Claims

[Claim 1] A method of embossing individually light-reflecting areas on a foil material, the method comprising

feeding a foil material into a roller nip between a pair of rollers, wherein the pair of rollers comprises a first roller and a second roller,

providing each of the first roller and second roller at their respective surfaces at least in a determined perimeter, respectively with a plurality of polyhedron-shaped positive projections and a plurality of negative projections complementary to the positive projections, wherein the determined perimeter comprises at least one positive projection,

whereby the plurality of positive projections are arranged according to a 2-dimensional grid,

whereby each one of the plurality of positive projections extends over an individual height from a base side of the positive projection at the surface of the first roller to a top side of the positive projection in a direction away from a rotation axis of the first roller, and each negative projection extends from the surface of the second roller to a bottom side of the negative projection in a direction towards the rotation axis of the second roller;

the method being characterized in that

the plurality of polyhedron-shaped positive projections seamlessly and gaplessly join with those corresponding negative projections at the intended embossing of the foil material, hence enabling a homogeneously jointed embossed polyhedron-like shape in the foil,

and in that it comprises, for the purpose of
- providing a plurality of light-reflecting areas on the foil material, that are intended to reflect light in line with a table of reflectivity values for the 2-dimensional grid, according to an orientation and shape of each of the plurality of light-reflecting areas, and
- enabling a perception by the human eye of a user, of the intended reflected light on a determined wide viewing angle covered by reflected light from any of the light-reflecting areas,

a step of adjusting for each of the plurality of light-reflecting areas to be provided, an orientation and shape of the corresponding positive projection in the 2-dimensional grid, that is intended to emboss the light-reflecting area.

[Claim 2] The method of claim 1, the step of adjusting comprising at least

designing each one of the plurality of the positive projections of the 2-dimensional grid, by departing from a determined base shape which has a base surface delimited by a base perimeter intended to be positioned on the surface of the first roller and a 3-dimensional shape described by a 3-dimensional shape-contour function, by applying either one operation of the following list:

- obtain the designed positive projection by leaving the determined base shape unchanged;

- cutting off a top of the determined base shape along an individual intersection of the determined base shape with an individual shape to obtain an individual form of the top side of the determined base shape, that is used to emboss a light-reflective area intended to have a reflectivity according to the table of reflectivity values for the 2-dimensional grid, the remaining part of the determined base shape being the designed positive projection to be

positioned at the surface of the first roller.

[Claim 3] The method of claim 1, the step of adjusting comprising at least

designing each one of the plurality of the positive projections of the 2-dimensional grid, by departing from a determined base shape which has a base surface delimited by a base perimeter intended to be positioned on the surface of the first roller and a 3-dimensional shape described by a 3-dimensional shape-contour function, by applying either one operation of the following list:

- obtain the designed positive projection by leaving the determined base shape unchanged;

- applying an individual 3-dimensional gain-factor function to the determined base shape to obtain the designed positive projection, that is used to emboss a light-reflective area intended to have a reflectivity according to the table of reflectivity values for the 2-dimensional grid, the individual 3-dimensional gain-factor function being configured to be applied to the 3-dimensional shape-contour function such that the designed positive projection has the same base perimeter as the determined base shape, the designed positive projection has no part that overlaps beyond the base perimeter, and any point in the contour of the designed positive projection is free from overlap with another point of the contour maintaining a base surface of the determined base shape intended to be positioned at the surface of the first roller and, resulting in an overall deformation of the determined base shape in proportion to the individual gain factor.

[Claim 4] The method of claim 1, the step of adjusting comprising at least

designing each one of the plurality of the positive projections of the 2-dimensional grid, by departing from a determined base shape which has a

base surface delimited by a base perimeter intended to be positioned on the surface of the first roller and a 3-dimensional shape described by a 3-dimensional shape-contour function, by applying either one operation of the following list:

- obtain the designed positive projection by leaving the determined base shape unchanged;

- applying an individual 3-dimensional offset function to the determined base shape to obtain the designed positive projection, that is used to emboss a light-reflective area intended to have a reflectivity according to the table of reflectivity values for the 2-dimensional grid, the individual 3-dimensional offset function being configured to be applied to the 3-dimensional shape-contour function such that each value of the 3-dimensional shape-contour function is potentially changed from a respective individual height to a corresponding modified height, resulting in an overall deformation of the determined base shape in relation to the 3-dimensional individual offset.

[Claim 5] The method according to any one of the preceding claims,

in which the 2-dimensional grid comprises a tessellation of grid surfaces, each grid surface comprising a grid surface perimeter with a plurality of corners,

wherein single ones of the plurality of positive projections are positioned at corresponding corners, each corner comprising at most a single positive projection.

[Claim 6] The method according to any one of claims 1 to 4,

in which the 2-dimensional grid comprises a tessellation of grid surfaces, each grid surface comprising a grid surface perimeter with a plurality of corners,

wherein single ones of the plurality of positive projections are positioned in corresponding individual grid surfaces, each individual grid surface comprising at most a single positive projection.

[Claim 7] The method of according to any one of the preceding claims, wherein the 2-dimensional grid is an unstructured grid.

[Claim 8] The method of any one of claims 1 to 6, wherein the 2-dimensional grid is a regular grid.

[Claim 9] The method of claim 8, wherein the 2-dimensional grid is one of the list comprising: a Cartesian grid, a rectilinear grid, a curvilinear grid.

[Claim 10] The method of any one of claims 8 or 9,

whereby the 2-dimensional grid comprises a plurality of rows and columns, the tessellation of grid surfaces is organized in the plurality of rows and columns,

further wherein single ones of the plurality of positive projections are positioned in corresponding individual grid surfaces in rows,

the positive projections being spaced among each other according to a value of a first step function that describes a distance between grid surfaces in a direction of the row,

whereby adjacent rows of positive projections are separated by a value of a second step function that describes a distance between grid surfaces in a direction of the column.

[Claim 11] The method of claim 10,

wherein in each of the rows of positive projections, between two consecutive

positive projections, a second negative projection is provided on the first roller, such that a plurality of second negative projections becomes arranged in the same row as the positive projections, the second negative projections of the row being regularly spaced among each other according to the value of the first step function, and whereby adjacent rows of second negative projections are separated by the value of the second step function,

whereby each second negative projection extends from the surface of the first roller to a bottom side of the second negative projection in a direction towards the rotation axis of the first roller,

further comprising, from one row to an adjacent row, providing next to a positive projection from the one row in the adjacent alignment a further second negative projection distant from the positive projection in column direction, whereby two consecutive second negative projections in a same column are separated by the value of the second function,

the method further comprising

providing on the second roller a plurality of second positive projections complementary to the second negative projections, and the plurality of second negative projections seamlessly and gaplessly join with those corresponding second positive projections at the intended embossing of the foil material.

[Claim 12] The method of any one of claims 1 to 11, further comprising

providing the first roller at least on the surface in the determined perimeter, with a relief topography comprising at least one of an elevation or a depression of the surface,

providing on the second roller a complementary relief topography complementary to the relief topography,

whereby the 2-dimensional grid is projected onto the relief topography.

[Claim 13] The method according to any one of claims 1 to 12,

whereby the step of providing each of the first roller and second roller at their respective surface with respectively positive and negative projections applies to surfaces of a plurality of determined perimeters, and the 2-dimensional grid is different for each of at least two surfaces of distinct determined perimeters, each of the 2-dimensional grids being associated to its own table of reflectivity values.

[Claim 14] The method of any one of claim 4,

in which the individual height (h) is less or equal to 500 µm.

[Claim 15] The method of any one of claims 1 to 14,

in which the foil material is anyone of the list comprising packaging material and films such as metallic foils, metallized papers, polymer films, laminates and the like.

[Claim 16] The method of any one of claims 1 to 15,

the foil material being for anyone application of the list comprising a seal pack with decoration for, e.g., smoking articles, a blister pack with decoration on a cover foil for, e.g., smoking articles or medication, a soft-wrap for sweet goods, a Tetra Brik (registered trademark) with decoration, a decoration of cover foil for beverage capsules, a wrapping-decoration of chewing gum.

[Claim 17] The method according to any one of claims 1 to 16,

further comprising operating the pair of rollers in a quick-change device, the quick-change device including a housing with a first and a second mounting for receiving respectively a first roller carrier and a second roller carrier, the first roller carrier configured for fastening the first or the second roller which is driven via a drive and the second roller carrier configured for fastening respectively the second or the first roller, the quick-change device further configured to enable a pushing of the first roller carrier into the first mounting and the second roller carrier into the second mounting.

[Claim 18] An embossing device configured for embossing of individually light-reflecting areas on a foil material, the device comprising

a pair of roller configured to form a roller nip for admission of the foil material, wherein the pair of rollers comprises a first roller and a second roller,

each of the first roller and second roller comprising at their respective surfaces at least in a determined perimeter, respectively a plurality of polyhedron-shaped positive projections and a plurality of negative projections complementary to the positive projections, wherein the determined perimeter comprises at least one positive projection,

whereby the plurality of positive projections are arranged according to a 2-dimensional grid,

whereby each one of the plurality of positive projections extends over an individual height from a base side of the positive projection at the surface of the first roller to a top side of the positive projection in a direction away from a rotation axis of the first roller, and each negative projection extends from the surface of the second roller to a bottom side of the negative projection in a direction towards the rotation axis of the second roller;

the device being characterized in that

the plurality of polyhedron-shaped positive projections are shaped to seamlessly and gaplessly join with those corresponding negative projections at the intended embossing of the foil material, hence enabling a homogeneously jointed embossed polyhedron-like shape in the foil,

and in that it comprises, for the purpose of
- providing a plurality of light-reflecting areas on the foil material, that are intended to reflect light in line with a table of reflectivity values for the 2-dimensional grid, according to an orientation and shape of each of the plurality of light-reflecting areas, and
- enabling a perception by the human eye of a user, of the intended reflected light on a determined wide viewing angle covered by reflected light from any of the light-reflecting areas,

for each of the plurality of light-reflecting areas to be provided, a corresponding positive projection that is adjusted in an orientation and shape, in the 2-dimensional grid, that is intended to emboss the light-reflecting area.

[Claim 19] The device of claim 18, wherein

each one of the plurality of the positive projections of the 2-dimensional grid, is described by departing from a determined base shape which has a base surface delimited by a base perimeter intended to be positioned on the surface of the first roller and a 3-dimensional shape described by a 3-dimensional shape-contour function, by applying either one operation of the following list:

- obtain the designed positive projection by leaving the determined base shape unchanged;

- cutting-off a top of the determined base shape along an individual intersection of the determined base shape with an individual shape to obtain

an individual form of the top side of the determined base shape, that is used to emboss a light-reflective area intended to have a reflectivity according to the table of reflectivity values for the 2-dimensional grid, the remaining part of the determined base shape being the designed positive projection to be positioned at the surface of the first roller.

[Claim 20] The device of claim 18, wherein

each one of the plurality of the positive projections of the 2-dimensional grid, is described by departing from a determined base shape which has a base surface delimited by a base perimeter intended to be positioned on the surface of the first roller and a 3-dimensional shape described by a 3-dimensional shape-contour function, by applying either one operation of the following list:

- obtain the designed positive projection by leaving the determined base shape unchanged;

- applying an individual 3-dimensional gain-factor function to the determined base shape to obtain the designed positive projection, that is used to emboss a light-reflective area intended to have a reflectivity according to the table of reflectivity values for the 2-dimensional grid, the individual 3-dimensional gain-factor function being configured to be applied to the 3-dimensional shape-contour function thereby such that the designed positive projection has the same base perimeter as the determined base shape, the designed positive projection has no part that overlaps beyond the base perimeter, and any point in the contour of the designed positive projection is free from overlap with another point of the contour maintaining a base surface of the determined base shape intended to be positioned at the surface of the first roller and, resulting in an overall deformation of the determined base shape in proportion to the individual gain factor.

[Claim 21] The device of claim 18, wherein

each one of the plurality of the positive projections of the 2-dimensional grid, is described by departing from a determined base shape which has a base surface delimited by a base perimeter intended to be positioned on the surface of the first roller and a 3-dimensional shape described by a 3-dimensional shape-contour function, by applying either one operation of the following list:

- obtain the designed positive projection by leaving the determined base shape unchanged;

- applying an individual 3-dimensional offset function to the determined base shape to obtain the designed positive projection, that is used to emboss a light-reflective area intended to have a reflectivity according to the table of reflectivity values for the 2-dimensional grid, the individual 3-dimensional offset function being configured to be applied to the 3-dimensional shape-contour function such that each value of the 3-dimensional shape-contour function is potentially changed from a respective individual height to a corresponding modified height, resulting in an overall deformation of the determined base shape in relation to the 3-dimensional individual offset function.

[Claim 22] The device according to any one of the claims 18 to 21,

in which the 2-dimensional grid comprises a tessellation of grid surfaces, each grid surface comprising a grid surface perimeter with a plurality of corners,

wherein single ones of the plurality of positive projections are positioned at corresponding corners, each corner comprising at most a single positive projection.

[Claim 23] The device according to any one of claims 18 to 21,

in which the 2-dimensional grid comprises a tessellation of grid surfaces, each grid surface comprising a grid surface perimeter with a plurality of corners,

wherein single ones of the plurality of positive projections are positioned in corresponding individual grid surfaces, each individual grid surface comprising at most a single positive projection.

[Claim 24] The device according to any one of the claims 18 to 23, wherein the 2-dimensional grid is an unstructured grid.

[Claim 25] The device of any one of claims 18 to 23, wherein the 2-dimensional grid is a regular grid.

[Claim 26] The device of claim 25, wherein the 2-dimensional grid is one of the list comprising: a Cartesian grid, a rectilinear grid, a curvilinear grid.

[Claim 27] The device of any one of claims 25 or 26,

whereby the 2-dimensional grid comprises a plurality of rows and columns, the tessellation of grid surfaces is organized in the plurality of rows and columns,

further wherein single ones of the plurality of positive projections are positioned in corresponding individual grid surfaces in rows,

the positive projections being spaced among each other according to a value of a first step function that describes a distance between grid surfaces in a direction of the row,

whereby adjacent rows of positive projections are separated by a value of a second step function that describes a distance between grid surfaces in a direction of the column.

[Claim 28] The device of claim 27,

wherein in each of the rows of positive projections, between two consecutive positive projections, a second negative projection is provided on the first roller, such that a plurality of second negative projections becomes arranged in the same row as the positive projections, the second negative projections of the row being regularly spaced among each other according to the value of the first step function, and whereby adjacent rows of second negative projections are separated by the value of the second step function,

whereby each second negative projection extends from the surface of the first roller to a bottom side of the second negative projection in a direction towards the rotation axis of the first roller,

further comprising, from one row to an adjacent row, providing next to a positive projection from the one row in the adjacent alignment a further second negative projection distant from the positive projection in column direction, whereby two consecutive second negative projections in a same column are separated by the value of the second function,

the device further comprising

on the second roller a plurality of second positive projections complementary to the second negative projections, and the plurality of second negative projections seamlessly and gaplessly join with those corresponding second positive projections at the intended embossing of the foil material.

[Claim 29] The device of any one of claims 18 to 28, further comprising

on the first roller at least on the surface in the determined perimeter, a relief topography comprising at least one of an elevation or a depression of the surface,

on the second roller a complementary relief topography complementary to the relief topography,

whereby the 2-dimensional grid is projected onto the relief topography.

[Claim 30] The device according to any one of claims 18 to 29,

whereby on each of the first roller and second roller there is comprised at their respective surface respectively positive and negative projections in surfaces of a plurality of determined perimeters, and the 2-dimensional grid is different for each of at least two surfaces of distinct determined perimeters, each of the 2-dimensional grids being associated to its own table of reflectivity values.

[Claim 31] The device of any one of claims 18 to 30,

in which the individual height (h) is less or equal to 500 µm.

[Claim 32] The device of any one of claims 18 to 31,

in which the foil material is anyone of the list comprising packaging material and films such as metallic foils, metallized papers, polymer films, laminates and the like.

[Claim 33] The device of any one of claims 18 to 32,

the foil material being for anyone application of the list comprising a seal pack with decoration for, e.g., smoking articles, a blister pack with decoration on a cover foil for, e.g., smoking articles or medication, a soft-wrap for sweet goods, a Tetra Brik (registered trademark) with decoration, a decoration of cover foil for beverage capsules, a wrapping-decoration of chewing gum.

[Claim 34] The device according to any one of claims 18 to 33,

further comprising a quick-change device configured to operate the pair of rollers, the quick-change device including a housing with a first and a second mounting for receiving respectively a first roller carrier and a second roller carrier, the first roller carrier configured for fastening the first or the second roller which is driven via a drive and the second roller carrier configured for fastening respectively the second or the first roller, the quick-change device further configured to enable a pushing of the first roller carrier into the first mounting and the second roller carrier into the second mounting.