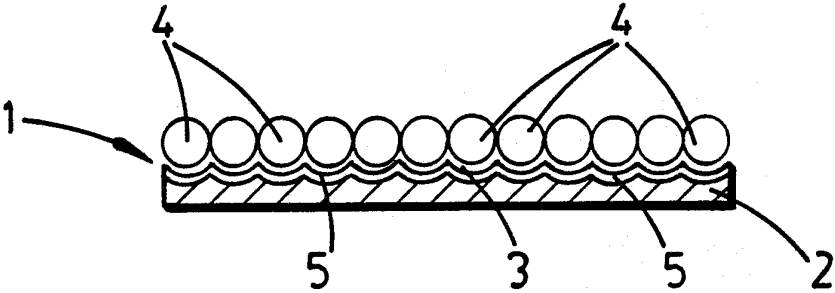




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(54) Title: REFLECTIVE MATERIAL		
		
(57) Abstract A reflective material (1) comprises a carrier sheet (2) with a finely embossed surface, a thin reflective layer (3) deposited on the surface and of a thickness such that the exposed surface of the film follows the contours of the embossing, and transparent microparticles (4) received within the recesses of the reflective film and bonded thereto.		

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REFLECTIVE MATERIAL

The present invention relates to a reflective material which is useful particularly but by no means exclusively in road safety applications (eg. for providing a reflective sleeve on a road cone so as to render the cone more visible in the light from a car headlamps during day and night time driving) or traffic signs.

Various constructions of reflective materials for use in road safety applications are known in the art which comprise glass microspheres behind which is a specularly reflective coating. Examples of such constructions are shown in US Patent No. 4 767 659, EP-A-0 227 448, and EP-A-0 170 518.

In the United Kingdom, BS 873:Part 6:1983 specifies criteria which retroreflective and non-retroreflective signs should meet. In this Standard, retroreflective materials are classified as Class 1, 2 or 3 according to their minimum coefficients of retroreflection. A retroreflective material for use on a road cone must meet the Class 2 reflectivity requirements for white light and furthermore must have a minimum luminance factor (for white light) of 0.25. There is a problem with prior art reflective material for use on road cones in that the production methods used for the prior art materials produce inconsistent products in that the minimum values of reflectivity and luminance (as specified by the above mentioned BS 873 Class 2) are not always simultaneously met. In other words, the prior art material may satisfy the luminance minimum but not the reflectivity minima or vice versa. There are methods of producing prior art materials which will consistently produce a product which meets the luminance and reflectivity minima of BS 873 Class 2, but these methods are generally not cost effective.

According to a first aspect of the present invention there is provided a reflective material comprising a carrier sheet with a finely embossed surface, a thin reflective film deposited on said surface and of a thickness such that the exposed surface of the film follows the contours of the embossing, and transparent microparticles received within the recesses and bonded to the surface of the reflective film.

According to a second aspect of the present invention there is

provided a method of producing a reflective material comprising providing a base material which itself comprises a carrier sheet with a finely embossed surface having deposited thereon a thin reflective film of a thickness such that the exposed surface of the film follows the contours of the embossing, and bonding transparent microparticles to said exposed surface of the film such that the microparticles are received within the recesses of the film.

The carrier sheet is preferably of a plastics material, most preferably a flexible plastics carrier sheet. When such a flexible carrier sheet is used, the material of the invention is particularly useful as a reflective sleeve for a traffic cone. For this purpose, a suitably shaped blank of the material (eg. trapezoidal) is folded into a general conical or frusto-conical shape which may simply be located on the cone.

The carrier sheet may be clear or opaque and preferably has a thickness of 150 to 300 microns dependent on final application. The carrier sheet is preferably of PVC. Ideally, the PVC should be a high impact PVC (ie. of low plasticiser content). Preferably the PVC sheet is a calendered sheet. Such materials are comparatively easy to emboss and their high impact properties are required for the preferred use of the reflective material (ie. as a sleeve for a road cone). The size of the embossed pattern is preferably so related to the cross-sectional size of the microparticles that the surface depressions of the embossed pattern will receive only a single microparticle, a portion of which will project out of the depression. Furthermore, the number of depressions (in the embossed pattern) per unit area should preferably be such that adjacent portions of microparticles projecting from the depressions are either in contact with each other or in close proximity thereto. It should not however be assumed that every depression of the embossed pattern must receive a microparticle since the methods by which the material will be produced (see below) cannot guarantee that this will be the case. However, a substantial proportion of the depressions will receive a microparticle. Furthermore, not all microparticles in the material will be received within a depression since some (although only a minor proportion) of the microparticles may simply be located on the surface of the material. The embossing applied to the sheet is preferably a fine embossing pattern,

particularly of the type known as satin, poplin, rayon, or suede embossing.

The reflective film is preferably a metallized film (most preferably aluminium) which can be deposited on the carrier sheet by conventional metallizing techniques, (eg. by electrodischarge). The metal film should be very thin such that the exposed surface of the film substantially reproduces the embossed pattern of the sheet.

In an advantageous (although not essential) embodiment of the invention a printed marking may be applied to the metallized film. This will particularly be the case where the reflective material is to be used for signposts, road signs, clothing for emergency service officers, advertising posters etc. In this case the printing is done before the microparticles are applied. Alternatively for certain applications it may be desirable to print onto the microparticles .

In the manufacture of the reflective material, the metallized film (with or without printed marking) is sprayed or otherwise coated with an adhesive, typically a low solids/high solvent based adhesive. The adhesive may take the form of a silver ink (preferably matt). Transparent microparticles (which are preferably of glass and which are preferably microspheres) are scattered onto the adhesive so that they become bonded to the metallic film. The adhesive may then be dried and excess microparticles removed.

If desired, the reflective side of the material may be coated with a protective layer, utilising a self-cleaning sealing medium, this being dependent upon final application. The advantage of the film is that the reflective material may be considered to be self-cleaning in that (during outdoor use) any deposits of dirt on the material are easily washed off by rain.

This is a considerable advantage where the material is being used in a road safety application (eg. as a sleeve for a traffic cone) in that the material is kept clean and therefore reflective without the need for expensive maintenance and cleaning operations.

For a material which is to meet the minimum Class 2 reflectivity requirements and the minimum luminance requirements of BS 873: Part 6 for white light, it is preferred that the reflective film be "silvery" aluminium and that the adhesive be a silver ink. It is however within the scope of the invention for the reflective film (which may be a

metallic layer) and/or the adhesive to be of another colour for the case where the material is required to have special reflectivity requirements for that colour. It will be appreciated from the foregoing description that the material of the invention is comparatively easy to produce.

The invention will be further described by way of example only with reference to the accompanying drawings in which:

Fig 1 is a schematic cross-section to an enlarged scale showing one embodiment of light reflective material in accordance with the invention; and

Fig 2 is an enlarged view of Fig 1.

The reflective material 1 illustrated in Fig 1 comprises a base layer 2, a metallized film 3, and microspheres 4.

Base layer 2 is of a calendered, high impact PVC having a thickness of up to 300 microns, preferably 150 to 300 microns (the exact value in this range being dependent on the intended use of the material 1). The PVC will typically have a specific gravity of about 1.33. The base layer 2 has been pre-formed (ie prior to the manufacture of the material 1) with a fine embossing pattern of the rayon, poplin, satin or suede type so that there are a multitude of the surface depressions per square centimetre of the material.

The metallized film 3 is of aluminium and has been deposited by conventional techniques onto the base layer so that the embossed pattern thereof is substantially reproduced in the film 3. Typically the aluminium will be deposited in an amount of about 0.08 grammes per square metre onto the base layer 1 thus giving a coating thickness of about .003 microns.

The microspheres 4 are bonded to the metallic coating preferably by means of a layer of a silver printing ink 5 (preferably a matt ink). The microspheres 3 will typically be in the size range 50 to 150 microns. Furthermore, it is possible to use non-spherical glass microparticles instead of the microspheres 4.

As will be seen from Figs 1 and 2, the illustrated microspheres 4 each locate (or "sit") in a reflective cup with a portion of the microsphere 4 projecting above layer 1. The size of the microspheres 4 is so related to the embossing pattern that the projecting portions of adjacent microspheres 4 are in contact with each other or at least

are in close proximity to each other. It should however be noted that the structure illustrated in Fig.1 is somewhat idealised in that each depression in the embossing pattern is shown as receiving a microsphere. In practice a minor proportion of the depressions may not be so occupied. Furthermore a minor proportion of microspheres may "sit" on the layer of microspheres 4.

One method of producing the illustrated reflective material will now be described.

The exemplary process starts with a reel of base material which comprises the embossed PVC carrier sheet 2 on which has been deposited the metallized layer 3. The base material is unwound and is passed successively through the following sequence of operations.

- a) Application of adhesive, preferably a silver printing ink onto the exposed surface of the metallized layer 3. The purpose of the ink is to serve as a binding agent. The ink may be applied by a spray and the amount used is dependent on the requirements for the finished product.
- b) Glass microspheres are scattered in excess onto the ink layer (ie an amount of glass microspheres are used greater than that required for the final product). The microspheres may be applied by means of a scatter coating roller.
- c) The material is then passed through a curing or drying oven by means of a heat resistant belt, eg. Kevlar (Registered Trade Mark) belt so that the ink may be cured/dried. The heating medium used is preferably air drawn down onto the ink (preferably with fan assistance) although "infra-red" or "gas heated" systems could be used.
- d) Once the drying/curing of the ink has been achieved the excess microspheres are removed from the surface by means of a variable speed elliptical roller vibrating on the reverse surface of the material. Any beads shaken free are collected for recycling.
- e) The material is then passed through a second stage warm air drier to complete the drying process.

This completes preparation of the material as illustrated in Fig 1 which may now be cut into panel form or rolled dependent on final requirements.

A number of additions may be made to the described process. Thus, for example, after stage (e) it is possible to apply a polyurethane or acrylic coating or a vinyl acrylic VARNISH over the microspheres to provide self-cleaning sealing medium. Alternatively, or additionally an adhesive coating may be applied to the reverse (ie exposed) surface of the PVC layer if so required. Furthermore, provision may be made immediately after stage (e) for further microsphere removal as in stage (d). This will enable extra control on luminance and reflectivity/refractivity as necessary.

Although reference has been made to spraying the adhesive onto the base material, other application methods can be used, eg screen printing.

To illustrate the reflective properties of a typical material shown in Fig 1, reference is made to Table 1 below. The material tested comprised a flexible PVC carrier sheet with a suede emboss on which was deposited a metallized aluminium layer. The microspheres were size 16s which have a size range of 74-105 microns.

Additionally the material had a luminance factor of 0.29 (for white light) which is to be compared with the minimum value of 0.25 as specified by BS 873: Part 6.

It can thus be readily seen that the material of the invention comfortably meets the reflectivity and luminance factor minima (for white light) specified in BS 873:Part 6.

Table 1

Entrance Angle	Observation Angle	Min Coefficient of Retroreflection ¹	Material of Fig 1
5	12'	70	144.5
	20'	50	93.4
	1.0°	5	22.6
15	12'	55	118.7
	20'	45	76.3
	1.0°	3	18.6
40	12'	15	39.1
	20'	10	24.4
	1.0°	1.5	7

¹As specified by BS 873 Class 2 for white light.

CLAIMS

- 1 A reflective material comprising a carrier sheet with a finely embossed surface, a thin reflective layer deposited on said surface and of a thickness such that the exposed surface of the film follows the contours of the embossing, and transparent microparticles received within the recesses of the reflective film and bonded thereto.
- 2 A material as claimed in claim 1 wherein the carrier sheet is flexible.
- 3 A material as claimed in claim 1 of 2 wherein the carrier sheet is of a plastics material.
- 4 A material as claimed in only one of claims 1 to 3 wherein the carrier sheet has a thickness of 150 to 300 microns.
- 5 A material as claimed in only one of claims 1 to 4 where the carrier sheet is of PVC.
- 6 A material as claimed in claim 5 wherein the carrier sheet is of a high impact PVC.
- 7 A material as claimed in claim 5 or 6, wherein the carrier sheet is calendered.
- 8 A material as claimed in any one of claims 1 to 7 wherein the size of the embossed pattern is such that a surface depression of the pattern receives a single microparticle which projects partly from the depression and projecting portions of microparticles in adjacent surface depressions are in contact with, or close proximity to each other.
- 9 A material as claimed in any of the claims 1 to 8 wherein the embossing of the carrier sheet is a rayon, satin, poplin, or suede embossing.

- 10 A material as claimed in any one of claims 1 to 7 wherein the reflective film is a metallic film.
- 11 A material as claimed in claim 10 wherein the metallic film is aluminium.
- 12 A material as claimed in any one of claims 1 to 11 wherein the transparent microparticles are microspheres.
- 13 A material as claimed in any one of claims 1 to 12 wherein the microparticles have a size of 50 to 150 microns.
- 14 A material as claimed in any one of claims 1 to 13 provided with a self-cleaning sealing medium over the microparticles.
- 15 A method of producing a reflective material comprising providing a base material which itself comprises a carrier sheet with a finely embossed surface having deposited thereon a thin reflective film of a thickness such that the exposed surface of the film follows the contours of the embossing, and bonding transparent microparticles to said exposed surface of the film such that the microparticles are received within the recesses of the film.

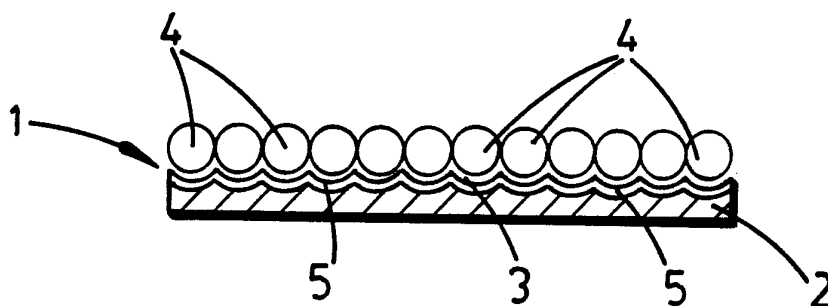


FIG. 1

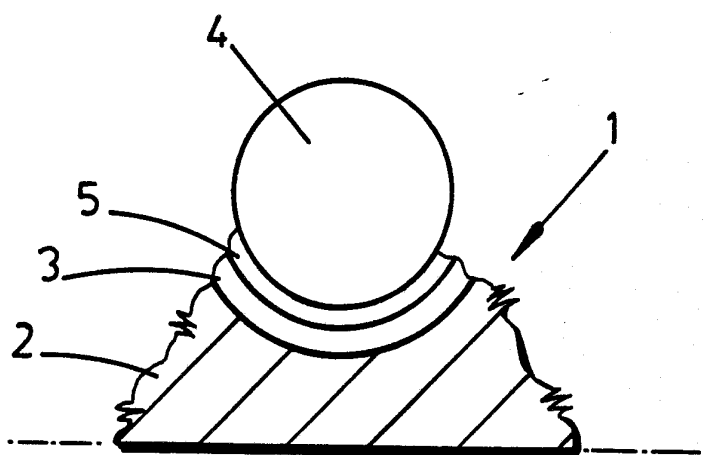


FIG. 2

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 90/01690

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC ⁵ : G 02 B 5/128, B 29 D 11/00, E 01 F 9/04, B 29 C 37/00		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC ⁵	G 02 B, B 29 D, B 29 C, E 01 F	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
Y	US, A, 3989775 (JACK) 2 November 1976 see column 1, lines 13-21, 44-59; column 2, lines 10-48, 59-68; column 3, lines 1-12, 25-51; column 5, lines 45-68; column 6, lines 34-68; column 7, lines 1-41; figure 7	1
A	---	2, 3, 5, 10-15
Y	EP, A, 0227448 (MINNESOTA MINING) 1 July 1987 see column 4, lines 1-65; column 5, lines 1-63; figures 1-5 cited in the application	1
A	---	2, 3, 5, 10-15
	./.	
¹⁰ 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 "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 "Z" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
15th January 1991	11. 02. 91	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	M. PEIS <i>M. Peis</i>	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages	Relevant to Claim No.
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A	US, A, 4332847 (ROWLAND) 1 June 1982 see abstract; column 1, lines 13-53; column 6, lines 51-58; figures 1,9 ---	1,7,15
A	FR, A, 2572023 (ARIB) 25 April 1986 see page 6, lines 4-30; page 7, lines 1-30; page 8, lines 1-28; figures 1A - 1F ---	1,15
A	DE, A, 2929313 (MINNESOTA MINING) 31 January 1980 see page 122, lines 19-36; page 123, lines 1-3; figure 4A ---	1-3,15
A	Patent Abstracts of Japan, volume 10, no. 22, (P-424)(2079), 28 January 1986 & JP, A, 60175004 (IDE KOGYO K.K.), 9 September 1985 see abstract; figure ---	1,2,3,7,8,10,12
A	US, A, 4388359 (ETHEN et al.) 14 June 1983 see column 2, lines 37-68; column 3, lines 1-30; figure -----	1-3,12,13

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

GB 9001690

SA 41576

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 05/02/91. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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		CA-A- 1203103	15-04-86

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		JP-A- 58208041	03-12-83
