (either permanent or removable) is deposited in a known way on the base layer 6, which serves to fix the laminate 1 to an external surface (for example a road surface), protected by a film of paper or silicone. Application of the laminate 1 on a road surface is done in known ways. The laminate is particularly useful for horizontal road signals, has a high back-reflecting power, and can maintain a high reflective capacity over a long period of time, even where subject to wear and stress, such as for example atmospheric agents or passage of motor vehicles. The laminate provides a horizontal signal which will last over a long period of time and which does not require any particular maintenance. The horizontal signal offers very high visibility for drivers even in very bad weather, such as for example at night or when it is foggy or raining, thus improving road safety. The laminate has excellent anti-skid surface characteristics, especially for vehicle tyres. The laminate has colour and luminosity characteristics which satisfy the requirements of the laws, while maintaining a high degree of reflection.

Claims.

1). A reflector laminate, comprising: a multilayer film (2) which comprises an upper layer (21) which is transparent or coloured transparent, preferably made of a heat-formable material, which is attached by a bottom side thereof to a structured surface (21a) giving rise to a reflective property; a reflector layer (22) made of reflector material being located beneath the structured surface (21a), and one or more than one layers of protective material beneath the underlying reflector layer (22); the multilayer film (2) being shaped so as to exhibit a distribution of macroscopic reliefs (4) projecting from an upper side of the laminate, and on a base side thereof, a distribution of cells (5) which correspond to the macroscopic reliefs (4);

a base filler layer (6) of material filling the cells (5) and covering the bottom side of the multilayer film (2).

2). The reflector laminate of claim 1, wherein the structured surface (21a) exhibits an array of microprisms.

3). The reflector laminate of claim 1 or 2, wherein a thin-lined outline (3) is printed on the structured surface (21a); the outline being light-coloured and opaque, and being a repeated pattern so as to form a sort of lattice which to a predetermined degree partially hides the underlying reflector layer (22).

4). The reflector laminate of any one of the preceding claims, wherein the structured surface (21a) forms valleys and peaks which are covered by at least one protective layer (24).

5). The reflector laminate of any one of the preceding claims, wherein the reflector layer (22) is metallic and is covered by a thin primer layer (23) for metals.

6). The reflector laminate of any one of the preceding claims, wherein the

material of which the base filler layer (6) is made of a plastic material containing one or more additives taken from what follows: one or more bleaches, particles of one or more abrasive materials, one or more white or coloured pigments.

7). A process for manufacturing a reflector laminate, comprising the following stages: distributing a reflector layer (22) made of a reflector material on a structured surface (21a); distributing one or more protective layers on the reflector layer (22); forming, preferably by a heat forming process, a multilayer film (2) obtained as described in the present claim in order to obtain, on an upper side of the multilayer film (2) a distribution of macroscopic reliefs (4) and a corresponding distribution of cells (5) on a bottom surface of the multilayer film (2);

distributing a filler base layer (6) on the cells (5), filling the cells (5) and covering all of the bottom surface of the multilayer film (2).

8). The process of claim 7, wherein a thin-lined outline (3) is printed on the structured surface (21a) before the structured surface (21a) is structured or after it is structured; the outline being light-coloured and opaque, and being a repeated pattern so as to form a sort of lattice which to a predetermined degree partially hides the reflector layer (22), which reflector layer (22) is applied subsequently.

9). The process of claim 7 or 8, wherein during the heat-forming process the multilayer film (2) is preheated and passed between two opposing embossing cylinders, one of which embossing cylinders is peripherally provided with a male matrix, another of which embossing cylinders is peripherally provided with a female matrix; the two opposing embossing cylinders cooperating to impart the reliefs (4) on one side of the multilayer film (2) and the cells (5) on another side of the multilayer film (2).

10). The process of claim 9, wherein the male matrix is made of an elastically-deformable material.

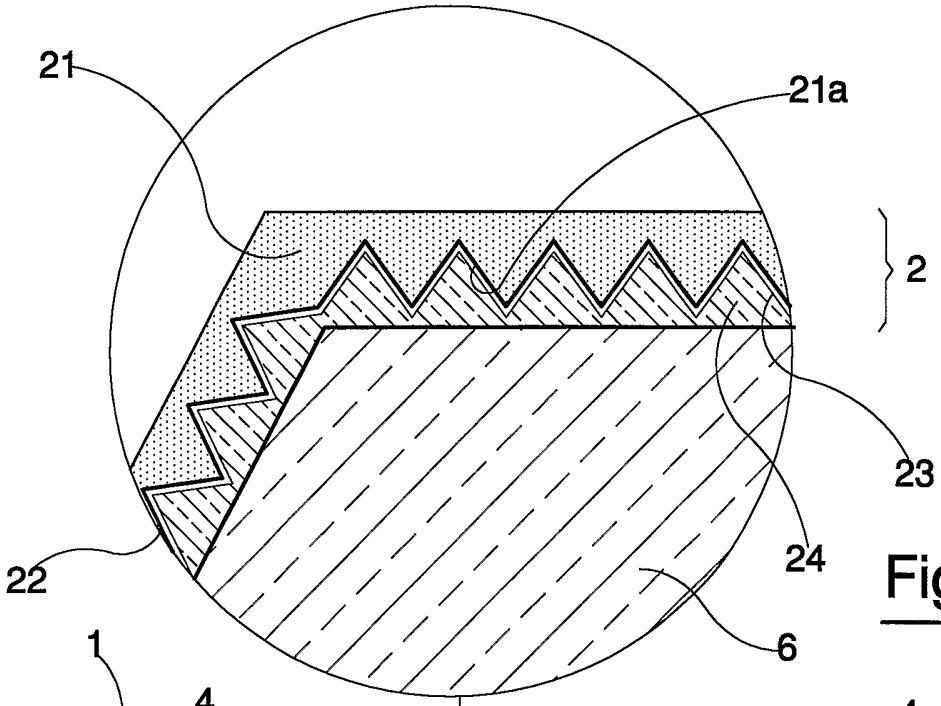
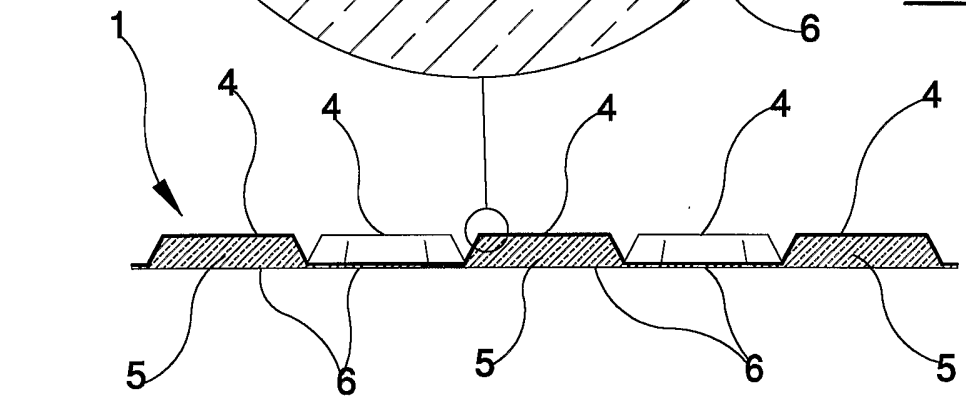


Fig.2



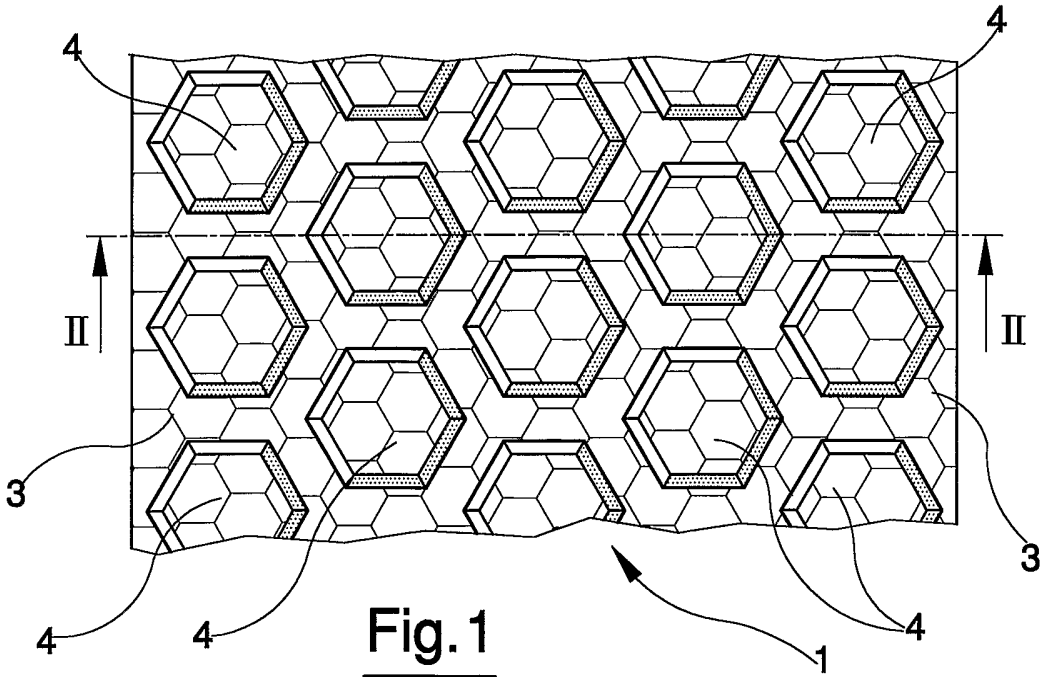


Fig.1

INTERNATIONAL SEARCH REPORT

Ir onal Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G02B5/124

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 7 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)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 376 431 A (ROWLAND WILLIAM P) 27 December 1994 (1994-12-27) cited in the application	1,2,4,7
Y	abstract; claims 1,5,6,10,11,15,17; figure 5 column 1, line 38 - line 41 column 1, line 65 -column 2, line 2 column 4, line 32 - line 68	3,5,6, 8-10

X	US 6 139 158 A (NILSEN ROBERT B ET AL) 31 October 2000 (2000-10-31) cited in the application	1,2,4,7
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A	column 4, line 48 -column 5, line 7	3,8-10
Y	column 5, line 50 - line 58	5,6

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
30 September 2002	15/10/2002

Name and mailing address of the ISA	Authorized officer
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	Michel, A

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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