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set of claims

What is Claimed is:

1. A paper structure comprising:
a first region disposed at a first elevation and having a first thickness;
a second region disposed at a second elevation different from the first elevation, the second region having a second thickness;
a third region interconnected with the first region, the third region having a third thickness; and the third region having a third elevation; and
a fourth transition region having a fourth thickness, the transition region interconnecting the second region with at least one of the first and third regions;
characterized in that the fourth thickness is greater than the first thickness, the fourth thickness is greater than the second thickness, and characterized in that the third thickness is greater than the first thickness.
2. The paper structure of Claim 1 characterized in that the first elevation is different from the third elevation.
3. The paper structure of Claim 2 characterized in that the first region comprises a plurality of discrete protuberances dispersed throughout the third region.
4. The paper structure of Claims 1, 2, and 3 characterized in that the difference between the first elevation and the second elevation is at least about 0.05 millimeter.
5. The paper structure of Claims 1, 2, 3, and 4 characterized in that the fourth thickness is at least 1.5 times the second thickness.
6. The paper structure of Claims 1, 2, 3, 4, and 5 characterized in that the fourth thickness is at least 1.5 times the first thickness.
7. The paper structure of Claims 1, 2, 3, 4, 5, and 6 characterized in that the paper structure has a background matrix comprising at least a portion of each of the first and third regions, and characterized in that the second region inscribes a circular portion of the background matrix having a projected area of at least 50 square millimeters.

8. The paper structure of Claims 1, 2, 3, 4, 5, 6, and 7 characterized in that the paper structure is foreshortened at two different elevations.
9. The paper structure of Claims 1, 2, 3, 4, 5, 6, 7, and 8 characterized in that at least a portion of the second region is bordered by a variable frequency creping region.
10. A paper structure comprising:
 - a first region;
 - a second patterned region;
 - a background matrix comprising at least a portion of the first region and a third region, the first region comprising a plurality of discrete protuberances dispersed throughout the third region in the background matrix;
 - a transition region interconnecting the second region with the background matrix; and
 - a variable creping frequency region, the variable creping frequency region bordering at least a portion of the second patterned region, and the variable creping frequency region extending from a border of the patterned second region and terminating in the background matrix.
11. An apparatus for use in making a web of papermaking fibers, the apparatus comprising:
 - a foraminous background element having a first web contacting surface at a first elevation; and
 - a web patterning layer joined to the foraminous background element, the layer extending above the first web contacting surface of the foraminous background element to form a second web contacting surface at a second elevation different from the first elevation;characterized in that the web patterning layer inscribes a plurality of circular portions of the foraminous background element, each circular portion having a projected area of at least 50 square millimeters.
12. The apparatus of Claim 11 characterized in that each circular portion has a projected area of at least 100 square millimeters.

13. The apparatus of Claims 11 and 12 characterized in that the projected area of the second web contacting surface is between about 5 and about 20 percent of the projected area of the apparatus.
14. The apparatus of Claim 13 characterized in that the projected area of the second web contacting surface is between about 5 and about 14 percent of the projected area of the apparatus.
15. The apparatus of Claims 11, 12, 13, and 14 characterized in that the foraminous background element comprises woven filaments, and characterized in that the first web contacting surface of the foraminous background element comprises discrete web contacting knuckles at the cross-over points of the woven filaments.
16. The apparatus of Claims 11, 12, 13, 14, and 15 characterized in that the difference between the first elevation and the second elevation is at least about 0.05 millimeter.
17. The apparatus of Claims 11, 12, 13, 14, 15, and 16 characterized in that the web patterning layer comprises discrete web patterning elements.
18. The apparatus of Claims 11, 12, 13, 14, 15, 16, and 17 characterized in that the web patterning layer comprises a continuous network second web contacting surface.
19. A method of forming a paper structure comprising the steps of:
 - providing a wet web of paper making fibers;
 - deflecting the web in a first deflection step to provide a non-monoplanar web having a first uncompacted web region, and a second uncompacted web region having an elevation different from the elevation of the first uncompacted web region while the web has a consistency of between about 8 and about 30 percent;
 - deflecting the first uncompacted web region relative to the second uncompacted web region in a second deflection step to temporarily reduce the difference in elevation between the first uncompacted web region and the second uncompacted web region;

compacting a predetermined portion of the first uncompacted web region at a web consistency of between about 40 to about 80 percent to provide a first compacted region and a third uncompacted region;
compacting at least a portion of the second uncompacted web region at a web consistency of between about 40 to about 80 percent to form a second compacted web region; and
restoring at least some of the difference in elevation lost in the first deflection step to provide the first compacted region at an elevation different from the elevation of the second compacted region.

20. The method of Claim 19 further comprising the step of foreshortening the web after compacting the web.
21. The method of Claim 20 comprising the step of imparting a variable frequency crepe pattern to a portion of the web bordering at least a portion of the second compacted web region.
22. The method of Claims 19, 20, and 21 characterized in that the step of compacting the first uncompacted web region comprises forming a first compacted web region comprising a plurality of discrete compacted protuberances dispersed throughout the third uncompacted region.
23. The method of Claims 17, 18, 19, 20, 21, and 22 characterized in that the step of deflecting the web in the first deflection step comprises providing a differential fluid pressure across the thickness of the web.
24. A method of forming a paper structure comprising the steps of:
providing an uncompacted, generally monoplanar web of paper making fibers;
providing a web support apparatus comprising a foraminous background element having a first web contacting surface and a web patterning layer joined to the foraminous background element, the web patterning layer extending from the first web contacting surface to form a second web contacting surface at an elevation different from the elevation of the first web contacting surface, and the web patterning layer inscribing a plurality of circular portions of the foraminous background element, each of the inscribed circular portions of the foraminous background element having a projected area of at least 50 square millimeters;

supporting the web on the web support apparatus;
deflecting a portion of the web to form a non-monoplanar web having a first uncompacted web region supported on the first web contacting surface at an elevation different from an elevation of a second uncompacted web region supported on the second web contacting surface while the web has consistency of between about 8 and about 30 percent;
providing a compaction surface;
positioning the web intermediate the web support apparatus and the compaction surface;
deflecting the first web contacting surface relative to the second web contacting surface in a second deflection step to reduce the difference in elevation between the first uncompacted web region and the second uncompacted web region;
compacting a predetermined portion of the first uncompacted web region between the first web contacting surface and the compaction surface to form a first compacted region comprising a plurality of discrete compacted protuberances dispersed throughout a relatively uncompacted region;
compacting at least a portion of the second uncompacted web region between the second web contacting surface and the compaction surface to form a second compacted region;
drying the web to a consistency of at least about 90 percent; and
creping the web from the compaction surface.