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(54) **TRANSFER STRIP FOR ACCOMMODATING DECORATIVE RIGID BODIES**

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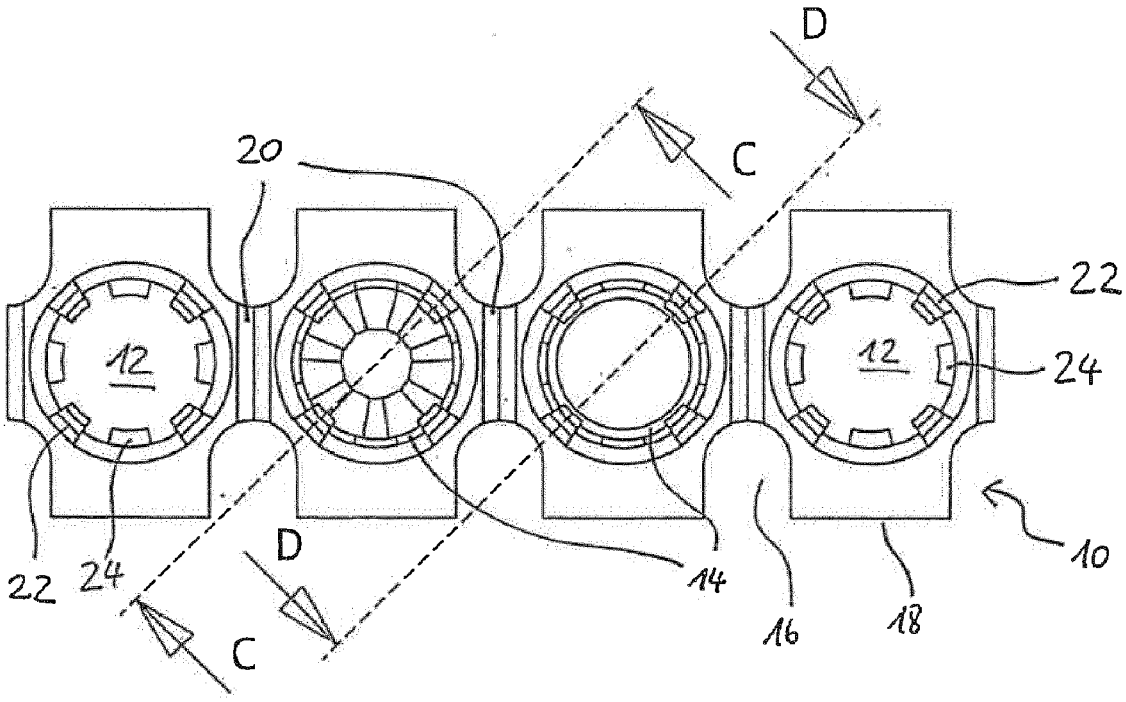
(57) **ABSTRACT**

A transfer strip for accommodating decorative rigid bodies to be transferred onto a substrate has upper and lower faces and an array of openings each having a first, upper end and a second, lower end. A diameter of each opening is larger than a distance between the first and second ends of the opening. Each opening has an annular reinforcement structure at the first end, a continuous or discontinuous annular rim formed at an inner circumference of the first end, and at least two, three or four spaced-apart inward hooks as the second end in a mutual arrangement adapted to hold the respective decorative rigid body in the opening.



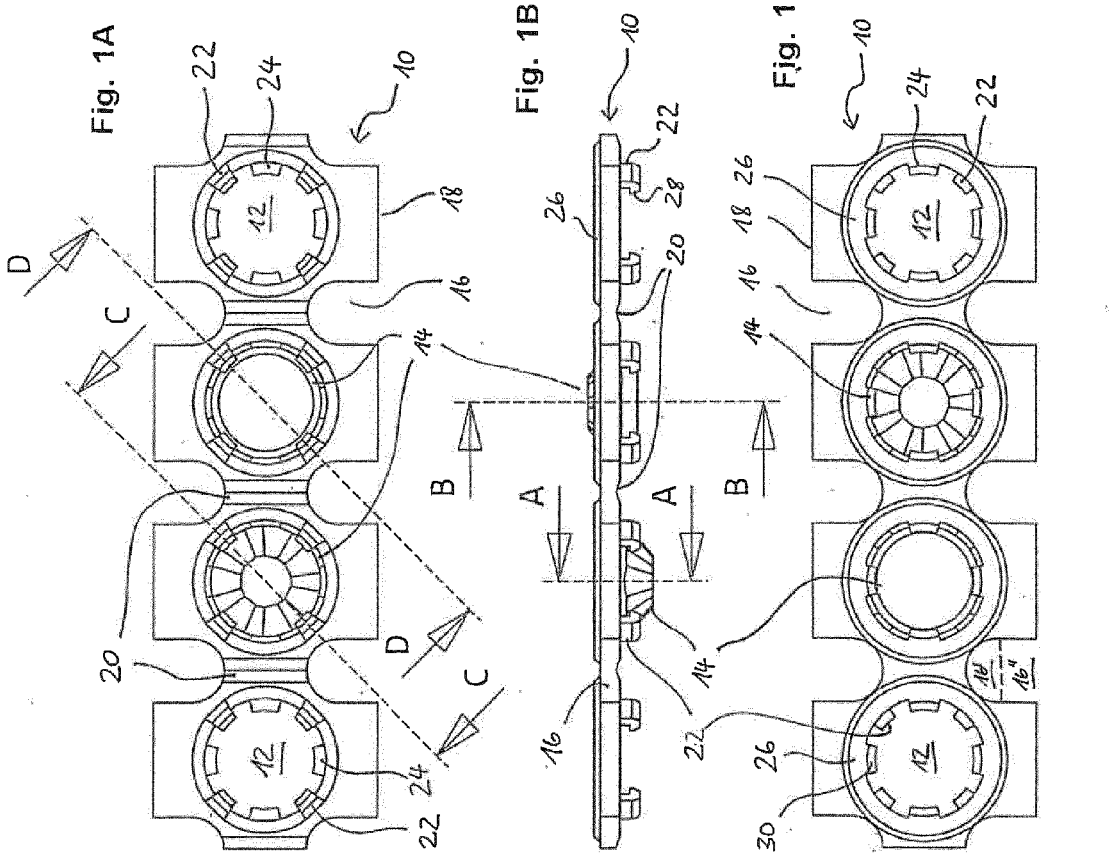


Fig. 1A
Fig. 1B
Fig. 1C
10
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14
16
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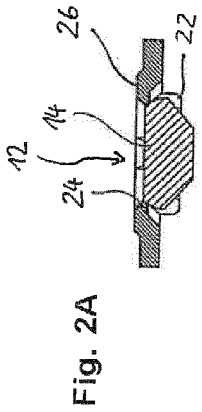
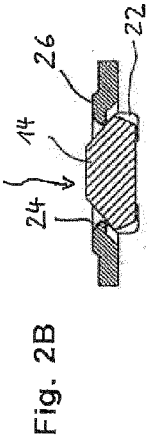
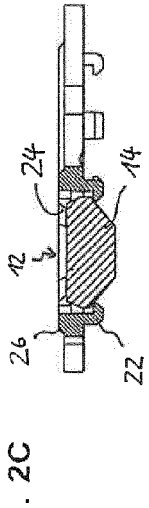
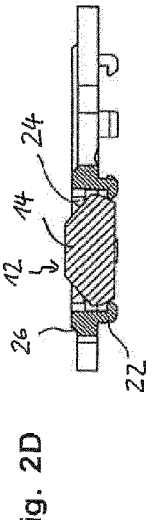
A
B
C
D


SECTION A-A
Fig. 2A
12
14
22
24
26


SECTION B-B
Fig. 2B
12
14
22
24
26


SECTION C-C
Fig. 2C
12
14
22
24
26


SECTION D-D
Fig. 2D
12
14
22
24
26

TRANSFER STRIP FOR ACCOMMODATING DECORATIVE RIGID BODIES

[0001] The present invention relates to a magazine strip for rigid bodies, such as gems or glass crystals or other decorative rigid bodies. In particular, the invention relates to a strip suitable for transferring such decorative rigid bodies onto a substrate e.g. one by one, either manually or by means of a device; and to a method of manufacturing such transfer strip.

[0002] A magazine strip for gems is known from U.S. Pat. No. 5,252,377, which magazine strip has a sandwich structure with a middle soft layer and reversibly deformable layers above and under the soft layer. This magazine strip has holes into and out of which gems can be pressed.

[0003] An apparatus for fixing decorative rigid bodies from another transfer strip onto a substrate is known from the present inventor's International application WO 2012/116806 A1.

[0004] It has been found that the transfer strip of U.S. Pat. No. 5,252,377 is not capable of reliably holding and providing the gems.

[0005] It is therefore an object of the present invention to provide a transfer strip, and method of manufacture thereof, which offers a more reliable holding and providing the decorative rigid bodies in particular for automatic transfer by means of an apparatus.

[0006] According to the present inventor's studies, one important factor to be considered in the design of a transfer strip is that the gems or other decorative rigid bodies, such as glass crystals, do not all have the same size, but vary quite a bit in terms of their overall extensions, most notably their largest diameter and their thickness. This is self-evident in the case of naturally occurring gem stones, but also applies to artificial glass crystals, the manufacturers of which sell such items with a specified nominal size, whereas the actual size will differ from this size within a given tolerance.

[0007] This circumstance must have, and indeed has, a marked effect on the magazine strip such as the one of U.S. Pat. No. 5,252,377, which relies on the holding force exerted by the middle soft layer. This holding force will be more or less proportional to the indentation provided by the gem inserted into the hole, which hole naturally must be somewhat smaller than the equatorial diameter of the gem. Clearly, even assuming an identical hole diameter for all the holes, any variation in the gem diameters must materially affect the amount of indentation provided by the individual gems to the soft layer surrounding them, and must therefore lead to an accordingly varying holding force. In relative terms, this effect is much enhanced by the circumstance that it is the individual difference of the gem diameter to the hole size which determines the holding force; assuming the holes to be 10% smaller than the nominal gem size, this means that an individual gem being only 10% smaller than the nominal size would fall right through the hole, as there would be no holding force at all. Conversely, a gem having an individual diameter 10% larger than the nominal size would require about twice the force to introduce it, and to expel it from its hole, than a nominally sized gem. It is difficult to manufacture a transfer device able to properly deal with such variations.

[0008] The present invention accordingly proposes a transfer strip for accommodating decorative rigid bodies to be transferred onto a substrate, which transfer strip has upper and lower faces and comprises an array of openings each having a first, upper end and a second, lower end, wherein a diameter of each opening is larger than a (shortest) distance between the first and second ends of the opening, each opening having an annular reinforcement structure at the first end, a continuous or discontinuous annular rim formed at an inner circumference of the first end, and at least two, three or four spaced-apart inward protrusions such as hooks or struts as the second end in a mutual arrangement adapted to hold the respective rigid body in the opening.

[0009] According to this structure, the decorative rigid bodies can be inserted into, and expelled from, the openings formed in the transfer strip from the second ends, to be held in place by the combined presence of the upper annular rim and lower hooks. The reinforcement structures serve to maintain the relative positions of the upper annular rim and lower hooks even when the transfer strip as a whole is bend or guided along curved paths, in that any bending of the strip takes place between adjacent reinforcement structures. The annular reinforcement structures in an embodiment protrude from the upper face of the transfer strip (i.e., from the first end).

[0010] In some embodiments, the annular rim at the first end is discontinuously formed as at least two, three or four spaced-apart tabs extending radially inwardly from the circumference of the opening. In this case, the tabs and hooks may be spaced apart equidistantly about the opening, and may be staggered around the circumference.

[0011] In some embodiments, the tabs and hooks have inclined outward faces so as to ease proper alignment of the decorative rigid bodies at insertion from the second end, or of an expelling piston entering into the opening from the first end. In either case, the inclination suitably is radially inwardly.

[0012] The decorative rigid bodies accommodated in the openings in some embodiments each have a frustopyramidal or an asymmetric bifrustopyramidal shape. The exact shape is not so limited, however, and may likewise have one pyramidal or conical tip.

[0013] In some embodiments, the sloped faces of the frustopyramid, or the more steeply sloped faces of the bifrustopyramid, face the first ends of the openings. In this context, a face shall be understood as "more sloped" if its normal forms a smaller angle with the direction of the central axis of the opening.

[0014] In some embodiments, the end faces of the decorative rigid bodies facing the second ends of the openings are coated with an instant bonding adhesive. According to this arrangement, it is feasible to directly adhere the decorative rigid bodies by arranging the transfer strip near the intended substrate and by expelling the decorative rigid bodies exerting a force upon them individually from the first ends. The decorative rigid bodies are thereby pressed onto the substrate, and may adhere thereto.

[0015] According to a different embodiment, the sloped faces of the frustopyramid, or the more sloped faces of the bifrustopyramid, face the second ends of the openings. In this case, the end faces of the rigid bodies facing the second ends of the openings may be coated with a heat sensitive or melt adhesive. According to this arrangement, it is feasible to temporarily adhere the decorative rigid bodies on an intermediate substrate such as a transfer sheet, e.g. an inverted pattern, by arranging the transfer sheet near the intended substrate and by fixing the decorative rigid bodies applying heat to the entire pattern through the transfer sheet. The decorative rigid bodies are thereby melt-fixed or heat-bonded to the substrate, and may adhere thereto.

[0016] The present invention also proposes a process of injection-molding the transfer strip as described above, the process in some embodiments including manufacturing the mold, injecting the flowable strip material into the mold, solidifying the material and removing the transfer strip from the mold.

[0017] In some embodiments, the process further includes inserting the decorative rigid bodies through the respective second openings so that the sloped faces of the frustopyramid, or the more sloped faces of the bifrustopyramid, face the first ends of the openings. In this case, the decorative rigid bodies may be such ones which are coated with a pressure sensitive adhesive on their larger end faces.

[0018] In other embodiments, the process further includes inserting the rigid decorative bodies through the respective second openings so that the sloped faces of the frustopyramid, or the more sloped faces of the bifrustopyramid, face the second ends of the openings. In this alternative case, the rigid decorative bodies may be such ones which are coated with a heat sensitive adhesive on their larger end faces. They may additionally be coated with a pressure sensitive adhesive on their opposing, smaller end faces, to ease adhering them to a transfer sheet as described above.

[0019] Embodiments of the invention will be described below in more detail, by referring to the following drawings, which show:

[0020] FIGS. **1**A-C bottom, side and top view of a transfer strip with two decorative rigid bodies accommodated therein in mutually different orientations;

[0021] FIGS. **2**A-D cross-sectional views of the transfer strip.

[0022] FIGS. **1**A through **1**C mainly serve to explain two general ways of accommodating decorative rigid bodies, more clearly shown to have the shape of asymmetric bifrustopyramids having an essentially prismatic equatorial portion between the two pyramidal frustrums in FIGS. **2**A through D, in a transfer strip according to the invention. Specifically, in the second opening from the left, a glass crystal is held in an upside-down orientation, i.e. the smaller end face protrudes from the bottom side, whereas in the third opening from the left, a glass crystal is held in an upside-up orientation, i.e. the smaller end face protrudes from the upper side. The outermost openings are shown empty. The skilled person will realize that typically, an actual transfer strip would have all the openings filled with glass crystals oriented in the same, rather than different manner. It will be noted that in this example, the smaller end faces of the glass crystals, which border on the more sloped side faces, protrude from the respective side of the transfer strip, while the other end faces do not. In this context, it may be noted that except in extraordinary cases, the angles between the normals of the sloped side faces and the central axis of the respective opening are larger for the shorter (and less sloped) side faces bordering the larger end faces. One such extreme case is shown in the above-mentioned U.S. Pat. No. 5,252,377, according to which the side face angles seem to be all identical (45°). In such a case, the shorter side face necessarily borders on the larger end face. In fact, that crystal only has one end face, the other end being pointed.

[0023] In this example, the transfer strip **10** extends in a left-right direction. The outermost openings **12** are indicated. The openings form a linear array along the length of the strip. The glass crystals are indicated as **14**, although they need not always be present according to the invention. The strip further has U-shaped notches **16** formed in its side rims **18**. The bottom side shown in FIG. **1**A has V-shaped grooves **20** between successive openings. Each opening **12** has four hooks **22** evenly spaced around the circumference of the respective opening. From the bottom side as in FIG. **1**A, and through the outermost openings **12**, four tabs **24** are visible, which are arranged at the top end. In the two central openings accommodating glass crystals, these tabs are not visible.

[0024] The side view according to FIG. **1**B reveals another feature of the inventive transfer strip **10**, namely a protruding ring **26** formed on the top side of the transfer strip surrounding each opening. The hooks **22** are discernible to have radially inwardly inclined faces **28** at their innermost outward faces. As in FIG. **1**A, the hooks **22** are shown in FIG. **1**B to touch the sloped faces of the glass crystals **14**.

[0025] The annular protrusion **26** is also discernible in FIG. **1**C, which is a top view of the same transfer strip **10** as above. This view shows the upper side tabs **24** to be directly formed at the inner circumference of the annular protrusion **26**. The tabs **24**, like the hooks **22** as described above, have radially inwardly inclined faces **30** at their innermost outward faces. The notches **16** have inner **16'** and outer **16"** portions.

[0026] FIGS. **2**A through **2**D are cross-sectional views taken along different section planes A-A, B-B, C-C and D-D, the latter two of which are oblique to the longitudinal extension of the transfer strip. The rationale is that in some more advanced embodiments, the retaining features at the top (tabs **24**) and at the bottom (hooks **22**) of the accommodating openings are staggered with respect to one another. Each section plane therefore is chosen to bisect the retaining features at the bottom or else, at the top, respectively. These features are darkly hatched. From the cross-sectional views, it becomes evident that the decorative rigid bodies **14** (lightly hatched) are actually held not at their equatorial portions, and not even necessarily at their end faces (although that would also be feasible), but rather at their sloped side faces. It has been found that this manner is least sensitive to a varying size of the glass crystals (or other decorative rigid body). FIGS. **2**C (section C-C) and **2**D (section D-D) show that the cylindrical pouch diameter that accommodates the decorative rigid bodies should be larger than the largest diameter of same. The annular gap should be sufficiently large so as to avoid the bodies getting stuck due to temperature changes and different thermal expansion coefficients of the strip and crystal materials.

[0027] Naturally, particularly small individual glass crystals have quite some space in their opening within which to move. Each opening being less high (in a direction along the central axis of the opening) than wide (across its diameter), there is no danger of even the smallest glass crystals to be held in the openings overturning. Conversely, even the largest glass crystals within a reasonable tolerance of the nominal size will still safely fit within the openings, in some cases with some outward bending of the retaining features. Moreover even such outward bending will hardly affect the required force for expelling the glass crystals from their openings. The underlying reason is that the glass crystals are not held by a frictional force exerted upon them, but by the shape of the openings.

[0028] A prominent feature visible in all the drawings is the ring protruding on the upper side around each opening. Actually, the top side retaining features, shown as tabs, are formed at the inner circumference of this ring. The reinforcement structure provides stability of the transfer strip across the

opening, while allowing bending of the transfer strip between adjacent openings (i.e. between the side rim notches). This is advantageous as it keeps the bottom side hook features from moving apart when the transfer strip is guided around curved paths (such as by a guiding or transfer reel). Without such reinforcement structure, the material of the transfer strip had to be chosen inherently stiffer, or thicker, making it more difficult to safely guide the strip around narrowly curved paths. Eventually, this circumstance leads to larger and more costly transfer devices being necessary.

[0029] The different orientations of the glass crystals within the respective openings lend themselves to different modes of use as shall be explained in the following: According to the first, direct use, the glass crystals are accommodated with their larger end faces downward (see FIG. **2**B). In actual use of the transfer strip, an external force will be applied from above by means of a piston or the like, either automatically or manually. The piston (or other member) will act on the top of the glass crystal, thereby pushing its lower (less sloped) side faces against the inside of the hooks, and accordingly bending the hooks outwards so that the glass crystal can protrude from the bottom side. It will there come into contact with, and be pressed against an intended substrate and adhere thereto, usually because of a pressure sensitive adhesive being present on the larger (downward) end face of the glass crystals. While other schemes of adherence are also possible, the above is quite simple and requires no further device. In one basic example, the piston could even be the tip of a small stick, pressed manually on the glass crystals. In more involved examples, an apparatus moving a piston transversely to moving the transfer strip is used, in order to provide more control over the positioning and adhering of the glass crystals. The apparatus may be hand-held or even mounted in a system which also holds the substrate, and moves the latter in respect to the transfer apparatus.

[0030] According to the second, indirect use, the glass crystals are accommodated the other way round. Regardless of whether they carry a pressure sensitive adhesive on their lower, smaller end faces, they are coated on their opposing, larger end faces with a heat-sensitive or melt adhesive. In actual use, the glass crystals are temporarily fixed on an intermediate transfer sheet (which may itself be sticky or tacky if there is no pressure sensitive adhesive on the lower end faces of the glass crystals). The pattern in which the glass crystals are placed on the intermediate sheet, should be inverted with respect to the eventually desired pattern. After the inverted pattern is completed, the transfer sheet is reversed and placed on the intended substrate. Heat is then applied (e.g. through the transfer sheet) to the melt adhesive in order to thermally bond the glass crystals to the substrate. Usually, this application of heat occurs for the entire pattern at the same time, but in some applications, it may be more suitable to apply the heat (or thermal radiation, for that matter) individually to each of the decorative rigid bodies.

[0031] In the above described examples, there are 4 tabs or hooks, respectively, at each the top and bottom (first and second) ends of the openings, which are evenly spaced and staggered. This arrangement has a particularly high degree of symmetry. In other embodiments, the number of plural tabs (if present) and hooks may individually be any other integral number such as 2 or 3, in particular if combined with even spacings. A staggered arrangement eases the manufacturing independently from the number of retaining features. Any number of features larger than 4 is also feasible, but renders the manufacturing more involved.

[0032] In the above examples, the reinforcement structure is a circular continuous ring. Other suitable structures include non-circular annular ones; or, independently, discontinuous ones. If, in the latter case, there are plural more or less evenly spaced discontinuities, it may be advantageous to place such interruptions between adjacent annular structures rather than between the annular discontinuous structure and the nearest side rim portion of the transfer strip, because such interruptions might enable some undesirable bending flexibility around a transverse axis of the transfer strip passing through the openings reducing the reliability with which the decorative rigid bodies are held in the openings. Bending flexibility around a transverse axis of the transfer strip passing between adjacent openings is more desirable. To this end, as discernible in FIGS. **1**A and **1**C, generally U-shaped notches are formed in both side rims of the transfer strip, wherein the notches of one side rim directly oppose those formed in the other side rim, and all are staggered with respect to the openings accommodating the glass crystals or other decorative rigid bodies. Each notch has an outer portion which has generally straight edges, transverse or even perpendicular to the lengthwise extension of the strip; and an inner portion with rounded shape contiguous with the outer straight edges. In this manner, the weakening of the transfer strip by the notches is minimized, while allowing considerable flexibility with regard to bending. At the same time, the notches allow external devices such as toothed gear to engage in the notches for exerting a forwarding force. The symmetry of the notch arrangement renders such forwarding force to be substantially only in the lengthwise direction. In the example shown the depth of the straight-edge portion is about equal to the depth of the rounded-edge portion. This is preferred, but other ratios of the straight-edge depth to the rounded-edge depth (as measured perpendicularly to the strip length direction) within 1:3 to 3:1 or 1:2 to 2:1 (or 1:3 to 2:1, or 1:2 to 3:1) are also feasible in some cases. If the rounding-off is (half-)circular as in FIG. **1**B, the width of each notch is twice its radius. The ratio of the width of each depth to its overall depth typically lies in the same range 1:3-3:1, 1:2-2:1, 1:3-2:1, or 1:2-3:1. A suitable material for the transfer strip is polypropylene, PP.

[0033] The skilled person will notice that various modifications or alteration are possible to the examples described above, without leaving the scope of the appended claims. E.g., the V-shaped notch between adjacent openings, which according to the above examples is formed in the bottom side of the transfer strip, may take other forms, such as a perforation. Similarly, the reinforcing annular protrusion is disclosed as being made of the same material as the remainder of the transfer strip, but may also be made of a different one, such as being a region of the strip surface modified after its shape has been defined, by applying an agent or radiation. The reinforcing structure may be formed at the bottom side of the transfer strip, around the bases of the hooks; or both on the upper and bottom side of the transfer strip. The decorative rigid bodies may be diamonds or other gem stones; rather than bifrustopyramidal, they may be bifrustoconical or frustoconical. The lower-side hooks may contact the lower end faces in particular of upside-up-oriented crystals or bodies. The hooks may be arcuately bent rather than angled, or there may be struts inclined to the axis of the respective opening or perpendicular thereto. Conversely, the upper-side tabs may likewise be formed as hooks. The openings are generally shown as being

cylindrical, but may be prismatic, or somewhat frustoconical, or frustopyramidal. They may also be bifrustoconical or bifrustopyramidal.

[0034] According to one embodiment the invention can comprise a transfer strip for accommodating decorative rigid bodies to be transferred onto a substrate, the transfer strip having upper and lower faces and comprising an array of openings each having a first, upper end and a second, lower end, wherein a diameter of each opening is larger than a distance between the first and second ends of the opening,

[0035] each opening having an annular reinforcement structure at the first end, a continuous or discontinuous annular rim formed at an inner circumference of the first end, and plural spaced-apart inward protrusions, such as hooks or struts, as the second end in a mutual arrangement adapted to hold the respective rigid body in the opening.

[0036] According to an embodiment, the invention can comprise, that the annular reinforcement structure protrudes from the upper face of the transfer strip.

[0037] According to an embodiment, the invention can comprise, that the annular rim at the first end is formed as plural spaced-apart tabs extending radially inwardly.

[0038] According to an embodiment, the invention can comprise, that the tabs and hooks are spaced apart equidistantly about the opening.

[0039] According to an embodiment, the invention can comprise, that the tabs and hooks are staggered around the circumference.

[0040] According to an embodiment, the invention can comprise, that the tabs and hooks have inclined outward faces.

[0041] According to an embodiment, the invention can comprise, a transfer strip in which the decorative rigid bodies are accommodated, wherein the decorative rigid bodies each have a frustopyramidal or an asymmetric bifrustopyramidal shape.

[0042] According to an embodiment, the invention can comprise, that the sloped faces of the frustopyramid, or the more sloped faces of the bifrustopyramid, face the first ends of the openings.

[0043] According to an embodiment, the invention can comprise, that the end faces of the rigid bodies facing the second ends of the openings are coated with a pressure sensitive or instant bonding adhesive.

[0044] According to an embodiment, the invention can comprise, that the sloped faces of the frustopyramid, or the more sloped faces of the bifrustopyramid, face the second ends of the openings.

[0045] According to an embodiment, the invention can comprise, that the end faces of the rigid bodies facing the first ends of the openings are coated with a heat sensitive or melt adhesive.

[0046] According to an embodiment, the invention can comprise a process of manufacturing the transfer strip including injection-molding.

[0047] According to an embodiment, the process can comprise inserting the rigid decorative bodies through the respective second openings so that the sloped faces of the frustopyramid, or the more sloped faces of the bifrustopyramid, face the first ends of the openings.

[0048] According to an embodiment, the process can comprise including inserting the rigid decorative bodies through the respective second openings so that the sloped faces of the frustopyramid, or the more sloped faces of the bifrustopyramid, face the second ends of the openings.

[0049] According to an embodiment, the process can comprise arranging the transfer strip on the substrate, and exerting an external force onto the decorative rigid bodies individually towards the substrate to expel the respective decorative rigid body from the opening in which it is accommodated, and to bring that end face of the respective decorative rigid body formerly facing the second end of the opening in contact with the substrate.

1-14. (canceled)

15. A transfer strip accommodating rigid bodies to be transferred onto a substrate, the transfer strip comprising:

upper and lower faces, said faces having an array of openings formed therein, a diameter of each of said openings is larger than a distance between said upper and lower faces defining said openings;

an annular reinforcement structure disposed in each of said openings at said upper face;

said upper face having annular rims, selected from the group consisting of continuous annular rims and discontinuous annular rims, formed at an inner circumference defining each of said openings;

a plurality of spaced-apart inward protrusions selected from the group consisting of hooks and struts extending from said lower face;

decorative rigid bodies;

said lower face being in a mutual configuration adapted to hold said decorative rigid bodies in said opening; and

said decorative rigid bodies each have a frustopyramidal shape or an asymmetric bifrustopyramidal shape.

16. The transfer strip according to claim **15**, wherein said annular reinforcement structure protrudes from said upper face.

17. The transfer strip according to claim **15**, wherein said annular rims at said upper face are formed as plurality of spaced-apart tabs extending radially inwardly.

18. The transfer strip according to claim **17**, wherein said tabs and said hooks are spaced apart equidistantly about said openings.

19. The transfer strip according to claim **17**, wherein said tabs and said hooks are staggered around said inner circumference.

20. The transfer strip according to claim **17**, wherein said tabs and said hooks have inclined outward faces.

21. The transfer strip according to claim **15**, wherein:

said frustopyramidal shaped decorative rigid bodies have sloped faces facing said upper faces; or

said asymmetric bifrustopyramidal shaped decorative rigid bodies have more sloped faces facing said upper faces.

22. The transfer strip according to claim **21**, wherein said decorative rigid bodies have end faces facing said lower face of said openings, said end faces being coated with a pressure sensitive or instant bonding adhesive.

23. The transfer strip according to claim **15**, wherein:

said frustopyramidal shaped decorative rigid bodies have sloped faces facing said lower faces; or

said asymmetric bifrustopyramidal shaped decorative rigid bodies have more sloped faces facing said lower faces.

24. The transfer strip according to claim **23**, wherein said decorative rigid bodies have end faces facing said upper face around said openings, said end faces being coated with a heat sensitive or melt adhesive.

25. A process for manufacturing transfer strips, which comprises the steps of:

injection-molding a transfer strip, containing:

upper and lower faces, the faces having an array of openings formed therein, a diameter of each of the openings is larger than a distance between the upper and lower faces defining the openings;

an annular reinforcement structure disposed in each of the openings at the upper face;

the upper face having annular rims, selected from the group consisting of continuous annular rims and discontinuous annular rims, formed at an inner circumference defining each of the openings;

a plural spaced-apart inward protrusions selected from the group consisting of hooks and struts extending from said lower face; and

inserting decorative rigid bodies through the lower faces of the openings, the decorative rigid bodies each have a frustopyramidal shape or an asymmetric bifustopyramidal shape, the lower face being in a mutual configuration adapted to hold the decorative rigid bodies in the openings.

26. The process according to claim **25**, which further comprises inserting the rigid decorative bodies in a manner so that sloped faces of the frustopyramidal shape, or more sloped faces of the asymmetric bifrustopyramidal shape, face the upper face defining the openings.

27. The process according to claim **25**, which further comprises inserting the rigid decorative bodies in a manner so that sloped faces of the fustopyramidal shape, or more sloped faces of the asymmetric bifrustopyramidal shape, face the lower face defining the openings.

28. The process according to claim **25**, which further comprises arranging the transfer strip on a substrate, and exerting an external force onto the decorative rigid bodies individually towards the substrate to expel a respective decorative rigid body from the opening in which the respective decorative rigid body is accommodated, and to bring a face of the respective decorative rigid body formerly facing the lower face of the opening in contact with the substrate.

* * * * *