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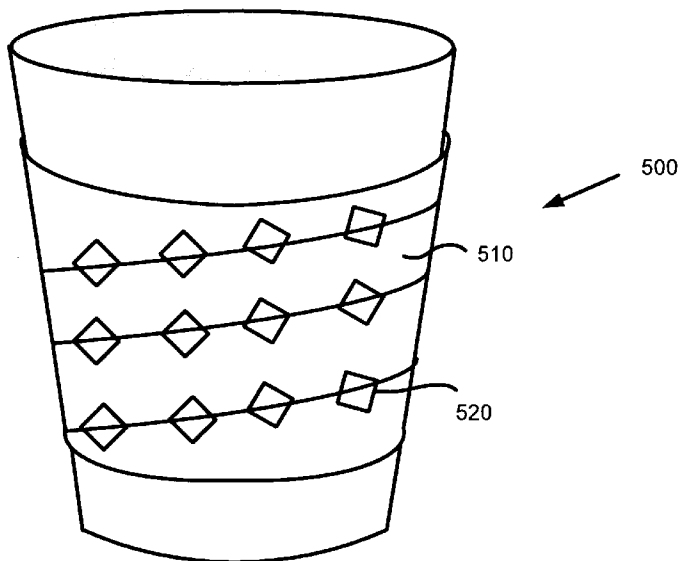
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(57) Abstract: A moiré pattern display sheet is defined by a surface, with the surface being configured to be curved. A first layer has a pattern printed thereon. The pattern comprises a series of visual elements in a first row that have been distorted at least in a first direction. At least some of the series of visual elements are printed to approximately follow an arc having a sweep angle associated therewith. A light steering optical layer overlays the first layer. The light steering optical layer comprises a plurality of parallel optical features which each have a width and which change the direction of the light and thereby provide a depth effect of the visual elements to a viewer looking through the light steering optical layer.



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LAYERED IMAGE DISPLAY SHEET

This application claims the benefit of U.S. Provisional Application Serial
5 No. 60/848,719 filed on October 2, 2006, entitled "LAYERED IMAGE DISPLAY SHEET," which application is incorporated herein by reference in its entirety.

BACKGROUND

The invention generally relates to applications and techniques of moiré
pattern display sheets which create a visual layered image effect and which may be
10 used as labeling for containers or other uses.

It is conventionally known to create display sheets which may be used for
labeling, decoration, advertising, etc. that provide a visual effect of depth. The
visual effect provides a pattern which appears to be in back of another image in the
foreground. This depth effect may also be referred to as a layered image effect.
15 Such a layered image effect may be produced by using a series of images that are
distorted in one direction (e.g. distorted in the width). The effect is created by
overlaying a lenticular display screen which steers light thereby producing the depth
effect of the series of images. A foreground image may interrupt and overlay the
series of images. The foreground image may be a plain image, an interlaced image,
20 or other types of images.

This technique may be referred to as the creation of moiré patterns which is
an interferometric effect.

Often it is desirable to use the display sheets as labels for containers or as
advertising. However, when a visual display sheet that has the layered depth effect
25 is curved and/or curved around a non-cylindrical object, an undesirable look may
occur. The undesirable look may be a slant of a row of images forming a pattern or
a distortion of the expected pattern. Accordingly, there is a need for techniques in
which moiré patterns may be generated and applied to curved surfaces and to
products having curved surfaces.

30 The techniques herein below extend to those embodiments which fall within
the scope of the appended claims, regardless of whether they accomplish one or
more of the above-mentioned needs.

SUMMARY

What is provided is a moiré pattern display sheet defined by a surface, with the surface being configured to be curved. The display sheet comprises a first layer having a pattern printed thereon. The pattern comprises a series of visual elements in a first row that have been distorted at least in a first direction. At least some of the series of visual elements are printed to follow an arc having a sweep angle associated therewith. At least some of the series of visual elements are rotated relative to one another along the arc. A light steering optical layer overlays the first layer. The light steering optical layer comprises a plurality of optical features which each have a width and which change the direction of the light and thereby provide a depth effect of the visual elements to a viewer looking through the light steering optical layer.

What is also provided is a method of forming a moiré pattern display sheet defined by a surface, with the surface being configured to be curved. The method comprises printing a first layer with a pattern. The pattern comprises a series of visual elements in a first row that have been distorted at least in a first direction. At least some of the series of visual elements are printed to follow an arc having a sweep angle associated therewith. At least some of the series of visual elements are rotated relative to one another along the arc. The method also comprises providing a light steering optical layer that overlays the first layer. The light steering optical layer comprises a plurality of parallel optical features which each have a width and which change the direction of the light and thereby provide a depth effect of the visual elements to a viewer looking through the light steering optical layer.

Further, what is provided is a moiré pattern display sheet defined by a surface, with the surface being configured to be curved. The display sheet comprises a first layer having a pattern printed thereon. The pattern is divided into at least a first and second region. The pattern comprises a series of visual elements in a first region that have been distorted at least in a first direction. The series of visual elements of the first region are spaced apart by a first spacing and each of the series of visual elements of the first region have a first width. The series of visual elements of the second region are at least one of spaced apart by a second spacing different than the first spacing or the series of visual elements have a second width different

than the first width. The display sheet also comprises a light steering optical layer overlaying the first layer. The light steering optical layer comprising a plurality of parallel optical features which each have an optical element width and which change the direction of the light and thereby provide a depth effect of the visual elements to a viewer looking through the light steering optical layer.

Further still what is provided is a method of forming a moiré pattern display sheet defined by a surface, with the surface being configured to be curved. The method comprises printing a first layer having a pattern printed thereon. The pattern is divided into at least a first and second region. The pattern comprises a series of visual elements in a first row that have been distorted at least in a first direction. The series of visual elements of the first region are spaced apart by a first spacing and each of the series of visual elements of the first region have a first width. The series of visual elements of the second region are at least one of spaced apart by a second spacing different than the first spacing or the series of visual elements have a second width different than the first width. The method also comprises providing a light steering optical layer overlaying the first layer. The light steering optical layer comprises a plurality of parallel optical features which each have an optical element width and which change the direction of the light and thereby provide a depth effect of the visual elements to a viewer looking through the light steering optical layer.

Alternative exemplary embodiments relate to other features and combinations of features as may be generally recited in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the features and advantages of the present invention will be obtained by reference to the following detailed description that sets forth illustrative embodiments by way of example only, in which the principles of the invention are utilized, and the accompanying drawings, of which:

FIG. 1 is an exemplary cross sectional diagram of a lenticular lens sheet overlaying a printed layer, the structure configured to produce a layered image effect.

FIG. 2 is an exemplary depiction of a resultant display sheet having a layered image effect.

FIG. 3 is an exemplary diagram of a distorted pattern used to produce the layered image effect.

FIG. 4 is an exemplary diagram of a background pattern in accordance with an exemplary embodiment.

5 FIG. 5 is an exemplary diagram of a cup labeled with a non preferred configuration of a layered image effect.

FIG. 6 is an exemplary diagram of a cup labeled with a preferred configuration of a layered image effect in accordance with an exemplary embodiment.

10 FIG. 7 is an exemplary diagram of a flattened label for a frustoconical shaped container in accordance with an exemplary embodiment.

FIG. 8 is an exemplary process diagram for forming a display sheet in accordance with an exemplary embodiment.

15 FIG. 9 is an exemplary top view of an elliptical container showing the location of transition regions.

FIG. 10 is an exemplary diagram of the label regions for the label of FIG.9.

FIG. 11 is an exemplary diagram depicting spacing for the label of FIG. 9.

FIG. 12 is another exemplary process diagram for forming a display sheet in accordance with an exemplary embodiment.

20 **DETAILED DESCRIPTION**

Before describing in detail the particular improved display sheet and method, it should be observed that the invention includes, but is not limited to a novel structural combination of conventional components and optical sheets, and not in the particular detailed configurations thereof. Accordingly, the structure and methods
25 for the most part, have been illustrated in the drawings by readily understandable block representations and schematic diagrams, in order not to obscure the disclosure with structural details which will be readily apparent to those skilled in the art, having the benefit of the description herein. Further, the invention is not limited to the particular embodiments depicted in the exemplary diagrams, but should be
30 construed in accordance with the language in the claims.

Referring now to FIG. 1, an exemplary embodiment of a cross section of a lenticular label 100, in accordance with the invention, is depicted. A backing sheet

20, for example, an opaque or clear plastic such as a vinyl laminate layer (alternatively, paper or other materials may be applied), is coated with an adhesive layer 30, such as but not limited to, a glue or resin formulation (alternatively, layer 30 may be a bonding layer created to couple layers 20 and 40 during manufacture through heating or the like). An optional core sheet, for example, an opaque or clear plastic sheet, can be situated between adhesive layer 30 and image layer 40. It is understood that when an optional core sheet is used, a second adhesive layer 37 may be used between the optional core sheet and image layer 40. Image layer 40 can be formed using a variety of materials and methods, such as but not limited to, a curable ink or alternatively a separate image sheet. The lenticular lens top sheet 50 can be formed from a variety of materials, including but not limited to, a clear plastic sheet, a polyvinyl chloride (PVC) sheet, an amorphous polyethylene terephthalate (APET). An optional primer layer (not shown) can be interposed between layers 20-30, 30-40, or 40-50 for better bonding between the layers.

Referring now to FIG. 2, a display sheet 200 having a background pattern image 210 with a foreground image 220 is depicted. Background pattern image 210 is a moiré pattern having a depth effect when coupled with a light steering optical element such as but not limited to a lenticular lens sheet. Foreground image 220 may be a conventional flat image or may be an interlaced image providing motion, flips, three – dimensional effects, or other effects as may be conventionally created with a lenticular lens screen. Further, foreground image 220 is representative of a focal image or a static image. A focal or static image may be configured to appear as a foreground image, a background image or in the same layer as the moiré pattern image represented in FIG. 2 as background image 210. Patterns may have varying degrees of depth, as described below.

The layered image effect or moiré pattern is created by the combination of a lenticular lens, fisheye lens, barrier screen, or other light steering device having elongated parallel light steering optical elements coupled with distorted pattern elements. For example, an exemplary raw image sheet 300 is depicted in FIG. 3. Raw image sheet 300 has a plurality of distorted pattern elements 310 arranged in a plurality of columns 320 and rows 330. The moiré pattern generation is one application of the science of interferometry (as utilized in the graphic arts' industry),

giving optic images the effect of relief, viewed either through transparency or by reflection.

Referring now to FIG. 4, an exemplary raw image pattern 400 is depicted. Raw image pattern 400 includes a plurality of distorted pattern elements 410. Each of the distorted pattern elements has a height h which is the height of the resultant pattern element 420 when viewed under a lenticular lens. The width w is distorted from the resultant pattern element 420 width kw , where k is a constant factor typically, but not limited to, on the order of tens or hundreds. Thus, the width of resultant pattern element 420 may be said to be distorted or squeezed in the width direction to have a distorted pattern element 410 width w . In an exemplary embodiment, the width w may be approximately the same width as a single lenticule. The resultant moiré pattern may then be a plurality of pattern elements 420 distributed over a surface but appearing in the background. Referring again to FIG. 2 it may often be desirable to have a foreground image such as image 220 which interrupts the pattern. Further, it is possible to adjust the degree of apparent depth of the pattern by changing the distortion or the aspect ratio of the moiré pattern images. Another way in which the apparent depth of the pattern may be changed is to change the optical characteristics of the light steering optical layer being used. For example, the shape of the lenticules may be changed or the line density of the lenticules may be changed in order to change the apparent depth.

Referring now to FIG. 5, a cup 500 is depicted. Cup 500 includes a label with a moiré pattern coupled thereto. In the case that a moiré pattern was printed on a sheet, the label cut directly from the sheet, and the label applied to the curved surface of the exterior of the frustoconical shaped cup, the moiré pattern 510 would be seen, however the moiré pattern elements would tend to follow a curved line (such as line 520) trajectory that is not parallel to the cup bottom or top. Also, the moiré pattern elements 510 may tend to change orientation around the circumference of the cup. This change in orientation and the curved trajectory of the moiré pattern elements may be undesirable for certain designs. More desirable may be a cup 600, as depicted in FIG. 6 in which the moiré pattern tends to appear parallel to the cup top and bottom (following a circumferential line 620) and the

orientation of the moiré pattern elements 610 is the same with respect to one another.

Depicted in FIG. 7 is an exemplary cut label layout 700 of a label for a frustoconical cup. A centerline 710 is depicted and an angle α defines the angle of the end of the label 720. A number of lines x of lenticular lens elements between the centerline and the end 720 can be determined. This number x will change moving in the direction 730. In an exemplary embodiment, the moiré pattern display sheet may be defined by a surface 740. Because of the application and the geometry of label 700, surface 740 is configured to be curved. A printing may be added that includes, in accordance with an exemplary embodiment, one or more rows of series of visual design elements. The series of visual design elements are distorted in their width. In order to defeat the undesirable curvature effects associated with FIG. 5 and to achieve a more desirable look as depicted in FIG. 6, at least some of the series of visual elements are printed to follow an arc 750 having a sweep angle α associated therewith. Also, at least some of the series of visual elements may be rotated relative to one another along the arc 750 such that at point 755, the elements have a vertical centerline that is approximately parallel with line 710 and at point 760, the elements have an orientation that is approximately parallel with line 720. After the raw pattern is printed on surface 740, a light steering optical layer overlaying layer 740 is applied. The light steering optical layer includes a plurality of parallel optical features which each have a width of approximately w and which change the direction of the light and thereby provide a depth effect of the visual elements to a viewer looking through the light steering optical layer. Such a light steering optical layer may be a lenticular lens sheet or any of a variety of light steering optical elements. In accordance with alternative embodiments, it should be understood that the orientation of the light steering optical layer may be any of a variety of orientations without departing from the scope of the invention. The light steering optical layer may be adhered to the printed layer by any of a variety of methodologies including adhesives, direct printing onto the lenticular lens sheet or directly printing the lenticular lenses onto the printed raw image sheet.

In accordance with an exemplary embodiment, because x increases along direction 730, it may be desirable to have rows at the bottom have the same number

of elements as rows at the top, and therefore change the spacing *s* between the elements in the raw image. In accordance with an alternative embodiment, the number of elements may grow larger in the direction 730, while keeping the spacing *s* the same across each row of elements. The choice to use one methodology over another may depend on numerous factors including desired appearance, software and printing capabilities, and other characteristics of the design, printing, and viewing processes.

As stated above, it may be desirable to have the *x* images follow arc 750 in an approximate manner. That is, the following of arc 750 may be done in steps such that a number of distorted images, e.g. 30 images, may follow a straight line. The next 30 images would then be stepped down approximately following arc 750, but aligned in the direction perpendicular to direction 730 on surface 740. The result is a following of the arc in a discretized manner.

Also in accordance with an exemplary embodiment, the angular orientation of the image elements across surface 740 may change. In one exemplary embodiment, the angle of each design element may change by an angle that is proportional to the ratio of the sweep angle to the number of visual elements along the arc. The design is not limited to this methodology of changing angular orientation but may include other angles and also may be reoriented in groups as opposed to individually.

In accordance with exemplary embodiments, a curved label of this type or similar to this may have any of a variety of applications including but not limited to being used as a cup or container label, being used as a cup wrap or sleeve, among others. In one exemplary embodiment, the wrap with the lens may be formed and then placed into a mold whereby a cup or container is then injection molded or blow molded and the label becoming coupled to the cup or container during the molding process. Alternatively, the label may wrap around, either fully or partially, the cup or container and be coupled thereto, or the label may form the wall of the container itself if a suitable material is used for at least one of the label layers.

Referring now to FIG. 8, a process 800 for forming a moiré pattern display sheet defined by a surface, with the surface being configured to be curved is depicted. A determination of the arc to be followed by the pattern is made (process

810) dependent upon the shape and size of the curved surface. Next a determination of the number of elements in each row and the spacing between the elements is made (process 820). The first layer is then printed with a distorted and series of pattern (process 830). The pattern may comprise a series of visual elements in rows each of the elements having been distorted at least in a first direction (e.g., the width), at least some of the series visual elements are printed to follow an arc having a sweep angle associated therewith, and at least some of the series of visual elements are rotated relative to one another along the arc. Once printed, a lenticular lens sheet or other light steering optical element is coupled to or associated with the printed layer. In accordance with an exemplary embodiment, the visual elements may be distorted in the width to be approximately the same width of one of the parallel optical features of the light steering optical element (e.g., a single lenticule).

In another exemplary embodiment, a determination is made of the orientation of each visual element. The visual elements are then rotated to be printed each by an angle that is proportional to the ratio of the sweep angle to the number of visual elements along the arc. Alternatively other methods and formulations of determining the orientation of the elements may be used without departing from the scope of the invention.

In an exemplary embodiment, a second foreground image may be printed which interrupts a portion of the pattern of the first layer. The second image may be but is not limited to an interlaced image that, when coupled with a lenticular lens sheet may provide the effect of depth or motion.

Referring now to FIG. 9, an irregular curved surface such as the elliptical curved surface 900 (shown from above) presents undesirable visual effects on certain portions of the surface if some or more of the techniques described are not applied. The curved surface may be divided up into a number of zones in which each of the number of zones has either different spacing of the pattern elements or has different distortion widths of the pattern elements, than other zones.

Alternatively, the spacing or the distortion widths in a particular zone may be gradually changed through the zone. For example, a zone 910 may have pattern spacing s and distortion widths w throughout the zone. A zone may have changing spacing or widths throughout the zone such that near zone 910 the spacing or widths

are approximately s or w respectively and near zone 930 the spacing or widths may be less than s or w . For example the spacing may be $s-.03s$ or the width may be $w-.03w$. The factor $.03$ is being used here for illustration purposes only and any applicable factor may be used to generate the desired image characteristics. Other zones may be the same as or different than zones 910, 920, 930. Also, either changes in spacing, changes in widths, or a combination of changing spacing and changing widths may be used without departing from the scope of the invention.

Referring now to FIG. 10, a flat label 1000 is depicted having a plurality of zones. When printing a label which could be for a curved surface such as curved surface 900 or for any curved surface, the label may be printed flat and then curved to the desired shape. Label 1000 depicts the various zones of a printed label. Also referring to FIG. 11, two zones 1110 and 1120 are depicted. The distorted image elements of zone 1110 are depicted being spaced apart by a distance s . The zone 1120 depicts a graduated change in spacing where image elements are spaced by an amount which either increases or decreases across the zone. Alternatively, the spacing is either more or less than in zone 1110.

Referring now to FIG. 12, a method of a process 1200 of forming a moiré pattern display sheet defined by a surface is depicted. The surface is one which is configured to be curved. Process 1200 comprises dividing a label into at least a first and second region or zone (process 1210). The pattern comprises a series of visual elements in at least one row that have been distorted in at least a first direction. The series of visual elements of the first region are spaced apart by a first spacing and each of the series of visual elements of the first region having a first width. Next a determination is made of the spacing of the series of visual elements of the second region. The spacing of the distorted visual elements are spaced apart by a second spacing different than the first spacing (process 1220). The series of visual elements may have a second width different than the first width. Once the spacing has been determined, a first layer having a pattern is printed according to the determined spacing (process 1230). Once printed, the lenticular lens sheet may be coupled to the printed layer (process 1240).

In accordance with another exemplary embodiment, it may be desirable to change the frequency of the lenticular lens sheet or to change other optical

characteristics of the lenticular lens sheet instead of or in combination with changing the spacing and/or the aspect ratio of the distorted pattern elements. Such configurations are a matter of design choice depending on the desired application, the cost, and the desired effect.

5 While the detailed drawings, specific examples, and particular formulations given described exemplary embodiments, they serve the purpose of illustration only. It should be understood that various alternatives to the embodiments of the invention described maybe employed in practicing the invention. It is intended that the following claims define the scope of the invention and that structures within the
10 scope of these claims and their equivalents be covered thereby. The configurations and processes shown and described may differ depending on the chosen performance characteristics and physical characteristics of the display. For example, the cost and depth desired may differ. The systems shown and described are not limited to the precise details and conditions disclosed. Method steps provided may
15 not be limited to the order in which they are listed but may be ordered any way as to carry out the inventive process without departing from the scope of the invention. Furthermore, other substitutions, modifications, changes and omissions may be made in the design, operating conditions and arrangements of the exemplary
embodiments without departing from the scope of the invention as expressed in the
20 appended claims.

CLAIMS

What is claimed is:

1. A moiré pattern display sheet defined by a surface, with the surface being
5 configured to be curved, comprising:
 - a first layer having a pattern printed thereon, the pattern comprising a series
of visual elements in a first row that have been distorted at least in a first
direction, at least some of the series of visual elements printed to
approximately follow an arc having a sweep angle associated therewith; and
10 a light steering optical layer overlaying the first layer, the light steering
optical layer comprising a plurality of optical features which each have a
width and which change the direction of the light and thereby providing a
depth effect of the visual elements to a viewer looking through the light
steering optical layer.
- 15 2. The display sheet of claim 1, wherein the series of visual elements are distorted
only in one direction.
3. The display sheet of claim 1, wherein the distortion of the visual elements in the
20 first direction is approximately the same width as one of the plurality of optical
features.
4. The display sheet of claim 1, wherein the display sheet comprises a second row of
visual elements, the first row being parallel to the second row.
- 25 5. The display sheet of claim 4, wherein the first row is longer than the second row
but contains the same number of printed visual elements
6. The display sheet of claim 4, wherein the first row is longer than the second row
30 but contains a larger number of printed visual elements.
7. The display sheet of claim 1, wherein the printed visual elements are each rotated
by an angle that is proportional to the ratio of the sweep angle to the number of

visual elements along the arc.

8. The display sheet of claim 1, wherein the light steering optical layer comprises a lenticular lens sheet.

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9. The display sheet of claim 1, wherein the light steering optical layer comprises a lenticular lens sheet that has been printed onto the first layer.

10. The display sheet of claim 1, wherein the display sheet is used as a label.

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11. The display sheet of claim 1, wherein the display sheet is coupled to a container.

12. The display sheet of claim 1, wherein the display sheet is coupled to a cup.

15 13. The display sheet of claim 1, wherein the display sheet is configured as a wrap for a container.

14. The display sheet of claim 1, wherein the display sheet is configured to be placed in a mold so that a molded product may be coupled thereto during the molding process.

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15. The display sheet of claim 1, wherein the display sheet is configured as at least a portion of a sleeve to fit around an object.

25 16. The display sheet of claim 1, wherein a second image interrupts a portion of the pattern of the first layer.

17. The display sheet of claim 16, wherein the second image is an interlaced image.

30 18. The display sheet of claim 1, wherein at least some of the series of visual elements are rotated relative to one another along the arc.

19. A method of forming a moiré pattern display sheet defined by a surface, with the surface being configured to be curved, comprising:

printing a first layer with a pattern, the pattern comprising a series of visual elements in a first row that have been distorted at least in a first direction, at
5 least some of the series of visual elements printed to approximately follow an arc having a sweep angle associated therewith; and
providing a light steering optical layer that overlays the first layer, the light steering optical layer comprising a plurality of parallel optical features which each have a width and which change the direction of the light and thereby
10 provide a depth effect of the visual elements to a viewer looking through the light steering optical layer.

20. The method of claim 19, further comprising:
distorting the printed visual elements in only one direction.

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21. The method of claim 19, further comprising:
distorting the visual elements in the first direction to be approximately the same width of one of the parallel optical features.

20 22. The method of claim 19, further comprising:
printing a second row of visual elements, the first row being parallel to the second row.

23. The method of claim 22, wherein the first row is longer than the second row but
25 contains the same number of printed visual elements.

24. The method of claim 22, wherein the first row is longer than the second row but contains a larger number of printed visual elements.

30 25. The method of claim 19, further comprising:
rotating the printed visual elements each by an angle that is proportional to the ratio of the sweep angle to the number of visual elements along the arc.

26. The method of claim 19, wherein the light steering optical layer comprises a lenticular lens sheet.

5 27. The method of claim 19, wherein the light steering optical layer comprises a lenticular lens sheet that has been printed onto the first layer.

28. The method of claim 19, further comprising:
printing a second image to interrupt a portion of the pattern of the first layer.

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29. The method of claim 28, wherein the second image is an interlaced image.

30. The method of claim 19, wherein at least some of the series of visual elements are rotated relative to one another along the arc.

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31. A moiré pattern display sheet defined by a surface, with the surface being configured to be curved, comprising:

20 a first layer having a pattern printed thereon, the pattern being divided into at least a first and second region, the pattern comprising a series of visual elements in a first row that have been distorted at least in a first direction, the series of visual elements of the first region being spaced apart by a first spacing and each of the series of visual elements of the first region having a first width, the series of visual elements of the second region being at least one of spaced apart by a second spacing different than the first spacing or the series of visual elements having a second width different than the first width;
25 and

30 a light steering optical layer overlaying the first layer, the light steering optical layer comprising a plurality of parallel optical features which each have an optical element width and which change the direction of the light and thereby provide a depth effect of the visual elements to a viewer looking through the light steering optical layer.

32. The display sheet of claim 31, wherein both the second width and the second spacing are different than the first width and the first spacing respectively.
33. The display sheet of claim 31, wherein the second width is not a fixed width but
5 changes across the second region.
34. The display of claim 31, wherein the second spacing is not a fixed width but changes across the second region.
- 10 35. The display sheet of claim 31, wherein the display sheet comprises a second row of visual elements, the first row being parallel to the second row and having the same spacing and widths of the visual elements as the corresponding visual elements of the first row.
- 15 36. The display sheet of claim 31, wherein the light steering optical layer comprises a lenticular lens sheet.
37. The display sheet of claim 31, wherein the light steering optical layer comprises a lenticular lens sheet that has been printed onto the first layer.
- 20 38. The display sheet of claim 31, wherein the display sheet is used as a label.
39. The display sheet of claim 31, wherein the display sheet is coupled to a container.
- 25 40. The display sheet of claim 31, wherein the display sheet is coupled to a cup.
41. The display sheet of claim 31, wherein the display sheet is configured as a wrap for a container.
- 30 42. The display sheet of claim 31, wherein the display sheet is configured to be placed in a mold so that a molded product may be coupled thereto during the

molding process.

43. The display sheet of claim 31, wherein the display sheet is configured as at least a portion of a sleeve to fit around an object.

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44. The display sheet of claim 31, wherein a second image interrupts a portion of the pattern of the first layer.

45. The display sheet of claim 31, wherein the second image is an interlaced image.

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46. A method of forming a moiré pattern display sheet defined by a surface, with the surface being configured to be curved, comprising:

printing a first layer having a pattern printed thereon, the pattern being divided into at least a first and second region, the pattern comprising a series of visual elements in a first row that have been distorted at least in a first direction, the series of visual elements of the first region being spaced apart by a first spacing and each of the series of visual elements of the first region having a first width, the series of visual elements of the second region being at least one of spaced apart by a second spacing different than the first spacing or the series of visual elements having a second width different than the first width; and

providing a light steering optical layer overlaying the first layer, the light steering optical layer comprising a plurality of parallel optical features which each have an optical element width and which change the direction of the light and thereby provide a depth effect of the visual elements to a viewer looking through the light steering optical layer.

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47. The method of claim 46, wherein both the second width and the second spacing are different than the first width and the first spacing respectively.

48. The method of claim 46, wherein the second width is not a fixed width but changes across the second region.

49. The method of claim 46, wherein the second spacing is not a fixed width but changes across the second region.
- 5 50. The method of claim 46, wherein the display sheet comprises a second row of visual elements, the first row being parallel to the second row and having the same spacing and widths of the visual elements as the corresponding visual elements of the first row.
- 10 51. The method of claim 46, wherein the light steering optical layer comprises a lenticular lens sheet.
52. The method of claim 46, wherein the light steering optical layer comprises a lenticular lens sheet that has been printed onto the first layer.
- 15 53. The method of claim 46, wherein the display sheet is used as a label.
54. The method of claim 46, wherein the display sheet is coupled to a container.
- 20 55. The method of claim 46, wherein the display sheet is coupled to a cup.
56. The method of claim 46, wherein the display sheet is configured as a wrap for a container.
- 25 57. The method of claim 46, wherein the display sheet is configured to be placed in a mold so that a molded product may be coupled thereto during the molding process.
58. The method of claim 46, wherein the display sheet is configured as at least a portion of a sleeve to fit around an object.
- 30 59. The method of claim 46, wherein a second image interrupts a portion of the pattern of the first layer.

60. The method of claim 59, wherein the second image is an interlaced image.

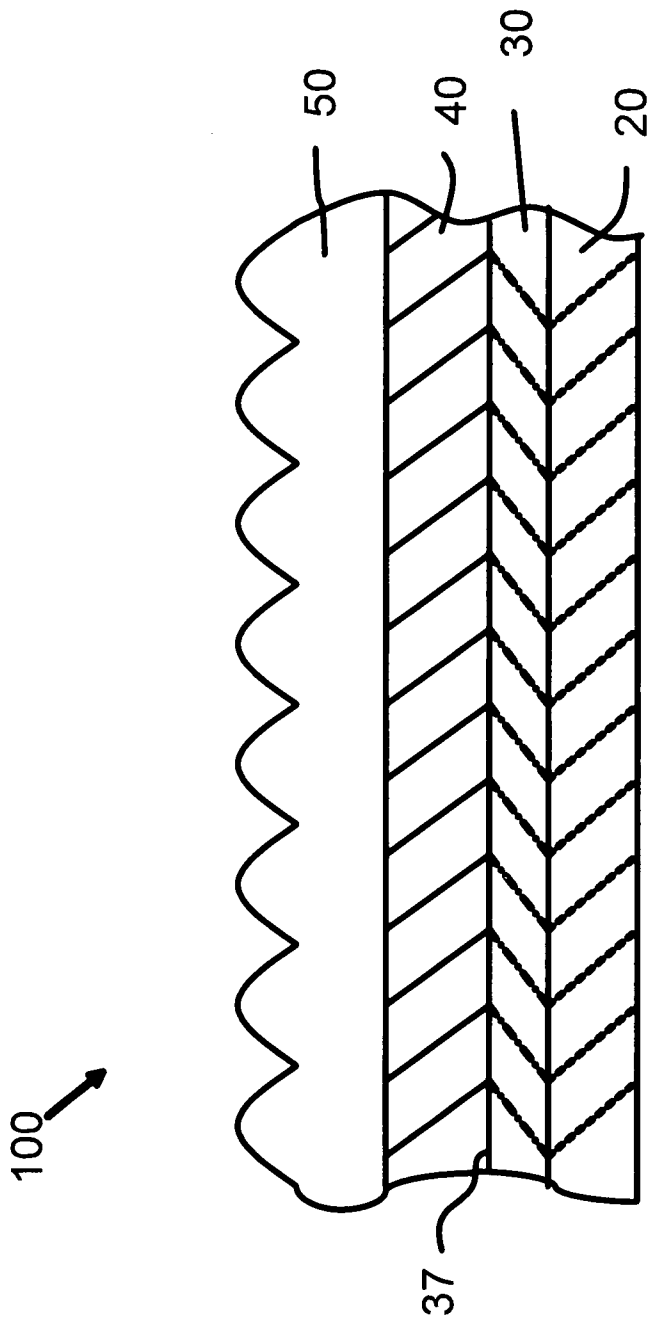


FIG. 1

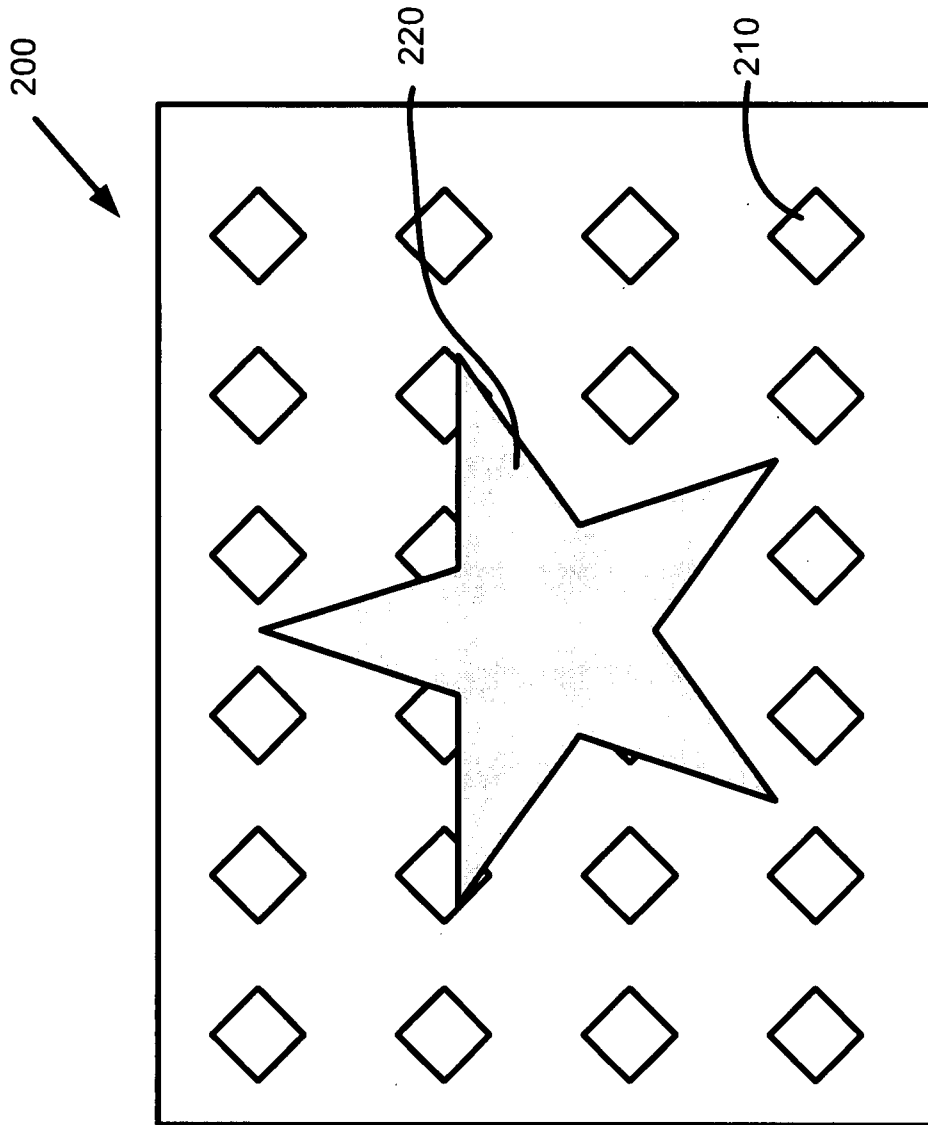


FIG. 2

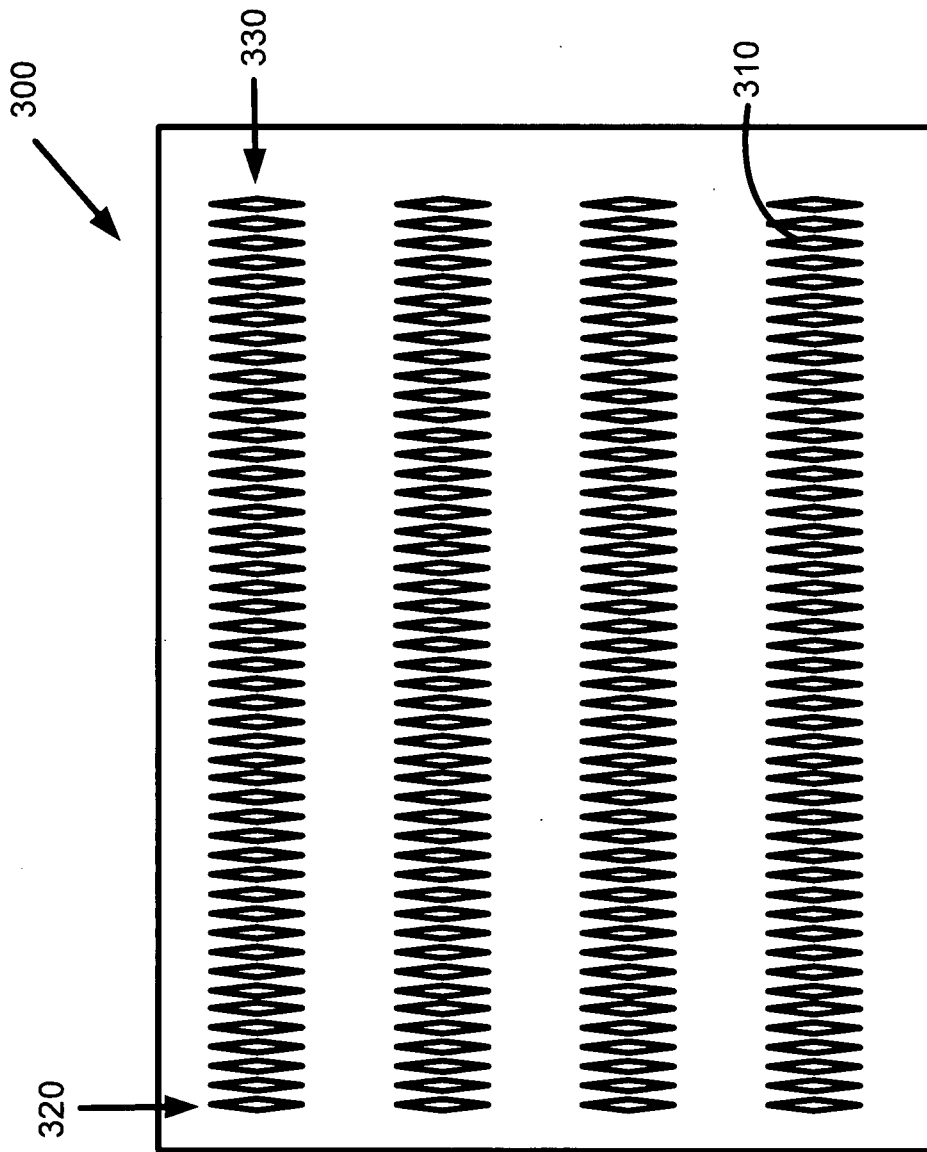


FIG. 3

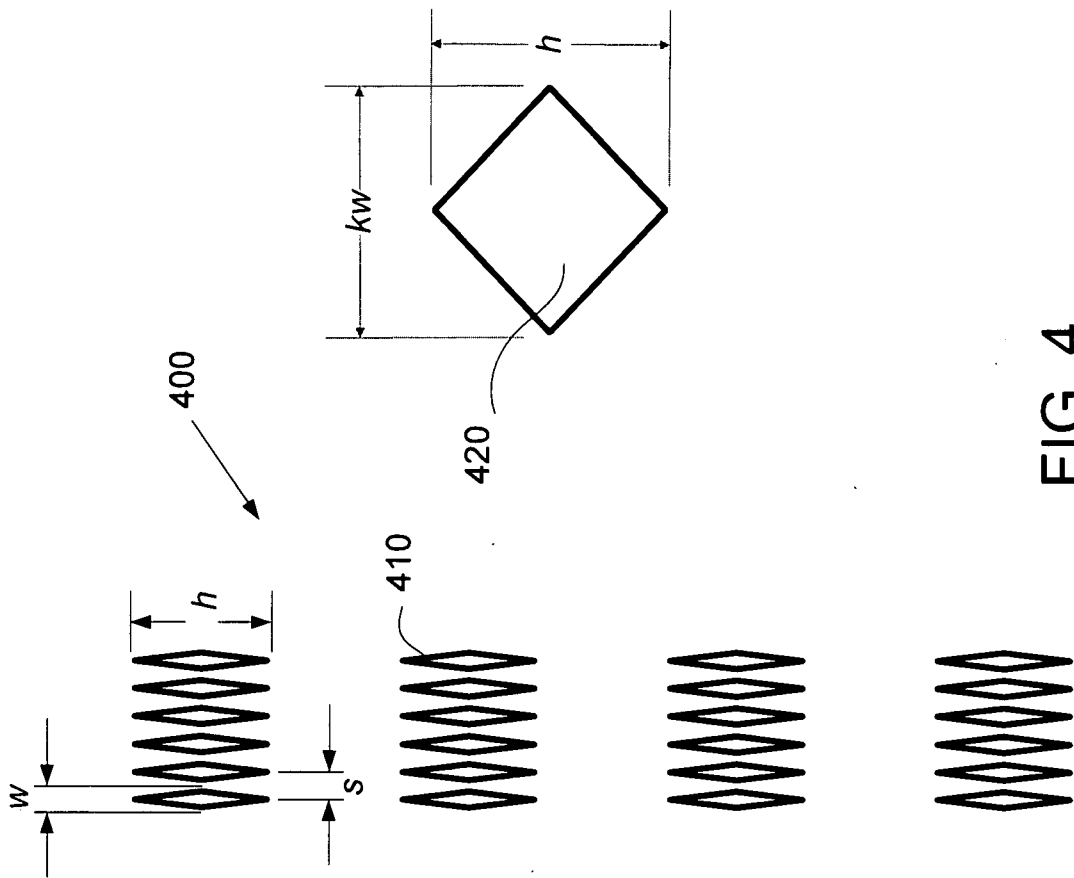


FIG. 4

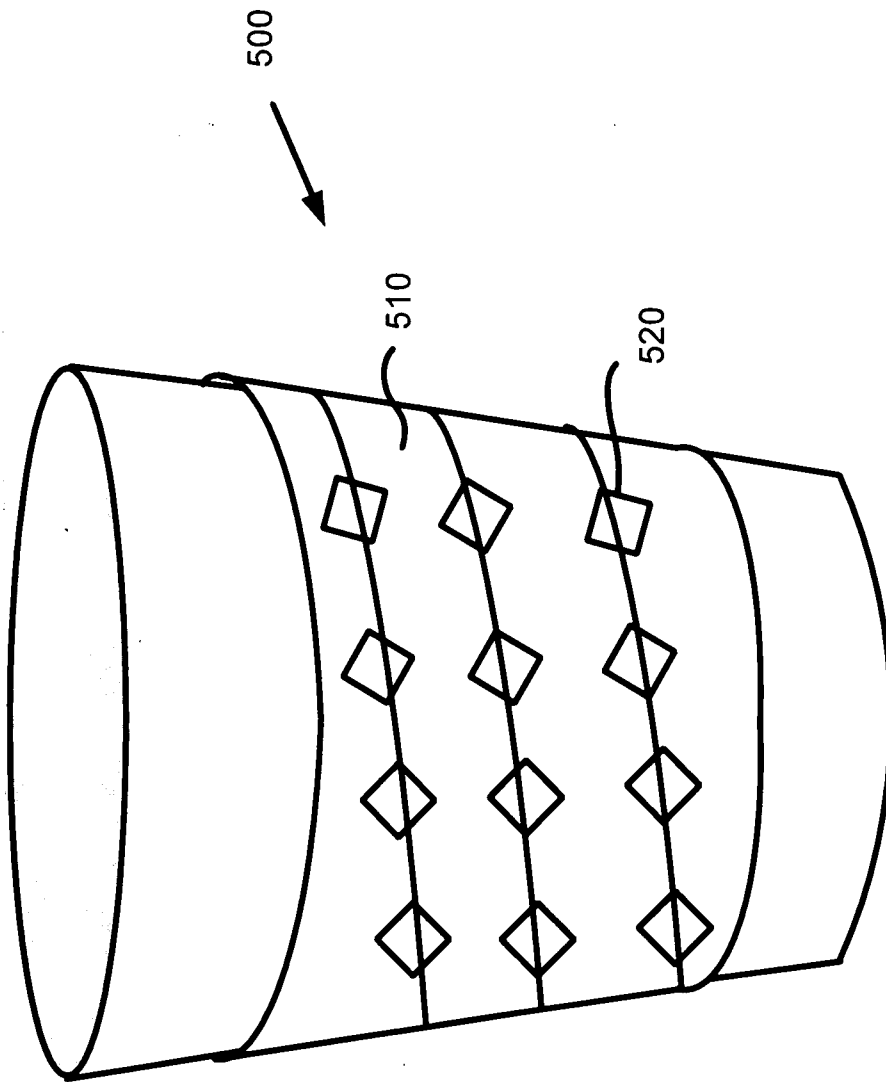


FIG. 5

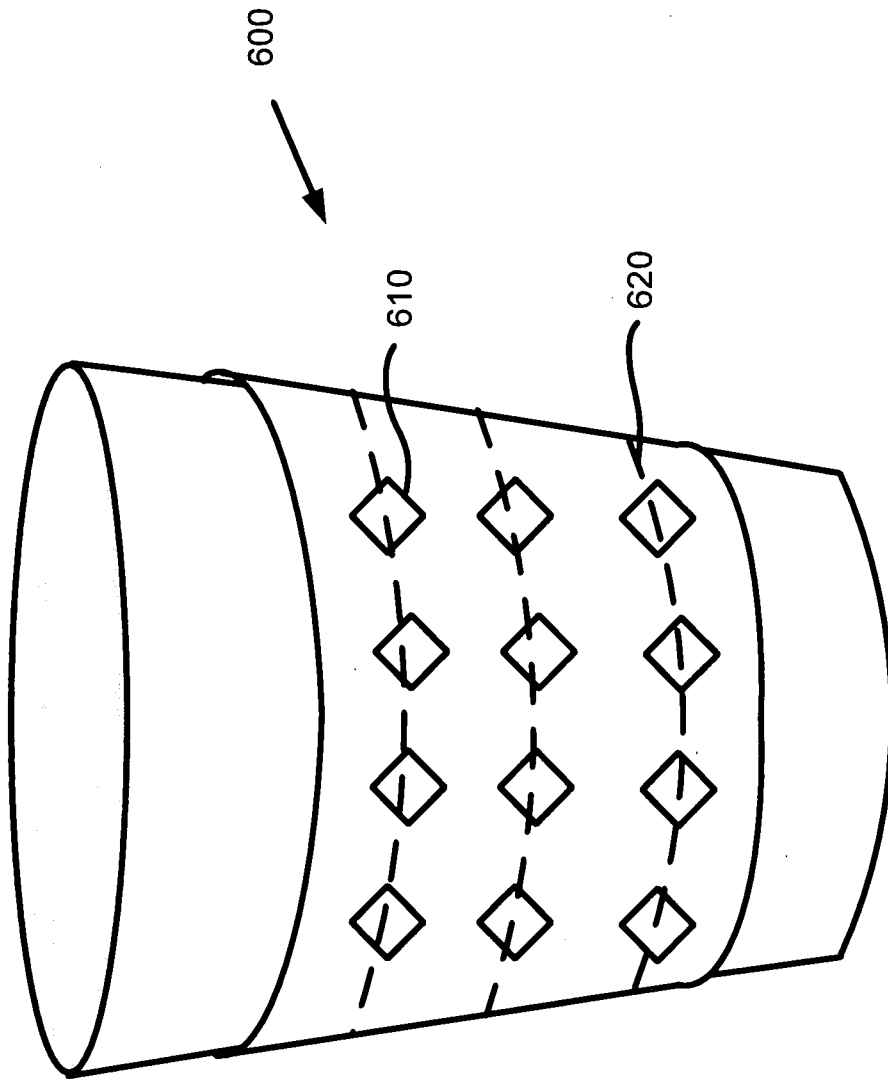


FIG. 6

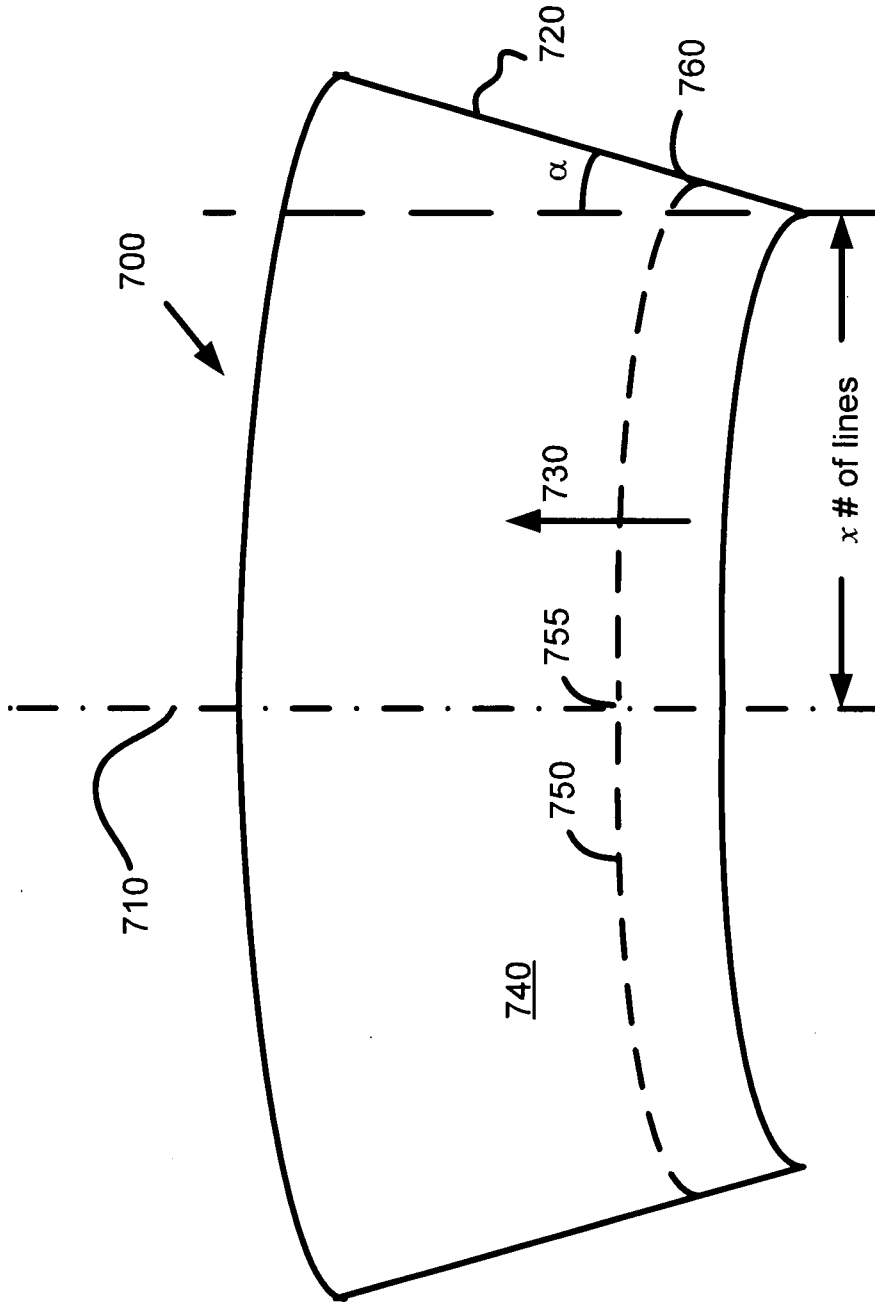


FIG. 7

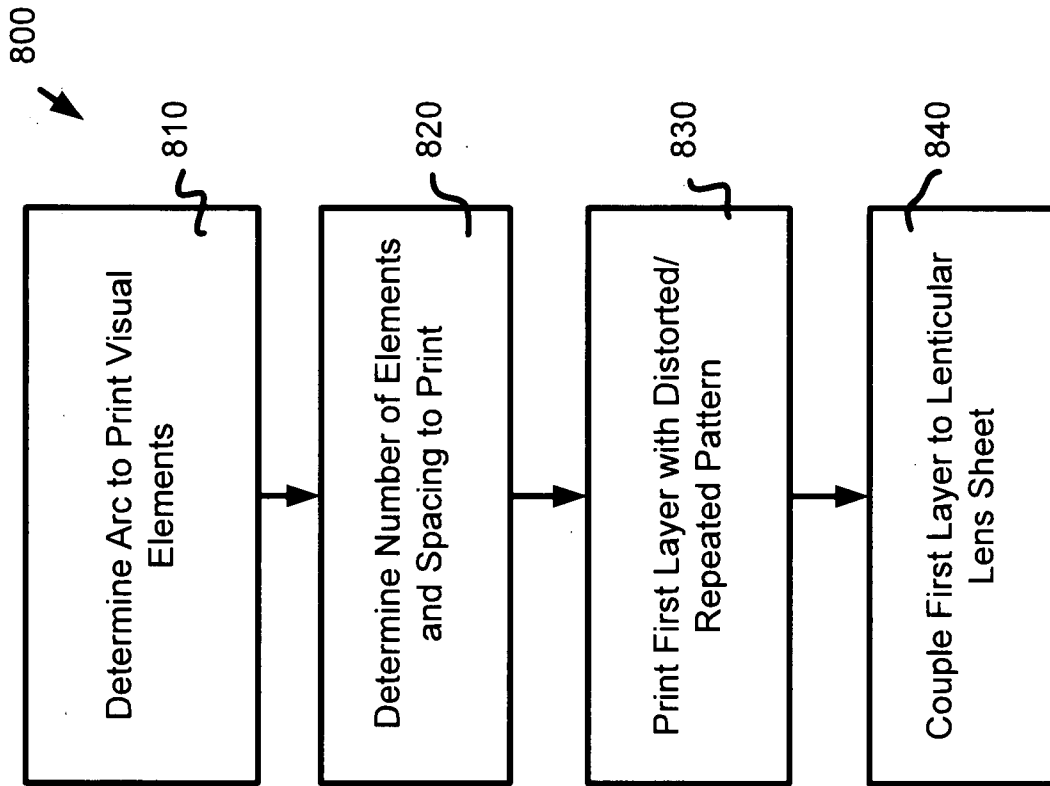


FIG. 8

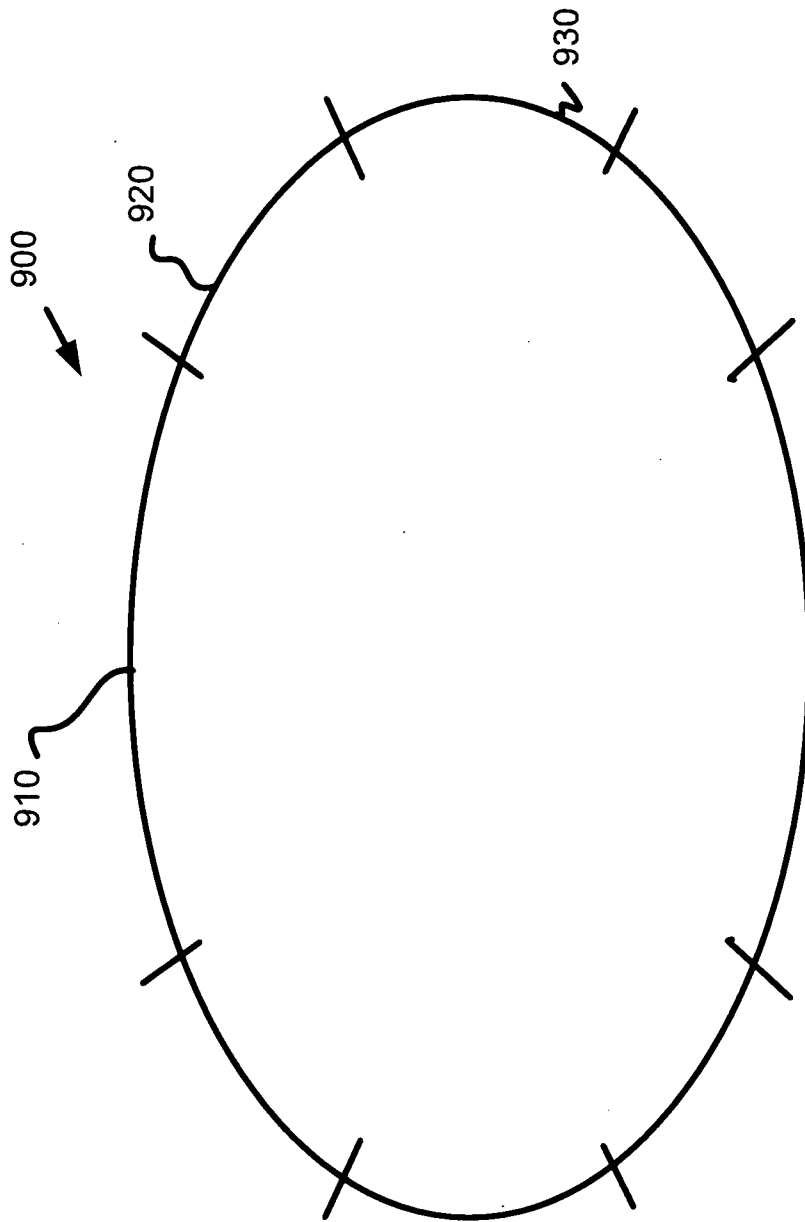


FIG. 9

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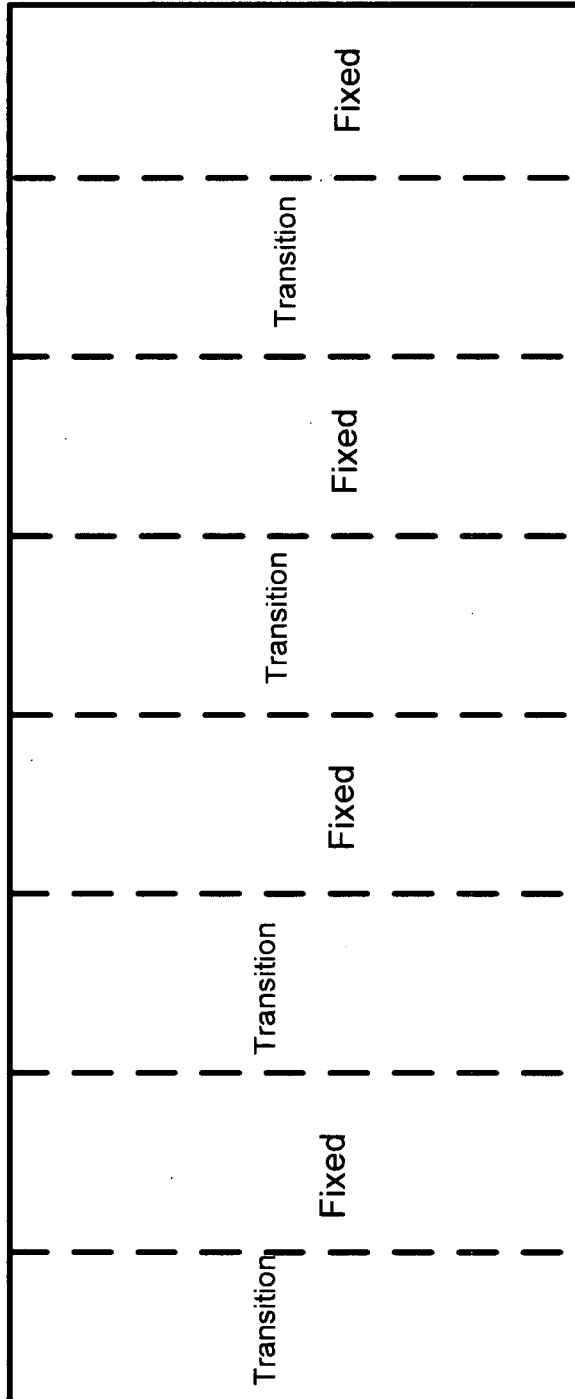


FIG. 10

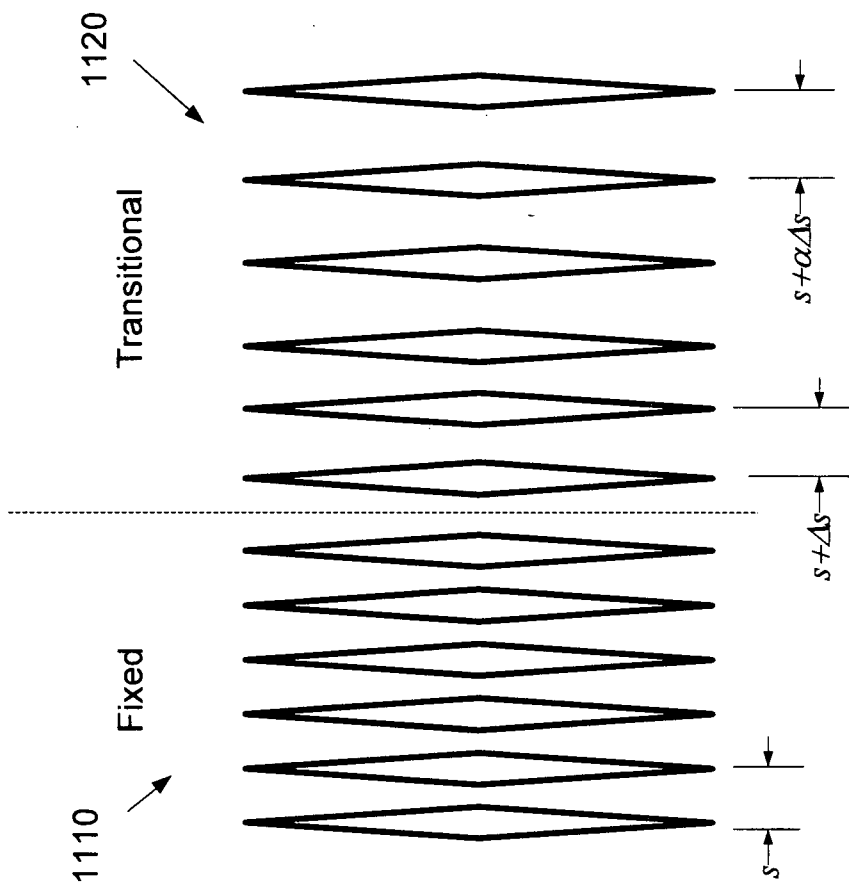


FIG. 11

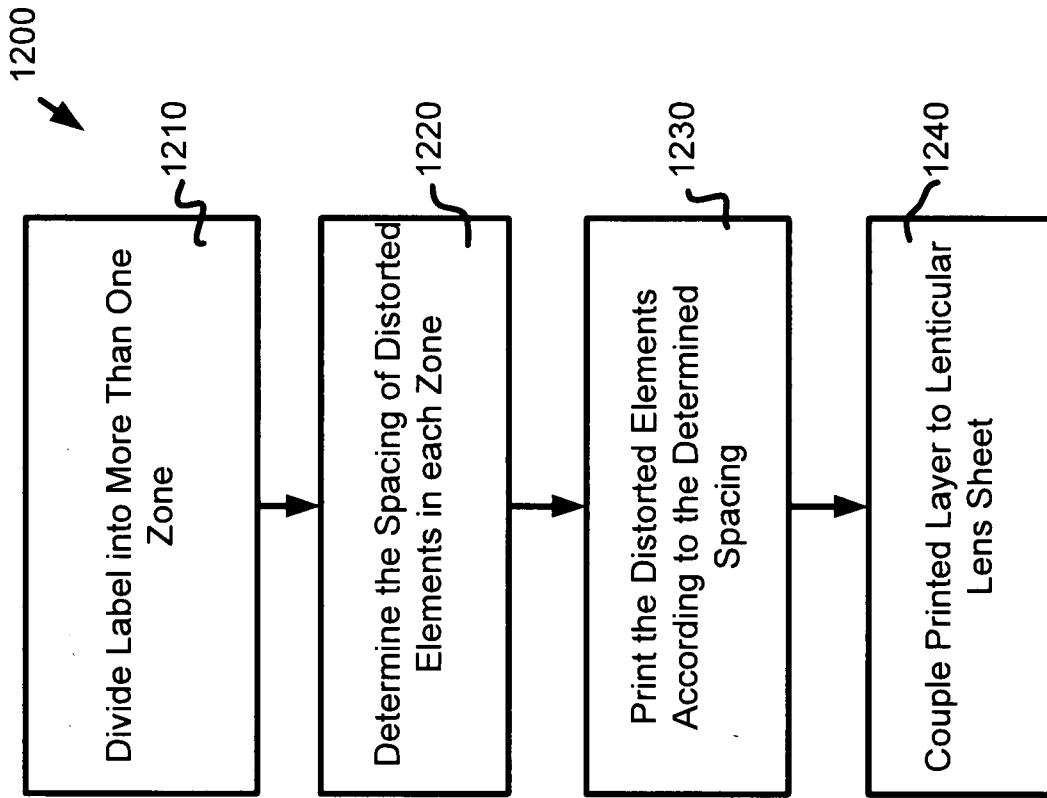


FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 07/21114

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - G03B 21/60 (2008.01) USPC - 359/457 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(8) - G03B 21/60 (2008.01) USPC - 359/457 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 practicable, search terms used) PubWEST(USPT,PGPB,EPAB,JPAB); Google patent; Google scholar Search terms - Lenticular, conical, cylindrical, cup, moire, interference, pattern, display, distorted, printed		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 6,251,566 B1 (BROSH et al.) 26 June 2001 (26.06.2001) Abstract; Figure 11; Claim 1; col. 2, ln. 29-34; col. 4, ln. 13-15; col. 4, ln. 63-66; col. 5, ln. 66-col. 6, ln. 2	1-5, 7, 8, 18-23, 25, 26, 30, 31, 35, 36, 46, 50, 51 ----- 6, 9-17, 24, 27-29, 32-34, 37-45, 47-49, 52-60
Y	US 6,490,092 B1 (GOGGINS) 03 December 2002 (03.12.2002) Figure 13.	6, 24, 32-34, 47-49
Y	US 7,075,725 B2 (TOMCZYK) 11 July 2006 (11.07.2006) col. 2, ln. 5-7; col. 10, ln. 28-31	9, 16, 17, 27-29, 37, 44, 45, 52, 59, 60
Y	US 2004/0115376 A1 (TOMCZYK) 17 June 2004 (17.06.2004) para [0016], [0018], [0023], [0024]	10-15, 38-43, 53-58
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/>		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 5 February 2008 (05.02.2008)		Date of mailing of the international search report 12 MAR 2008
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201		Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774