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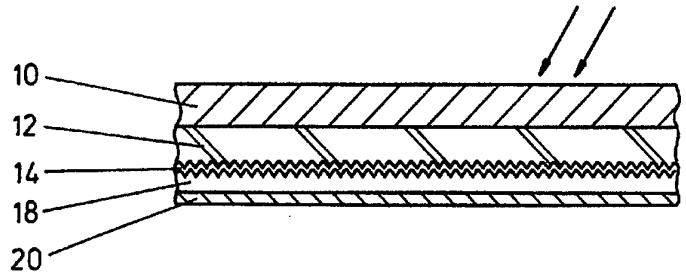

(57) Abstract

A surface relief structure comprises a substrate (12) having a surface formed with an optically variable relief pattern, and covered with a protective layer (18). The materials of the protective layer (18) and substrate (12) are soluble in the same solvents, so that the protective layer (18) cannot be dissolved without attacking the surface relief pattern of the substrate (12): the surface relief pattern is therefore protected against copying by taking a mould copy from it.

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PROTECTED RELIEF PATTERNS

This invention relates to structures having a surface relief pattern, particularly an optically variable relief pattern, for example diffraction gratings and surface relief holograms.

Optically variable devices (OVD's), having micro-fringe surface relief patterns (for example embossed or moulded holograms), are increasingly being used as security devices to authenticate documents and other items of value, and to inhibit counterfeiting. There are numerous methods by which masters for optical variable devices can be originated, and many of these methods have been documented and published: in all instances the surface of the master is formed with a micro-relief pattern of fringes. In order to mass replicate optically variable devices from this original master, the surface which carries the micro-relief pattern is rendered electrically conductive and a metal coating of nickel, for example, is formed over the surface by electrodeposition from a solution of nickel sulphamate. The nickel deposition, when of a sufficient thickness, is peeled from the surface of the master and carries a negative of the micro-relief pattern. The nickel member, commonly called a shim, is of robust structure and is then used either to mould or press the micro-relief pattern into blank substrates, to replicate the originally recorded OVD. In the embossing process, the shim is applied under heat and pressure to the surface of a thermoplastics substrate: this surface is metallised either before or after embossing, providing a degree of reflectivity to enable the e.g. hologram to be viewed under normal light conditions. There are many thermoplastics which will accept such embossing, including acrylic resins, polyurethane resins, and CAB. In the moulding process, resins mixed with a photoinitiator are used, and are cross-linked after the moulding by exposure to ultraviolet light: metallisation is applied to the micro-relief surface after the moulding, for example by sputtering, vacuum deposition or electron beam deposition.

When used as security devices, micro-relief OVD'S are

themselves subject to attempts to replicate them as counterfeits. One method which is used is to physically copy the surface relief pattern, by making a mould copy of the genuine OVD. Hitherto, the OVD has been adhered to a document or other article to be authenticated, by a layer of adhesive (for example a contact adhesive or a hot melt adhesive) applied over the micro-relief surface. However, it is possible by use of certain solvents to remove the adhesive layer without interfering with the underlying relief structure: once the adhesive layer has been removed and the micro-relief surface is exposed, the relief pattern can be copied.

This invention provides surface relief structures for which the above-described problems are alleviated.

In accordance with this invention, there is provided a surface relief structure which comprises a substrate having a surface formed with an optically variable relief pattern, and a protective layer covering said surface, in which the material comprising the substrate and the material comprising the protective layer are each independently soluble in the same solvent, and/or in which the material comprising the protective layer changes physical phase at a temperature not substantially less than that of the material comprising the substrate.

Thus, any chemicals that might be used to remove the protective layer will also attack the underlying substrate in which the relief pattern is formed, thus destroying the relief pattern. In addition or alternatively, any attempt to melt or evaporate the protective layer will also at least partially melt or evaporate the underlying substrate, again destroying the relief pattern.

Generally the resin substrate, in which the surface relief pattern is formed, is soluble in water or in solvents such as MEK, toluene, ethylacetate, isopropylalcohol, etc. The protective layer is preferably of substantially the same resin, or of a resin having similar solubility characteristics as the substrate resin.

Once the substrate is embossed or moulded, its surface is metallised or coated with a high refractive index layer, before the protective layer is applied. The metallised or high refractive index layer is porous, so that any solvent which is

effective on the protective layer permeates through the substrate and attacks its surface relief pattern. This effect is enhanced if the metallised or high refractive index layer is partially removed, for example in dots, to leave perhaps a 27% cover and a 63% exposure of the substrate.

Typically the substrate, which is formed with the surface relief pattern, comprises a layer applied to a carrier.

Also, in accordance with the invention there is provided a method of producing a surface relief structure, which comprises providing a substrate with an optically variable relief pattern, and applying a protective covering layer to said relief pattern, the material comprising the substrate and the material comprising the protective layer being each independently soluble in the same solvent and/or the material comprising the protective layer changes physical phase at a temperature not substantially less than that of the material comprising the relief pattern.

Typically the protective layer is applied in fluid form and is then converted rapidly to a continuous solid layer by the application of heat, such that the relief pattern remains substantially unchanged.

Embodiments of this invention will now be described by way of examples only and with reference to the accompanying drawings, in which:

FIGURE 1 is an enlarged cross-section through a base material prior to embossing;

FIGURE 2 is a similar cross-section through the material after embossing;

FIGURE 3 is a similar cross-section through the material after the application of a protective layer over the embossed surface; and

FIGURE 4 is a similar cross-section through a hot stamp foil in accordance with this invention.

Referring to Figure 1, there is shown a material prior to embossing, comprising a carrier film 10 for example of PET, OPP, PVC etc., having a layer of thermoplastic resin 12 on one surface, which in turn has a thin coating 14 of a material of high refractive index relative to the resin 12: coating 14 may instead be applied after embossing. Figure 2 shows the

material after formation of the micro-relief pattern 16 in its outer surface. Figure 3 shows the material after application of a protective coating 18, of essentially the same resin as the embossed resin layer 12, and an adhesive coating 20 to enable the device to be adhered to a document or other article to be authenticated.

Figure 4 shows an embodiment of foil for hot stamping uses. In this, a release layer 11 is provided between the carrier film 10 and the resin layer 12, so that the carrier film 10 can be removed as the structure is secured, by means of its adhesive coating 20, to the document or other article to be authenticated.

It will be appreciated that in Figures 1 to 4, the resin substrate 12 is transparent: in Figures 1 to 3 the carrier film is also transparent. The coating 14 typically comprises aluminium but may comprise other metals, and is typically applied by sputtering, vacuum deposition or electron beam deposition to a thickness of several molecules only. The coating 14 may comprise a rare earth oxide (e.g. titanium oxide) instead of metal. The coating 14 provides a degree of reflectivity so that the hologram or other image is visible through the carrier film 10 and substrate 12.

Preferably after the coating 14 is applied, it is partially removed by firstly covering discrete areas with a resin and then etching away the exposed areas of the coating 14 e.g. with caustic soda, before then the protective layer 18 is applied.

The protective layer 18 and the substrate 12 are chosen of the same base materials, or of materials soluble in the same solvents. Accordingly, any solvent used to dissolve the protective layer 18 will also attack the substrate 12 and so destroy its relief pattern.

The substrate 12 may comprise a water-based or solvent-based lacquer or coating formulation: after this has been applied to the carrier 10 and cured, the surface relief pattern 16 is formed by embossing (before or after application of the high refractive index coating 14). The protective layer 18 is then applied: this also preferably comprises a water-based or solvent-based lacquer or coating formulation which is then

subjected to high temperatures to dry it or drive off the solvents, before these have time to attack the substrate 12.

The surface relief pattern 16 may be any form of optically variable relief pattern, i.e. providing a different image or appearance when viewed (through the substrate) from different angles. For example the relief pattern may comprise a micro-fringe relief pattern or an interference relief pattern (particularly a diffraction grating pattern such as a hologram).

CLAIMS

1) A surface relief structure which comprises a substrate having a surface formed with an optically variable relief pattern, and a protective layer covering said surface, in which the material comprising the substrate and the material comprising the protective layer are each independently soluble in the same solvent, and/or in which the material comprising the protective layer changes physical phase at a temperature not substantially less than that of the material comprising the substrate.

2) A surface relief structure according to claim 1, wherein the protective layer comprises an aqueous based coating formulation.

3) A surface relief structure according to claim 1, wherein the protective layer comprises a solvent based coating formulation.

4) A surface relief structure according to claim 2 or 3, wherein said coating formulation comprises a base polymer, and the material comprising the substrate comprises substantially the same base polymer.

5) A surface relief structure according to any of claims 1 to 4, wherein the substrate is in the form of a coating applied to a carrier.

6) A surface relief structure according to claim 5, wherein said carrier comprises a film or sheet of plastics.

7) A surface relief structure according to any of claims 1 to 6, which includes an intermediate layer interposed between said relief pattern and said protective layer, said intermediate layer having a higher refractive index than that of the substrate.

8) A surface relief structure according to claim 7, wherein the intermediate layer comprises a metal.

9) A surface relief structure according to claim 7 or 8, wherein said intermediate layer is porous.

10) A surface relief structure according to claim 9, wherein said intermediate layer is foraminous.

11) A surface relief structure as claimed in any preceding claim, in which said substrate is transparent.

12) A surface relief structure as claimed in any preceding claim, further comprising an adhesive coating applied to said protective layer.

13) A surface relief structure as claimed in any preceding claim, in which said relief pattern comprises a micro-fringe relief pattern.

14) A surface relief structure as claimed in any one of claims 1 to 13, in which said relief pattern comprises an optical interference relief pattern.

15) A surface relief structure as claimed in claim 14, in which said relief pattern comprises a diffraction grating pattern.

16) A surface relief structure as claimed in claim 15, in which said relief pattern comprises a hologram.

17) A method of producing a surface relief structure, which comprises providing a substrate with an optically variable relief pattern, and applying a protective covering layer to said relief pattern, the material comprising the substrate and the material comprising the protective layer being each independently soluble in the same solvent and/or the material comprising the protective layer changes physical phase at a

temperature not substantially less than that of the material comprising the relief pattern.

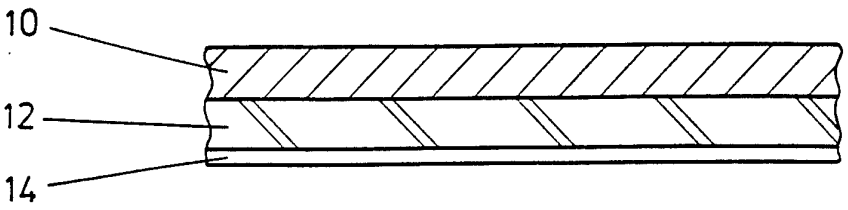

FIG. 1

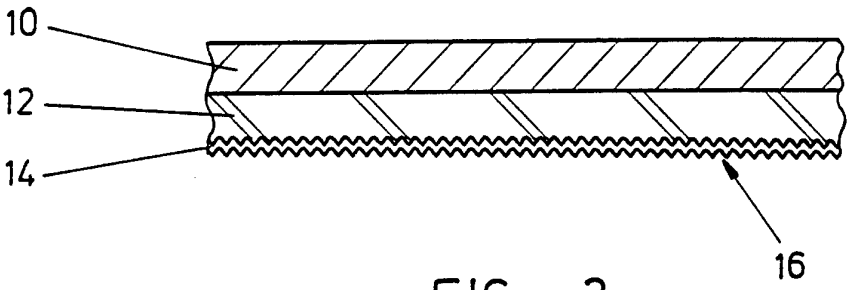

FIG. 2

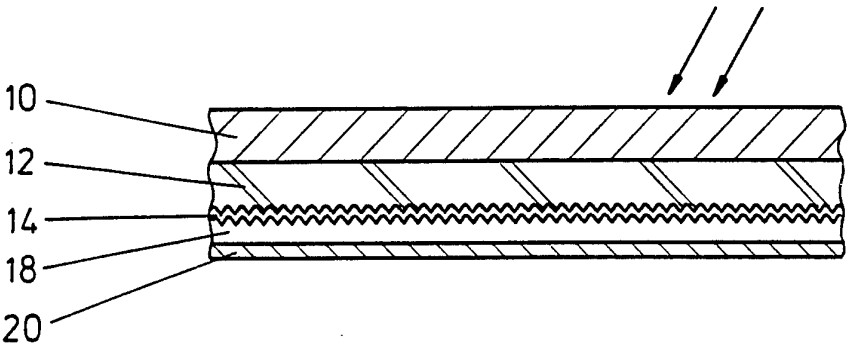

FIG. 3

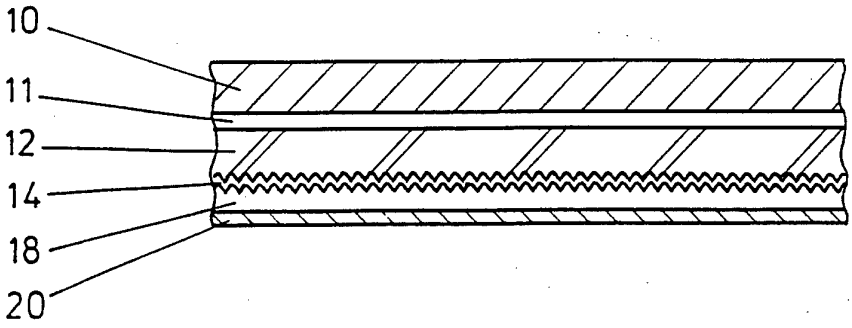

FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 95/00804

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G03H1/02 G06K19/16 B41M7/02 B41M3/14 B42D15/10

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 G03H B42D G06K B41M

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

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9 August 1995	17. 08. 95

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

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