CLAIMS

What is claimed is:

1. A method of forming a flexible capillary assembly having a set of at least one filled capillary, the method comprising:

winding a flexible, deformable capillary base web partially around the surface of a rotating cylinder that has a plurality of sets of recessed features formed therein, each set corresponding to a set of capillaries;

connecting the recessed features underlying the capillary base web to a source of reduced pressure to draw the capillary base web into the recessed features and form the set of capillaries therein;

applying a fill material to the surface of the capillary base web to fill the set of capillaries; and

laminating a flexible capillary barrier web over the capillary base web to close the set of capillaries.

2. The method according to claim 1, wherein the step of applying a fill material uses a chambered doctor blade system, with a central wet zone of the fill material and entrance and exit blades, to apply the fill material to the set of capillaries passing below the central wet zone of the chambered doctor blade system, as the cylinder rotates.

3. The method according to claim 1, wherein the step of laminating the capillary barrier web over the capillary base web comprises applying the capillary barrier web to the carrier base web, while the capillary base web is on the rotating cylinder, using a lamination roller.

4. The method according to claim 3, wherein the capillary barrier web comprises a barrier layer and a peelable support layer, and further comprising the step of forming vias in the barrier layer, which provide access to the capillaries when the peelable support layer is removed.

5. A method of forming a flexible capillary assembly having a set of at least one filled capillary, the method comprising:

winding a first flexible, deformable capillary base web partially around the surface of a rotating cylinder that has a plurality of sets of recessed features formed therein, each set corresponding to a set of capillaries;

selectively connecting the recessed features underlying the capillary base web to a source of reduced pressure to draw the capillary base web into the recessed features and form a set of capillaries therein; and

selectively disconnecting the recessed features exposed to the atmosphere from the source of reduced pressure.

6. The method according to claim 5, wherein the capillary base web is applied to the surface of the rotating cylinder with a first lay-on roller, and wherein the capillary base web is removed from the rotating cylinder with a second lay-on roller.

7. The method according to claim 6, wherein the recessed features in the surface of the cylinder between the first lay-on roller, where the capillary base web is applied and the second lay-on roller where the capillary base web is removed are selectively connected to a source of reduced pressure, and wherein the recessed features in the surface of the cylinder between the second lay-on roller where the capillary base web is removed and the first lay-

on roller, where the capillary base web is applied are selectively disconnected from the source of reduced pressure.

8. A tool for forming a flexible capillary assembly having at least one set of at least one filled capillary, the tool comprising:

a rotatably mounted cylinder having a plurality of circumferentially spaced zones;

at least one set of recessed features formed in the surface of at least some of the zones, each set corresponding to a set of capillaries, and each set having a port therein; and

each of the zones having a manifold communicating with the ports of each of the sets of recessed features in the zone, the manifold being selectively connectable to a source of reduced pressure to selectively connect the sets of recessed features in the zone to the source of reduced pressure.

9. The tool according to claim 8, wherein the cylinder comprises a core and a sleeve, removeably mounted over the core, and wherein the sets of recessed features are formed in the sleeve.

10. The tool according to claim 9, wherein at least a portion of the manifold of each zone is in the core, and further comprising at least one seal between the core and the sleeve to provide sealed communication between the manifold and the port of each set of recessed features.

11. The tool according to claim 10, wherein the at least one seal between the core and the sleeve is pressurizable.

12. The tool according to claim 10, wherein the seal comprises an o-ring surrounding an opening of the manifold in the core, which encompasses the port of at least one set of recessed features.

13. The tool according to claim 12, wherein the o-ring of each seal is seated in a seat formed in the surface of the core, and further comprising a passage for selectively pressurizing the seat to urge the o-ring into engagement with the sleeve installed over the core.

14. The tool according to claim 8, further comprising mating portions on the core and the sleeve to ensure that the sleeve is properly oriented with respect to the core.

15. A method of forming a flexible reservoir assembly having a set of at least one filled reservoir, the method comprising:

cutting the perimeter of the set of at least one reservoir into a flexible reservoir web secured to a peelable support layer;

removing the support layer and the waste cut interiors of the reservoirs of the set of reservoirs from the reservoir web;

securing the reservoir web to a base layer;

overfilling each reservoir in the set by depositing a plurality of layers of filling material into each reservoir; and

laminating a reservoir barrier layer over the overfilled reservoirs.

16. The method according to claim 15, further comprising cutting the perimeter of at least one catchment adjacent to at least one of the reservoirs of the set of reservoirs in the reservoir web; wherein the step of removing the support layer also removes the waste cut interior of the at least one catchment from the reservoir web; and wherein the step of laminating the reservoir barrier layer over the overfilled reservoirs forces excess filling material into the at least one catchment.

17. A method of forming a flexible reservoir assembly having a set of at least two filled reservoirs, the method comprising:

cutting the perimeter of at least one reservoir pre-form having at least two lobes separated by at least one juncture into a flexible reservoir web secured to a peelable support layer;

removing the support layer and the waste cut interior of the reservoir pre-form from the reservoir web;

securing the reservoir web to a base layer;

depositing a barrier material at the at least one juncture to divide the reservoir pre-form into separate reservoirs corresponding to the lobes;

overfilling each reservoir of the set by depositing a plurality of layers of filling material into each reservoir; and

laminating a reservoir barrier layer over the overfilled reservoirs.

18. The method according to claim 17, further comprising the step of calendaring the top surface of the deposited barriers material to the level of the surface of the reservoir web.

19. The method according to claim 18, further comprising the step of applying adhesive to the calendared surface of the deposited barrier material.

20. The method according to claim 18, wherein the reservoir pre-form has at least three lobes separated by at least two junctures, and wherein the step of depositing a barrier material comprises depositing barrier material at each of the at least two junctures to divide the reservoir pre-form into at least three reservoirs.

21. The method according to claim 20, wherein the step of depositing a barrier material comprises depositing at least two different materials.

22. The method according to claim 21, wherein the step of depositing two different materials comprises depositing at least first and second materials in such way that the second material is surrounded on the top and sides by the first material.

23. A method of manufacturing a flexible composite panel having a set of plurality of reservoirs connected by a set of at least one capillary, the method comprising:

forming a flexible capillary assembly having a set of at least one filled capillary by winding a first flexible, deformable capillary base web partially around the surface of a rotating cylinder that has a plurality of sets of recessed features formed therein, each set corresponding to a set of capillaries; connecting the recessed features underlying the capillary base web to a source of reduced pressure to draw the capillary base web into the recessed features and form the set of capillaries in the capillary base web; applying a fill material to the surface of the capillary base web to fill the set of capillaries; laminating a capillary barrier web over the capillary base web to close the capillaries; and

forming a flexible reservoir assembly having a set of at least two filled reservoirs by cutting the perimeter of the at least two reservoirs and associated catchments into a flexible reservoir web that is secured to a peelable support layer; removing the peelable support layer and the waste cut interiors of the reservoirs and the catchments from the reservoir web; securing the reservoir web to a base layer; overfilling each reservoir by depositing a plurality of layers of filling material; and

laminating the capillary assembly over the reservoir assembly, with the capillary barrier web in contact with the reservoir web, the lamination process driving excess filler from the reservoirs into the catchments.

24. The method according to claim 23, wherein the step of applying a fill material to the set of capillaries uses a chambered doctor blade system, with a central wet zone of the fill material and entrance and exit blades, to apply the fill material to the set of capillaries passing below the central wet zone of the chambered doctor blade system as the cylinder rotates.

25. The method according to claim 23, wherein the step of laminating the capillary barrier web over the capillary base web comprises applying the capillary barrier web to the capillary base web while the capillary base web is on the rotating cylinder, with a lamination roller.

26. The method according to claim 23, wherein the capillary barrier layer comprises a barrier layer and a peelable support layer, and further comprising the step of forming vias in the barrier layer, which provide access to the capillaries when the peelable capillary support layer is removed, and wherein the step of laminating the capillary assembly to the reservoir assembly comprises removing the peelable capillary support layer before laminating the capillary assembly to the reservoir assembly.

27. The method according to claim 23, wherein the capillary barrier web comprises a barrier layer and a peelable capillary support layer, and further comprising the step of forming vias in the barrier layer, which provide access to the capillaries.

28. The method according to claim 23, further comprising the steps of sub-dividing at least one of the reservoirs into at least two separate reservoirs by depositing a barrier material.

~~25.~~29. The method according to claim 19, wherein at least one of the reservoirs comprises at least two lobes separated by a juncture, and further comprising the step of sub-dividing the at least one reservoir into at least two reservoirs by depositing a barrier material into the junction.

~~26.~~30. The method according to claim ~~24~~29, further comprising the step of calendaring the top surface of the deposited barrier material to the level of the surface of the reservoir web.

~~27.~~31. The method according to claim ~~26~~30, further comprising the step of applying adhesive to the calendared surface of the deposited barrier material.

~~28.~~32. The method according to claim ~~25~~29, wherein the reservoir to be divided has at least three lobes separated by at least two junctures, and wherein the step of depositing a barrier material comprises depositing barrier material at each of the at least two junctures to divide the reservoir into at least three reservoirs.

~~29.~~33. The method according to claim ~~25~~29, wherein the step of depositing a barrier material comprises depositing at least two different materials.

~~30.~~34. The method according to claim ~~25~~33, wherein the step of depositing two different materials comprises depositing at least first and second materials in such a way that the second material is surrounded on the top and sides by the first material.

~~31.~~35. A method of manufacturing a flexible composite panel having a set of a plurality of reservoirs connected by a set of a plurality of capillaries, the method comprising:

forming a flexible capillary assembly having a set of at least two filled capillaries by winding a first flexible, deformable capillary base web partially around the surface of a rotating cylinder that has a plurality of sets of recessed features formed therein, each set corresponding to the set of capillaries; connecting the recessed features underlying the capillary base web to a source of reduced pressure to draw the capillary web into the recessed features and form the set of capillaries in the capillary base web; applying a fill material to the surface of the capillary base web to fill the set of capillaries; laminating a capillary barrier web over the capillary base web to close the capillaries; and

forming a flexible reservoir assembly having a set of a plurality of filled reservoirs by cutting the perimeter of at least a first reservoir, a second reservoir, and a third reservoir that comprises three lobes separated by two junctures, and associated catchments into a flexible reservoir web that is secured to a peelable support layer; removing the peelable support layer and the waste cut interiors of the reservoirs and the catchments from the reservoir web; securing the reservoir web to a base layer; sub-dividing the third reservoir into at least three separate reservoirs by depositing a barrier material at each of the two junctures; overfilling each reservoir by depositing a plurality of layers of filling material; and

laminating the capillary assembly over the reservoir assembly, the lamination process driving excess filler from the reservoirs into their associated

catchments, with one end of one of the at least two capillaries aligned with the first reservoir and the other end aligned of that capillary aligned with one of the junctures of the third reservoir, and with one end of the other of the at least two capillaries aligned with the second reservoir and the other end aligned with the other of the junctures of the third reservoir.

~~32.~~36. A method of manufacturing a flexible composite panel having a set of plurality of reservoirs connected by a set of at least one capillary, the method comprising:

laminating a flexible capillary assembly, that has at least one via communicating with the capillary, over a reservoir assembly, having at least one reservoir therein so that the contents of a reservoir and the contents of a capillary can react through a via, and crimping the capillary adjacent the via to restrict further interaction between the contents of the reservoir and the contents of the capillary.

~~33.~~35. The method according to claim ~~32~~36 wherein the step of crimping the capillary comprises applying a removable structure to temporarily crimp the capillary.