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(54) **IMPROVEMENTS IN OR RELATING TO WATER-SOLUBLE POUCHES**

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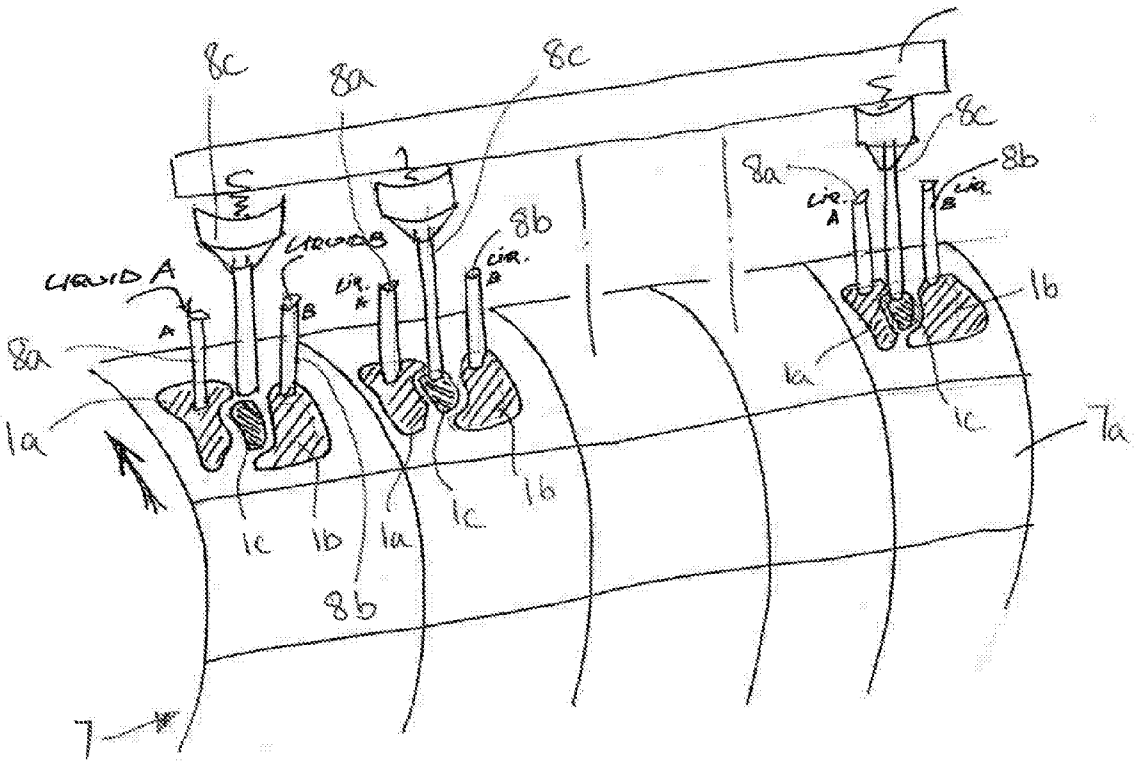
(57) **ABSTRACT**

A method and apparatus for producing multi-compartment water-soluble pouches **38** from a base web **27** and a lidding web **35** is disclosed. The apparatus includes a rotatable former **21** having compartment forming cavities **23** into which the base web **27** can be formed. The former **21** is configured so that compartments **26**,**29**,**32** of a pouch **38** can be formed and filled sequentially and thereafter all compartments **26**,**29**,**32** closed and sealed by affixing the lidding web **35** to the base web **27**.



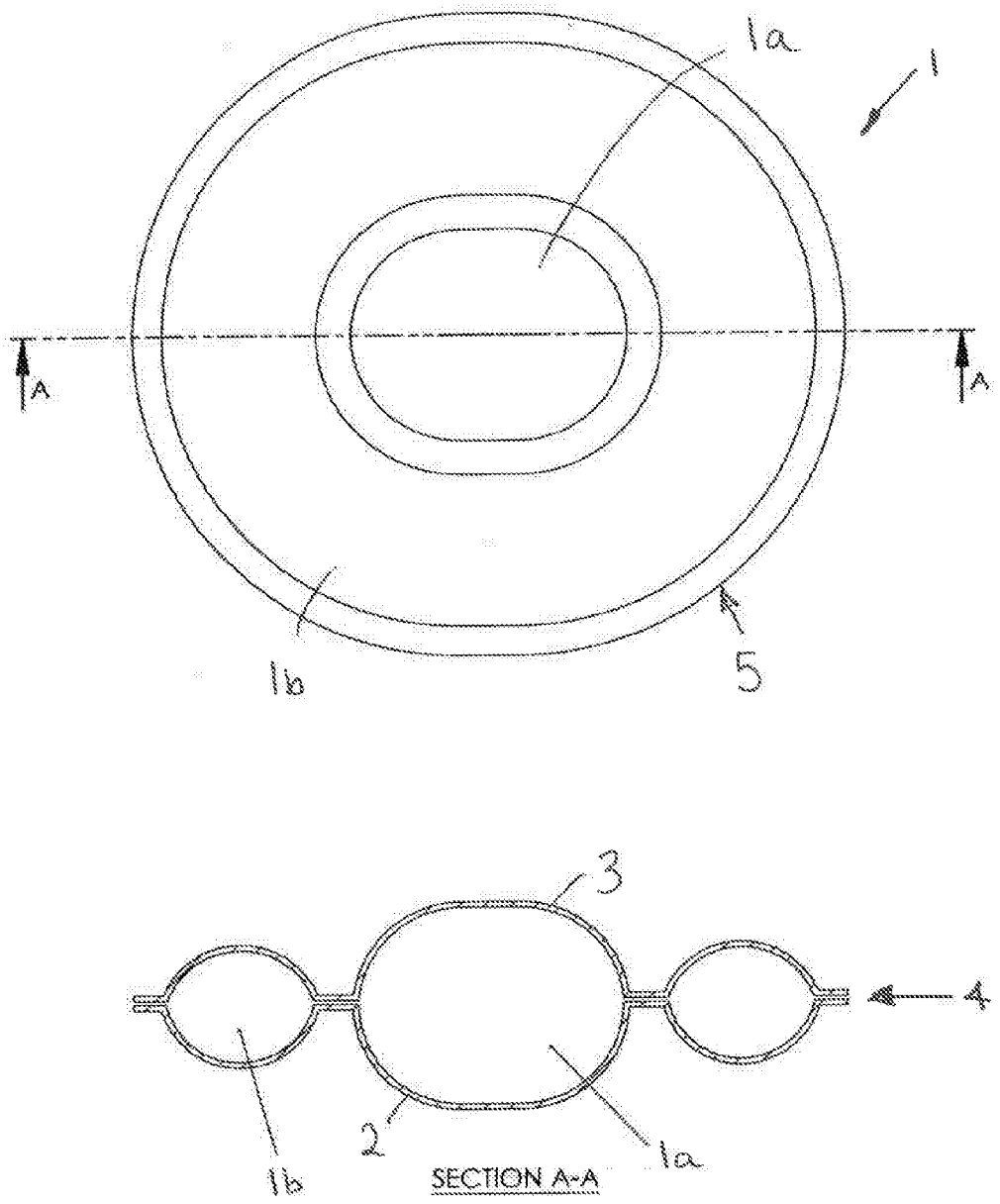


Figure 1

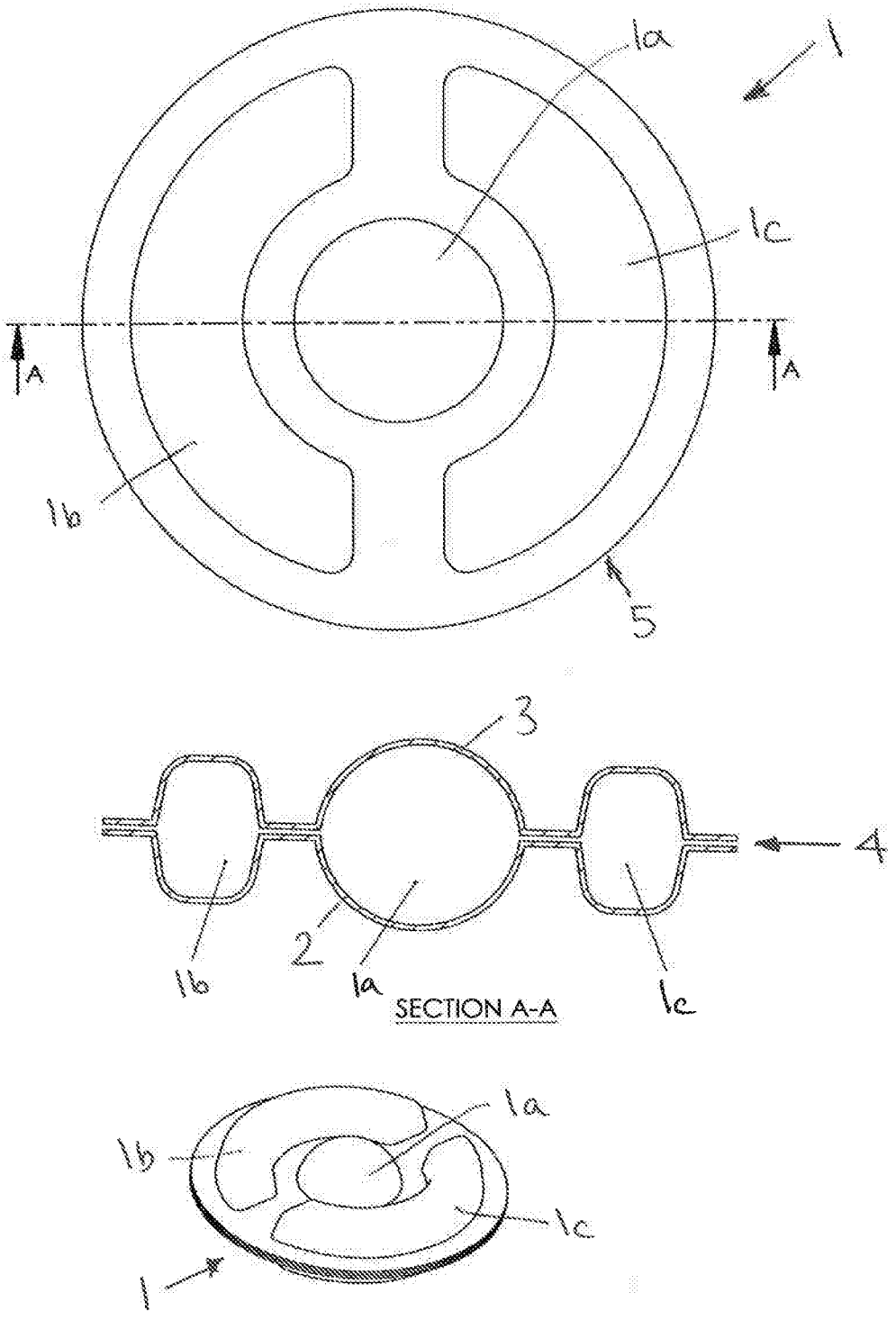
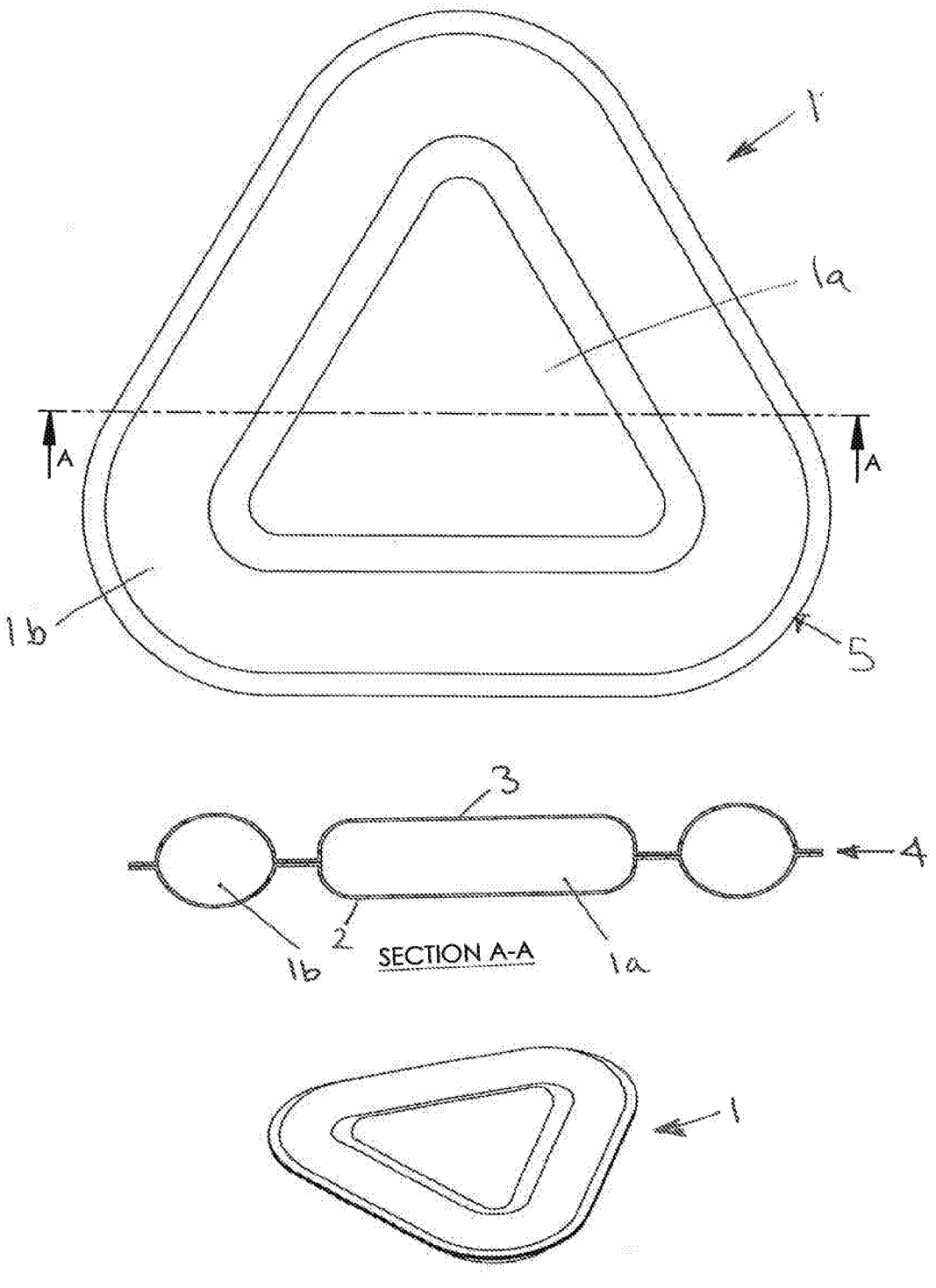


Figure 2



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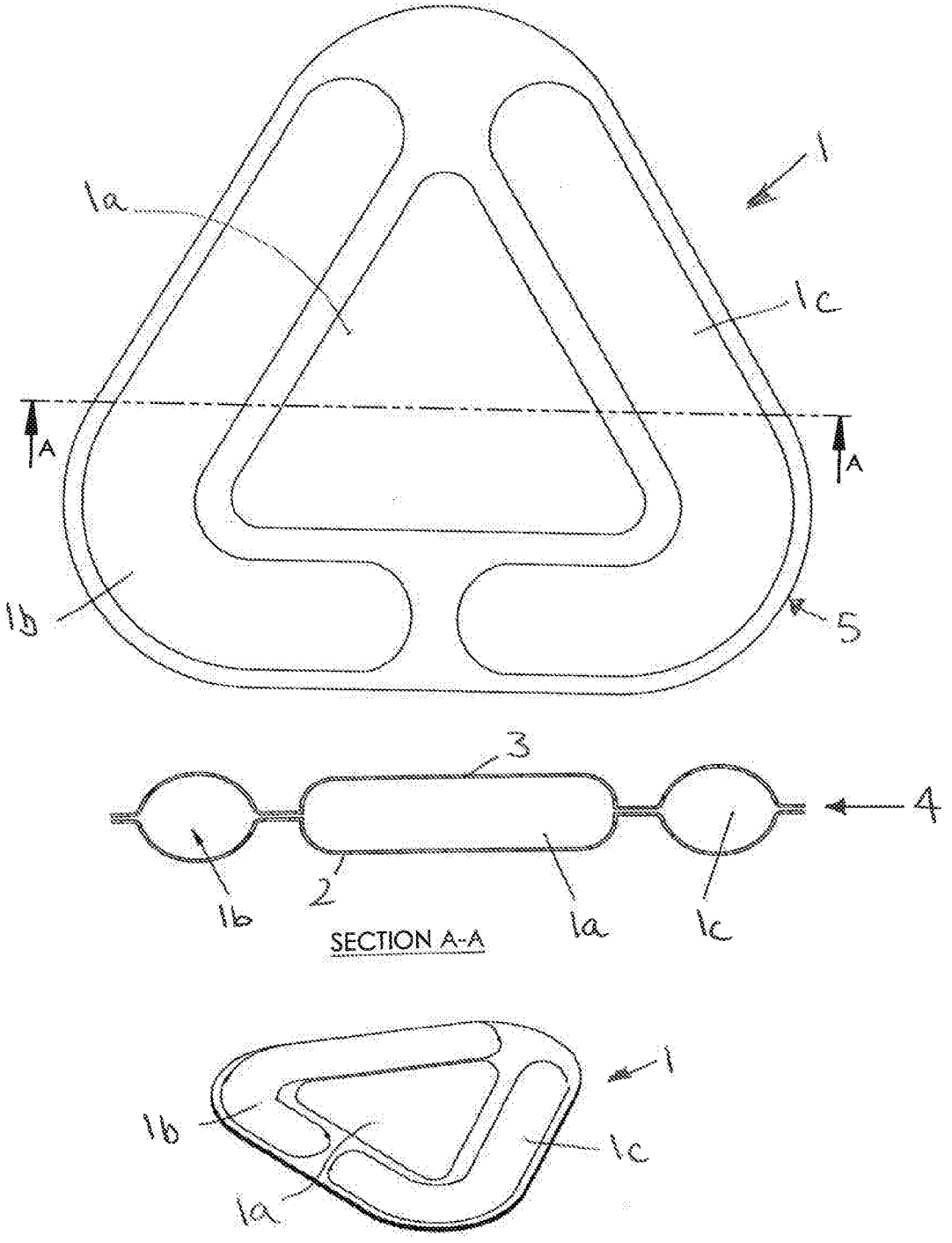

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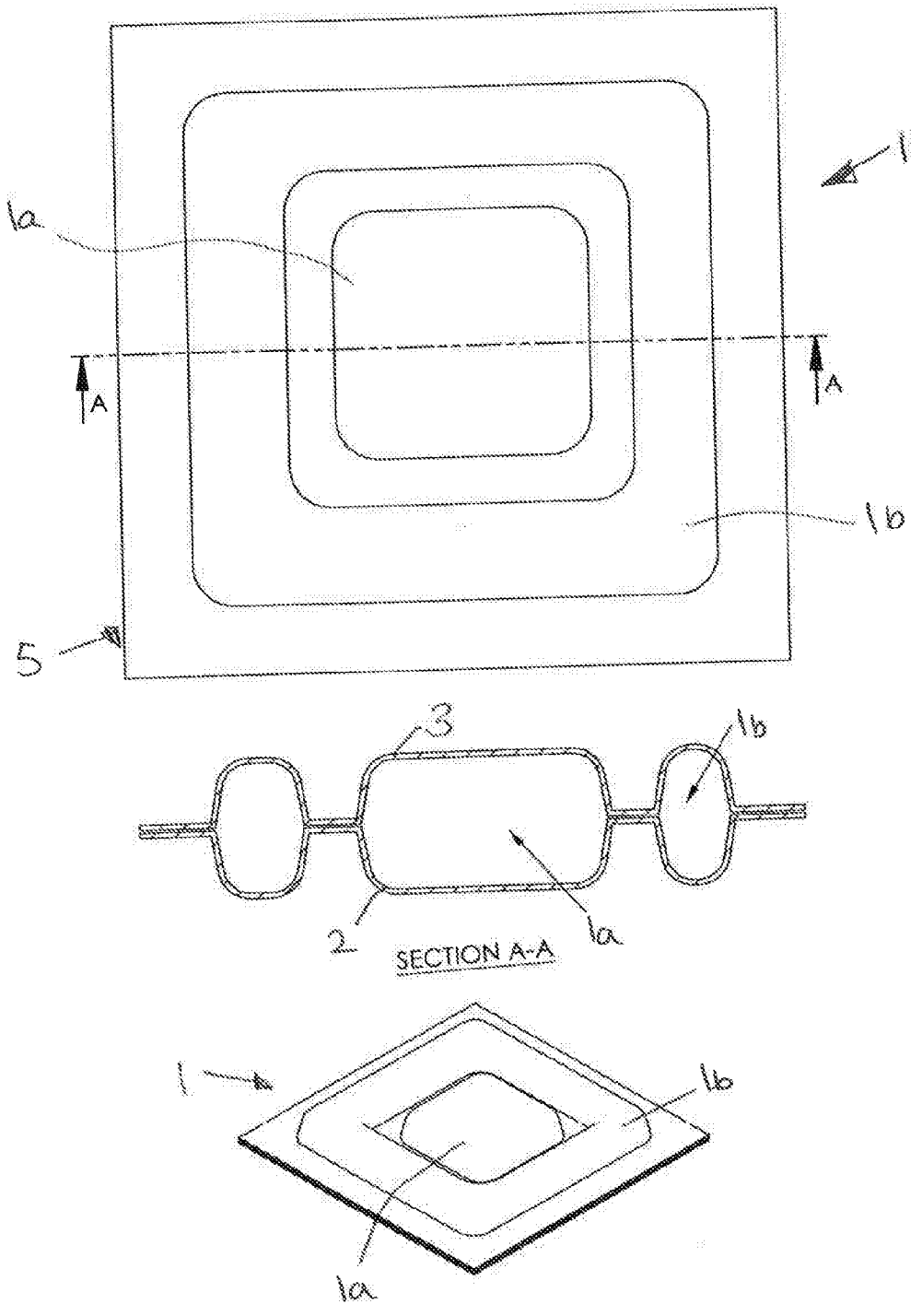

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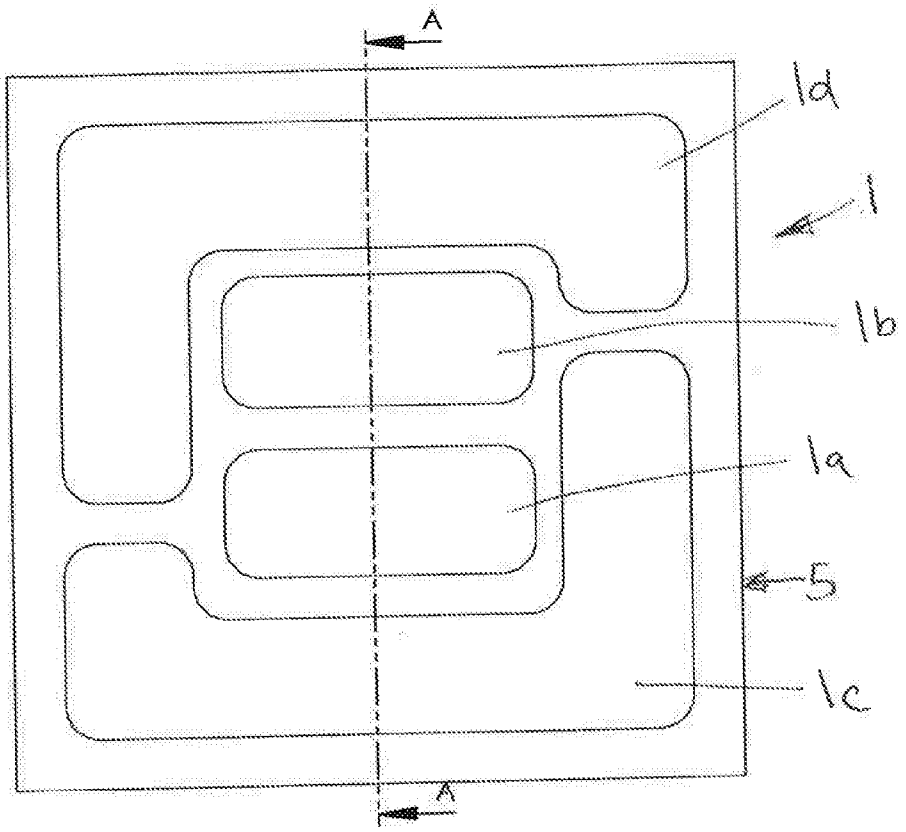
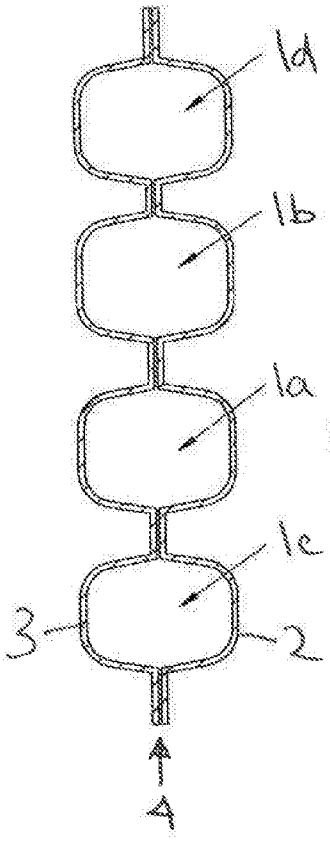
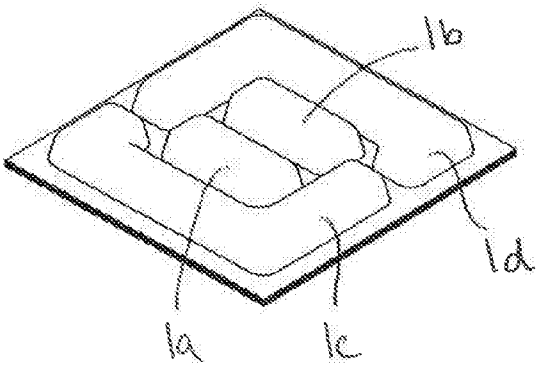




SECTION A-A



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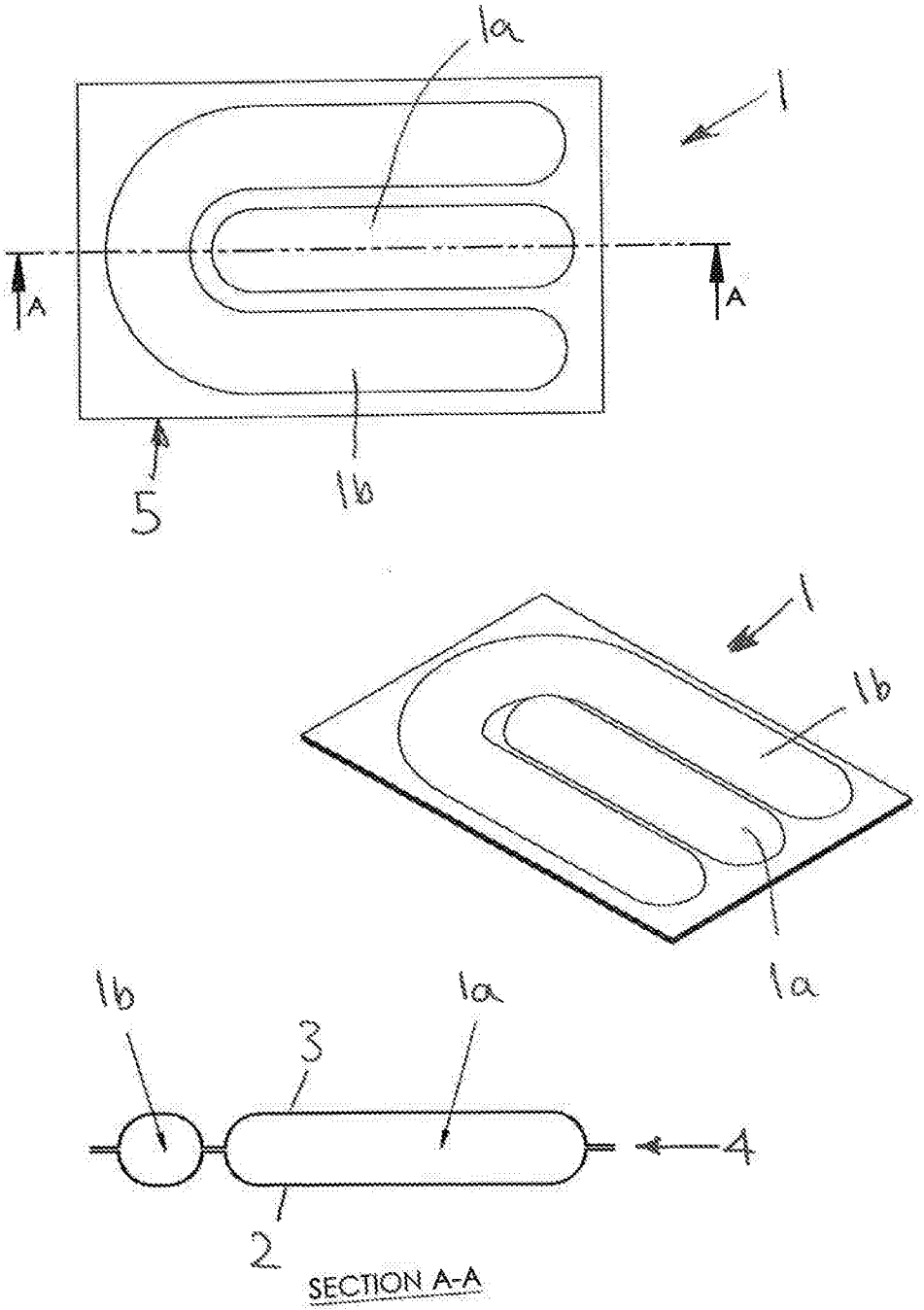

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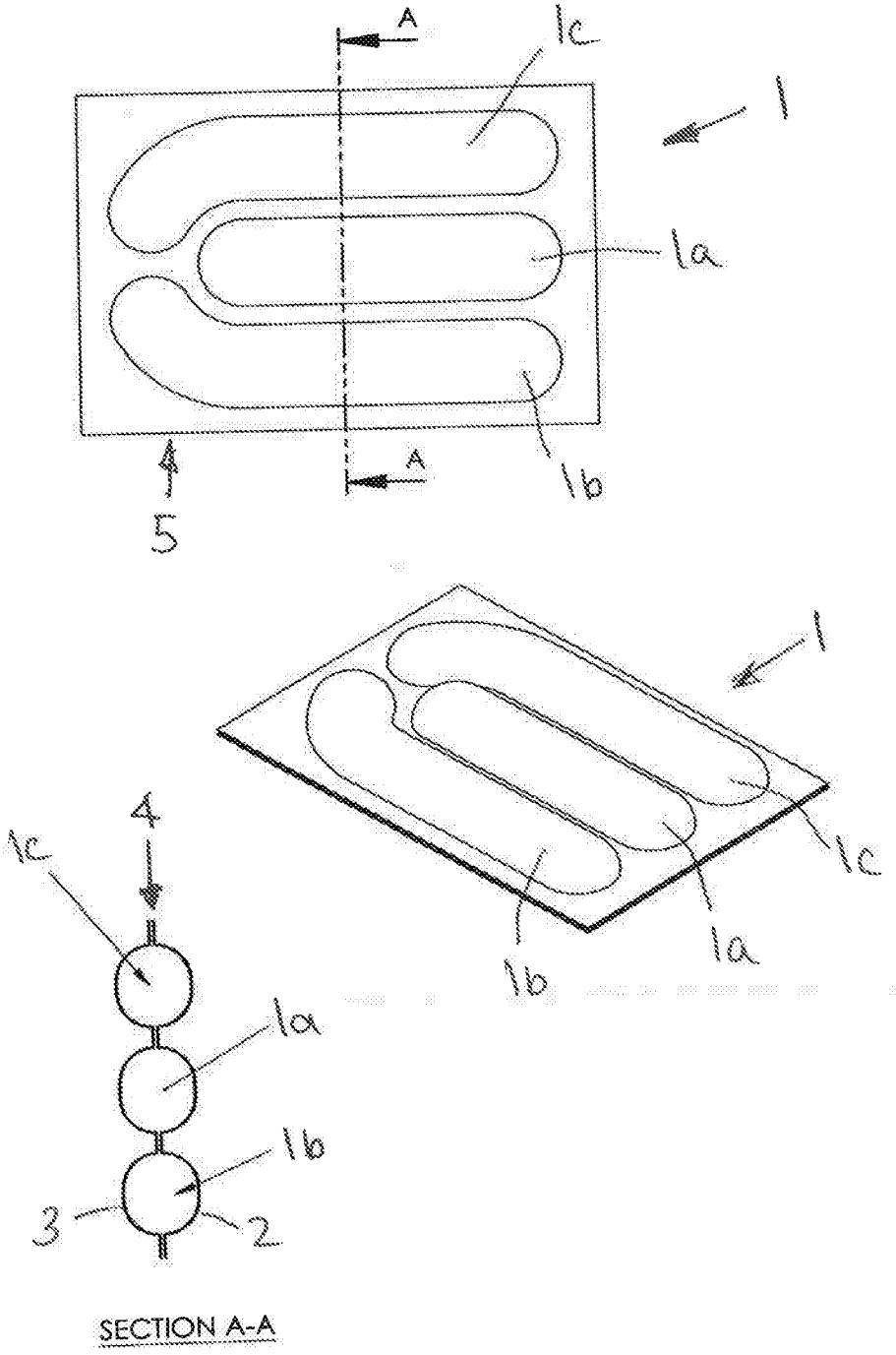

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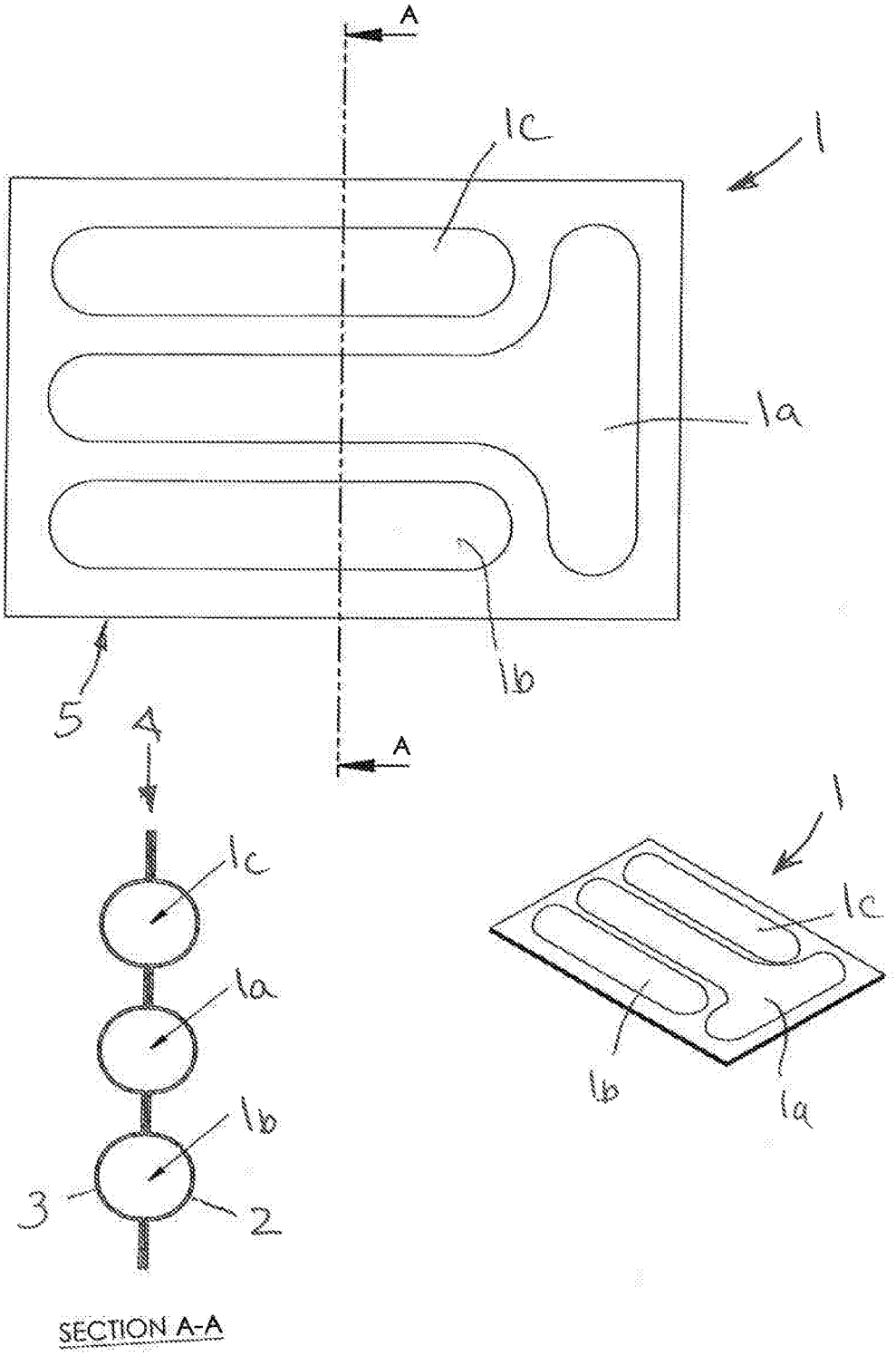

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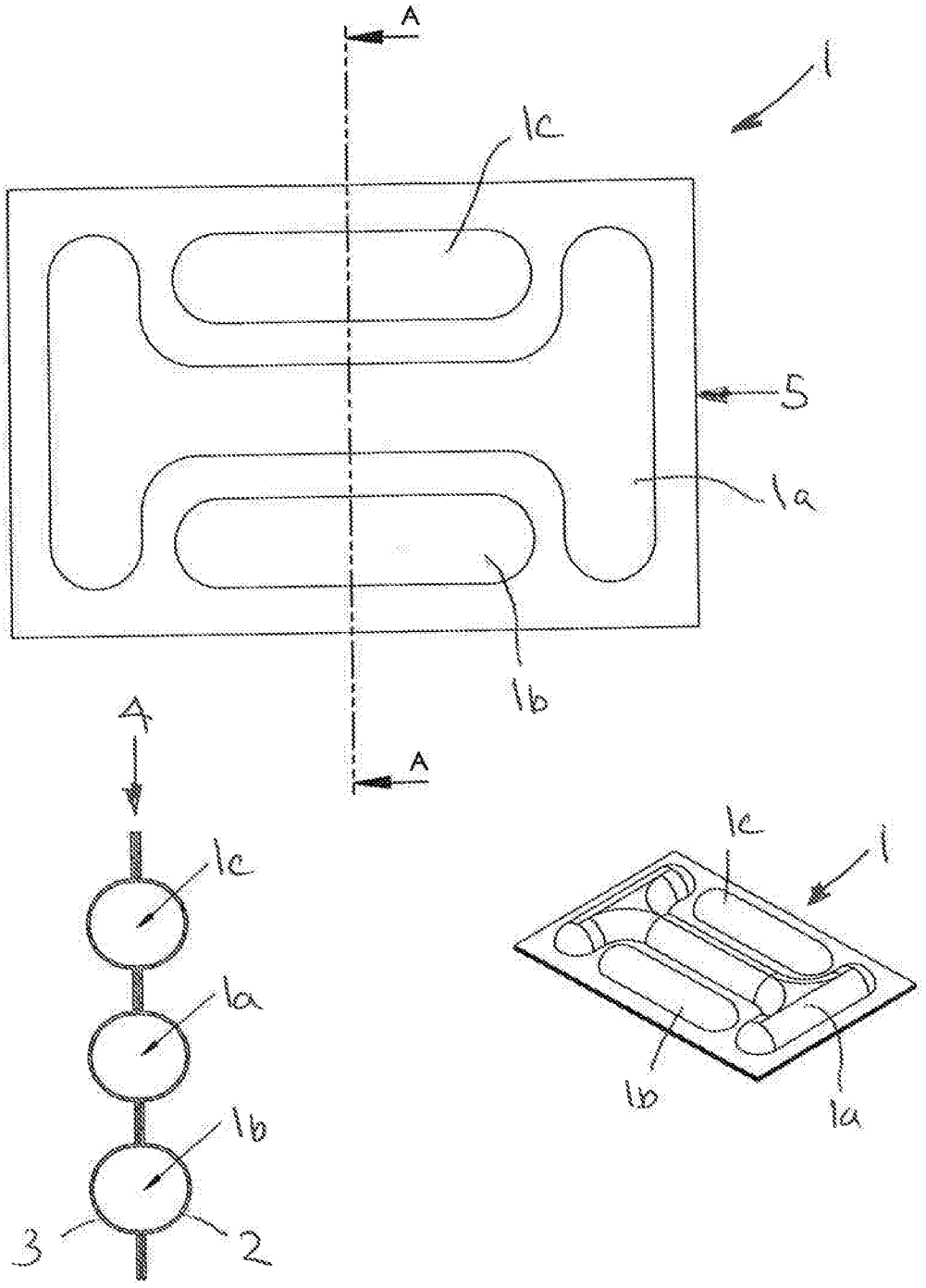

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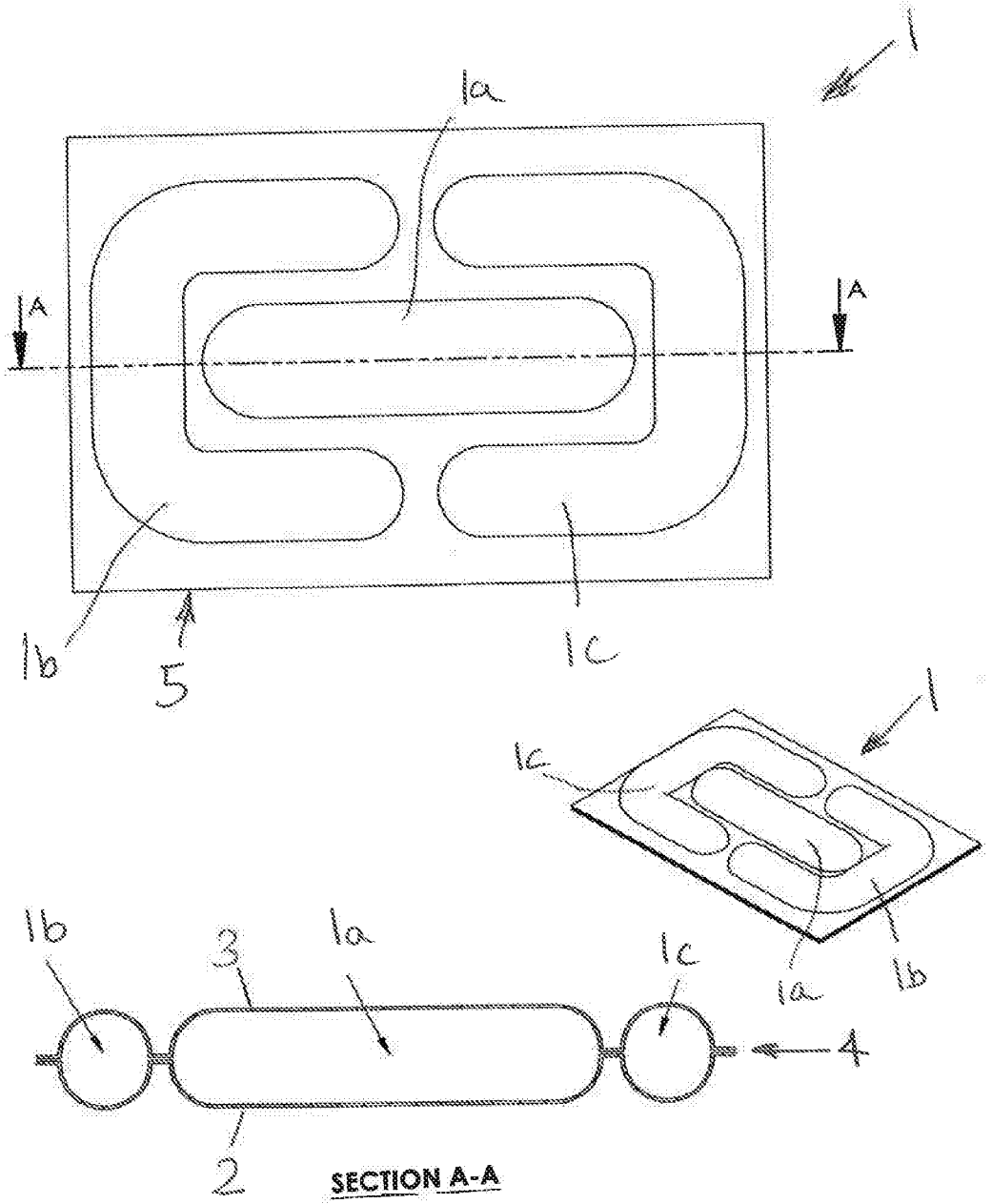

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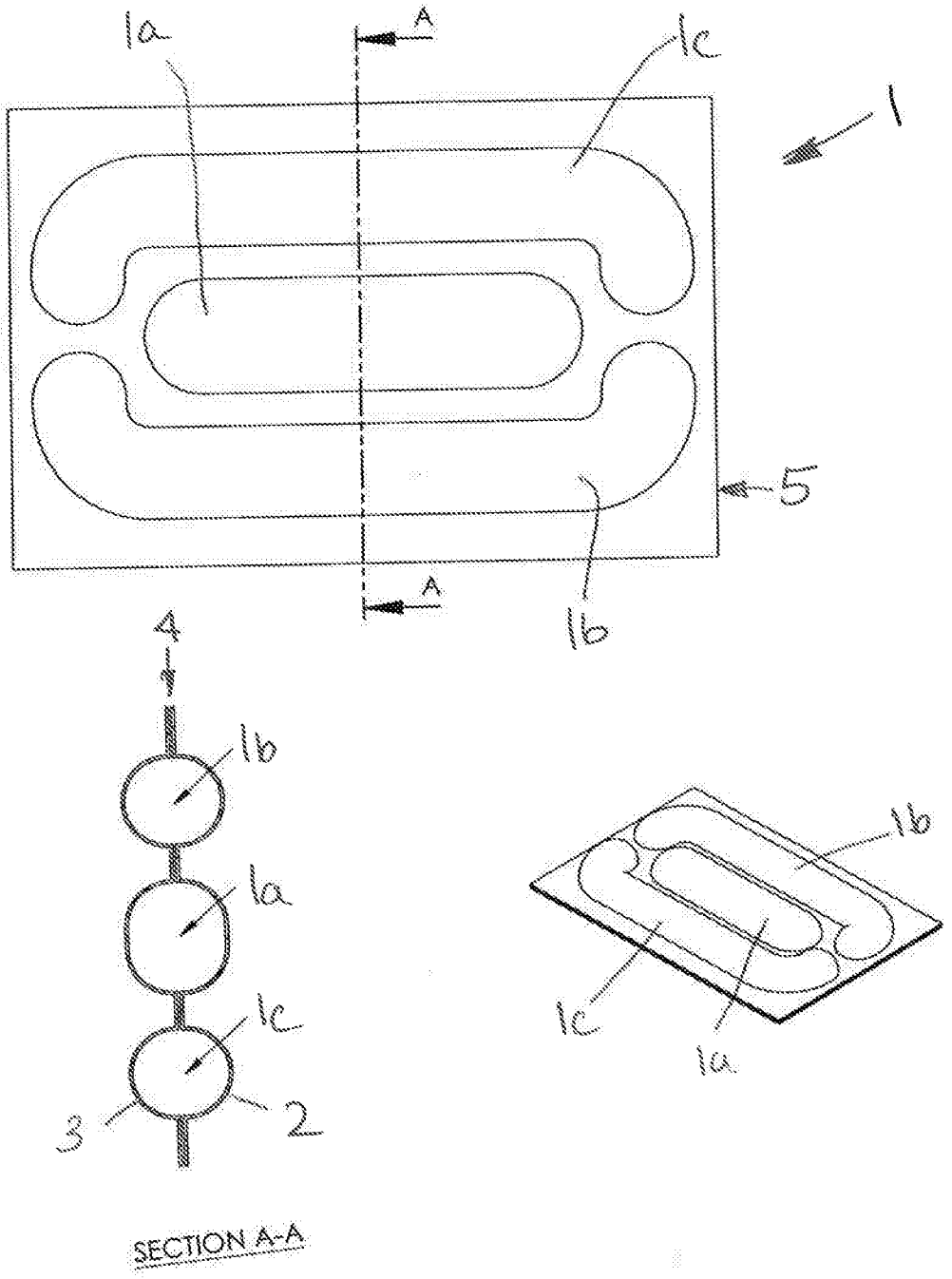
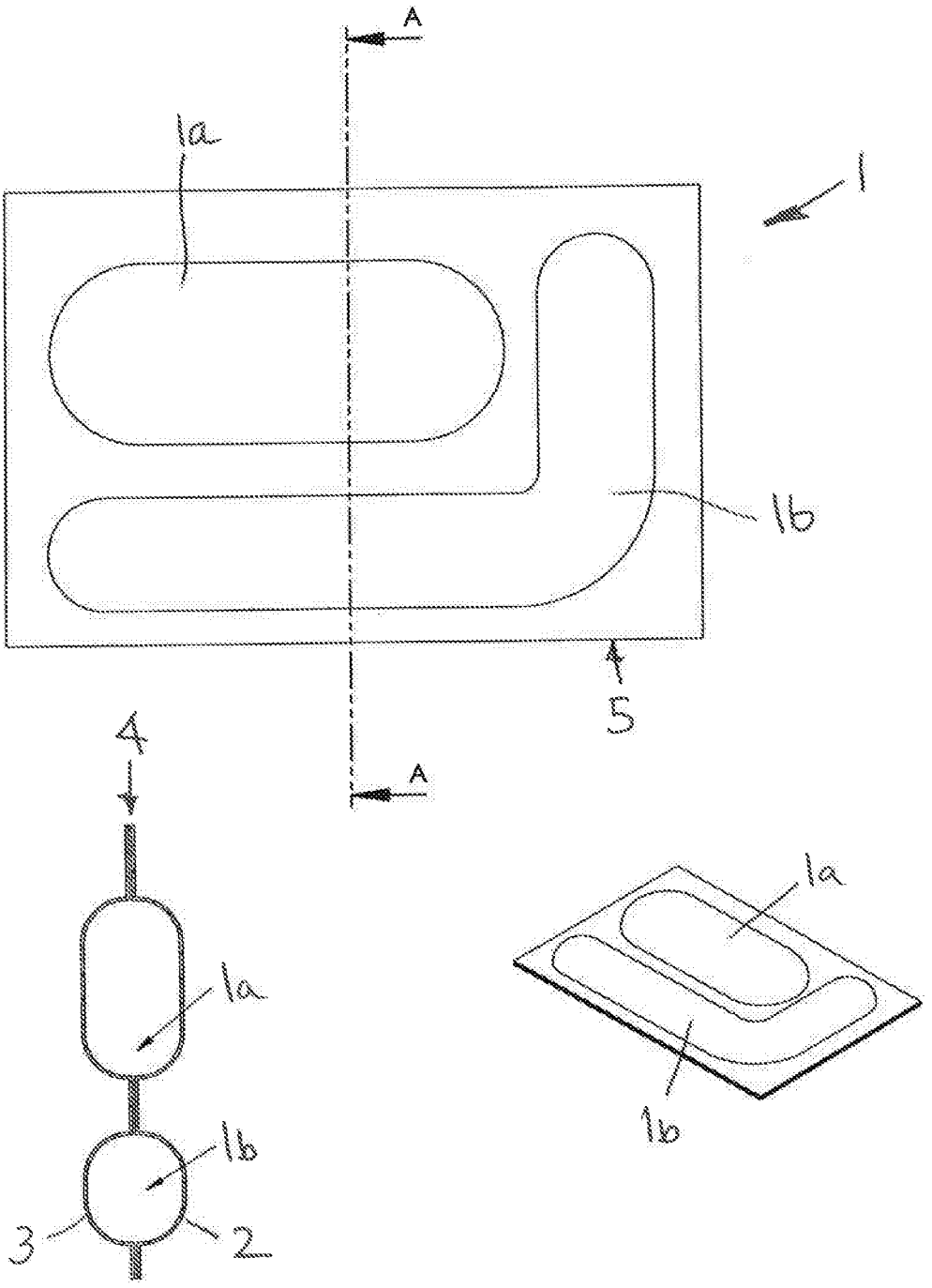
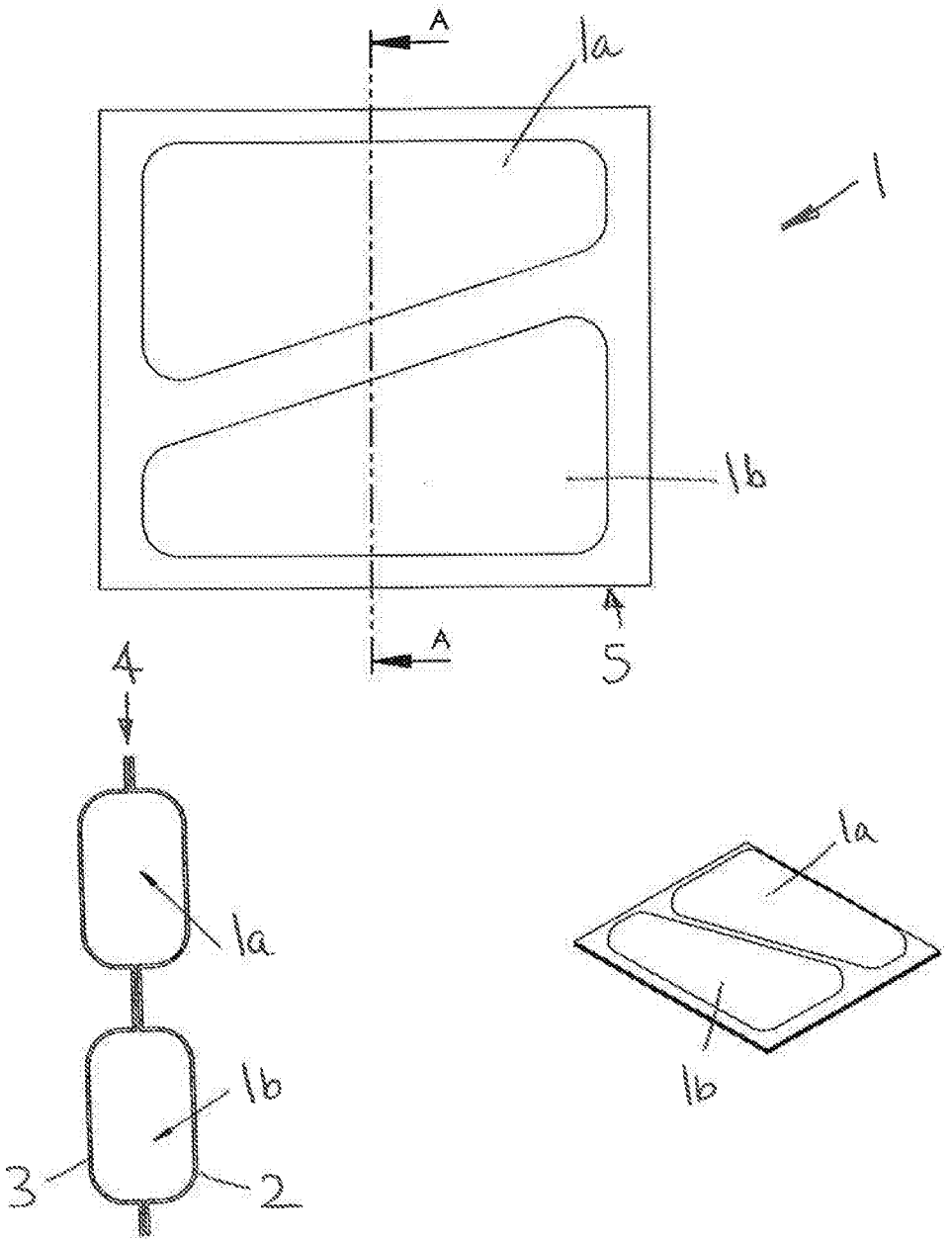


Figure 12



SECTION A-A

Figure 13



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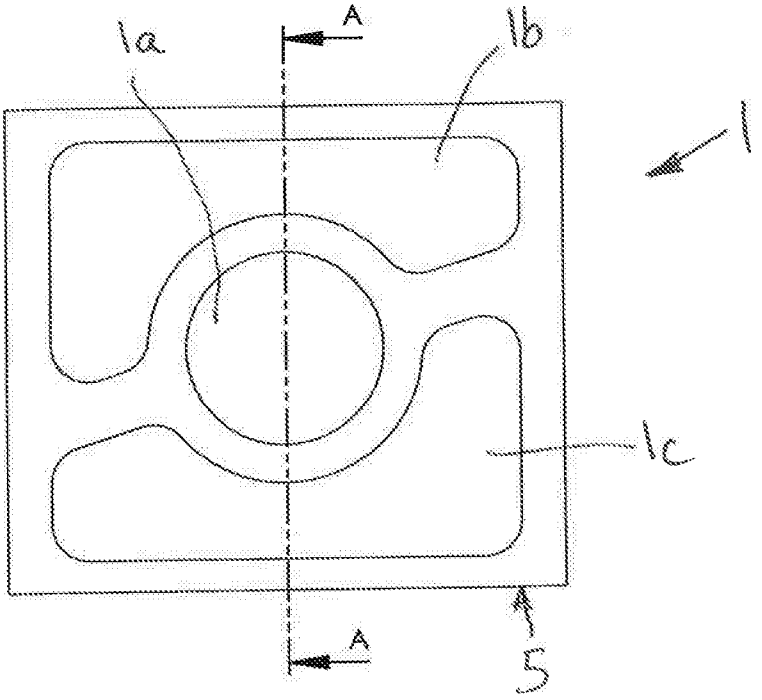
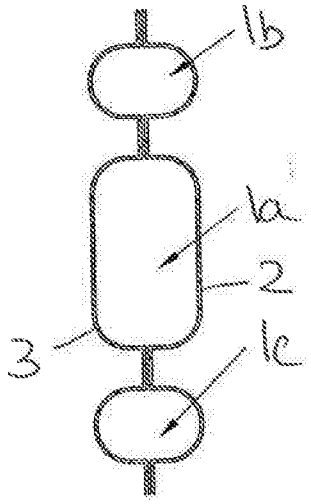
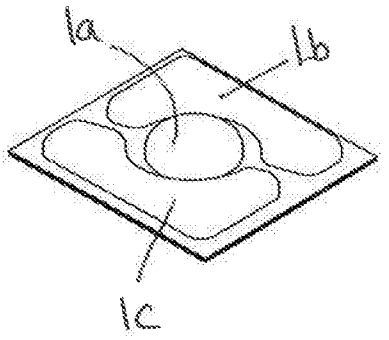






SECTION A-A

Figure 15

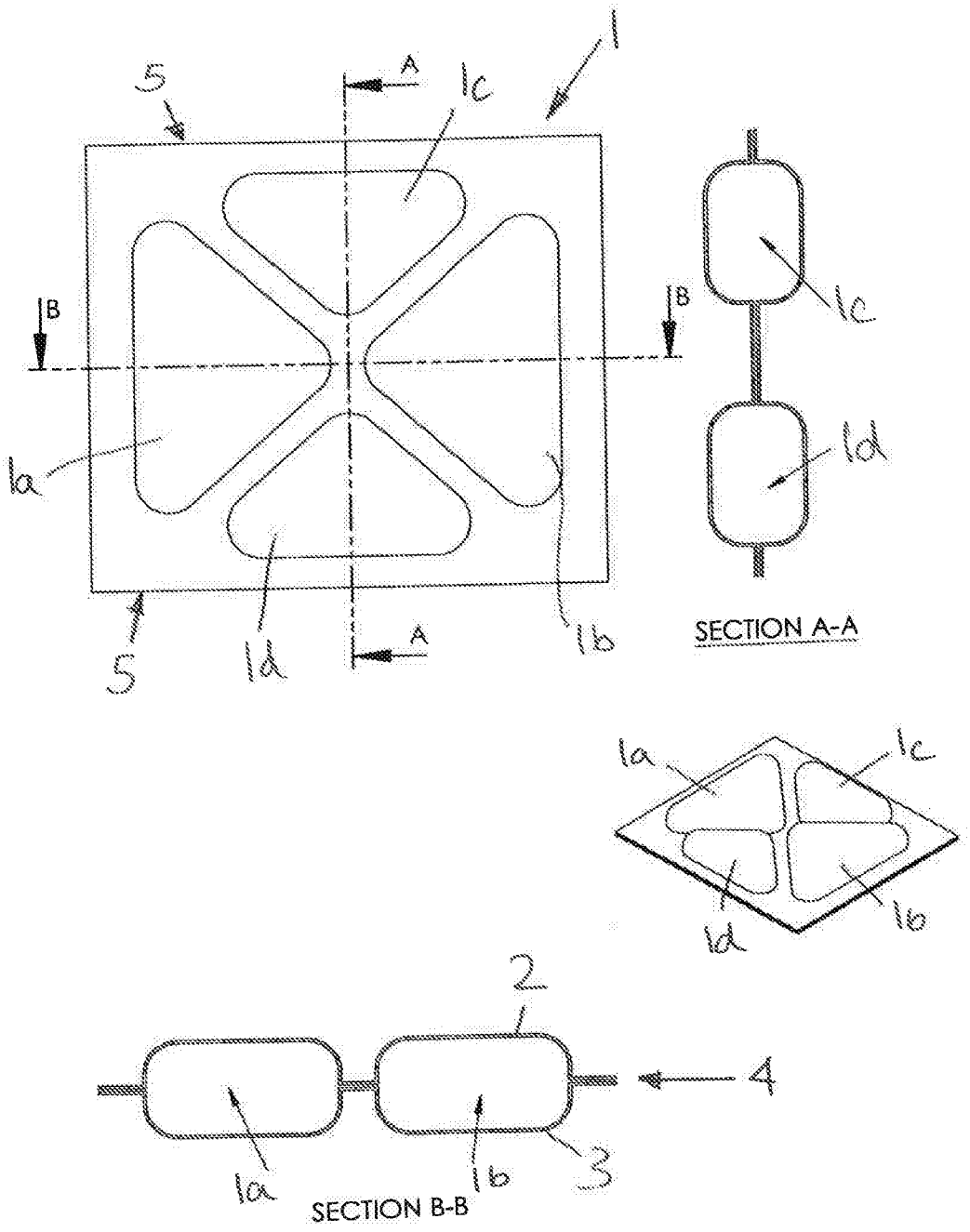
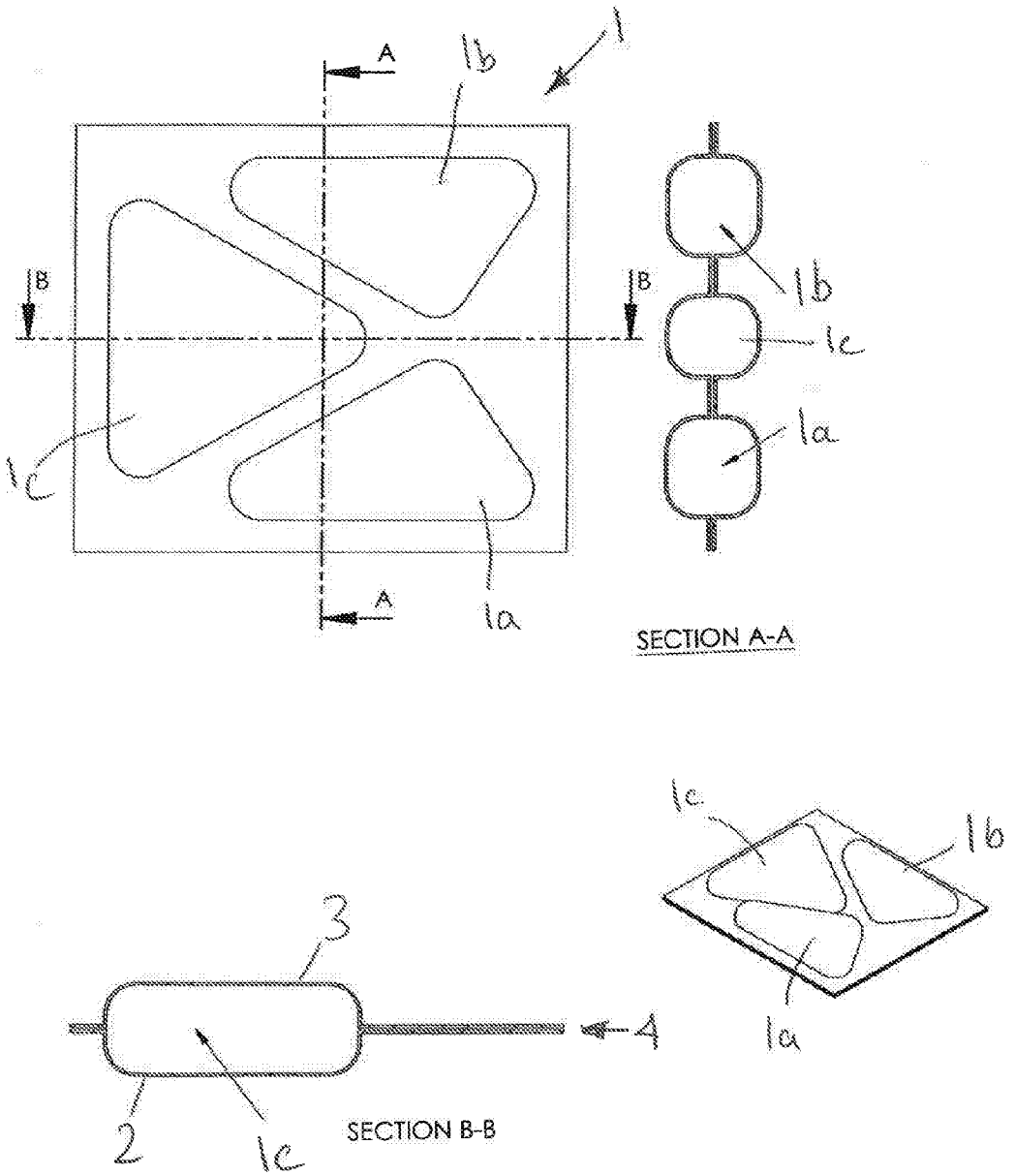

1
5
A
1c
B
B
1a
1d
1b
5
A
1c
1d
SECTION A-A
1a
1c
1d
1b
2
4
1a
1b
3
SECTION B-B

Figure 16



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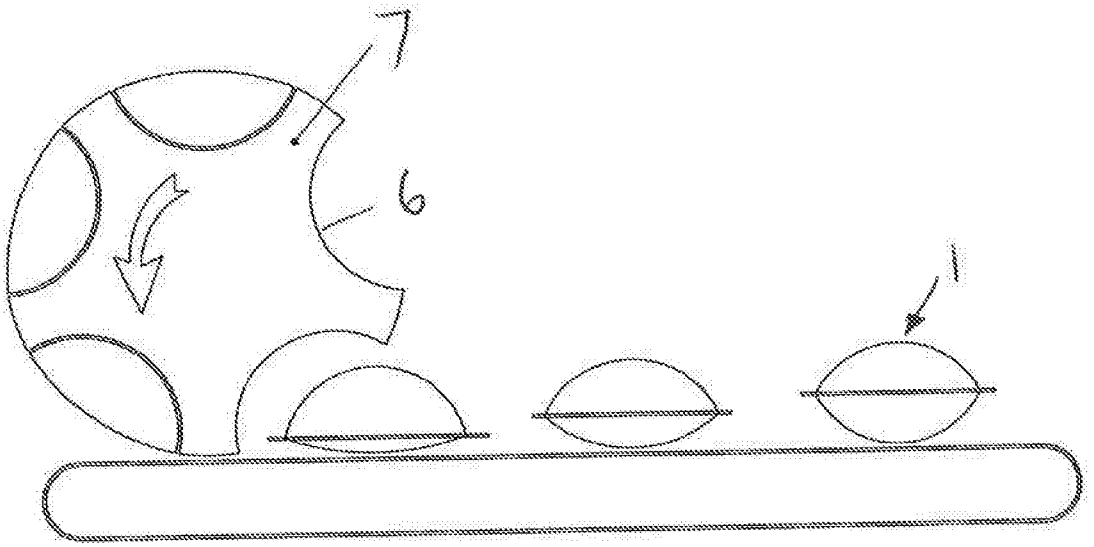

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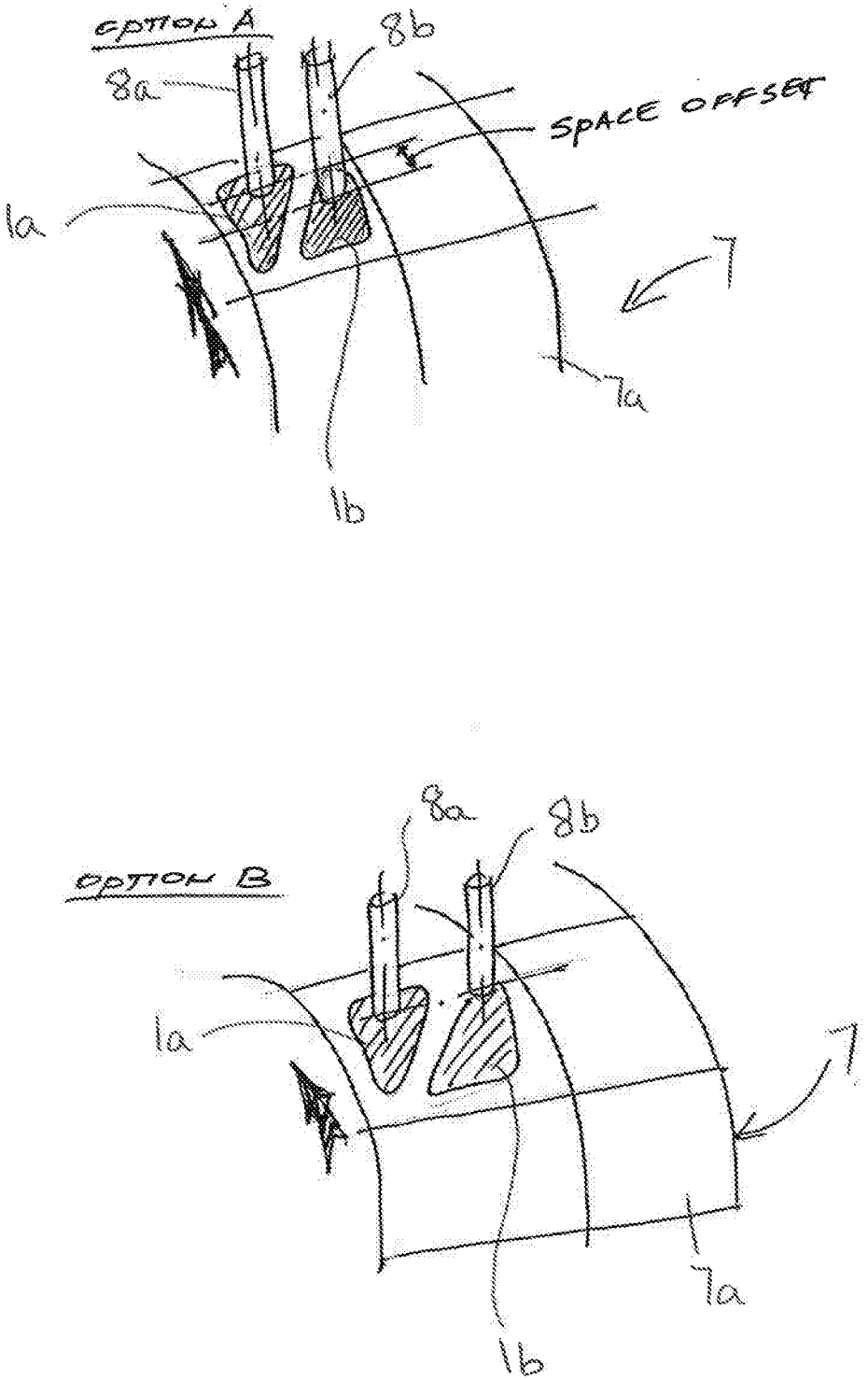

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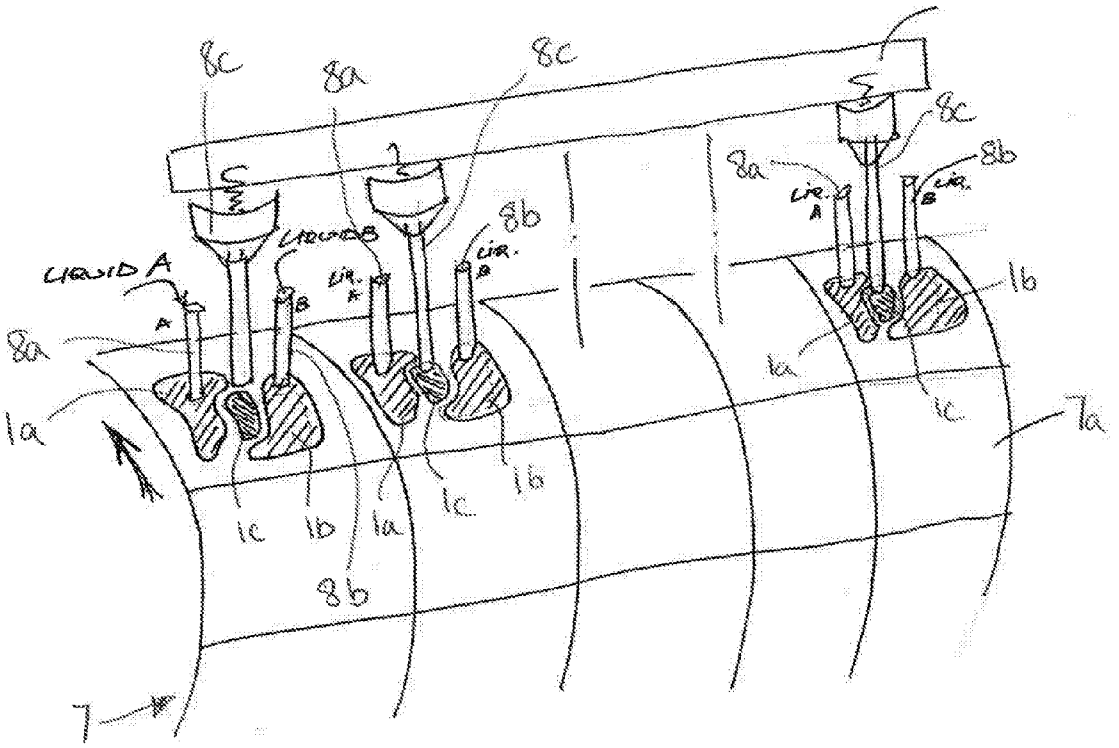
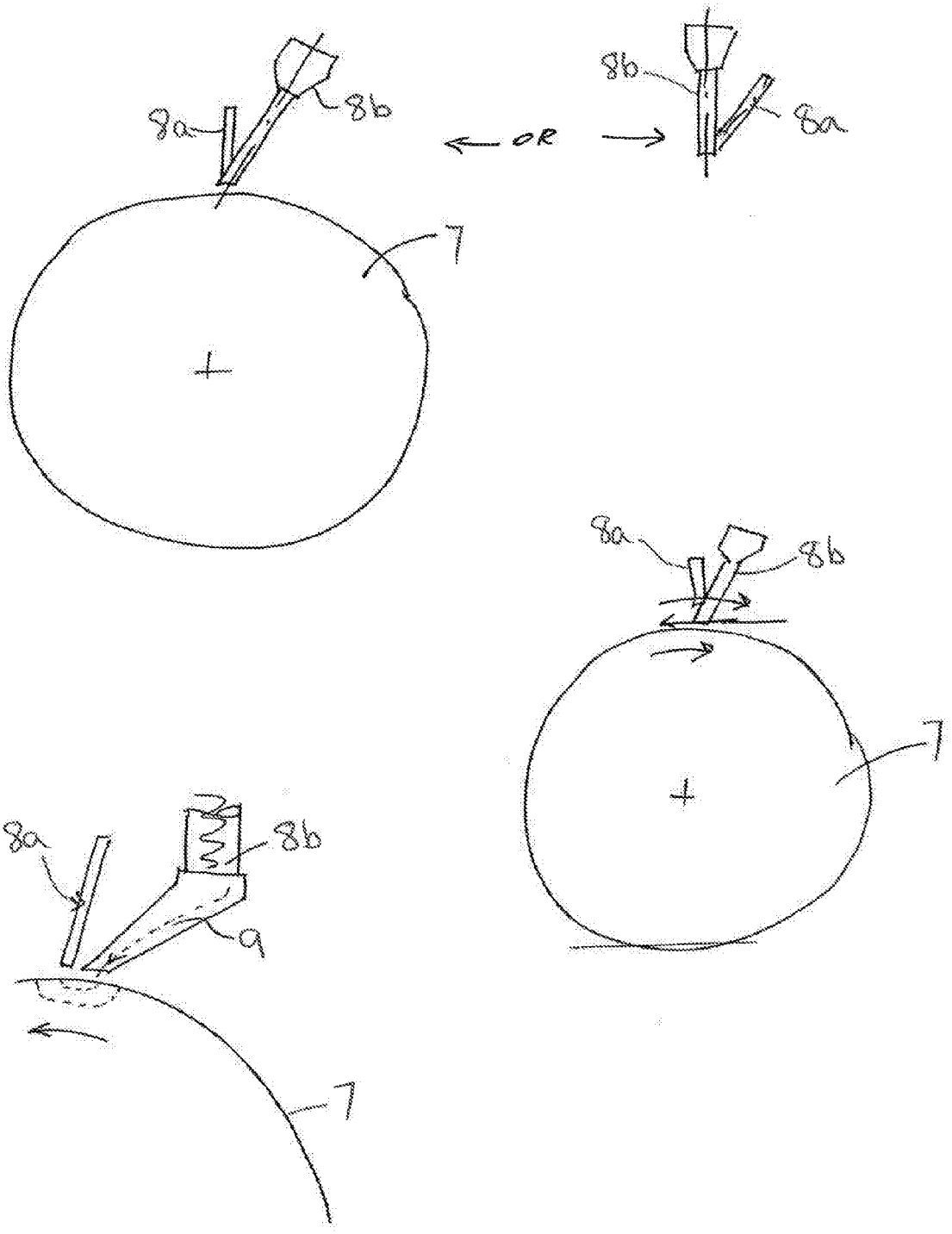

8c
8a
8c
8c
8a
8b
8b
LIQUID A
LIQUID B
8a
1a
1c
1b
1a
1c
1b
8b
1b
1a
1c
7a
7

Figure 20



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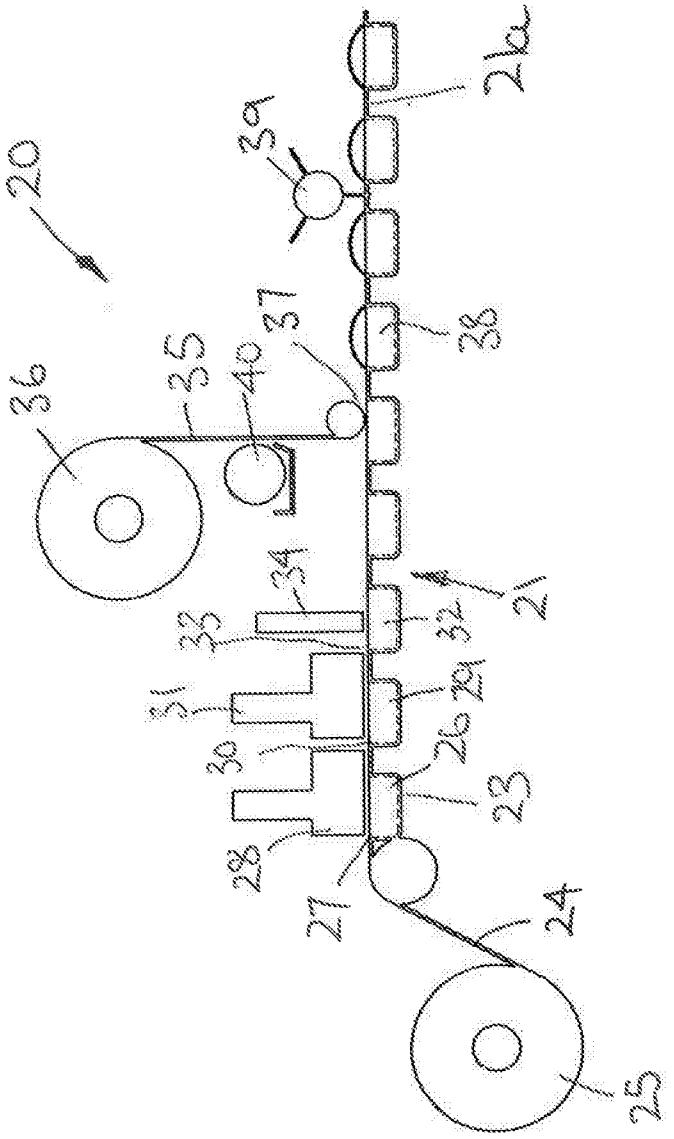

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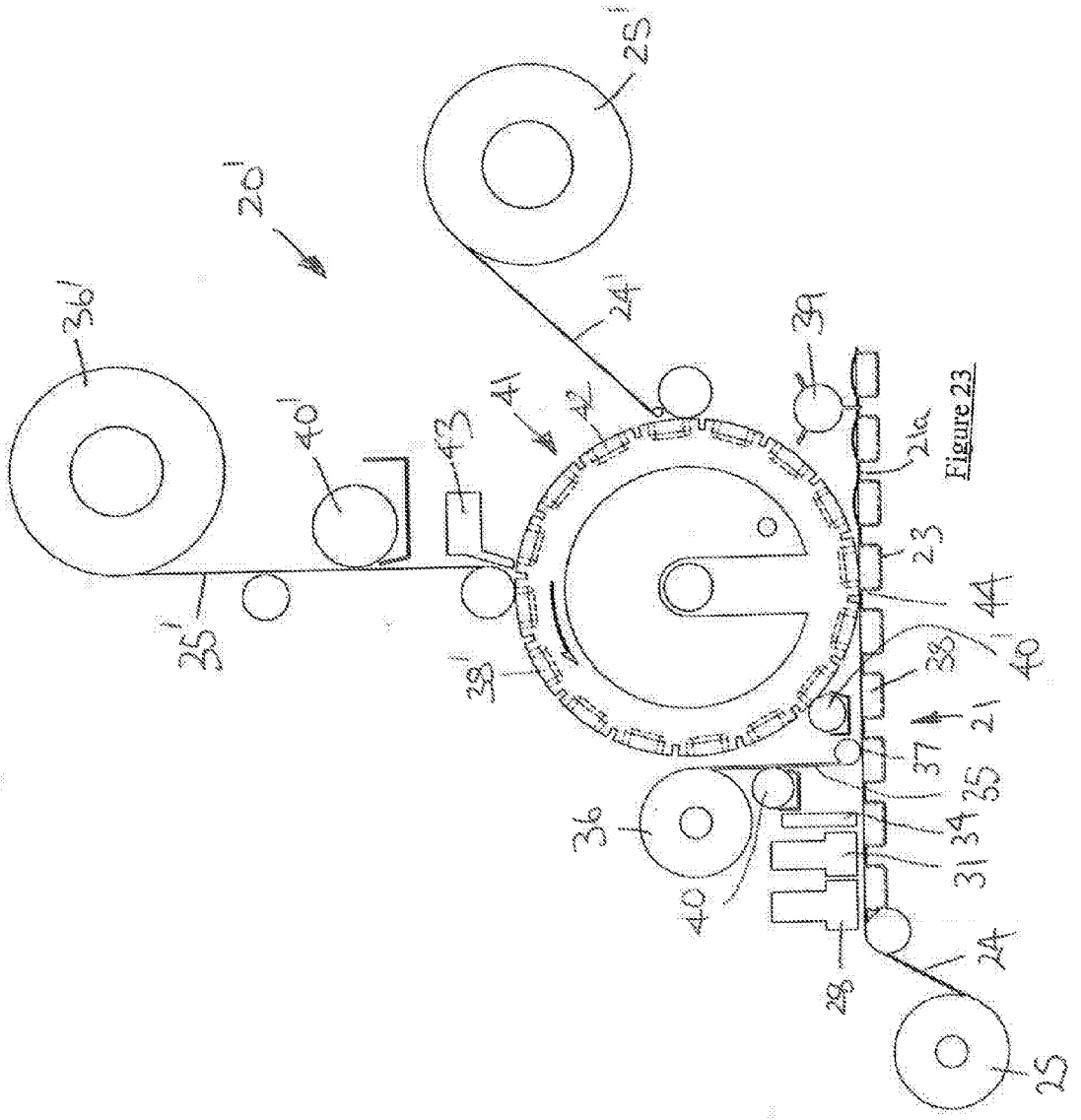
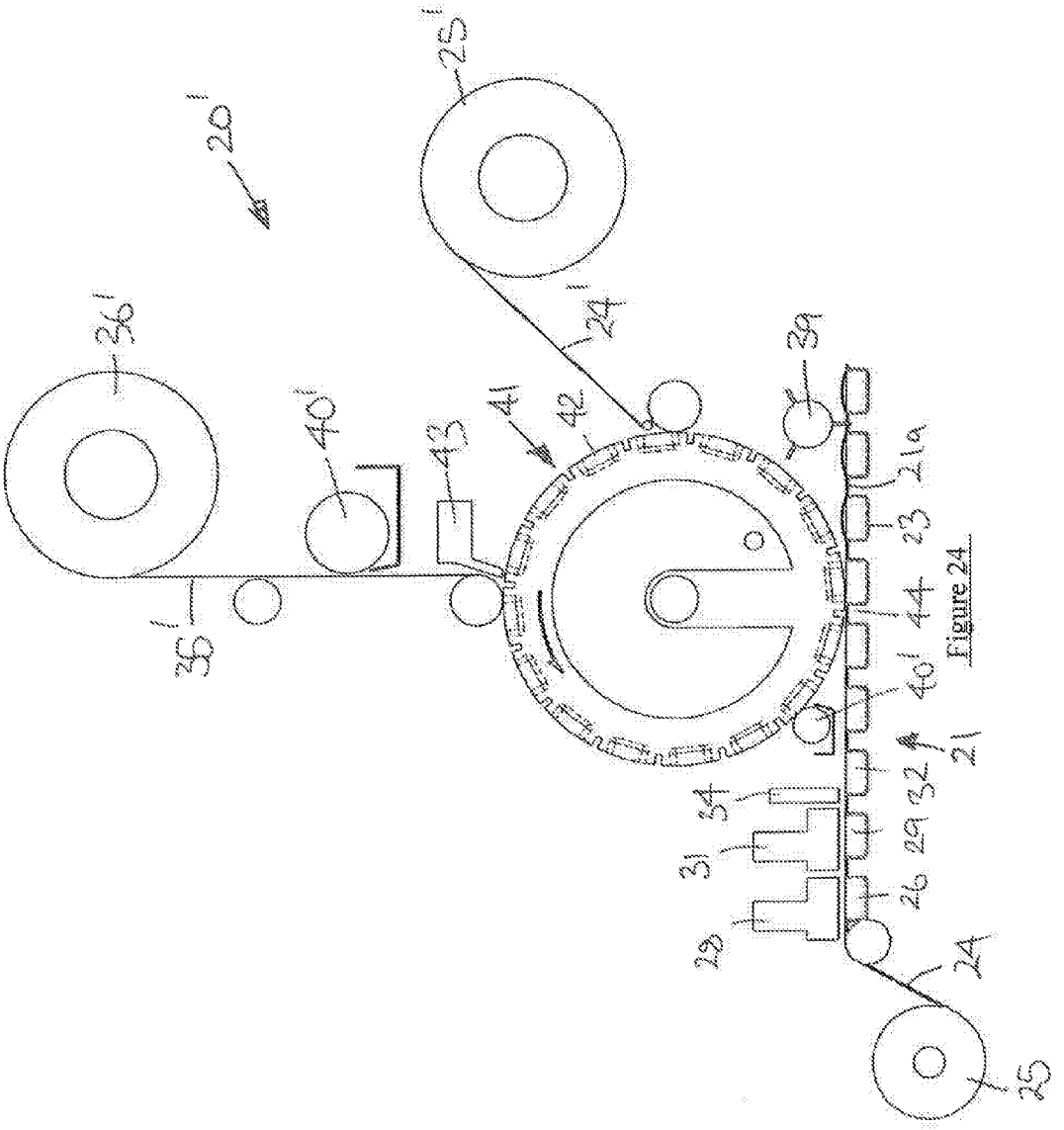

20'
23'
24'
29'
36'
40'
43'
41'
42'
24a'
23'
44'
40'
38'
21'
37'
35'
34'
31'
36'
40'
28'
24'
25'
25'
39'

Figure 23



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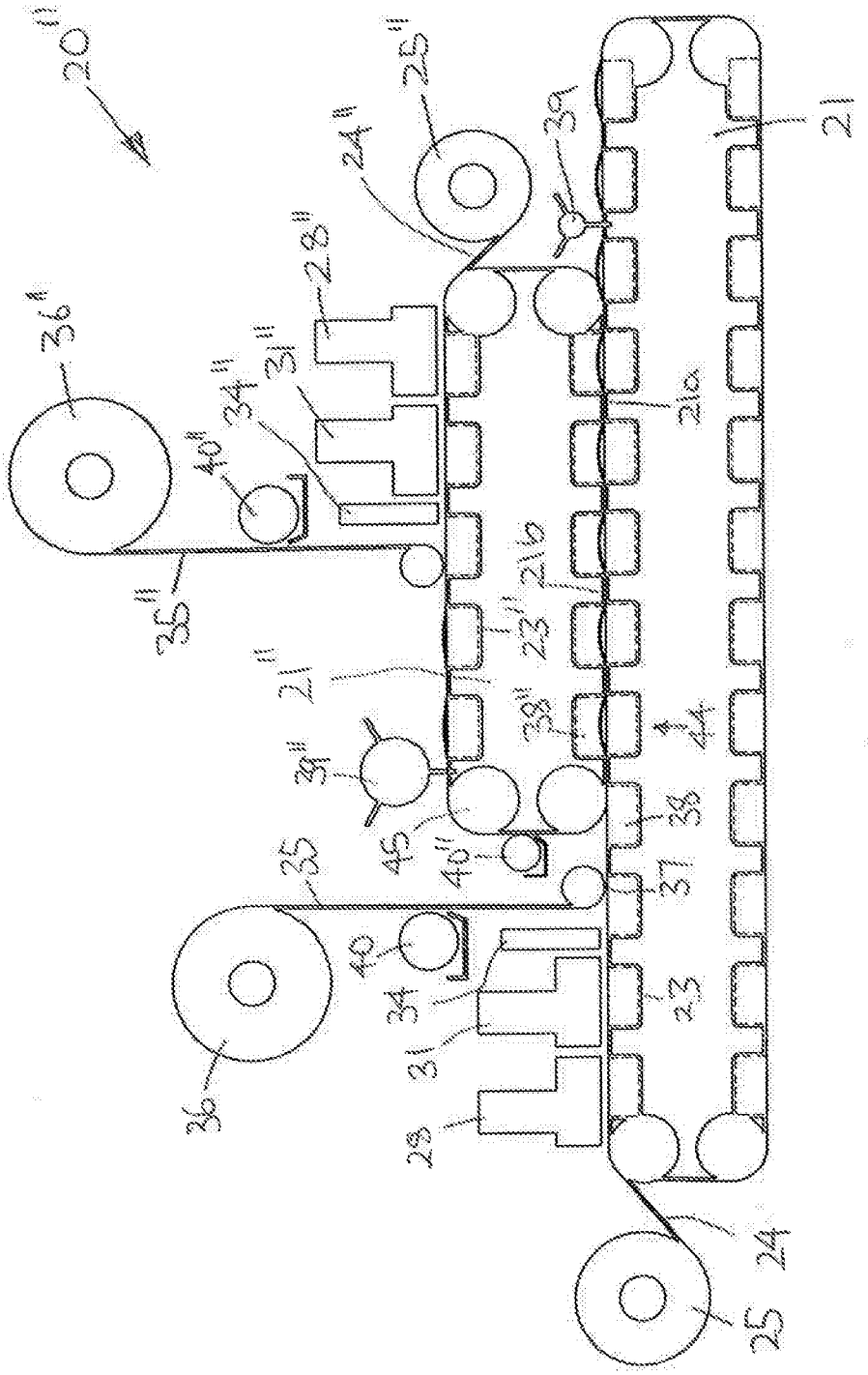

20''
25''
24''
39
21
28''
36''
31''
34''
40''
21a
35''
21b
23''
1''
21''
38''
44
39''
45
40''
36
37
35
40
34
31
23
28
26
25
24

Figure 25

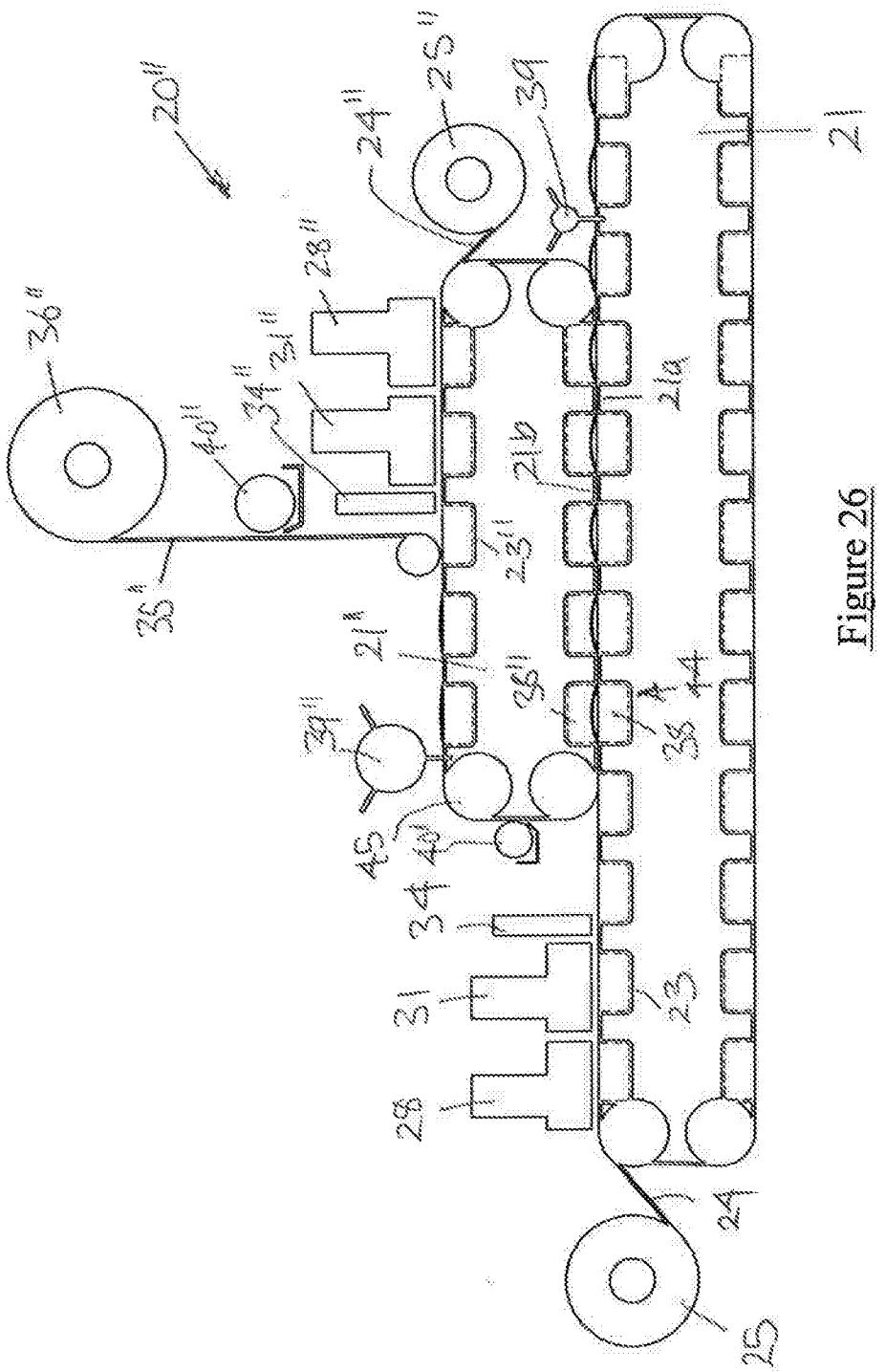
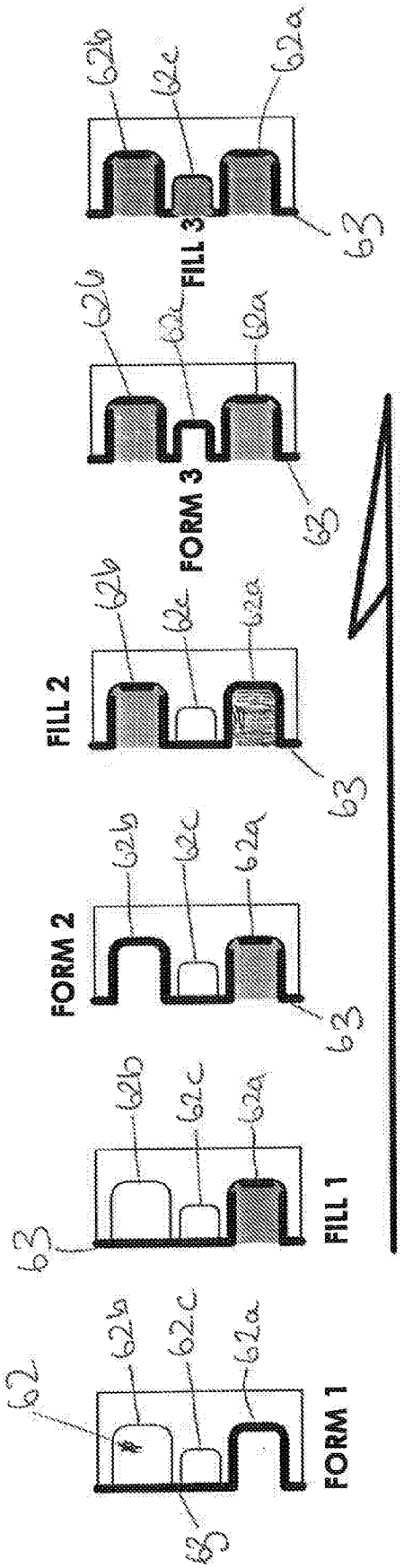

20"
24"
25"
34
21
36"
28"
34"
31"
40"
21a
21b
23"
35"
21"
39"
35"
44
38
45
43
34
31
23
28
24
25

Figure 26



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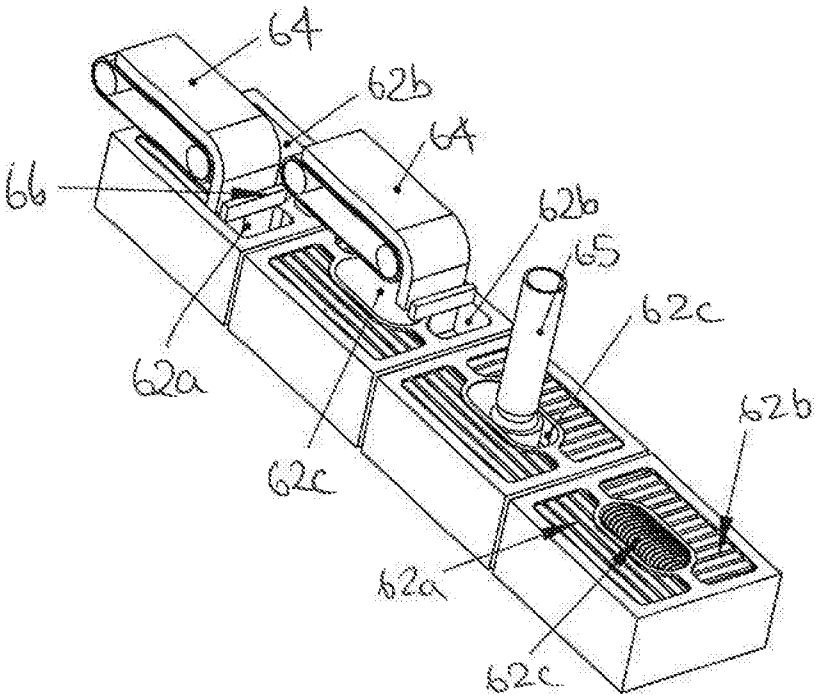

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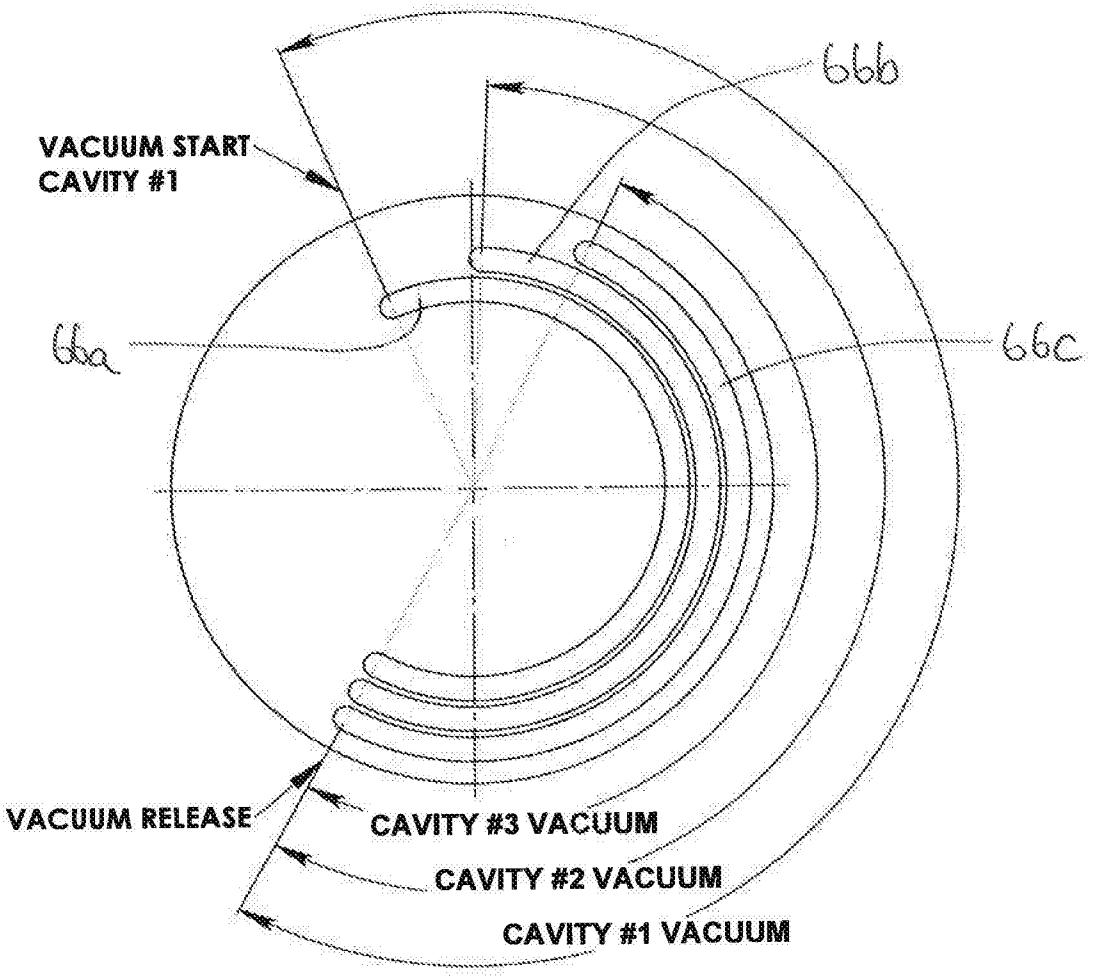

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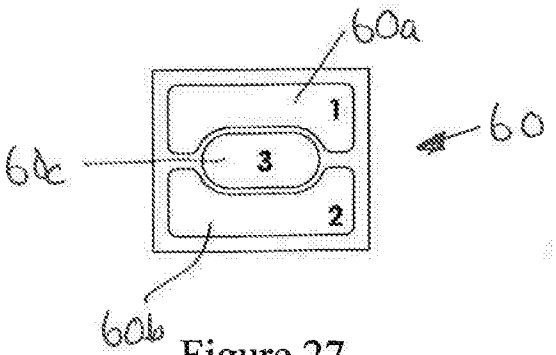

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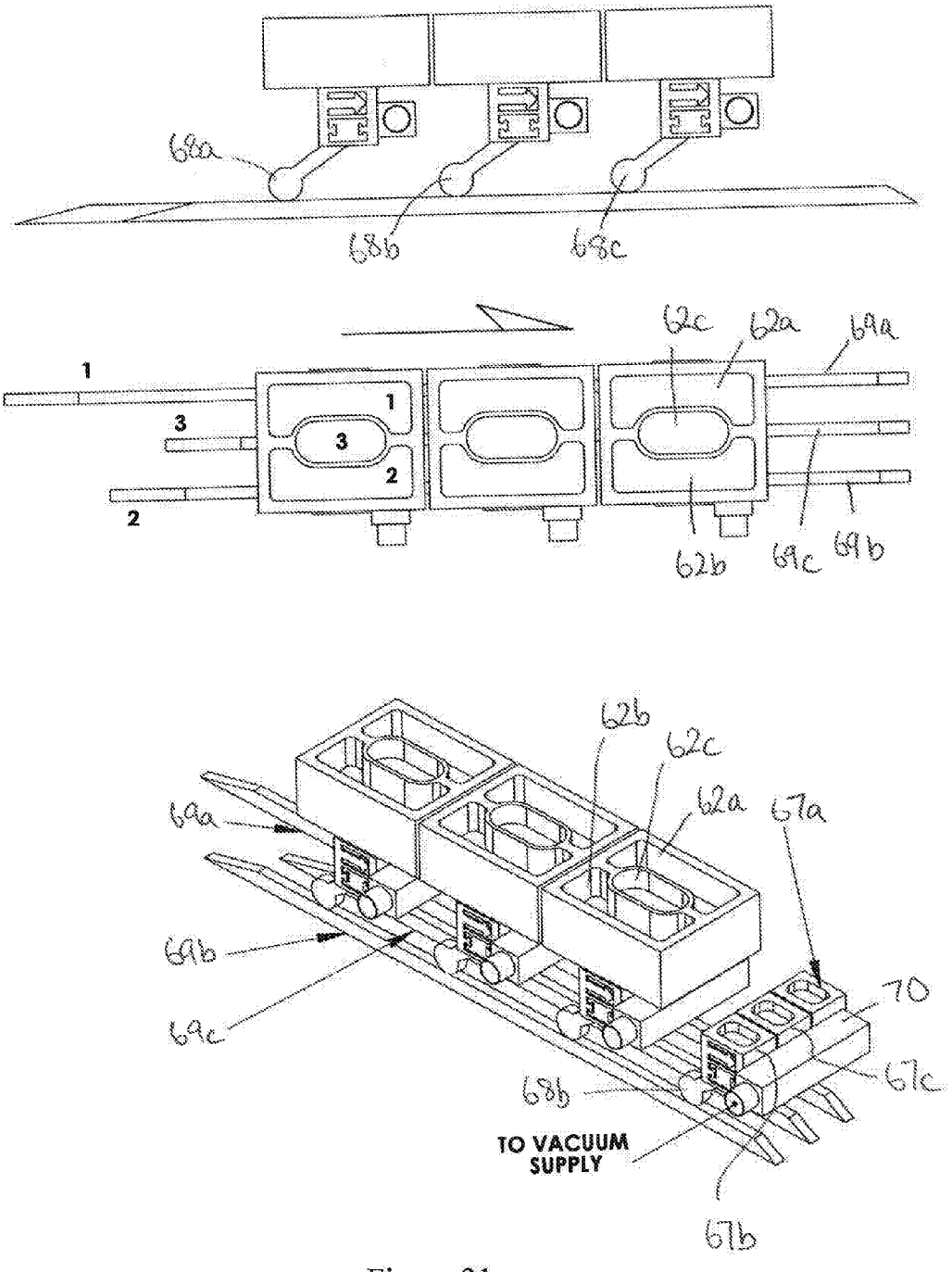
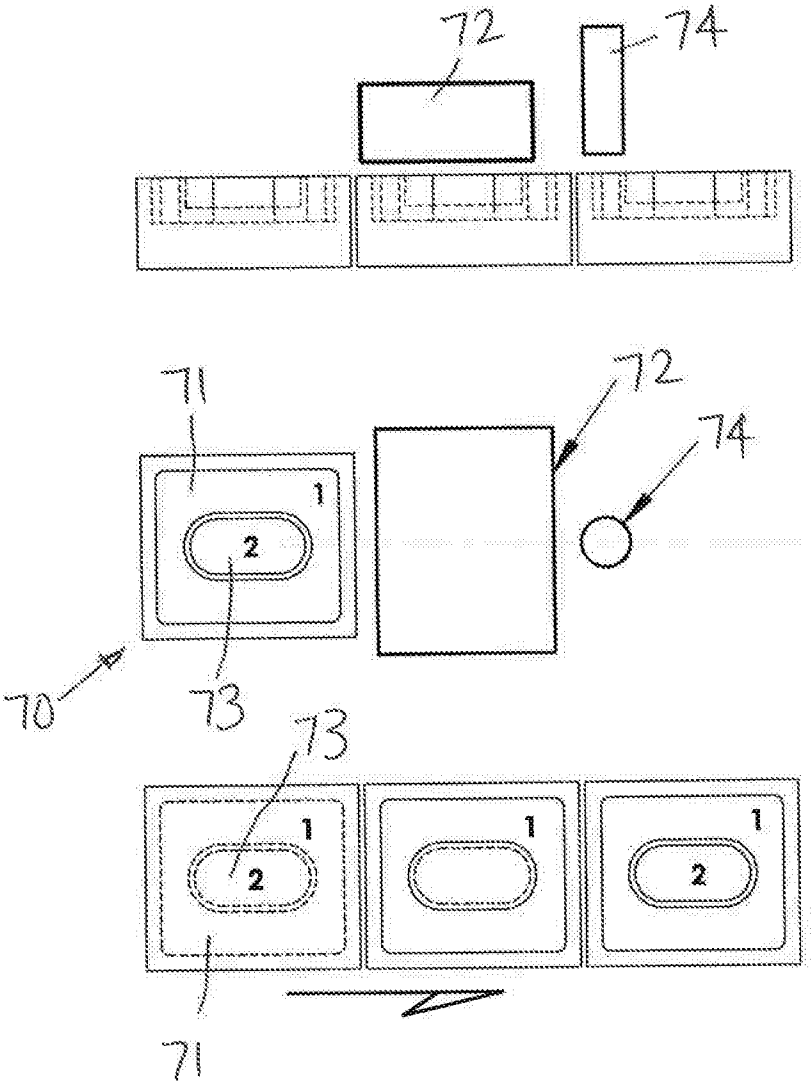

68a
68b
68c
62c
62a
69a
1
3
2
62b
69c
69b
67a
70
67c
TO VACUUM SUPPLY
67b

Figure 31



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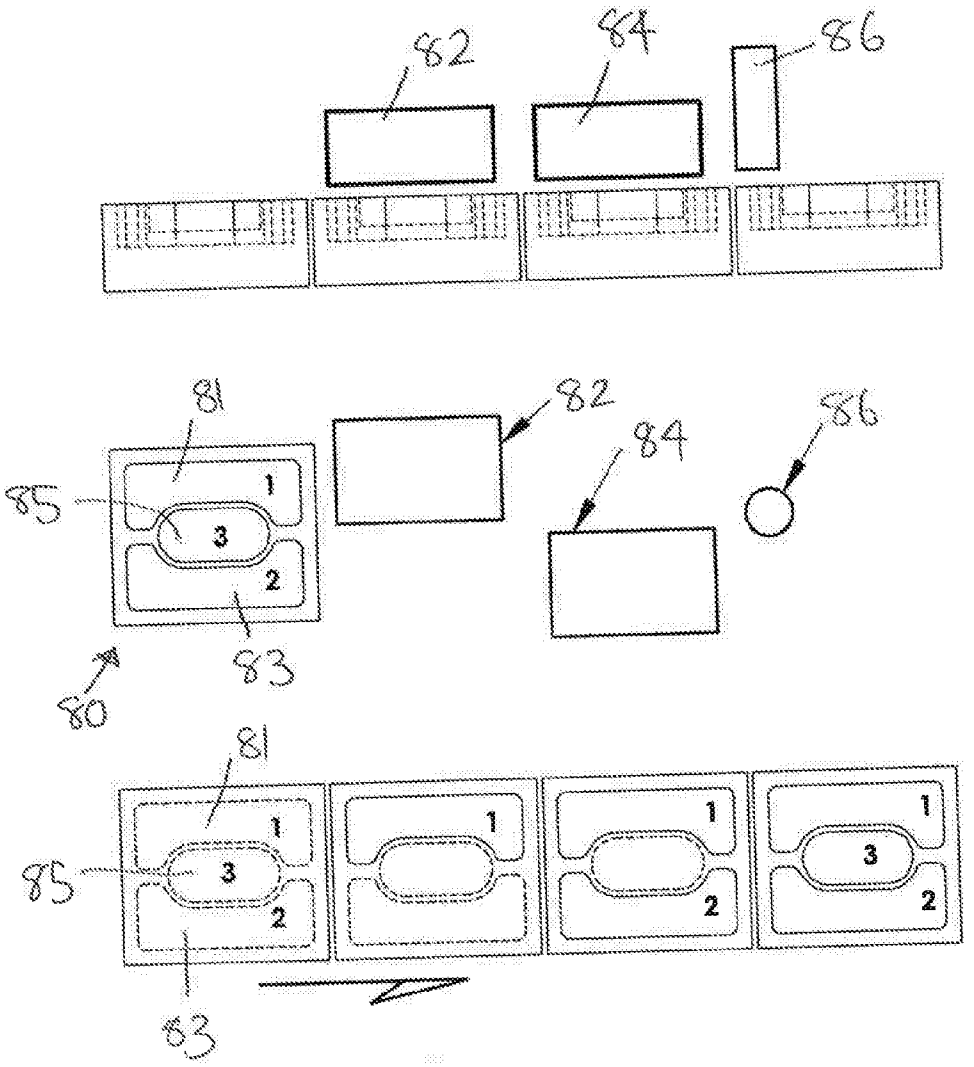

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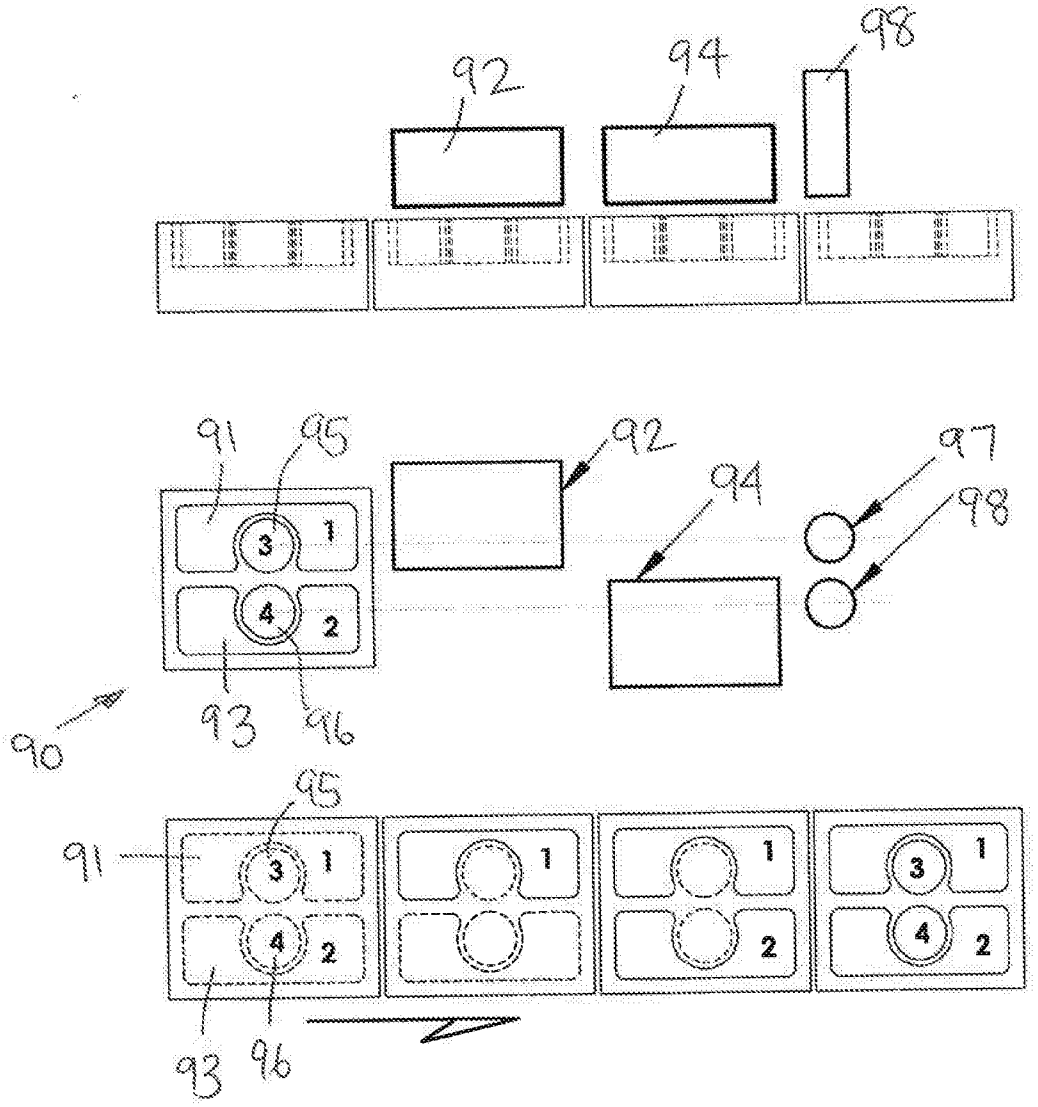

Figure 34

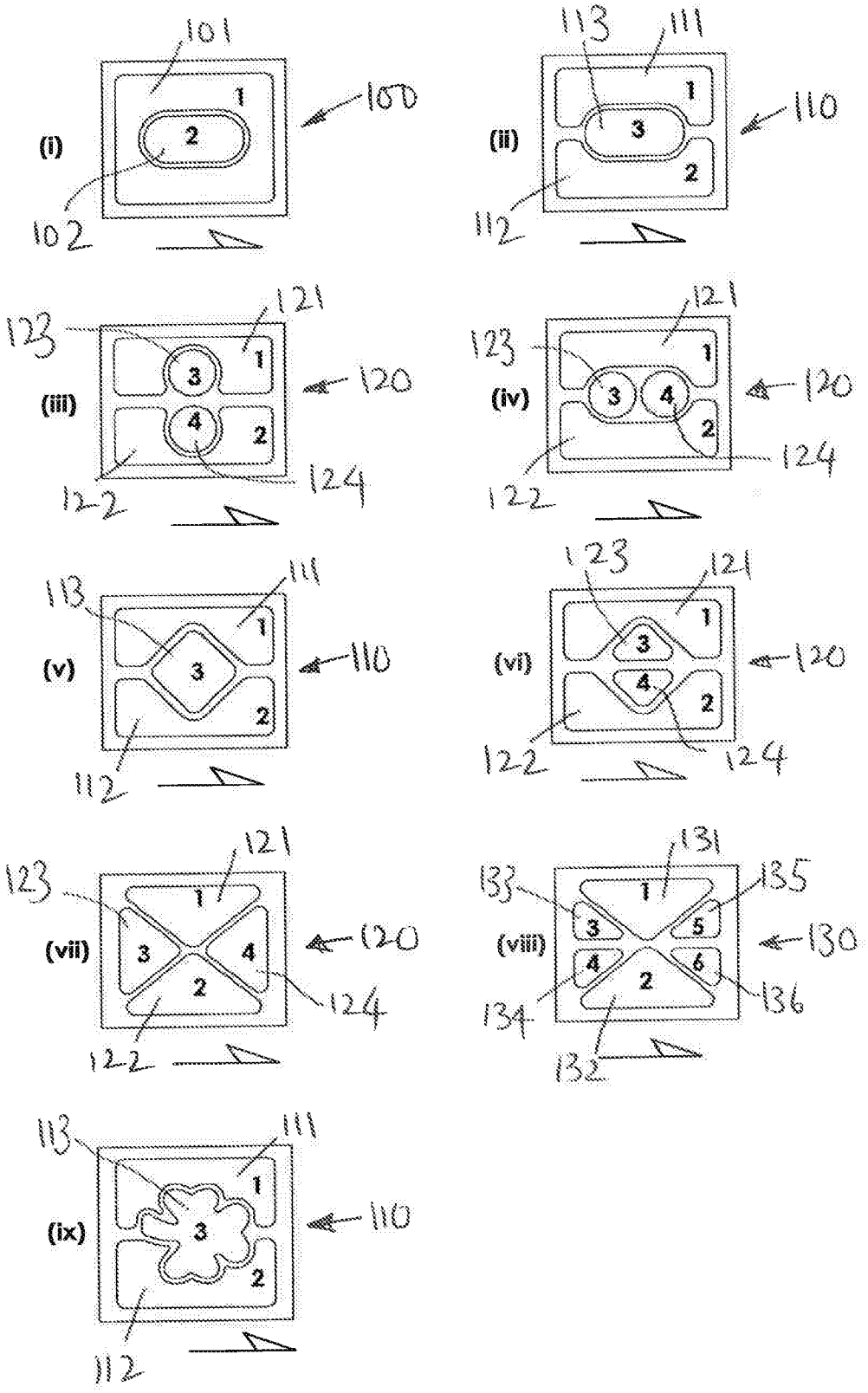
(i)
101
102
100
(ii)
113
111
112
110
(iii)
123
121
120
124
122
(iv)
123
121
120
124
122
(v)
113
111
110
112
(vi)
123
121
120
122
124
(vii)
123
121
120
124
122
(viii)
131
133
135
130
134
136
132
(ix)
113
111
110
112

Figure 35

IMPROVEMENTS IN OR RELATING TO WATER-SOLUBLE POUCHES

[0001] This invention concerns improvements in or relating to water-soluble pouches. More specifically, the invention concerns apparatus and methods for producing multi-compartment water-soluble pouches from two or more soluble substrates on continuous motion rotatable forming machines. The invention also concerns multi-compartment water-soluble pouches made from two or more soluble substrates, and in particular, but not exclusively, pouches made using the apparatus and methods of the present invention.

[0002] In our earlier applications WO2011/061628 and WO2013/190517, continuous motion rotatable formers and pouches made thereon have been described. In WO2011/061628, apparatus for making pouches from two water-soluble substrates was described wherein a rotatable former is provided with cavities into which a base web is formed to create open pockets in the base web. Once formed, the base web is tightly held by vacuum within the cavity throughout the process of filling the pockets, sealing the pockets with a top or lidding web to form pouches in the combined webs and separating the pouches from the combined web by transverse and web direction knives. In WO2013/190517, apparatus for making multi-compartment pouches from four water-soluble substrates via two pouches was described wherein each pouch was made from two water-soluble substrates on separate rotatable formers similar to the process described in WO2011/061628 and the web of pouches on one former then joined to the web of pouches on the other former produce combined pouches before separating the combined pouches from the combined webs by transverse and web direction knives.

[0003] As described in the above earlier applications, after separating, many water-soluble substrates, especially those based substantially upon polyvinyl alcohol, are subject to what is known as shrink-back after forming but by holding the base web tightly within the cavity throughout the filling, sealing and cutting operations, shrink-back of the base web is prevented.

[0004] When the machines described in the above earlier applications are used for making multi-compartment pouches from two water-soluble substrates, a particular difficulty arises when the number of compartments to be filled is greater than two due to the lack of space across the web in which to fit the necessary number of filling heads, and to the lack of time during which to complete the filling operation if the machine is to operate at its optimal manufacturing capacity. Lack of space across the web dictates the use of point filling heads such as nozzle injectors for liquids and gels, and augur fillers for powders and granules. However, even by means of point filling heads, it can be difficult to accommodate sufficient filling heads across the web, and particularly to fill powders and granules quickly enough.

[0005] It is an object of the present invention to provide apparatus and methods for producing multi-compartment water-soluble pouches from two or more soluble substrates on continuous motion rotatable forming machines that address one or more of the aforementioned problems.

[0006] In one aspect, the present invention provides a multi-compartment pouch formed from two water soluble substrates wherein the pouch is substantially symmetrical about a weld line between the two substrates.

[0007] It may be that the pouch comprises at least two compartments and wherein each compartment is formed between the same two substrates. The compartments may contain different products selected for example from liquids, gels, powders and granules. At least one compartment may be empty, i.e. not filled.

[0008] It may be that the pouch comprises three or more compartments.

[0009] It may be that the compartments are disposed within the pouch such that they provide resistance to planar distortion.

[0010] It may be that the compartments are disposed within the pouch such that any bending axis arbitrarily laid across the pouch cuts through the body of at least one compartment.

[0011] It may be that the pouch contains a perimetric compartment.

[0012] It may be that the pouch contains a divided perimetric compartment.

[0013] It may be that at least one compartment is filled with a flowable composition, for example a liquid or gel.

[0014] It may be that at least one compartment is filled with a solid composition, for example a powder or granules.

[0015] It may be that at least one compartment is filled with more than one composition wherein the compositions are mutually compatible and not antagonistic to each other.

[0016] It may be that one of the water soluble substrates is a top or lidding web and the other water soluble substrate is a base web. Multi-compartment pouches may be produced by forming a base web to create open pockets that are filled and then closed by a top or lidding web. The base web may be thermoformed.

[0017] It may be that the top or lidding web is thinner than the base web.

[0018] It may be that the top lidding web has a thickness of between 30% and 90%, more preferably between 50% and 75%, of that of the base web.

[0019] It may be that each compartment is filled to at least 80%, more preferably at least 90%, of the available volume.

[0020] It may be that the compartments are formed sequentially in the base web and each compartment is filled before a further compartment is formed and filled until all compartments have been filled whereupon the compartments are closed by sealing with a top or lidding web.

[0021] It may be that the pouch is sealed to a second closed multi-compartment pouch such that the combined pouch comprises four water-soluble substrates.

[0022] It may be that the pouch is sealed to a second open multi-compartment pouch such that the combined pouch comprises three water-soluble substrates.

[0023] It may be that at least two compartments are filled with a greater weight of a powder or granular composition than the weight of any compartment filled with a liquid or gel.

[0024] In another aspect, the present invention provides a method of making a multi-compartment pouch from two water soluble substrates consisting of a base web and a top lidding web, the method including providing a former having a plurality of multi-compartment pouch forming cavities in a peripheral surface of the former, drawing the base web into the cavities to form a plurality of pockets within each pouch, filling one or more pockets with at least one product, closing the pockets in the base web with the top lidding web to form a plurality of sealed multi-compartment pouches, and separating the sealed multi-compartment pouches from the combined base web and top lidding web, wherein the top lidding web is thinner than the base web so that, as the base web retracts or shrinks back after the pouch has left the former, the

pressure so generated within the pouch causes the top lidding web to distend to a greater extent than the contraction of the base web thereby increasing the internal volume of the pouch sufficiently to form a multi-compartment pouch substantially symmetrical about the weld line between the two substrates.

[0025] It may be that each pocket of the multi-compartment pouch is filled with at least one product.

[0026] It may be that the former is configured so that at least one open pocket of a pouch is formed and filled before at least one other open pocket of the pouch is formed and filled, and only once all open pockets have been filled is the pouch closed by sealing with a lidding web.

[0027] It may be that a second pouch is affixed to the multi-compartment water-soluble pouch to form a combined pouch.

[0028] It may be that each pouch comprises two water soluble substrates such that the combined pouch comprises four water-soluble substrates. The second pouch may be a multi-compartment pouch.

[0029] It may be that the top or lidding web of the multi-compartment water-soluble pouch is provided by the second pouch such that the combined pouches comprises three water-soluble substrates. The second pouch may be a multi-compartment pouch.

[0030] In yet another aspect, the present invention provides apparatus for producing multi-compartment water-soluble pouches, the apparatus comprising a rotatable former having compartment forming cavities into which a base web can be formed, wherein the apparatus is configured so that at least one open compartment of a pouch is formed and filled before at least one other open compartment of the pouch is formed and filled, and only once all open compartments have been filled is the pouch closed by sealing with a lidding web.

[0031] It may be that the former is a horizontal former and the multi-compartment pouch comprises two water soluble substrates.

[0032] It may be that the former is a horizontal former and the apparatus includes a second former for producing water-soluble pouches comprising one or more compartments, wherein the formers are configured to affix a lidding web of a pouch on the horizontal former to a lidding web of a pouch on the second former to form a combined pouch comprising four water soluble substrates.

[0033] It may be that the former is a horizontal former and the apparatus includes a second former for producing water-soluble pouches comprising one or more compartments, wherein the formers are configured to affix a lidding web of a pouch on the second former to a base web of a pouch on the horizontal former to form a combined pouch comprising three water soluble substrates.

[0034] In yet another aspect, the present invention provides a multi-compartment water-soluble pouch comprising two water-soluble substrates wherein at least two open compartments are formed and filled in a base web and closed by sealing with a lidding web wherein at least one open compartment is formed and filled before another open compartment is formed and filled.

[0035] It may be that the pouch is substantially symmetrical about a weld line between the two substrates.

[0036] It may be that each compartment is formed between the same two substrates. The compartments may contain different products selected for example from liquids, gels, powders and granules. At least one compartment may be empty, i.e. not filled.

[0037] It may be that the pouch comprises three or more compartments.

[0038] It may be that the compartments are disposed within the pouch such that they provide resistance to planar distortion.

[0039] It may be that the compartments are disposed within the pouch such that any bending axis arbitrarily laid across the pouch cuts through the body of at least one compartment.

[0040] It may be that the pouch contains a perimetric compartment.

[0041] It may be that the pouch contains a divided perimetric compartment.

[0042] It may be that at least one compartment is filled with a flowable composition, for example a liquid or gel.

[0043] It may be that at least one compartment is filled with a solid composition, for example a powder or granules.

[0044] It may be that at least one compartment is filled with more than one composition wherein the compositions are mutually compatible and not antagonistic to each other.

[0045] It may be that the base web is thermoformed.

[0046] It may be that the top or lidding web is thinner than the base web.

[0047] It may be that the top lidding web has a thickness of between 30% and 90%, more preferably between 50% and 75%, of that of the base web.

[0048] It may be that each compartment is filled to at least 80%, more preferably at least 90%, of the available volume.

[0049] It may be that at least two compartments are formed sequentially in the base web. All the compartments may be formed sequentially.

[0050] It may be that the pouch is sealed to a second closed multi-compartment pouch such that the combined pouch comprises four water-soluble substrates.

[0051] It may be that the pouch is sealed to a second open multi-compartment pouch such that the combined pouch comprises three water-soluble substrates.

[0052] It may be that at least two compartments are filled with a greater weight of a powder or granular composition than the weight of any compartment filled with a liquid

[0053] It may be that the closed multi-compartment pouch is affixed to a second, closed pouch such that the combined pouch comprises four water-soluble substrates. The second pouch may be a multi-compartment pouch.

[0054] It may be that the multi-compartment pouch is closed by affixing a second closed pouch such that the combined pouch comprises three water-soluble substrates. The second pouch may be a multi-compartment pouch

[0055] In a further aspect, the present invention provides a multi-compartment water-soluble pouch comprising two water-soluble substrates wherein a plurality of compartments is formed sequentially in a base web and each compartment is filled before a further compartment is formed and filled until all compartments have been filled whereupon the pouch is closed by sealing with a lidding web.

[0056] It may be that the pouch is substantially symmetrical about a weld line between the two substrates.

[0057] It may be that each compartment is formed between the same two substrates. The compartments may contain different products selected for example from liquids, gels, powders and granules. At least one compartment may be empty, i.e. not filled.

[0058] It may be that the pouch comprises three or more compartments.

[0059] It may be that the compartments are disposed within the pouch such that they provide resistance to planar distortion.

[0060] It may be that the compartments are disposed within the pouch such that any bending axis arbitrarily laid across the pouch cuts through the body of at least one compartment.

[0061] It may be that the pouch contains a perimetric compartment.

[0062] It may be that the pouch contains a divided perimetric compartment.

[0063] It may be that at least one compartment is filled with a flowable composition, for example a liquid or gel.

[0064] It may be that at least one compartment is filled with a solid composition, for example a powder or granules.

[0065] It may be that at least one compartment is filled with more than one composition wherein the compositions are mutually compatible and not antagonistic to each other.

[0066] It may be that the base web is thermoformed.

[0067] It may be that the top or lidding web is thinner than the base web.

[0068] It may be that the top lidding web has a thickness of between 30% and 90%, more preferably between 50% and 75%, of that of the base web.

[0069] It may be that each compartment is filled to at least 80%, more preferably at least 90%, of the available volume.

[0070] It may be that the compartments are formed sequentially in the base web and each compartment is filled before a further compartment is formed and filled until all compartments have been filled whereupon the compartments are closed by sealing with a top or lidding web.

[0071] It may be that the pouch is sealed to a second closed multi-compartment pouch such that the combined pouch comprises four water-soluble substrates.

[0072] It may be that the pouch is sealed to a second open multi-compartment pouch such that the combined pouch comprises three water-soluble substrates.

[0073] It may be that at least two compartments are filled with a greater weight of a powder or granular composition than the weight of any compartment filled with a liquid.

[0074] It may be that the weight of a powder or granular composition filled into one or more compartments of the pouch is greater than the weight of a liquid or gel composition filled into one more other compartments of the pouch.

[0075] It may be that the weight of a powder or granular composition filled into at least two compartments of the pouch is greater than the weight of a liquid or gel composition filled into other compartments of the pouch.

[0076] In yet another aspect, the present invention provides a method of making a water soluble multi-compartment pouch on a continuous motion rotatable forming machine having compartment forming cavities into which a base web can be formed, wherein the forming machine is configured so that at least one open compartment of a pouch is formed and filled before at least one other open compartment of the pouch is formed and filled, and only once all open compartments have been filled is the pouch closed by sealing with a lidding web.

[0077] It may be that the closed multi-compartment water-soluble pouch is affixed to a second closed pouch such that the combined pouch comprises four water-soluble substrates. The second pouch may be a multi-compartment pouch

[0078] It may be that the multi-compartment water-soluble pouch is closed by affixing a second closed pouch such that the combined pouch comprises three water-soluble substrates. The second pouch may be a multi-compartment pouch

[0079] In a further aspect, the present invention provides a multi-compartment water-soluble pouch comprising two water-soluble substrates wherein a plurality of compartments is formed sequentially in a base web wherein at least one compartment is formed and filled before a further compartment is formed and filled whereupon all compartments are closed by sealing with a lidding web.

[0080] It may be that the pouch is substantially symmetrical about a weld line between the two substrates.

[0081] It may be that each compartment is formed between the same two substrates. The compartments may contain different products selected for example from liquids, gels, powders and granules. At least one compartment may be empty, i.e. not filled.

[0082] It may be that the pouch comprises three or more compartments.

[0083] It may be that the compartments are disposed within the pouch such that they provide resistance to planar distortion.

[0084] It may be that the compartments are disposed within the pouch such that any bending axis arbitrarily laid across the pouch cuts through the body of at least one compartment.

[0085] It may be that the pouch contains a perimetric compartment.

[0086] It may be that the pouch contains a divided perimetric compartment.

[0087] It may be that at least one compartment is filled with a flowable composition, for example a liquid or gel.

[0088] It may be that at least one compartment is filled with a solid composition, for example a powder or granules.

[0089] It may be that at least one compartment is filled with more than one composition wherein the compositions are mutually compatible and not antagonistic to each other.

[0090] It may be that the base web is thermoformed.

[0091] It may be that the top or lidding web is thinner than the base web.

[0092] It may be that the top lidding web has a thickness of between 30% and 90%, more preferably between 50% and 75%, of that of the base web.

[0093] It may be that each compartment is filled to at least 80%, more preferably at least 90%, of the available volume.

[0094] It may be that the compartments are formed sequentially in the base web and each compartment is filled before a further compartment is formed and filled until all compartments have been filled whereupon the compartments are closed by sealing with a top or lidding web.

[0095] It may be that the pouch is sealed to a second closed multi-compartment pouch such that the combined pouch comprises four water-soluble substrates.

[0096] It may be that the pouch is sealed to a second open multi-compartment pouch such that the combined pouch comprises three water-soluble substrates.

[0097] It may be that at least two compartments are filled with a greater weight of a powder or granular composition than the weight of any compartment filled with a liquid.

[0098] It may be that the weight of a powder or granular composition filled into one or more compartments of the pouch is greater than the weight of a liquid or gel composition filled into one more other compartments of the pouch.

[0099] It may be that the weight of a powder or granular composition filled into at least two compartments of the

pouch is greater than the weight of a liquid or gel composition filled into other compartments of the pouch

[0100] In yet another aspect, the present invention provides a method of making a water soluble multi-compartment pouch on a continuous motion rotatable forming machine having compartment forming cavities into which a base web can be formed, wherein the forming machine is configured so that at least one open compartment of a pouch is formed and filled before at least one other open compartment of the pouch is formed and filled whereupon all compartments are closed by sealing with a lidding web.

[0101] It may be that the closed multi-compartment water-soluble pouch is affixed to a second closed pouch such that the combined pouch comprises four water-soluble substrates. The second pouch may be a multi-compartment pouch.

[0102] It may be that the multi-compartment water-soluble pouch is closed by affixing a second closed pouch such that the combined pouch comprises three water-soluble substrates. The second pouch may be a multi-compartment pouch

[0103] In yet another aspect the present invention provides a continuous motion rotatable forming machine for producing multi-compartment water-soluble pouches, the machine comprising a rotatable former having compartment forming cavities into which a base web can be formed, wherein the forming machine is configured so that at least one compartment of a pouch is formed and filled before at least one other compartment of the pouch is formed and filled, and only once all compartments have been formed is the pouch closed and sealed by affixing a lidding web.

[0104] It may be that at least one compartment is empty, i.e. not filled. It may be that at least two compartments are formed simultaneously.

[0105] It may be that the lidding web comprises a web of formed filled and sealed pouches. It may be that the machine comprises two formers of which at least one is a horizontal former wherein each former is able to produce water-soluble pouches comprising one or more compartments, the lidding films of which are then sealed or bonded together to form a combined pouch. It may be that the machine comprises two formers of which at least one is a horizontal former wherein each former is able to produce water-soluble pouches comprising one or more compartments, the lidding film of pouches on one former closing pouches on the other former to form a combined pouch.

[0106] In yet another aspect the present invention provides a multi-compartment water-soluble pouch comprising two water-soluble substrates wherein a plurality of compartments is formed sequentially in a base web and each sequentially formed compartment is filled before a further compartment is formed until all compartments have been formed whereupon the pouch is closed and sealed by affixing a lidding web.

[0107] It may be that at least one compartment is empty, i.e. not filled. It may be that at least two compartments are formed simultaneously.

[0108] It may be that the pouch is affixed to a second closed pouch such that the combined pouch comprises four water-soluble substrates. It may that the pouch is affixed to a second open pouch such that the combined pouch comprises three water-soluble substrates. It may be that the second pouch comprises one or more compartments.

[0109] It may be that at least two compartments are filled with a greater weight of a powder or granular composition than the weight of liquid or gel filled into any other compartment.

[0110] It may be that each compartment is formed by and between the base web and lidding web.

[0111] It may be that the pouch is symmetrical about a weld line between the base web and the lidding web.

[0112] In yet another aspect the present invention provides a method of making a water soluble multi-compartment pouch on a continuous motion rotatable forming machine having compartment forming cavities into which a base web can be formed, wherein the forming machine is configured so that at least one compartment of a pouch is formed and filled before at least one other compartment of the pouch is formed and filled, and only once all compartments have been formed is the pouch closed by sealing with a lidding web.

[0113] It may be that at least one compartment is empty, i.e. not filled. It may be that at least two compartments are formed simultaneously.

[0114] It may be that the multi-compartment water-soluble pouch is affixed to a second closed pouch such that the combined pouch comprises four water-soluble substrates. It may be that the lidding web of the multi-compartment water-soluble pouch comprises a lidding web comprising a second closed pouch such that the combined pouch comprises three water-soluble substrates. It may be that the second closed pouch comprises one or more compartments.

[0115] Aspects of the invention described herein may overcome the difficulties in the prior art described above of filling pouches comprising two substrates and containing multiple compartments, by forming and filling containers in the base web at separate stations along the web. These aspects are described herein as sequential forming and filling. The term container describes an open pocket created within the base web as a result of the forming process.

[0116] In contrast, our earlier aforementioned applications describe forming containers in the base web contemporaneously (at the same moment) and subsequently filling the containers contemporaneously (at the same moment). Sequential forming and filling may be of particular use for powder or granule filling without the use of point filling heads, allowing greater flexibility of filling and resulting in multi-compartment pouches which have hitherto not been possible to produce.

[0117] Powders or granules are often filled by spreading the powder or granules upon the surface of an already formed base web and then removing the excess by means of a scraper or doctor blade, leaving the powder or granules filling the formed container or a plurality of formed containers wherein there is substantially no powder or granules left upon the unformed portions of the base web.

[0118] The base web may be formed into cavities within the former by different means known to those skilled in the art, including therefore vacuum forming, if necessary assisted by pre-treating the base web by spraying it with or passing it through a water mist, and/or by pre-heating the base web (thermoforming).

[0119] Once formed, the base web may be held by vacuum within the cavity throughout the process of filling, sealing and separating the pouches by transverse and web direction knives from a combined base web and top or lidding web. Many water-soluble substrates, especially those based substantially upon poly-vinyl alcohol, are subject to what is

known as shrink-back after forming but by holding the base web tightly within the cavity throughout the filling, sealing and cutting operations, shrink-back of the base web may be prevented.

[0120] The foregoing is a summary and thus, by necessity, contains simplifications, generalizations, and omissions of detail. Any or all of the features, limitations, configurations, components, subcomponents, systems, and/or subsystems described above may be used in combination. Consequently, those skilled in the art will appreciate that the summary is illustrative only and is not intended to be in any way limiting. Other aspects, inventive features, and advantages of the devices and/or processes described herein, as defined by the claims, will become apparent in the detailed description set forth herein and taken in conjunction with the accompanying drawings wherein:

[0121] FIG. **1** shows plan and sectional views of a multi-compartment pouch made from two substrates according to the present invention

[0122] FIG. **2** shows plan, sectional and perspective views of a multi-compartment pouch made from two substrates according to the present invention;

[0123] FIG. **3** shows plan, sectional and perspective views of a multi-compartment pouch made from two substrates according to the present invention;

[0124] FIG. **4** shows plan, sectional and perspective views of a multi-compartment pouch made from two substrates according to the present invention;

[0125] FIG. **5** shows plan, sectional and perspective views of a multi-compartment pouch made from two substrates according to the present invention;

[0126] FIG. **6** shows plan, sectional and perspective views of a multi-compartment pouch made from two substrates according to the present invention;

[0127] FIG. **7** shows plan, sectional and perspective views of a multi-compartment pouch made from two substrates according to the present invention;

[0128] FIG. **8** shows plan, sectional and perspective views of a multi-compartment pouch made from two substrates according to the present invention;

[0129] FIG. **9** shows plan, sectional and perspective views of a multi-compartment pouch made from two substrates according to the present invention;

[0130] FIG. **10** shows plan, sectional and perspective views of a multi-compartment pouch made from two substrates according to the present invention;

[0131] FIG. **11** shows plan, sectional and perspective views of a multi-compartment pouch made from two substrates according to the present invention;

[0132] FIG. **12** shows plan, sectional and perspective views of a multi-compartment pouch made from two substrates according to the present invention;

[0133] FIG. **13** shows plan, sectional and perspective views of a multi-compartment pouch made from two substrates according to the present invention;

[0134] FIG. **14** shows plan, sectional and perspective views of a multi-compartment pouch made from two substrates according to the present invention;

[0135] FIG. **15** shows plan, sectional and perspective views of a multi-compartment pouch made from two substrates according to the present invention;

[0136] FIG. **16** shows plan, sectional and perspective views of a multi-compartment pouch made from two substrates according to the present invention;

[0137] FIG. **17** shows plan, sectional and perspective views of a multi-compartment pouch made from two substrates according to the present invention;

[0138] FIG. **18** shows reconfiguration of a formed pouch to a symmetrical configuration;

[0139] FIG. **19** shows arrangements for filling a multi-compartment pouch comprising two compartments;

[0140] FIG. **20** shows an arrangement for filling a multi-compartment pouch comprising three compartments;

[0141] FIG. **21** shows arrangements of the filling heads for filling multi-compartment pouches;

[0142] FIG. **22** shows an embodiment of a horizontal rotatable forming machine for producing pouches from two substrates;

[0143] FIG. **23** shows an embodiment of a horizontal rotatable former machine and a cylindrical rotatable forming machine for producing pouches from four substrates;

[0144] FIG. **24** shows an embodiment of a horizontal rotatable former machine and a cylindrical rotatable forming machine for producing pouches from three substrates;

[0145] FIG. **25** shows an embodiment of two horizontal rotatable forming machines for producing pouches from four substrates;

[0146] FIG. **26** shows an embodiment of two horizontal rotatable forming machines for producing pouches from three substrates;

[0147] FIG. **27** shows a pouch with three compartments;

[0148] FIGS. **28** and **29** show a method sequentially forming and filling the pouch of FIG. **27**

[0149] FIG. **30** shows apparatus for forming sequentially forming the compartments of the pouch shown in FIG. **27**;

[0150] FIG. **31** shows another apparatus for forming sequentially forming the compartments of the pouch shown in FIG. **27**;

[0151] FIG. **32** shows a method of sequentially forming and filling a pouch with two compartments;

[0152] FIG. **33** shows a method of sequentially forming and filling a pouch with three compartments;

[0153] FIG. **34** shows a method of sequentially forming and filling a pouch with four compartments;

[0154] Various multi-compartment pouches **1** are shown in FIGS. **1** to **17** and summarised in the following Table:

FIG. Number	Configuration in Plan View	Number of Compartments
1	Circular or Elliptical with a complete perimetric compartment	2
2	Circular or Elliptical with a divided perimetric compartment	3
3	Triangular with rounded corners and a complete perimetric compartment	2
4	Triangular with rounded corners and a divided perimetric compartment	3

-continued

FIG. Number	Configuration in Plan View	Number of Compartments
5	Square or Rectangular with a complete perimetric compartment	2
6	Square or Rectangular with a divided perimetric compartment and a divided central compartment	4
7	Horseshoe	2
8	Horseshoe with a divided external compartment	3
9	Central Tee compartment	3
10	Central H compartment	3
11	Rectangular with a divided perimetric compartment	3
12	Rectangular with a divided perimetric compartment	3
13	L-shaped external compartment	2
14	Wedge compartments	2
15	Wedge compartments with a central compartment	3
16	Shamrock compartments	4
17	Clover Leaf compartments	3

[0155] Each pouch **1** is formed from two water soluble substrates **2**, **3** which may be referred to as a base web **2** and a top or lidding web **3**. Any suitable water soluble substrates may be employed. Pouches **1** having two compartments **1***a*, **1***b* are shown in FIGS. **1**,**3**,**5**,**7**,**13**,**14**. Pouches **1** having three compartments **1***a*, **1***b*, **1***c* are shown in FIGS. **2**,**4**,**8**,**9**,**10**,**11**, **12**,**15**,**17**. Pouches having four compartments **1**,**1***b*,**1***c*,**1***d* are shown in FIGS. **6**,**16**. Each pouch **1** is symmertical about a weld line **4** between the base web **2** and top lidding web **3**. Each compartment **1***a*,**1***b*,**1***c*,**1***d* is formed between the base web **2** and the top or lidding web **3**. The footprint **5** of the pouches **1** and the number, shape and arrangement of the compartments **1***a*,**1***b*,**1***c*,**1***d* is exemplary only and other configurations that may be employed will be apparent to those skilled in the art. The term "footprint" is defined as the plan view of the pouch **1** as seen from above the top or lidding web **3** of the pouch **1**.

[0156] Water-soluble substrates are often by the very nature of the materials, lacking in rigidity. As a result, when forming a water soluble pouch from two water soluble substrates, the resulting pouch will itself have a tendency to lack rigidity or planar strength which will give an unattractive floppy aspect to the pouch when handled by the consumer. Such a lack of rigidity or planar strength is referred to herein as planar distortion. Whilst the majority of water-soluble substrates capable of being formed, for example thermoformed or vacuum formed, are at the present time, made substantially from polyvinyl alcohol resins, other water-soluble substrates capable of being formed may be used to practise the present invention.

[0157] Planar distortion of multi-compartment pouches may be overcome or significantly reduced in this invention by one or more of the following factors:

i) relative position and/or shape of the compartments **1***a*, **1***b*, **1***c*, **1***d* within the footprint **5**.

ii) filling each compartment **1***a*,**1***b*,**1***c*,**1***d* to a level of at least 80%, preferably at least 90%, of the available volume,

iii) selecting the relative thicknesses of the top lidding web **3** and the base web **2** in order to utilise the retraction or shrink-back of the base web **2** after the webs have been sealed together and the pouch ejected from the forming machine or apparatus,

[0158] These factors and their impact on planar distortion of the resulting pouch **1** are now discussed. It may be that these factors can be employed separately, or in combination of any two, or preferably in a combination of all three. The invention extends to and includes pouches **1** so formed. Aspects of the invention referred to herein may include any of these factors and we do not intend the invention to be limited to those aspects specifically mentioned.

Position and/or Shape of Compartments

[0159] Planar distortion may be reduced by employing a perimetric compartment as one of the compartments. The term "perimetric" in this context describes a compartment which is situated around the perimeter of the pouch. In its simplest form, the perimetric compartment may be square or rectangular with rounded corners, allowing maximum use of the area of the footprint, and hence providing maximum possible compartment fill volumes. When viewed from above the top lidding web, such a square or rectangular perimetric compartment may follow the cut edges of the pouch with its outer limit set back from the cut edges of the pouch, for example at least 1.5 mm from the cut edges of the pouch. A square or rectangular perimetric compartment may be rejected for marketing or other reasons in favour of other shapes, such as triangular with rounded corners, or pentagonal with rounded corners, or circular or elliptical although these shapes are by no means limiting. It will be apparent that departing from a square or rectangular perimetric compartment can reduce the combined fill volume of the compartments within the pouch and leave a larger flange around the perimetric or semi-perimetric compartment.

[0160] The perimetric compartment may be divided into two or more separate compartments in order to increase the number of compartments within a pouch of a given footprint. However, by sub-dividing the perimetric compartment, there may be a loss of planar stability. The invention overcomes this loss of planar stability by compartmental design. As an example, if the perimetric compartment is divided into two semi-perimetric compartments, the pouch may, unless corrective design features are introduced to prevent it, flex about a line joining the seal areas between the semi-perimetric

compartments. A multi-compartment pouch which is able to flex will be less appealing to the consumer than one which has planar stability.

[0161] One or more of the compartments within the multi-compartment pouch may be left unfilled in order to provide additional resistance to planar distortion of the pouch.

Compartment Fill Levels

[0162] Planar distortion may be reduced by filling each compartment of the pouch to at least 80%, preferably at least 90%, of its available volume. Such a percentage fill of the available volume of each compartment has been found to contribute to planar stability of the pouch.

Web Thicknesses

[0163] The thickness of the top lidding web **3** may be selected to be between 30% and 90%, preferably between 50% and 75%, of that of the base web **2**. By this means, when, after the pouches **1** have been sealed and ejected from the machine, the base web **2** retracts or shrinks back to reduce the internal volume of each compartment. The pressure so generated within each compartment of the pouch **1** causes the thinner top lidding web **3** to distend, typically to a greater degree than the shrinkage of the base web **2**, thereby increasing the internal volume of each compartment of the pouch **1**. This can result in the formation of a substantially symmetrical pouch **1** about the weld line **5**. This reconfiguration of pouches **1** ejected from cavities **6** of a rotable former **7** configured with a cylindrical surface is shown in FIG. **18**. The former may **7** may be circular as shown in FIG. **18** although this is not essential and other configurations of former may be employed, for example a rotable former configured with a flat horizontal surface. Examples of cylindrical and horizontal formers that may be employed are shown and described in WO2011/061628 to which the reader is directed for further details.

[0164] Whilst the reduction in planar distortion provided by any single factor may not be sufficient to assure planar rigidity of the pouch, when all three factors are combined, there is an unexpected increase in planar rigidity which in turn provides a marketing advantage to the multi-compartment pouch of the present invention.

[0165] Referring now to FIGS. **19** and **20**, examples of filling multi-compartment pouches **1** according to the present invention are illustrated although these examples are by no means limiting. The number of pouches **1** formed, filled and sealed across the web of a machine is known as the number of tracks or lanes.

[0166] In FIG. **19**, filling of pouches **1** with two compartments **1***a*,**1***b* similar to the pouch shown in FIG. **14** is illustrated. The rotatable former **7** of the pouch making machine may be configured as shown and described in WO2011/061628 with a cylindrical surface **7***a* or alternatively with a flat horizontal surface. The compartments **1***a*,**1***b* may be filled by heads **8***a*,**8***b*. The heads **8***a*,**8***b* may be point fillers. The heads **8***a*,**8***b* may be configured to add a liquid, gel, powder or granules, for example nozzle injectors for liquids or gels or augur fillers for powders or granules. Heads **8***a*,**8***b* may be connected to a feed for the same or different materials. The heads **8***a*, **8***b* may be arranged with a space offset in the direction of movement of the surface **7***a* and fire simultaneously (option A) or with no space offset and fire at slightly different set points (option B). A similar arrangement may be provided for each track or lane across the web of the machine. Heads in different tracks or lanes may be connected to the same or different supplies of material. This method is equally applicable where the multi-compartment pouch comprises more than two compartments. Generally, a filling head is provided for each compartment.

[0167] In FIG. **20**, filling of pouches **1** with three compartments **1***a*,**1***b*,**1***c* similar to the pouch shown in FIG. **15** is illustrated. The rotatable former **7** of the pouch making machine may be configured as shown and described in WO2011/061628 with a cylindrical surface **7***a* or alternatively with a flat horizontal surface. The compartments **1***a*,**1***b*, **1***c* may be filled by heads **8***a*,**8***b*,**8***c*. The heads **8***a*,**8***b*,**8***c* may be point fillers. The heads **8***a*,**8***b*,**8***c* may be configured to add a liquid or gel or a powder or granules, for example nozzle injectors for liquids and gels or augur fillers for powders and granules. In this embodiment, the heads **8***a*,**8***b* are configured to add a liquid or gel and head **8***c* is configured to add a powder or granules. Heads **8***a*,**8***b* may be connected to a feed for the same or different liquids or gels. A similar arrangement may be provided for each track or lane across the web of the machine. Heads in different tracks or lanes may be connected to the same or different supplies of material. Other arrangements of heads **8***a*,**8***b*,**8***c* for delivering any combination of liquids, gels, powders and granules are envisaged. This method is equally applicable where the multi-compartment pouch comprises two or more compartments. Generally a filling head is provided for each compartment.

[0168] Referring now to FIG. **21**, methods of arranging the heads are illustrated. The heads may be arranged to create space for a plurality of heads within the confined space available. In one arrangement, the heads may be inclined to each other. For example, a head **8***a* for a liquid or gel and a head **8***b* for a powder or granules may be inclined to each other. In another arrangement, a head **8***b* for a powder or granules may be provided with a chute **9**. The liquid or gel filling head **8***a* and chute **9** may be inclined to each other. The heads **8***a*, **8***b* may be arranged to follow the cavity **6** of the former **7** as it advances so that the time available for completion of the filling operation is thereby increased and the product being filled is spread more evenly along the compartment in the base web.

[0169] By use of the above filling arrangements and/or by the programming of the software integrating the filling operation with the running speed of the machine, it may be possible to fill the compartments of a multi-compartment pouch **1** during a time interval of up to one second. In this way, the machine may be capable of providing an output of approximately 60 pouches per minute for each track or lane of the machine. In the case of granular or powder solid products, the filling equipment is typically a multi-head auger filler and in the case of liquid products, the filling equipment is typically cylinder operated nozzle injectors with a cut off such that no drips arrive on the base web surrounding the cavities. Such contamination of the base web can subsequently inhibit good sealing of the base web with the top or lidding web. Hitherto, the filling operation has not allowed such filling speeds across so many tracks, preventing the compartments of a multi-compartment pouch from being filled within such a short time interval.

[0170] Embodiments of pouch forming machines are shown in FIGS. **22** to **26** wherein like reference numerals are used to indicate the same or similar parts such that the opera-

tion of the same or similar parts will be understood from a description of any embodiment without being repeated for other embodiments.

[0171] An embodiment of a pouch forming machine **20** is shown in FIG. **22** comprising a horizontal rotatable former **21**. The term horizontal rotatable former describes a machine wherein part of the former **21** comprises a horizontal surface or section **21***a*. The former **21** may comprise an endless belt (only part of the former is shown in FIG. **22**). The machine is configured to form multi-compartment pouches from two water soluble substrates by sequential forming and filling each compartment of the pouch. In this embodiment, the former is provided with pouch forming cavities **23** configured to form pouches with three compartments but it will be understood this is not limiting and the cavities **23** can be configured to form pouches having two or more compartments.

[0172] A base web **24** is unwound from an unwinding station **25** and a first open pocket or container **26** is formed in the base web at **27** and filled at **28**. A second open pocket or container **29** is formed in the base web at **30** and filled at **31**. A third open pocket or container **32** is formed in the base web at **33** and filled at **34**. A lidding web **35** is unwound from an unwinding station **36** and affixed to the base web at **37** thereby sealing and closing all the open pockets or containers **26**, **29**, **32** in the base web to form multi-compartment pouches **38** within the cavities **23**. The combined base web and lidding web is then moved to a cutting station **39** where the pouches **38** are separated from the combined web. In this embodiment, the top or lidding web **35** is affixed to the base web **24** by solvent welding by wetting the lidding web **35** at **40**. Other methods of affixing the top or lidding web may be employed such as heat sealing.

[0173] It is important to note that many possible designs of multi-compartment pouches having at least two compartments may be produced employing the machine **20** by appropriate design of the pouch forming cavities. For example, the machine **20** may produce any of the pouches shown in FIGS. **1** to **17** although this is not limiting on the scope of the invention. Each compartment may be sequentially formed and filled with different compositions. Alternatively, where more than one compartment contains the same composition, these compartment may be formed and filled simultaneously with at least one other compartment being formed and filled sequentially.

[0174] Further embodiments of a pouch forming machine **20'** are shown in FIGS. **23** and **24** comprising a combination of two rotatable formers wherein one rotatable former is a horizontal rotatable former **21** similar to FIG. **22** and the other rotatable former is a cylindrical rotatable former **41**. The term cylindrical rotatable former describes a machine where the former **41** comprises a circular surface or section **41***a*. The cylindrical former **41** is positioned above the horizontal section **21***a* of the horizontal former **21**. The former **41** is provided with pouch forming cavities **42** and may comprise a drum.

[0175] In FIG. **23**, multi-compartment water pouches **38** comprising a water-soluble base web **24** and a water-soluble top or lidding web **35** are formed on the horizontal rotatable former **21** as described previously and water-soluble pouches **38'** comprising a water soluble base web **24'** and a water soluble top or lidding web **35'** are formed on the cylindrical former **41**. The pouches **38**,**38'** are brought together in register and combined by joining the top or lidding webs **35**,**35'** to each other at **44**. The resulting combined pouch is formed from four water soluble webs or substrates. In this embodiment, the pouch **38'** comprises a single compartment filled at **43**. In other embodiments, the pouch **38'** may comprise more than one compartment. The pouches **38**,**38'** may comprise any of the pouches shown in FIGS. **1** to **17** although this is not limiting on the scope of the invention. In other embodiments, the pouch **38** may be a single compartment and the pouch **38'** may be multi-compartment.

[0176] In FIG. **24**, the top or lidding web **35** is omitted and the open pouches or containers formed by the base web **24** on the former **21** are closed by the top or lidding web **35'** of the pouches **38'** on the former **41**. The resulting pouch is formed from three water soluble webs or substrates

[0177] Further embodiments of a pouch forming machine **20"** are shown in FIGS. **25** and **26** comprising a combination of two rotatable formers wherein both rotatable formers are horizontal rotatable formers **21**,**21"** similar to FIG. **22** with a horizontal lower section **21***b***"** of the former **21"** positioned above the horizontal upper section **21***a* of the former **21**.

[0178] In FIG. **25**, multi-compartment pouches **38** comprising a water-soluble base web **24** and a water-soluble top or lidding web **35** are formed on the horizontal rotatable former **21** as described previously and water-soluble pouches **38"** comprising a water soluble base web **24"** and a water soluble top or lidding web **35"** are formed on the horizontal former **21"**. The pouches **38**,**38"** are brought together in register and combined by joining the top or lidding webs **35**,**35"** to each other at **44**. The resulting combined pouch is formed from four water soluble webs or substrates. An additional cutting station **39"** may be provided in at least the transverse direction so that the closed pouches **38"** produced on the upper horizontal former **21"**, despite the vacuum holding them within the cavities **23"** of the former **21"**, are not dislodged as the former **21"** passes over the roller at **45**.

[0179] In this embodiment, the pouch **38"** is a multi-compartment pouch formed in similar manner to the pouch **38**. In other embodiments, the pouch **38"** may comprise a single compartment or any other design with two or more compartments. The pouches **38**,**38"** may comprise any of the pouches shown in FIGS. **1** to **17** although this is not limiting on the scope of the invention.

[0180] In FIG. **26**, the top or lidding web **35** is omitted and the open pouches or containers formed by the base web **24** on the former **21** are closed by the top or lidding web **35"** of the pouches **38"** on the former **21"**. The resulting pouch is formed from three water soluble webs or substrates

[0181] By way of non-limiting example, a multi-compartment water soluble pouch **60** with three compartments **60***a*, **60***b*,**60***c* is shown in FIG. **27**. The method of sequentially forming and filling the pouch **60** is illustrated in FIGS. **28** and **29**.

[0182] Referring to FIGS. **28** and **29**, a former **61** has a cavity **62** with three recessed areas **62***a*,**62***b*,**62***c* corresponding to the compartments **60***a*,**60***b*,**60***c* of the pouch **60**. A base web **63** is formed into area **62***a* to form an open pocket or container for compartment **60***a*. Compartment **60***a* is then filled for example with a powder or granules by a belt feeder **64**. The feeder **64** may have a scraper blade **66** to prevent overfilling of the compartment **60***a*. Next, the base web **63** is formed into area **62***b* to form an open pocket or container for compartment **60***b*. Compartment **60***b* is then filled for example with a powder or granules by a belt feeder **64**. Finally the base web **63** is formed into area **62***c* to form an open pocket or container for compartment **60***c*. Compartment **60***c*

is then filled for example with a liquid or gel by a nozzle feeder **65**. The sequentially formed and filled compartments **60***a*,**60***b*,**60***c* can then be closed and sealed by a top or lidding web (not shown) by any of the methods and machines described previously.

[0183] By means of sequential forming and filling, it may be possible to form and fill open pockets or containers in a base web to form compartments which, in plan view, "overlap" each other in the direction of travel of the web. In this way, multi-compartment pouches containing overlapping compartments can be made employing the sequential forming and filling method described herein which could not be made by conventional methods employing contemporaneous forming of the compartments followed by filling due to filling constraints. The above method may be employed for any design of multi-compartment pouch.

[0184] Sequential forming of the base web **63** may be effected by different methods. One method involves applying a vacuum to each recessed area **62***a*,**62***b*,**62***c* of the cavity **62** in turn. Preferably the vacuum is maintained in each area in which the base web **63** is formed and filled until the pouch **60** is ejected from the former **61**. Sequential forming and filling offers the advantage of greater space, longer filling times and therefore ease of filling for powders or granules which do not flow freely from the filling heads.

[0185] The sequential vacuum supply to the cavities **62** may be provided in various ways. Generally mechanical methods of vacuum control are preferred as being potentially more reliable than, for example, an electrical method that would require spinning electrical connections. Two methods of arranging the vacuum supply for sequential forming the base web **63** to form open pockets or containers corresponding to compartments **60***a*,**60***b*,**60***c* of the pouch **60** are described below with reference to FIGS. **30** and **31**, although other methods will be envisaged by those skilled in the art.

[0186] In FIG. **30**, a vacuum shoe arrangement for sequential forming of base web **63** is employed comprising three vacuum slots **66***a*,**66***b*,**66***c* wherein each slot **66***a*,**66***b*,**66***c* controls the vacuum start and stop to each of the three recessed areas **62***a*,**62***b*,**62***c* respectively. The slots **66***a*,**66***b*,**66***c* are of different lengths and are configured so that stop point is the same for all recessed areas **62***a*,**62***b*,**62***c* in order to release the pouch from the cavity **62**. The first slot **66***a* has the earliest start point, then the second slot **66***b* and lastly the third slot **66***c*. In this way the vacuum is applied first to the area **62***a* through vacuum slot **66***a* so that the base web **63** can be drawn into the area **62***a* only to form an open pocket or container corresponding to compartment **60***a* which can then be filled. Whilst the vacuum to the area **62***a* is maintained, the vacuum is next applied to the area **62***b* through vacuum slot **66***b* so that the base web **63** can be drawn into the second area **62***b* to form an open pocket or container corresponding to compartment **60***b* which can then be filled. Whilst the vacuum to the areas **62***a*,**62***b* is maintained, the vacuum is applied to the area **62***c* through slot **66***c* so that the base web **63** can be drawn into the area **62***c* to form an open pocket or container corresponding to compartment **60***c* which can then be filled . . . . When all the pockets or containers have been formed and filled, a lidding web (not shown) can be affixed to the base web **63** around the open pockets or containers to close and seal the compartments to form the multi-compartment pouch **60**. The pouch **60** can then be separated from the combined web, the vacuum supply to all three recessed areas released and the pouch ejected from the cavity **62** in the rotatable former either by falling under gravity or by ejection with compressed air or a combination of both on to a suitable conveyor system.

[0187] In FIG. **31**, a vacuum valve arrangement for sequential forming of base web **63** is employed comprising three vacuum valves **67***a*,**67***b*,**67***c* wherein each valve **67***a*,**67**,**67***c* controls the vacuum start and stop to each of the three recessed areas **62***a*,**62***b*,**62***c* respectively. Each valve **67***a*,**67***b*,**67***c* is mechanically controlled by an actuator **68***a*,**68***b*,**69***c* co-operable with a straight cam **69***a*,**69***b*,**69***c* arranged underneath the valve. The cams **69***a*,**69***b*,**69***c* are of different lengths and are configured so that the stop point is the same for all recessed areas **62***a*,**62***b*,**62***c* in order to release the pouch from the cavity **62**. The first cam **69***a* is the longest, then the second cam **69***b* and the third cam **69***c* is the shortest. In this way vacuum valve **67***a* is actuated first to apply vacuum to the area **62***a* so that the base web **63** can be drawn into the area **62***a* only to form an open pocket or container corresponding to compartment **60***a* which can then be filled. Whilst the vacuum to the area **62***a* is maintained, the vacuum valve **67***b* is next actuated to apply vacuum to the area **62***b* so that the base web **63** can be drawn into the second area **62***b* to form an open pocket or container corresponding to compartment **60***b* which can then be filled. Whilst the vacuum to the areas **62***a*,**62***b* is maintained, the vacuum valve **67***c* is actuated to apply vacuum to the area **62***c* so that the base web **63** can be drawn into the area **62***c* to form an open pocket or container corresponding to compartment **60***c* which can then be filled . . . . When all the pockets or containers have been formed and filled, a lidding web (not shown) can be affixed to the base web **63** around the open pockets or containers to close and seal the compartments to form the multi-compartment pouch **60**. The pouch **60** can then be separated from the combined web, the vacuum supply to all three recessed areas released and the pouch ejected from the cavity **62** in the rotatable former either by falling under gravity or by ejection with compressed air or a combination of both on to a suitable conveyor system.

[0188] In arrangement of FIG. **31**, a simple vacuum shoe or some kind of a vacuum manifold for the initial vacuum connection to the valve block **70** is required. However, the cams **69***a*,**69***b*,**69***c* can be configured to be adjustable to alter the vacuum start and/or stop points to change the valve timing. For example the cams **69***a*,**69***b*,**69***c* may be made of two pieces (dove tailed, for example) which allows for length adjustment. Such adjustment may be effected remotely. This may allow easier adjustment of the valve timing compared to the arrangement of FIG. **30** where the vacuum shoe has to be removed and either replaced by a vacuum shoe with different length slots or the slots cut to change the length and the shoe refitted.

[0189] A further advantage of the arrangement of FIG. **31** is that there is only one vacuum line going to the valve block for the valves **67***a*,**67***b*,**67***c* for each of the recessed areas **62***a*,**62***b*,**62***c*. In the arrangement of FIG. **30**, individual lines from the vacuum shoe to each recessed area **62***a*,**62***b*,**62***c* are required.

[0190] In some embodiments the cavities **62** in the former may be heated by internal and/or external heaters to assist forming the base web **63** into the cavities. In some embodiments the base web **63** may pass over a heated roller prior to being drawn into the first recessed area **62***a*. In some embodiments, the base web **63** may be heated prior to be drawn into the second and/or third recessed areas to maintain flexibility of the web and assist forming into the recessed areas. Such

heating may be effected from above for example by means of externally mounted hot air jets or externally mounted infrared heaters.

[0191] FIG. **32** illustrates an example, which is by no means limiting, of a two compartment pouch **70** that can be produced on a machine similar to FIG. **22** wherein a first open pocket or container **71** is formed in a base web and in this example filled using a belt feeder **72** or similar type area filler and only once the first container **71** has been filled, is a second open pocket or container **73** sequentially formed in the base web and in this example, filled using a point feeder **74**. The feeders **72**,**74** may be replaced by any other feeders to suit the product added to the containers **71**,**73**.

[0192] FIG. **33** illustrates an example, which is by no means limiting, of a three compartment pouch **80** that can be produced on a machine similar to FIG. **22** wherein a first open pocket or container **81** is formed in a base web and in this example filled using a belt feeder **82** or similar type area filler and only once the first container **81** has been filled is a second open pocket or container **83** sequentially formed in the base web and in this example filled using a belt feeder **84** or similar type area filler and only once the second container **83** has been filled, is a third container **85** sequentially formed in the base web and in this example filled using a point feeder **86**. The feeders **82**,**84**,**86** may be replaced by any other feeders to suit the product added to the containers **81**,**83**,**85**. In a modification, containers **81** and **83** may be formed and filled simultaneously and container **85** formed and filled sequentially.

[0193] FIG. **34** illustrates an example, which is by no means limiting, of a four compartment pouch **90** that can be produced on a machine similar to FIG. **22** wherein a first container **91** is formed in a base web and in this example filled using a belt feeder **92** or similar type area filler and only once the first container **91** has been filled, is a second container **93** sequentially formed in the base web and in this example filled using a belt feeder **94** or similar type area filler and only once the second container **93** has been filled are a third container **95** and a fourth container **96** formed simultaneously in the base web and in this example, filled simultaneously using point feeders **97** and **98** respectively. The feeders **92**,**94**,**97**,**98** may be replaced by any other feeders to suit the product added to the containers **91**,**93**,**95**,**96**. In other arrangements, containers **91**, **93**, **95** and **96** may each be formed and filled sequentially. In other arrangements, containers **91** and **93** may be formed and filled simultaneously and containers **95** and **96** may be formed and filled sequentially. Other combinations of simultaneous and sequential forming and filling of the containers will be apparent to those skilled in the art.

[0194] FIG. **35** illustrates examples, which are by no means limiting, of pouch designs which may be produced by means of the present invention.

[0195] FIG. **35**(*i*) illustrates a two compartment pouch **100** where typically, although the nature of each composition as described hereafter is by no means limiting, open pocket or container **101** is formed first in a base web and filled with a powder or granular composition by means of a belt feeder or similar type area feeder, and container **102** is formed second and filled with a liquid or gel composition filled by means of a point feeder. The pouch **100** is then closed by means of a lidding web.

[0196] FIGS. **35**(*ii*), **35**(*v*), and **35**(*ix*) illustrate different three compartment pouches **110** where typically, although the nature of each composition as described hereafter is by no means limiting, an open pocket or container **111** is formed first in a base web and filled with a powder or granular composition by means of a belt feeder or similar type area feeder, open pocket or container **112** is formed second and filled with a powder or granular composition by means of a belt feeder or similar type area feeder, and container **113** is formed third and filled with a liquid or gel composition filled by means of a point feeder. The pouch **110** is then closed by means of a lidding web.

[0197] FIGS. **35**(*iii*), **35**(*iv*), **36**(*vi*) and **35**(*vii*) illustrate different four compartment pouches **120** where typically, although the nature of each composition as hereafter described is by no means limiting, an open pocket or container **121** is formed first in a base web and filled with a powder or granular composition by means of a belt feeder or similar type area feeder, container **122** is formed second and filled with a powder or granular composition by means of a belt feeder or similar type area feeder, containers **123** and **124** are formed and filled either sequentially or contemporaneously with the same or different liquid or gel composition(s) filled by means of point feeders. The pouch **120** is then closed by means of a lidding web.

[0198] FIG. **35**(viii) illustrates a six compartment pouch **130** where typically, although the nature of each composition as hereafter described is by no means limiting, container **131** is formed first in a base web and filled with a powder or granular composition by means of a belt feeder or similar type area feeder, container **132** is formed second and filled with a powder or granular composition by means of a belt feeder or similar type area feeder, and containers **133**, **134**, **135**, and **136** are formed and filled either sequentially or contemporaneously and filled with the same or different liquid or gel composition(s) by means of point feeders. The pouch is then closed by means of a lidding web.

[0199] For the two compartment pouch illustrated in FIG. **35**(*i*), the method of fill may be as follows:

1. Vacuum is applied to form container **101** in the base web
2. Container **101** is filled by a belt feeder or similar type area filler
5. Whilst maintaining the vacuum to form container **101**, vacuum is applied to form container **102**
6. Container **102** is filled with a point type filler, i.e auger or liquid nozzle.

[0200] For the remaining pouches illustrated in FIG. **35** the method of fill may be the same wherein:

1. Vacuum is applied to form container **111**,**121**,**131** only in the base web
2. Container **111**,**121**,**131** is filled by a belt feeder or similar type area filler
3. Whilst maintaining the vacuum to form container **111**,**121**, **131**, vacuum is applied to form container **112**,**122**,**132** in the base web
4. Container **112**,**122**,**132** is filled by similar means as container **111**,**121**,**131**
5. Whilst maintaining the vacuum to form containers **111**, **112**,**121**,**122**,**131**,**12**, vacuum is applied to form containers **113**,**123**,**133** and above (**134**, **135**, **136**) in the base web
6. Containers **113**,**123**,**133** and above (**134**,**135**,**136**) are filled with a point type filler, i.e auger, or liquid nozzle.

[0201] The construction and arrangement of the elements as shown in the exemplary embodiments are illustrative only. Although only a few embodiments of the present disclosure have been described in detail, those skilled in the art who review this disclosure will readily appreciate that many modifications are possible (e.g., variations in sizes, dimensions,

structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter recited. The elements and assemblies may be constructed from any of a wide variety of materials that provide sufficient strength or durability, in any of a wide variety of colors, textures, and combinations. Additionally, in the subject description, the word "exemplary" is used to mean serving as an example, instance, or illustration. Any embodiment or design described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other embodiments or designs. Rather, use of the word "exemplary" is intended to present concepts in a concrete manner. Accordingly, all such modifications are intended to be included within the scope of the present disclosure. Other substitutions, modifications, changes, and omissions may be made in the design, operating conditions, and arrangement of the preferred and other exemplary embodiments without departing from the scope of the appended claims.

[0202] For purposes of this disclosure, references to the orientation of the elements in this description are merely used to identify the various elements as they are oriented in the FIGURES. These terms are not meant to limit the element which they describe, as the various elements may be oriented differently in various applications. Further, the order or sequence of any process or method steps may be varied or re-sequenced according to alternative embodiments. Any means-plus-function clause is intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures. Other substitutions, modifications, changes and omissions may be made in the design, operating configuration, and arrangement of the preferred and other exemplary embodiments without departing from the scope of the appended claims. For example, the methods and apparatus described herein may be adapted to produce multi-compartment pouches wherein all compartments of the pouch are filled with a composition or wherein at least one compartment is filled and at least one compartment is empty (i.e. not filled). All combinations of filled and empty compartments may be produced by the method and apparatus described herein. Multi-compartment pouches may have the compartments formed simultaneously or sequentially or a combination of simultaneous and sequentially formed compartments may be produced by the method and apparatus described herein.

1. A continuous motion rotatable forming machine for producing multi-compartment water-soluble pouches, the machine comprising a rotatable former having compartment forming cavities into which a base web can be formed, wherein the forming machine is configured so that at least one compartment of a pouch is formed and filled before at least one other compartment of the pouch is formed and filled, and only once all compartments have been filled is the pouch closed and sealed by affixing a lidding web.

2. A machine according to claim **1** in which the lidding web comprises a web of formed filled and sealed pouches.

3. A machine according to claim **1** comprising two formers of which at least one is a horizontal former wherein each former is able to produce water-soluble pouches comprising one or more compartments, the lidding films of which are then sealed or bonded together to form a combined pouch.

4. A machine according to claim **1** comprising two formers of which at least one is a horizontal former wherein each former is able to produce water-soluble pouches comprising one or more compartments, the lidding film of pouches on one former closing pouches on the other former to form a combined pouch.

5-11. (canceled)

12. A method of making a water soluble multi-compartment pouch on a continuous motion rotatable forming machine having compartment forming cavities into which a base web can be formed, wherein the forming machine is configured so that at least one compartment of a pouch is formed and filled before at least one other compartment of the pouch is formed and filled, and only once all compartments have been filled is the pouch closed by sealing with a lidding web.

13. A method according to claim **12** wherein the multi-compartment water-soluble pouch is affixed to a second closed pouch such that the combined pouch comprises four water-soluble substrates.

14. A method according to claim **12** wherein the lidding web of the multi-compartment water-soluble pouch comprises a lidding web comprising a second closed pouch such that the combined pouch comprises three water-soluble substrates.

15. A method according to claim **13** wherein the second closed pouch comprises one or more compartments.

16. A method according to claim **14** wherein the second closed pouch comprises one or more compartments.

* * * * *