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ILLUMINATION PANELIntroduction

This invention relates to an illumination panel and, in particular, a panel for use in building and display applications including illuminated signage.

Background of the Invention

Illuminated signage, advertising and display boards are in popular use across the world. These signs usually incorporate discrete lighting which has the effect of illuminating the whole of the sign. There has been a number of past suggestions for using translucent plastics with edge lighting whereby the light is released by a matrix of dots to fully and evenly illuminate the entire surface area of the sign. Well known arrangements of this type of sign utilise an acrylic panel that has printed thereon a graded matrix of ink dots on one or both faces of the panel. The dots of ink affect the refractive and reflective nature of the acrylic and allow light introduced along an edge of the panel to be released across the whole surface area of the panel. When the dots are carried on both sides, the light reflects and refracts more effectively through both surfaces. In one option, a reflective film or sheet is placed on one side causing the light released on that side to be reflected back through the panel so the majority of light leaves the panel only through one ("front") surface. The same process of controlled, even light release can be achieved by laser etching the surface of an acrylic panel.

A problem with lighting systems of the kind described above is that the acrylic panel which carries the matrix of printed dots or laser etching has to be handled very carefully. If the panel becomes scratched or subjected to moisture, light escapes as bright spots thereby upsetting

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the even light distribution across the surface of the panel.

The vulnerability of the surfaces of the acrylic panel
5 reduces the effective use of such panels and it is
consideration of the problems associated with these
structures that has brought about the present invention.

Summary of the Invention

10 According to one aspect of the present invention there is
provided an illumination panel comprising a transparent
core having opposing surfaces, a matrix of dots
substantially covering one surface, and a protective panel
in abutting contact with said surface whereby the dots act
15 as an adhesive bonding the core to the protective panel.

In a preferred embodiment, both surfaces of the core are
provided with a matrix of dots that act as adhesive to
bond both surfaces to protective panels. The matrix of
20 dots may be applied to the transparent core by etching,
painting, screen printing, printing or spraying or any one
of a number of application techniques such as transfer
from a film or even as part of a film or panel that then
becomes the protective layer. Alternatively, the array of
25 dots may be provided by laser etching the surface of the
panel to define the array of dots.

Preferably, the core is acrylic and the protective panel
may be any suitable material that will bond to the core
30 via the medium of the dots. In one embodiment, a
reflective protective panel is attached to one side of the
core with a transparent or translucent protective cover
being bonded to the other side.

35 In accordance with a still further aspect of the present
invention there is provided a method of producing an
illumination panel comprising placing a protective panel

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in abutting parallel contact with a transparent core and laser etching an array of dots through the protective panel onto the surface of the core which at the same time adheres the panel to the core.

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The dots described above can be of any size or shape and are, for example, square, round, linear, rectangular, triangular, doughnut, or any other shape, even an irregular shape. The dots may be clear, translucent or
10 opaque and, more preferably, light coloured, for example, white.

Description of the Drawings

Embodiments of the present invention will now be described
15 by way of example only with reference to the accompanying drawings in which:

Figure 1 is a schematic cross sectional view of a single sided illumination panel;
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Figure 2 is a schematic cross sectional view of a double sided illumination panel;

Figure 3 is a perspective view of part of a process line
25 for manufacturing the panel of Figure 1;

Figure 4 is a perspective view of the end of the process line;

30 Figure 5 is a perspective view of a kitchen cabinet incorporating illumination panels of Figures 1 or 2;

Figure 6 is a perspective view of an illumination panel of Figures 1 or 2 attached to a structural panel
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Figure 7 is a perspective view of the interior of a refrigerator lined with panels of the kind illustrated in Figures 1 or 2;

- 5 Figure 8 is a perspective view of a retail display cabinet using illuminated walls, back panel and shelving incorporating panels shown in Figures 1 or 2;

- Figure 9 is a perspective view of a street sign
10 incorporating a panel of Figures 1 or 2; and

Figure 10 is a perspective view of a solar powered panel for use with a light diffusing panel of Figures 1 or 2.

15 Description of the Preferred Embodiments

An illumination panel essentially comprises a transparent sheet of clear acrylic plastics with at least one surface covered with a matrix of spaced light refracting and reflecting dots. When light is introduced to the
20 appropriate edges of the panel it is refracted and reflected by the dots to illuminate the whole surface of the panel. Patent Application No. WO92/05535 is an example of this kind of illumination panel.

- 25 As shown in Figures 1 and 2, an illumination panel 10 in accordance with the embodiments of this invention is shown in both a double sided (Figure 2) configuration and a single sided (Figure 1) configuration.

- 30 Each illumination panel 10 comprises a core 11 of transparent acrylic which is usually 6mm, 8mm or 10mm in thickness. The core may include an optical brightener. The core 11 can have any surface sectional area and, although shown planar in Figures 1 and 2, could be
35 appropriately curved. The acrylic core 11 has opposed surfaces 12 and 13, each of which is covered by a matrix of opaque, translucent or clear glue dots 20. The matrix

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of glue dots 20 acts as an adhesive to secure a protective panel 25, 26 to one or both sides of the core 11.

If required, a layer 30, 31 can be added to the outer side
5 of the protective panels 25, 26. It is understood that the layer 30, 31 may be any material such as glass, timber, metal, paint, ink, photographic film or veneer which could be attached to the protective panel 25, 26 for various purposes, for example painting or veneering a
10 surface to match the surroundings, or printing signs and images. The surfaces of the protective panels 25, 26 may also be left untreated, simply allowing the light to release for general illumination.

15 In a simpler configuration shown in Figure 1, the core 11 has the matrix of glue dots 20 only on one side 12 and a single protective panel 25 is attached to that side. The important feature of this embodiment is that the matrix of glue dots 20 acts as a light transmitting, refracting and
20 reflecting medium as well as an adhesive, firmly securing the protective panel 25 to the core 11 and protecting the core and dot matrix from damage, for example, by scratching or moisture while also providing a light transmitting surface that can be used without affecting
25 light distribution from the core. The glue is of a light reflecting, refracting or transmitting material and it is understood that there are a large variety of different glues which are suitable.

30 The matrix of adhesive dots may be applied in many different ways including by etching, painting, printing, screen printing or spraying or transferred from a film or even as part of a film or layer that is then fixed to the core by the adhesive dots. Alternatively, a laser can be
35 used to etch the surface of the core 11 through the protective panel 25 to define the array of dots whilst, at the same time, bonding the protective layer to the core.

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The process might also be achieved by laying an appropriate film between the core and protective layer and under laser activation, have the film bond to both surfaces in an array of light transmitting dots.

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One method of producing the panel shown in Figure 1 is illustrated in Figures 3 and 4. In this embodiment, the core of acrylic plastics 11 is passed along a roller conveyor 100 in the direction of the arrows shown in
10 Figures 3 and 4. An adhesive dispenser 101 is arranged to complete a reciprocal movement along a rod 102 transversely across the conveyor 100. The rod 102 is held by fixed rectangular supports 103, 104. The dispenser 101 places a line of spaced dots of adhesive transversely
15 across one surface of the core and, as the core moves forward, the rows of dots are spaced as shown in Figure 3. Downstream of the dispenser 101 is a UV light 105 which fully or partially cures the adhesive depending on type or process. A protective panel 25 is placed on top of the
20 glued surface and is then consolidated thereon through a pressing roller 110 that rotates to exert downward pressure on the panel 25 to bring the cover panel 25 into abutting contact with the dots on the core 11. It is understood that this process may also be achieved by the
25 adhesive being applied to the protective panel which is then bonded to the cores. In another method, the adhesive may be printed to the core or protective panel and the two components then pressed together and the adhesive cured by light.

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The dot matrix substantially covers the surface of the core 11 and operates to control the release of light introduced along one or more sides of the panel 10. It is usual for the density or size of dots, or both to increase
35 along the panel 10 in a direction away from the edge where the light is introduced for a single light source, and when light is introduced from opposite sides of the core

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panel, the density or size of dots or both increases to a point equal distance from both light sources. To achieve an even light distribution across the core panel, the density of dots can be increased or alternatively, the gaps between the dots can remain constant and the size of the dots increased, or both the density and size of the dots increased.

The dots may comprise a grid work of lines or even concentric circles of differing diameters. The adhesive dots may be any one of a number of adhesive materials including various formulations of UV curing inks and adhesives, and adhesive of clear or white silicon.

Both panels 10 described above are in themselves structural units and thus can be supported or used as wall panels, shelves or in a wide variety of structural environments. The panels do not have to be enclosed within a supporting frame and can, by themselves, operate as structural elements. In one embodiment, it is envisaged that at least one edge of the panel would have LEDs embedded therein which would operate on low voltage to define a highly illuminated structural element. The LEDs could also be simply attached to one or more edges of the panel by a metal or plastic extrusion, or clips. The advantage of embedding LED lighting into the panel means that, as a structural unit, it is complete. Since LEDs have a long lifespan the panels could be left illuminated for very lengthy periods operating on a low safe voltage without the need of maintenance. The light delivered could be white or any number of different colours available from LED lighting elements.

In another embodiment, the protective panel 25 could be either light transmitting or a reflective panel. The protective panel could be a suitable material such as plastics, glass, laminex, metal or timber. The surface of

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the panel 25 that is to be bonded to the core could be painted or treated to define a reflective surface when the panel operates as a reflector. For example, a white polystyrene or polyethylene panel may be bonded directly to the core 11 with the surface of the plastics reflecting the light released from the core by the glue dots. The opposite side of the core could be left untouched and the assembly may be placed behind, under or above a glass sheet without being attached. This arrangement could be used for a kitchen splashback or a glass shelf. Alternatively, the opposite side of the core could have an opal translucent panel bonded by a matrix of adhesive dots, and used as a single sided sign.

15 In a further example, a laminex veneer may be bonded directly to the core 11 with the inside (or bonding) surface of the veneer having been painted white to reflect light. The veneer then provides the finished external surface while the internal face of the veneer acts to reflect light back through the core and out the opposite surface. This front light releasing surface of the core can be protected by a clear or opal translucent material that is attached by another light releasing matrix of glue dots. This could be the case when the illumination panel is used as the walls and/or base of a cupboard, or a retail display, see Figures 5 and 8.

A rectangular kitchen cupboard 50 is shown in Figures 5 and 6, comprising hinged doors 51, 52, a top 53, sides 54, 55, base 56 and rear panel 57. The rear panel 57, top 53 and doors 51, 52 are manufactured of conventional joinery such as laminex, plywood, timber, chip board etc. The base 56 and sides panels 54, 55 are constructed of illuminated panels 10 shown in greater detail in Figure 6. In Figure 5, the cupboard is mounted against a wall 60 above a bench surface 61. Since the side panels and base panels are illuminated panels, light is passed into the

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interior of the cupboard by the side panels and down onto the bench surface 61 by the base panel 56.

As shown in Figure 6, each panel 10 comprises an acrylic
5 core 11 with a matrix of dots 20 on either side. The
matrix of glue dots secures a reflective cover 25 on one
side and a translucent layer 26 on the other side. The
edge of the panel has attached thereto an elongated light
strip 65 and the light strip, together with the panel, is
10 located within a rectangular aluminium extrusion 70. The
extrusion 70 has an upstanding web 77 which is keyed into
a slot 72 in the panel 57 which constitutes the timber,
veneer or laminex structural rear panel 57 of the cabinet
50. The side panels may transmit light either internally
15 into the cabinet or on both sides and the base panel is
designed primarily to transmit light to the underside. A
single or dual light source is located along the rear and
or front edges and a reflective covering is placed on the
top side. Where the light travels in both directions it
20 is understood that translucent panels would be used on
both sides.

In Figure 7, there is an illustration of an embodiment
where illuminated panels 10 are incorporated as the walls
25 of a refrigerator 40. The panels have at least one edge
lined with LEDs. The core 11 is bonded to a reflecting
panel or the wall of the refrigerator so that each side
wall 41, 42 and rear panel 43 constitutes a light source.
A translucent acrylic panel is bonded to the core to
30 provide the hard wearing exterior surface within the
interior of the refrigerator. A door operated switch (not
shown) can be used to control operation of the lights. In
both embodiments shown in Figures 5 to 7, it is understood
that the shelves could incorporate illumination panels of
35 the kind described above.

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In Figure 8, there is an illustration of a retail display 65 in which the side walls 66, 67, back panel 68 or shelving 69 could be manufactured of illuminating panels 10 of the kind described above. As described in earlier
5 embodiments, a line of LEDs is secured along the edges of the side walls and rear wall and along one or more edges of the shelves and the core is covered on both sides by acrylic or glass panels to provide hard wearing surfaces that can be used as shelving in retail displays, or carry
10 images and branding information.

In Figure 9, there is an illustration of a street sign 80 comprising an elongate rectangular panel 10 incorporating a core 11 and front and rear translucent acrylic faces 25,
15 26. The longitudinal and side edges of the panel are sealed and LED elements 81 are positioned along the inner edge. The whole assembly is housed in an aluminium extrusion 82 which forms a housing which in turn contains a battery or transformer to power it as an illuminated
20 street sign. The printing can be carried on either acrylic face.

In the embodiment shown in Figure 10, a solar panel 90 incorporates an illuminated panel 10 of the kind described
25 above whereby solar panels in the form of photo voltaic cells with a reflective under surface are bonded to the exterior of the panel 10 on the top surface and they are coupled to either battery storage or battery packs which in turn power LEDs 92 positioned down the side edges of
30 the panel. The edges of the panel can be protected with an acrylic or metal edging strip 94, 95 and, in this manner, the panel absorbs the sun during the day which can be stored as electricity in a battery pack ensuring that the panel is illuminated at night. In this panel, a
35 translucent diffuser is bonded to the core 11 to define the underside of the panel and the upper side of the panel

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has a reflective surface that is part of or which supports the solar panels 91.

In another embodiment, the core could comprise a series of thin panels each with appropriate positioning of adhesive dots which are in alignment or offset from the adhesive dots on the adjacent panel. In this way a laminated structure is produced with an added dimension of dot matrix refinement; in the direction horizontally away from the light source the dots may get bigger on each layer and then vertically in the direction of the light being released the dots may get proportionally smaller. Seen from the light releasing face, the dots may appear to cover the surface, but in fact they may be positioned on each layer in different positions.

In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

CLAIMS :

- 1 An illumination panel comprising a transparent structural core having two
opposing surfaces, a matrix of light releasing and distributing dots substantially
5 covering both said opposing surfaces, and a protective layer in abutting contact
with at least one of said opposing surfaces whereby the dots are an adhesive for
bonding the core to the protective layer and wherein the density and/or size of the
dots increases across the panel in a direction away from a panel edge adjacent a
light emitting element.
- 10 2 The illumination panel according to claim 1, wherein both surfaces of the
core are provided with a matrix of dots that is an adhesive to bond both surfaces
to protective layers.
- 15 3 The illumination panel according to claim 1, wherein an outer layer is
bonded to the protective layer.
- 20 4 The illumination panel according to claim 3, wherein the outer layer is
paint, ink, a transfer, metal, glass, plastics, wood or wood veneer.
- 25 5 An illumination panel according to claim 1, wherein the transparent
structural core is acrylic.
- 6 6 The illumination panel according to claim 1, wherein the protective layer is
metal, timber, plastics or glass and can be translucent or reflective.
- 30 7 The illumination panel according to claim 1, wherein the matrix of dots is
applied to the transparent structural core by etching, painting, screen printing,
printing or spraying, or transferred from or as part of a film.
- 8 8 The illumination panel according to claim 1, wherein the matrix of dots is
provided by laser etching the surface of the core through the protection layer.

- 9 The illumination panel according to claim 1, wherein the matrix of dots is provided by induction, dielectric or microwave activation of a distributed receptor that bonds the surface of the core to the protective layer.
- 5 10 A method of manufacturing the illumination panel according to claim 1, including the step of curing the matrix of dots by UV light or infra-red heating or laser activation to bond the surface of the core to the protective layer.
- 11 The illumination panel according to claim 1, wherein a reflective protective
10 panel is bonded to one side of the core with a transparent or translucent protective layer being bonded to the other side.
- 12 An illumination panel according claim 1, wherein a light is positioned adjacent or on at least one an edge of the panel.
- 15 13 The illumination panel according to claim 12, wherein the lights comprise a plurality of LEDs secured to or imbedded in one or more edges of the panel.
- 14 A cabinet having walls and shelves, some of the walls or shelves
20 comprising illumination panels according to claim 1 with a light source adjacent or in one edge of each panel.
- 15 A road sign comprising a housing having a mounting flange adapted to be
25 secured to one edge of an illumination panel according to claim 12, the light being wired to the interior of the housing.
- 16 A method of producing an illumination panel according to claim 1, the method comprising the step of placing a protective layer in abutting parallel contact with a transparent structural core and laser etching or activating a matrix
30 of light releasing dots through the protective layer onto the surface of the core to adhere the layer to the core and providing light distribution across the transparent structural core.

- 17 An illuminated solar panel comprising a transparent structural core having opposing surfaces, a matrix of dots substantially covering both said opposing surfaces and a protective layer of reflective material in abutting contact with an upper surface, said protective layer carrying a plurality of solar cells whereby the
- 5 solar cells generate electricity that is passed to a battery pack or accumulator and power from the battery pack or accumulator is fed back to a light source positioned along at least one edge of the panel to allow light to be introduced and distributed by the matrix of dots and released through a diffuser on a lower surface of the panel.
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- 18 An illumination panel according to claim 12 wherein the light releasing dots increase along the panel in density, size or combinations thereof across the panel in a direction away from the light source.
- 15 19 An illumination panel comprising a transparent structural core having two opposing surfaces, a matrix of light releasing dots substantially covering at least one of the opposing surfaces, and a protective layer in abutting contact with the at least one opposing surfaces whereby the dots are a pressure sensitive adhesive for bonding the core to the protective layer.
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- 20 The illumination panel according to claim 1, wherein a transparent or translucent protective panel is bonded to both sides of the core.