(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 762 217 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.08.2014 Bulletin 2014/32

(51) Int Cl.:
A63H 33/10 *(2006.01)* ***A63H 33/08*** *(2006.01)*

(21) Application number: **14153309.1**

(22) Date of filing: **30.01.2014**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **04.02.2013 US 201313758926**

(71) Applicant: **ITSPHUN**
Portland OR 97209 (US)

(72) Inventors:
- **Draghicescu, Mircea**
  Portland, Oregon 97209 (US)
- **Browne, Ioana**
  Palo Alto, California 94303 (US)

(74) Representative: **Coulon, Ludivine et al**
Gevers Patents
Holidaystraat 5
1831 Diegem (BE)

(54) Geometric systems for building 3-D structures

(57) Geometric systems for building 3-D structures from a plurality of 2-D building elements, including a first building element defining a first shape defined by edges with a first dimension, and a second building element defining a second shape incongruent to the first shape defined by edges with a second dimension incongruent to the first dimension. Further, each building element defines an imaginary circle having a center aligned with the center of the building element, and defines a plurality of notches positioned at and tangential to the circumference of the imaginary circle, where the plurality of building elements are configured to fit together at their respective notches to form a 3-D structure. Geometric systems may include a first building element defining a first shape with a first contour, and a second building element defining a second shape incongruent to the first shape with a second contour incongruent to the first contour.

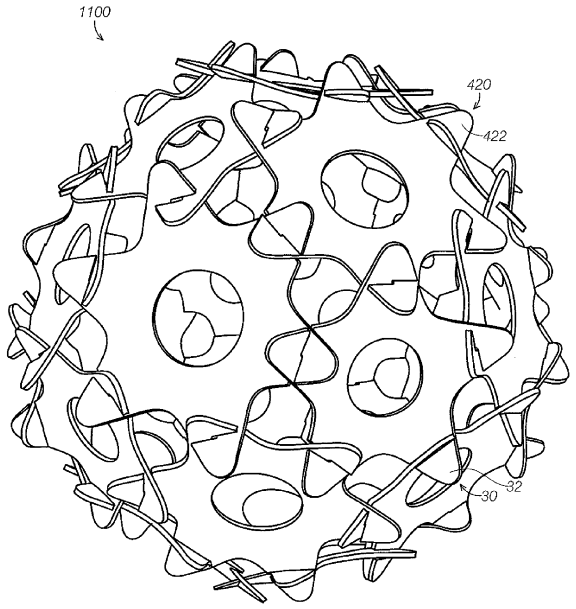


FIG.14

EP 2 762 217 A1

Description

[0001] The present disclosure relates generally to geometric systems. In particular, geometric systems with interfitting building elements for building 3-D structures are described.

[0002] The construction of 3-D structures from 2-D building elements is an effective means for studying various geometric shapes, including, but not limited to, Platonic, Archimedean, and Johnson solids as well as prisms, antiprisms, and various non-convex structures with regular faces. This area of study also lends itself well to the understanding of mathematical concepts associated with these geometric shapes and may aid in the development of the user's creative appetite. Indeed, geometric building systems are an excellent means for constructing an infinite number of geometric shapes while exposing users to an activity that intersects the world of art with the world of mathematics to make wonderful and colorful creations.

[0003] Known geometric systems are not entirely satisfactory for the range of applications in which they are employed. For example, existing geometric systems do not allow for the interfitting or interconnection of individual incongruent elements to construct a 3-D structure. In addition, conventional geometric systems, because of their failure to allow the interconnection of incongruent elements, are limited to a very small subset of 3-D structures that can actually be constructed.

[0004] Thus, there exists a need for geometric systems that improve upon and advance the design of known geometric systems. Examples of new and useful geometric systems for building 3-D structures relevant to the needs existing in the field are discussed below.

[0005] Disclosure addressing one or more of the identified existing needs is provided in the detailed description below. Examples of references relevant to geometric systems for building 3-D structures include U.S. Patent References: 7,469,898; 5,593,337; 5,489,230; and U.S. Patent Application Publication: 20120164912. However, each one of these references suffers from one or more of the following disadvantages: the individual building elements used to construct the 3-D structures can only be interconnected with other building elements that are exactly the same shape and the material from which these building elements are manufactured is limited to either only flexible materials or only rigid materials, but never a combination of both types of material. The complete disclosures of the above patents and patent applications are herein incorporated by reference for all purposes.

[0006] The present disclosure is directed to geometric systems for building 3-D structures from a plurality of 2-D building elements, including a first building element defining a first shape defined by edges with a first dimension, and a second building element defining a second shape incongruent to the first shape defined by edges with a second dimension incongruent to the first dimension. Further, each building element defines an imaginary circle having a center aligned with the center of the building element and defines a plurality of notches positioned at the circumference of the imaginary circle and aligned tangentially to the imaginary circle and where the plurality of building elements, including the first building element and the second building element defining incongruent shapes, are configured to fit together at their respective notches to form a 3-D structure. In some examples, geometric systems include a first building element defining a first shape defined by edges with a first contour, and a second building element defining a second shape incongruent to the first shape defined by edges with a second contour incongruent to the first contour.

[0007] The disclosed geometric systems will become better understood through review of the following detailed description in conjunction with the figures. The detailed description and figures provide merely examples of the various inventions described herein. Those skilled in the art will understand that the disclosed examples may be varied, modified, and altered without departing from the scope of the inventions described herein. Many variations are contemplated for different applications and design considerations; however, for the sake of brevity, each and every contemplated variation is not individually described in the following detailed description.

[0008] Throughout the following detailed description, examples of various geometric systems are provided. Related features in the examples may be identical, similar, or dissimilar in different examples. For the sake of brevity, related features will not be redundantly explained in each example. Instead, the use of related feature names will cue the reader that the feature with a related feature name may be similar to the related feature in an example explained previously. Features specific to a given example will be described in that particular example. The reader should understand that a given feature need not be the same or similar to the specific portrayal of a related feature in any given figure or example.

Fig. 1 is a perspective view of a first example of a geometric system depicting two incongruent building elements interconnecting.

Fig. 2 is a perspective view of the geometric system shown in Fig. 1 depicting two incongruent building elements interconnecting.

Fig. 3 is a perspective view of the geometric system illustrating four incongruent building elements interconnecting.

Fig. 4 is a top plan view of two building elements, a first building element at the top of the figure in the shape of a triangle and having non-rectilinear notches and a second building element at the bottom of the figure in the shape of a triangle and having rectilinear notches.

Fig. 5 depicts the first building element and the second building element shown in Fig. 4 with the first building element interconnecting with the second building element by joining together the non-rectilin-

ear notch of the first building element and the rectilinear notch of the second building element.

Fig. 6 is a top plan view of an example building element.

Fig. 7 is a top plan view of another example building element.

Fig. 8 is a top plan view of another example building element.

Fig. 9 is a top plan view of another example building element.

Fig. 10 is a top plan view of another example building element.

Fig. 11 is a top plan view of another example building element.

Fig. 12 is a top plan view of a geometric system constructed from a plurality of building elements to form an octahedron structure.

Fig. 13 is a top plan view of a geometric system constructed from a plurality of building elements to form a cuboctahedron structure.

Fig. 14 is a top plan view of a geometric system constructed from a plurality of building elements to form a truncated icosahedron structure.

[0009] With reference to Figs. 1-14, a geometric system 18 for building 3-D structures will now be described. Geometric system 18 includes a first building element 20 and a second building element 30. The reader should understand that geometric systems described herein may include a plurality of building elements, such as 2, 3, 5, 10, 50, or 100 or more building elements.

[0010] In use, as shown in Figs. 1-3, 5, and 12-14, two or more building elements are interconnected together to form a three-dimensional (3-D) structure. In some examples, the geometric system forms a 3-D structure in the form of a polyhedron whereas in other examples, the system forms an irregular 3-D structure. The user's imagination and skill will lead to a variety of 3-D shapes, which adds to the enjoyment and learning possible with the geometric systems described herein.

[0011] For example, the geometric systems described herein may form Platonic solids, Archimedean solids, and Johnson solids by interconnecting building elements together. Alternatively, a user may interconnect building elements to each other to form a variety of 3-D polyhedrons or other 3-D structures. Of course, substantially planar structures may be created with geometric systems described herein as well, which might be considered two-dimensional given the relative dimensions of the resulting structure.

[0012] In many examples, the building elements are made from a lightweight, inexpensive material, such as paper, which leads to 3-D structures that are aesthetically pleasing, but not structurally sound. However, in some examples, the building elements are made from structurally significant materials, such as wood, hard plastic, metal, or other rigid material, and may be used to construct 3-D structures with structural integrity. For instance, geometric systems including structural building elements may form enhanced 3-D structures such as lamps, toys, or even more permanent structures as part of an arts and crafts kit.

[0013] The plurality of building elements may be the same shape and/or configuration, as shown in Fig. 2, or may include one or more different shapes and/or configurations, as shown in Figs. 1, and 3-5. In some examples, the building elements are each a different shape and/or configuration from the other building elements within the plurality of building elements. In other examples, the plurality of building elements includes a mix of building elements that are congruent to other building elements and incongruent to other building elements in the plurality or set of building elements making up the geometric system.

[0014] Figs. 4 and 5 demonstrate one example what is meant by a different configuration: the reader can see that the building element in Figs. 4 and 5 are the same shape when viewed in profile, but are configured differently with regard to the shape of their notches. In Fig. 4, a building element 120 is shown at the top of the figure in the shape of a triangle with edges 124 and non-rectilinear notches 126. Building element 130 is shown at the bottom of Fig. 4 and is in the shape of a triangle with edges 134 and rectilinear notches 136.

[0015] Turning attention to Fig. 1, building element 20 defines a first geometric shape 22, a 3-pointed star, defined by outer edges 24. While building element 20 is technically three-dimensional in that it has a length, a width, and a thickness, it may be referred to as substantially two-dimensional (2-D) given that its thickness is significantly smaller than its length and width. In other examples, the building element may have a thickness that is larger and in those instances the building element may be considered a three-dimensional component.

[0016] Building element 20 defines an imaginary circle having a center aligned with the center of building element 20. In the example shown in Fig. 1, building element defines an aperture 28 in the shape of a circle that is also aligned with the center of the building element. However, in some examples the building element does not define an aperture in the shape of a circle, but instead defines an aperture of another shape, such as a triangle, square, another regular polygon, or an irregular polygon. Aperture 26 may assist users to hold and manipulate building element 20 while constructing 3-D structures. In some examples, the building element does not define an aperture.

[0017] Building element 20 defines three notches 26. In certain examples, the building element includes less than three notches, such as one or two notches. In still further examples, the building element includes more than three notches, such as four, five, or six or more notches.

[0018] Notches 26 are substantially rectilinear in shape as compared to notches 126 shown in Fig. 4, which are non-rectilinear in shape. In various examples, the building element may define rectilinear notches, non-rectilin-

ear notches, or a combination of rectilinear and non-rectilinear notches. In the example shown in Figs. 1 and 2, notches 26 are proximally disposed to the circumference of the imaginary circle and aligned tangentially to the imaginary circle.

[0019] In the example shown in Figs. 1 and 2, building element 20 has a first size. In some examples, the geometric system may include building elements with the same shape, but a different size than building element 20. The building elements having the same shape as building element 20 may be larger and smaller than building element 20.

[0020] Building element 20 may be manufactured from such materials as foam, ethylene vinyl acetate, poster board, or laminated paper. Additionally or alternatively, the building elements of the present invention may be manufactured from wood veneer, acrylic, or sisal. The reader should understand that the building elements described herein may be manufactured from virtually any material currently known or yet to be discovered that would allow the building elements to interconnect and form 3-D structures.

[0021] Continuing with Fig. 1, another building element, building element 30, will be described. Building element 30 in Fig. 1 and the other building elements described herein, such as those shown in Figs. 3-14, are similar in some respects to building element 20 and different in other respects. Accordingly, the distinctions between the building elements will be highlighted and the reader should understand that the features and contemplated variations of building element 20 described above may apply to the other building elements described herein.

[0022] As shown in Fig. 1, building element 30 defines a second geometric shape 32, a 6-pointed star, with outer edges 34. Building element 30 is larger than building element 20. Building element 30 defines an imaginary circle having a center aligned with the center of building element 30. Building element 30 further defines a centrally positioned aperture 38 in the shape of a circle.As shown in Fig. 1, building element 30 defines three notches 36 that are rectilinear in shape and are proximally disposed to the circumference of the imaginary circle and aligned tangentially to the imaginary circle.

[0023] The reader can see in Fig. 1 that building element 30 is incongruent to building element 20. However, building elements 20 and 30 can be interconnected through their respective notches 36 and 26 to form a 3-D structure. Alternatively, in other examples, such as shown in Fig. 2, building elements that are congruent may also be interconnected via their notches. As further shown in Figs. 3, 5, and 12-14, geometric systems described herein may include a variety of interconnected building elements, some congruent and some incongruent, to form 3-D structures.

[0024] Interconnecting incongruent building elements, such as building element 20 and building element 30, may be facilitated by forming notches 26 and 36 to be of equal length. Further, placing notches 26 and 36 proximate the circumference of the imaginary circles centered on the building elements helps enable a user to construct 3-D structures having regular faces, i.e., faces that are equiangular and equilateral. Having a plurality of building elements, each with notches oriented proximate the circumference of an imaginary circle centered on the building element, enable a user to interconnect an large number of building elements, whether the building elements are congruent or incongruent to one another, such as shown in see Fig. 3. Different building elements defining different shapes and different numbers of notches with respect to other building elements in the geometric system allows a user to construct a wide variety of 3-D structures.

[0025] Turning attention to Fig. 4, a second example of a geometric system 118 will now be described. Geometric system 118 includes many similar or identical features to geometric system 18. Thus, for the sake of brevity, each feature of geometric system 118 will not be redundantly explained. Rather, key distinctions between geometric system 118 and geometric system 18 will be described in detail and the reader should reference the discussion above for features substantially similar between the two geometric systems.

[0026] As can be seen in Fig. 4, geometric system 118 includes a building element 120 and a building element 130. Building elements 120 and 130 define a plurality of notches 126 and 136 and a plurality of edges 124 and 134, respectively. Here, geometric system 118 differs from geometric system 18 in building elements 120 and 130 define a substantially similar shape when viewed in profile, namely, a triangle, but the building elements are configured differently. In particular, building element 120 defines a plurality of non-rectilinear notches 126 whereas building element 130 defines rectilinear notches 136.

[0027] Fig. 4 illustrates that notches 126 are non-rectilinear, but still configured to be interconnected with rectilinear notches 136 of building element 130. This is possible because of the location of non-rectilinear notches 136 relative to building element 130. Non-rectilinear notches 126 of building element 120 are disposed proximate the circumference of the imaginary circle centered on the building element and aligned tangentially to the imaginary circle as in building element 20. The placement of the notches, whether rectilinear or non-rectilinear, proximate the circumference of the imaginary circle relative to each geometric shape allows different building elements with the same or different shape profile to interconnect with each other, such as shown in Fig. 5.

[0028] Turning attention to Fig. 6, additional building elements that may be added to both geometric system 18 and geometric system 118 will now be described. The additional building elements include similar or identical to the building elements included in geometric system 18 and geometric system 118. Thus, for the sake of brevity, each feature the additional building elements will not be redundantly explained. Rather, key distinctions between

these additional building elements and the building elements from geometric system 18 and geometric system 118 will be described in detail and the reader should reference the discussion above for features substantially similar between the additional building elements and the building elements of system 18 and system 118.

[0029] As can be seen in Fig. 6, a building element 320 defines a third geometric shape 322, a 4-pointed star, with edges 324. Building element 320 defines a plurality of notches 326 and an aperture 328. The primary difference between building element 20 and building element 320 is their respective shapes. Building element 20 defines a first geometric shape 22, which is a 3-pointed star, and building element 320 defines a third geometric shape 322, which is a 4-pointed star.

[0030] Turning attention to Fig. 7, a building element 420 defines a fourth geometric shape 422, a 6-pointed star, with edges 424. Building element 420 defines a plurality of notches 426 and an aperture 428. The main difference between building element 20 and building element 420 is their respective shapes. Building element 20 defines a first geometric shape 22, which is a 3-pointed star and building element 420 defines a fourth geometric shape 422, which is a 6-pointed star.

[0031] Turning attention to Fig. 8, a building element 720 defines a fifth geometric shape 722, a triangle, with edges 724. Building element 720 includes a plurality of edge tabs 725 and a plurality of notches 726. Differences between building element 20 and building element 720 include their respective shapes and the addition of edge tabs 725 in building element 720. Building element 20 defines a 3-pointed star and building element 720 defines a fifth geometric shape, which is a triangle.

[0032] As shown in Fig. 8, tab 725 is a semicircular-shaped tab that is integrally formed with edge 724. Tab 725 is positioned with a semicircular portion 727 extending away from edge 724. A flat edge 728 of tab 725 cooperates with edge 724 to form a rectilinear notch 726. Alternatively, in other examples, the flat edge of the semicircular tab and edge may cooperate to form a non-rectilinear notch.

[0033] Shifting to Fig. 9, a building element 820 defines a sixth geometric shape 822, a square, and includes edges 824. Building element 820 includes a plurality of tabs 825 and a plurality of notches 826. The primary difference between building element 720 and building element 820 is their respective shapes. Building element 720 defines a triangle and building element 820 defines a square.

[0034] Building element 820 also includes a plurality of semicircular tabs 825 that are integrally formed with edges 824 and positioned with a semicircular portion 827 of tab 825 extending away from edge 824. A flat edge 828 of tab 825 cooperates with edge 824 to form a rectilinear notch 826. Alternatively, the flat edge of the semicircular tab and edge may cooperate to form a non-rectilinear notch.

[0035] Figures 10 and 11 detail two more variations of the nearly unlimited shapes that can be used with the present invention to construct 3-D polyhedrons. Fig. 10 illustrates a building element 520 that defines a seventh shape 522 that resembles a variation of a 4-pointed star. Fig. 11 illustrates a building element 620 that defines an eighth shape 622 that resembles a 5-pointed leaf.

[0036] Figures 12 through 14 illustrate three of the virtually unlimited possible structures that can be constructed with the geometric systems described herein. Fig. 12 illustrates an octahedron 900 constructed from eight building elements 22, which define 3-pointed stars. Fig. 13 illustrates a cuboctahedron 1000 constructed from eight building elements 22, which define 3-pointed stars, and six building elements 322, which define 4-pointed stars. Fig. 14 illustrates a truncated icosahedron 1100 constructed from 12 building elements 30, which define 5-sided stars and 20 building elements 420, which define 6-sided stars.

[0037] The disclosure above encompasses multiple distinct inventions with independent utility. While each of these inventions has been disclosed in a particular form, the specific embodiments disclosed and illustrated above are not to be considered in a limiting sense as numerous variations are possible. The subject matter of the inventions includes all novel and non-obvious combinations and subcombinations of the various elements, features, functions and/or properties disclosed above and inherent to those skilled in the art pertaining to such inventions. Where the disclosure or subsequently filed claims recite "a" element, "a first" element, or any such equivalent term, the disclosure or claims should be understood to incorporate one or more such elements, neither requiring nor excluding two or more such elements.

[0038] Applicant(s) reserves the right to submit claims directed to combinations and subcombinations of the disclosed inventions that are believed to be novel and non-obvious. Inventions embodied in other combinations and subcombinations of features, functions, elements and/or properties may be claimed through amendment of those claims or presentation of new claims in the present application or in a related application. Such amended or new claims, whether they are directed to the same invention or a different invention and whether they are different, broader, narrower or equal in scope to the original claims, are to be considered within the subject matter of the inventions described herein.

[0039] Although the preferred embodiments of the invention have been disclosed for illustrative purpose, those skilled in the art will appreciate that various modifications, additions or substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

Claims

1. A geometric system for building three dimensional structures, comprising:

a plurality of two dimensional building elements configured to connect together for building three dimensional structures, including:

a first building element defining a first shape, and
a second building element defining a second shape incongruent to the first shape; and

where each building element:

defines an imaginary circle having a center aligned with the center of the building element, and
defines a plurality of notches disposed at the circumference of the imaginary circle and aligned tangentially to the imaginary circle; and

where the plurality of building elements, including the first building element and the second building element defining incongruent shapes, are configured to fit together at their respective notches to form a three-dimensional structure.

2. The geometric system of claim 1, wherein the first shape is defined by edges with a first dimension and the second shape is defined by edges with a second dimension incongruent to the first dimension.

3. The geometric system of claim 1, wherein the first shape is defined by edges with a first contour and the second shape is defined by edges with a second contour incongruent to the first contour.

4. The geometric system of any one of claims 1 to 3, wherein the plurality of notches are rectilinear for the first building element and non-rectilinear for the second building element.

5. The geometric system of any one of claims 1 to 3, wherein the plurality of notches are arbitrarily rectilinear and non-rectilinear in shape for all of the interconnected two dimensional building elements.

6. The geometric system of any one of claims 1 to 5, wherein the notches of each building element to be interconnected are of equal length.

7. The geometric system of any one of claims 1 to 6, wherein the distance from the notches to the center of the building elements is selected to cause the plurality of building elements to form a three dimensional structure having faces that are equiangular and equilateral when interconnected.

8. The geometric system of any one of claims 1 to 7, wherein the location of the notches in relation to the center of each building element is selected to cause the plurality of building elements to form a three dimensional Platonic structure, a three dimensional Johnson structure, or a three dimensional Archimedean structure when interconnected.

9. The geometric system of any one of claims 1 to 8, wherein the two dimensional building elements are made from ethylene vinyl acetate, poster board, or laminated paper.

10. The geometric system of any one of claims 1 to 8, wherein the two dimensional building elements are made from wood veneer, acrylic, or sisal.

11. The geometric system of any one of claims 1 to 10, wherein the edges of the two dimensional building elements are curvilinear.

12. The geometric system of any one of claims 1 to 11, wherein each two dimensional building element is configured with at least three notches.

13. The geometric system of any one of claims 1 to 12, wherein the plurality of notches are non-rectilinear, allowing the interconnection of two dimensional building elements that are made of various materials.

14. The geometric system of any one of claims 1 to 13, wherein the notches of each two dimensional building element to be interconnected are of equal length.

15. The geometric system of any one of claims 1 to 14, further comprising a plurality of edge tabs, the edge tabs being integrally formed with the edges of the two dimensional building elements to form the notches.

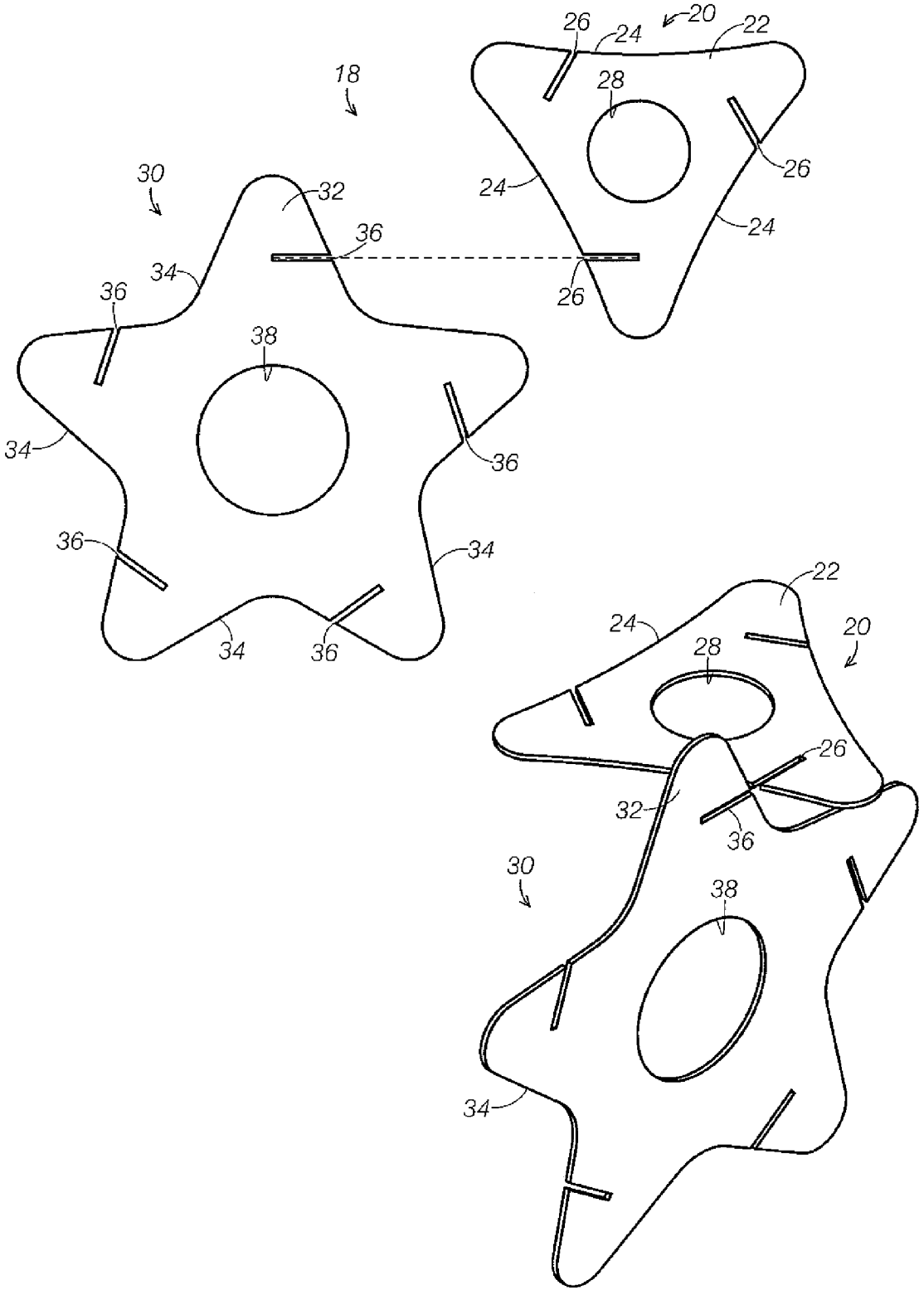


FIG.1

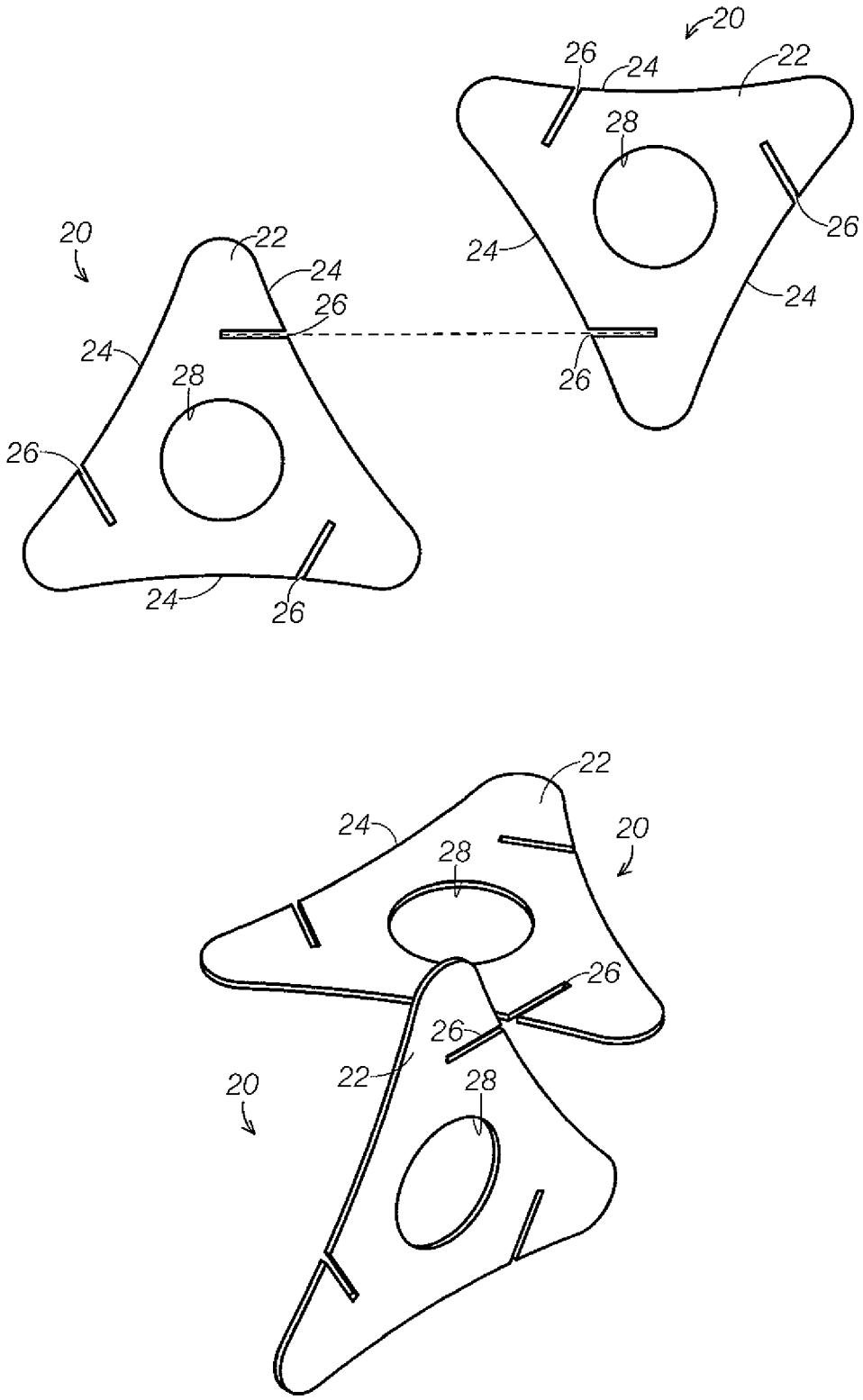


FIG.2

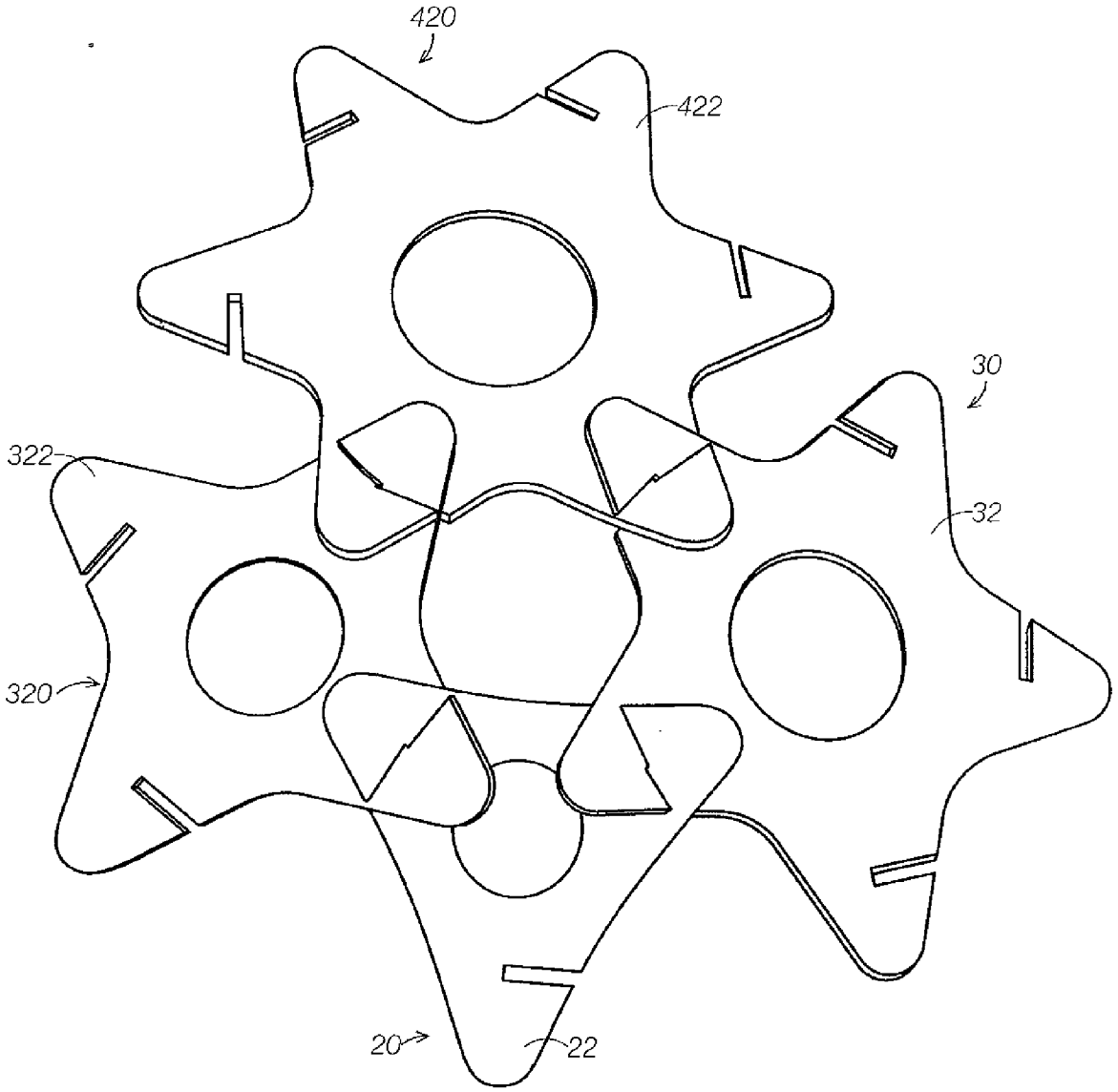
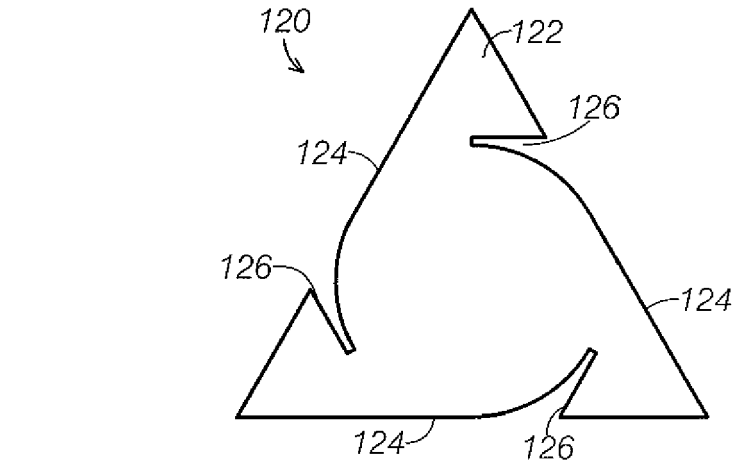


FIG.3


120
122
126
124
126
124
124
126

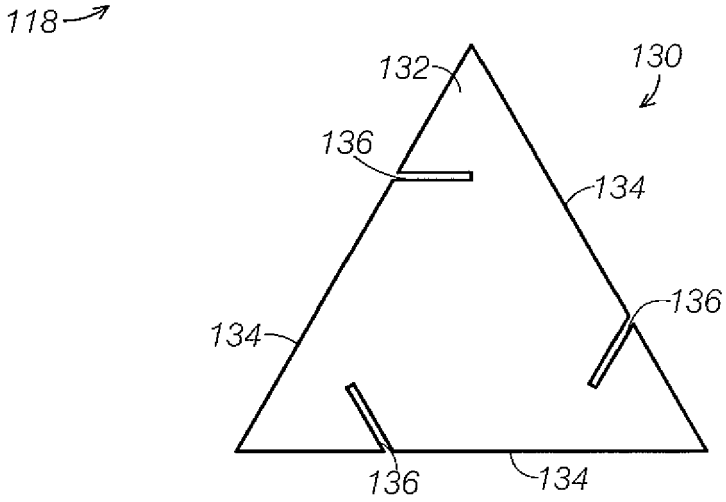
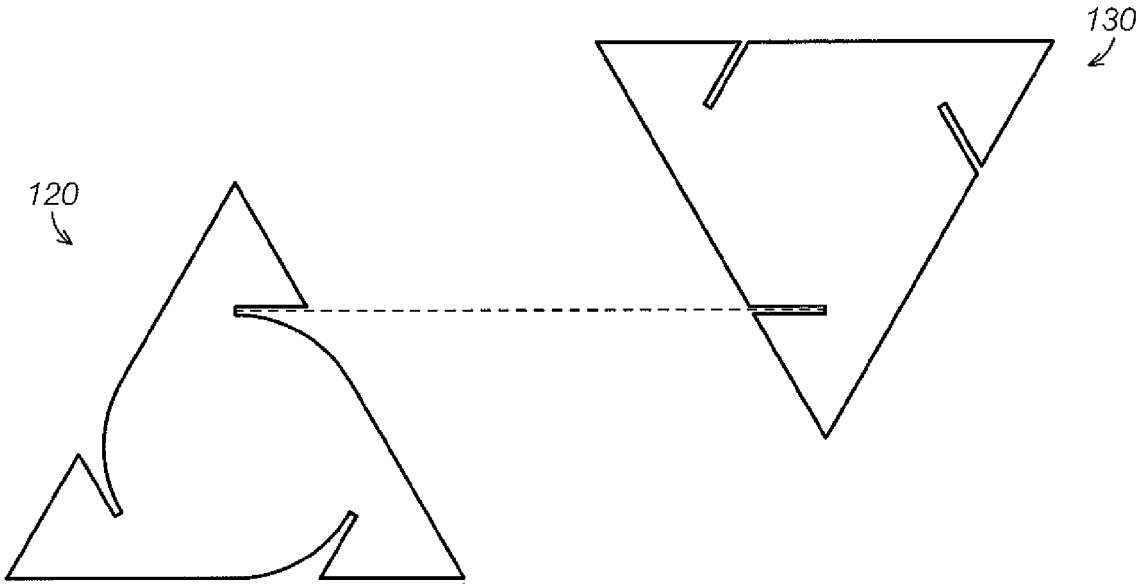

118
132
130
136
134
136
134
136
134

FIG.4



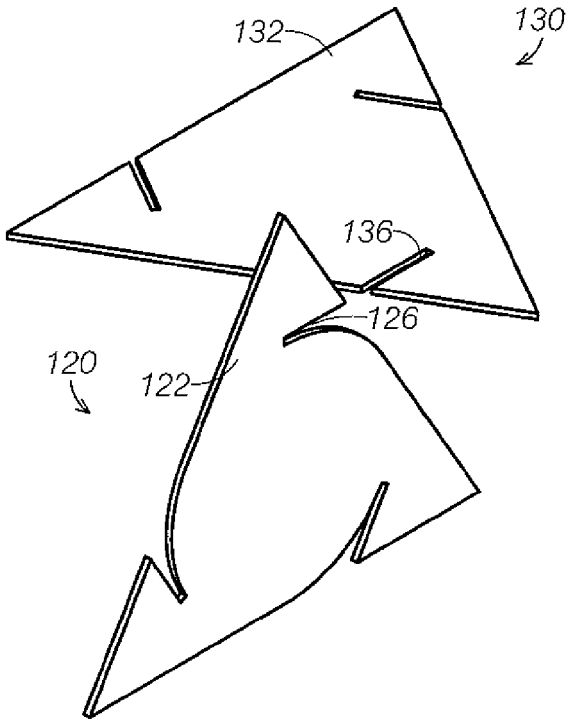


FIG.5

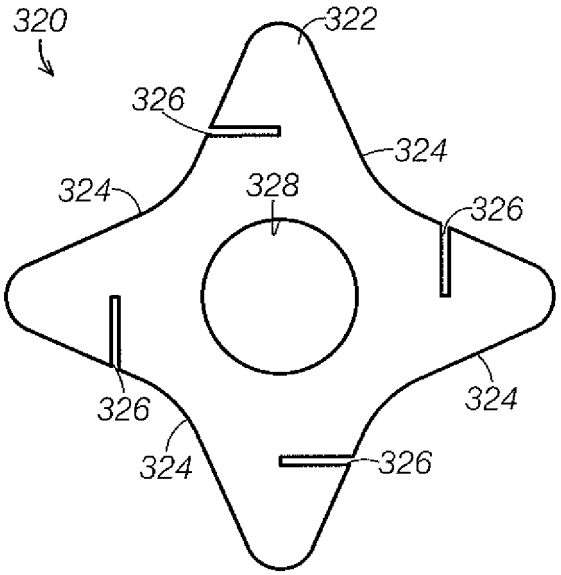

320
322
326
324
328
324
326
326
324
324
326

FIG.6

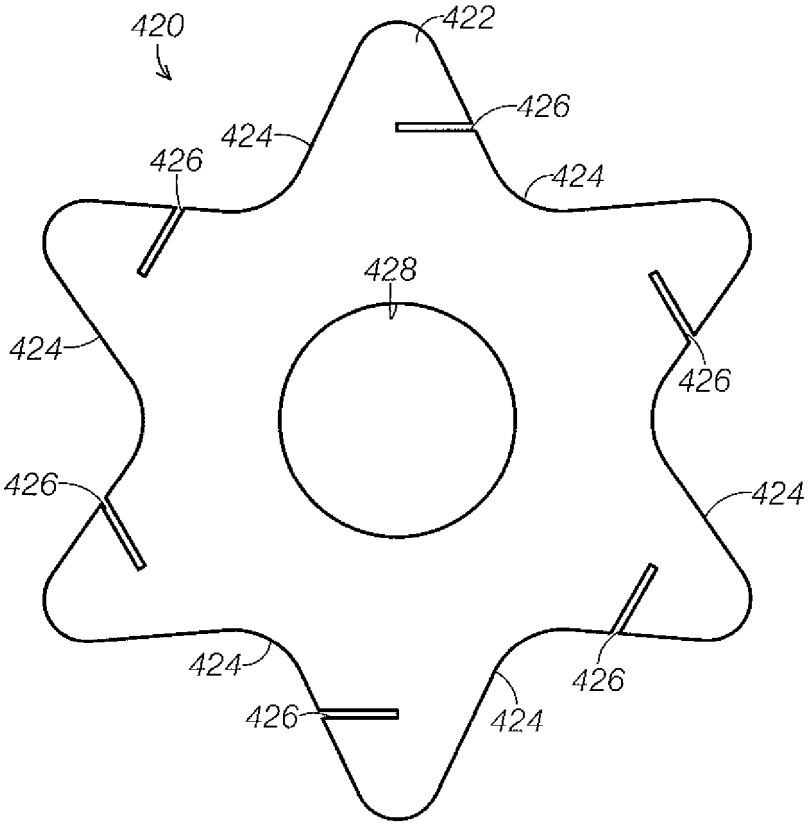

420
422
426
424
426
424
428
424
426
426
424
424
426
426
424

FIG.7

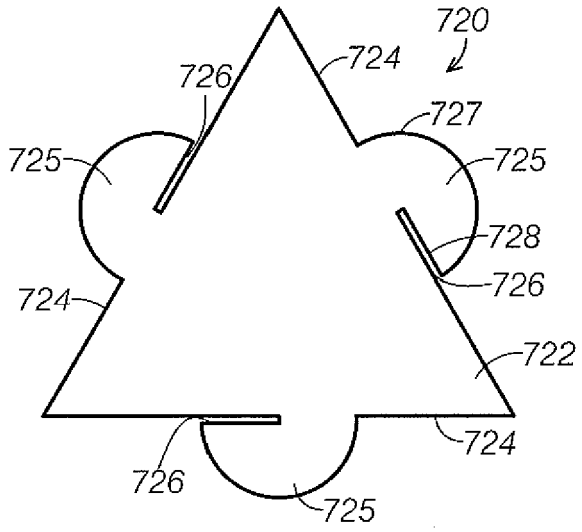

720
724
726
727
725
725
728
726
724
722
724
726
725

FIG.8

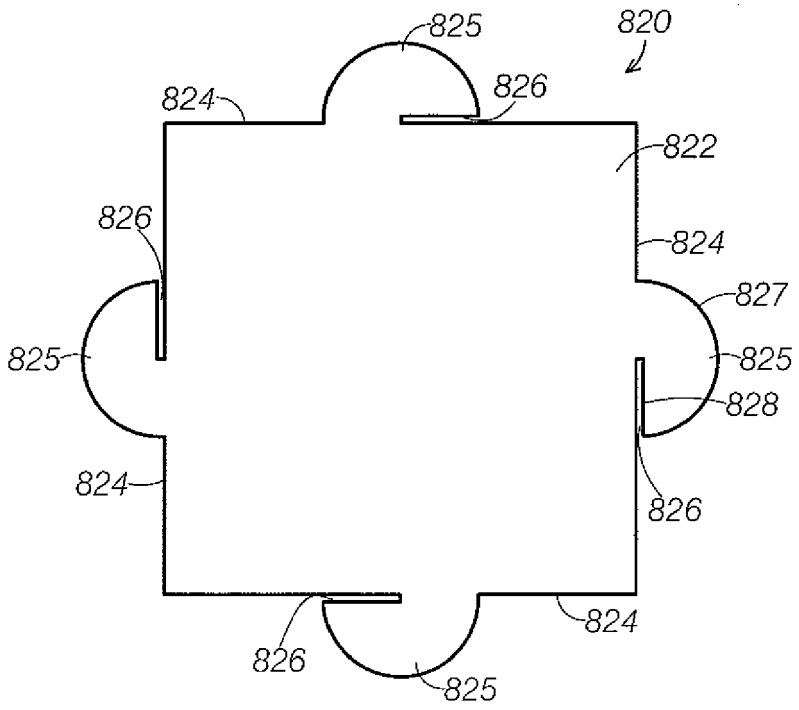

825
820
826
824
822
826
824
827
825
825
828
824
826
826
824
825

FIG.9

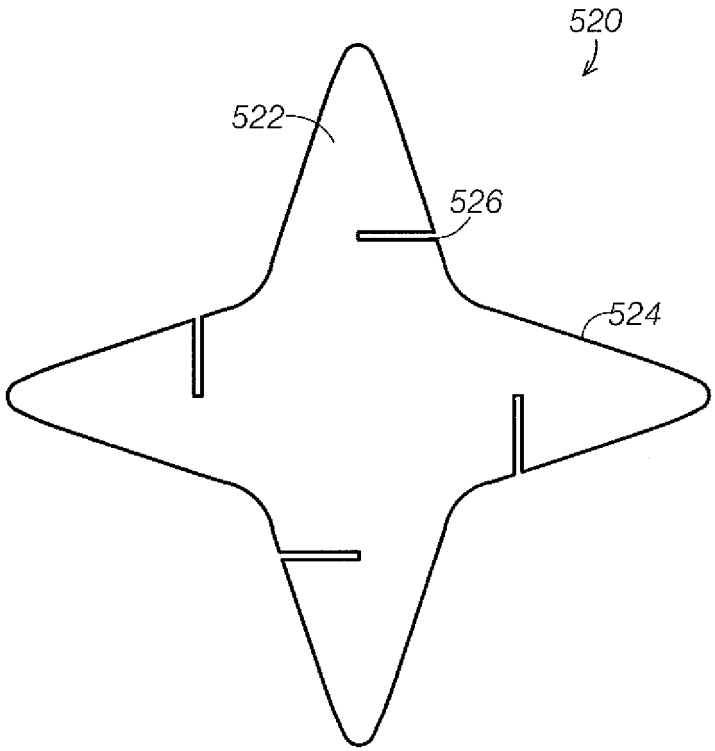


FIG.10

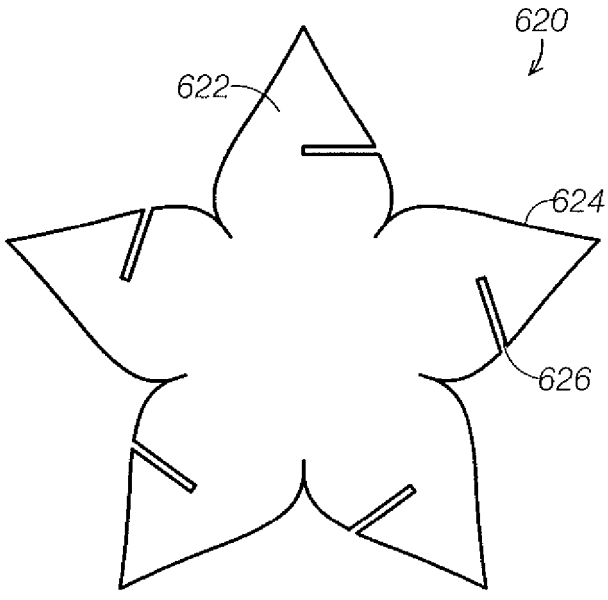


FIG.11

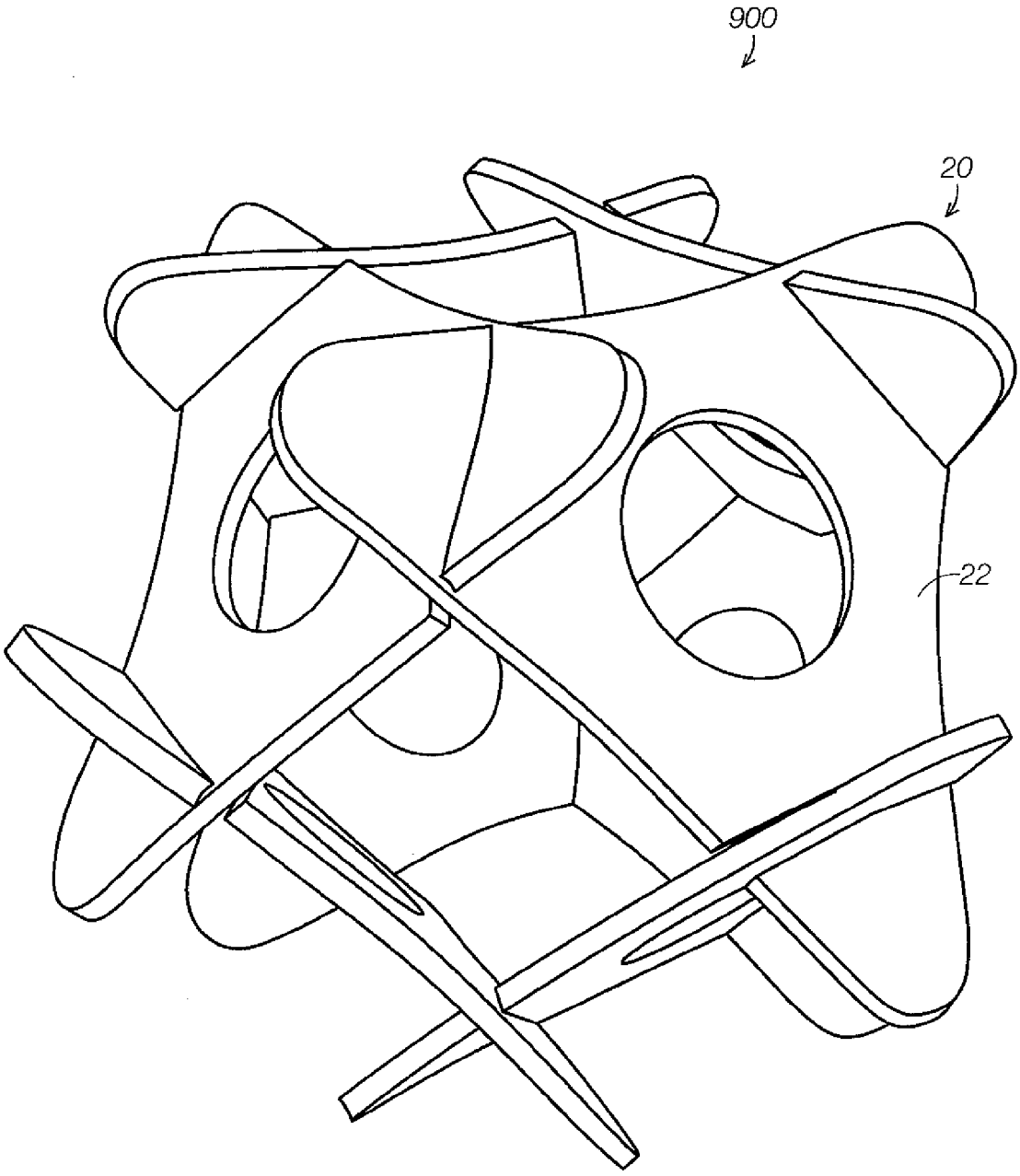


FIG.12

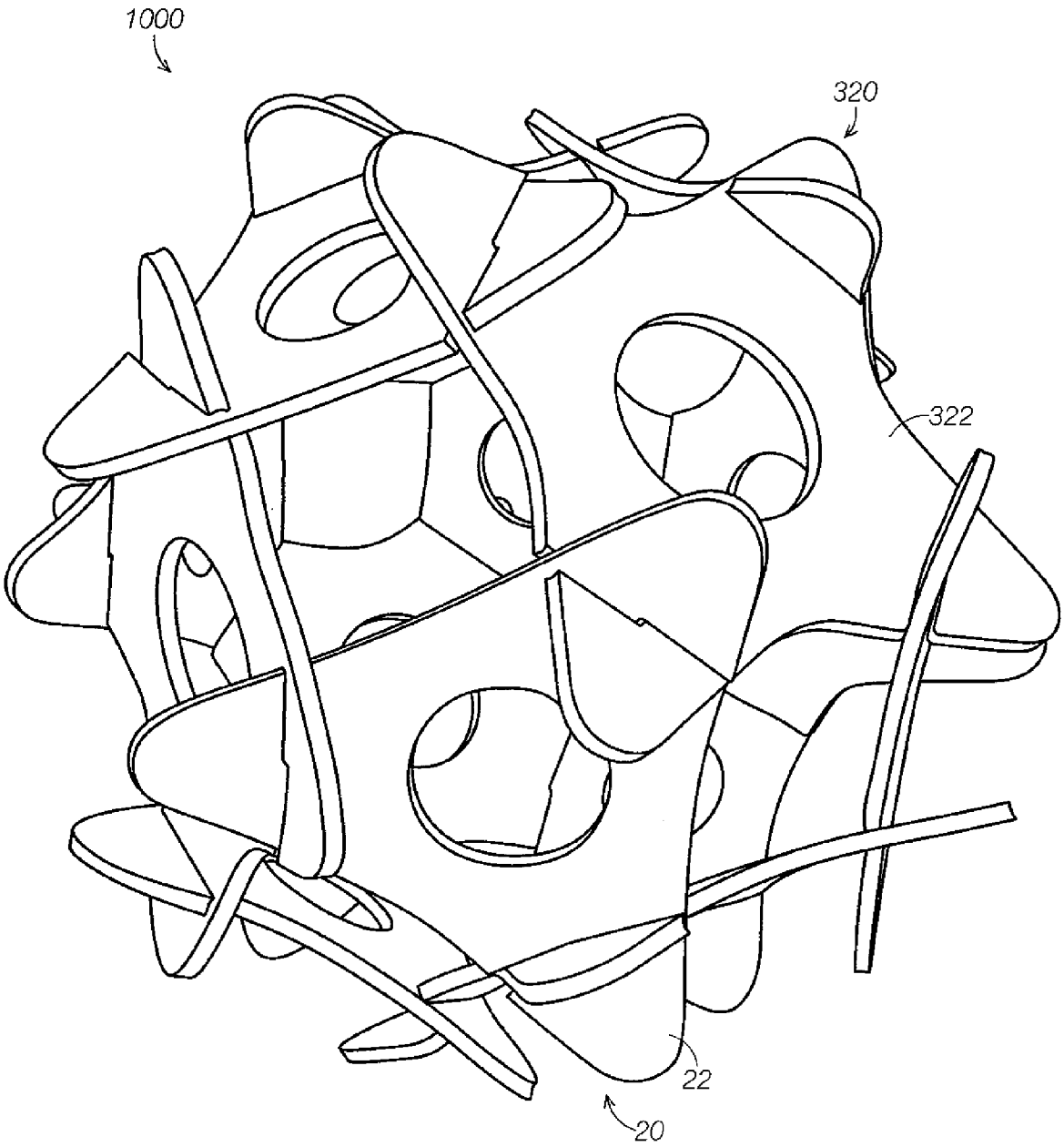


FIG.13

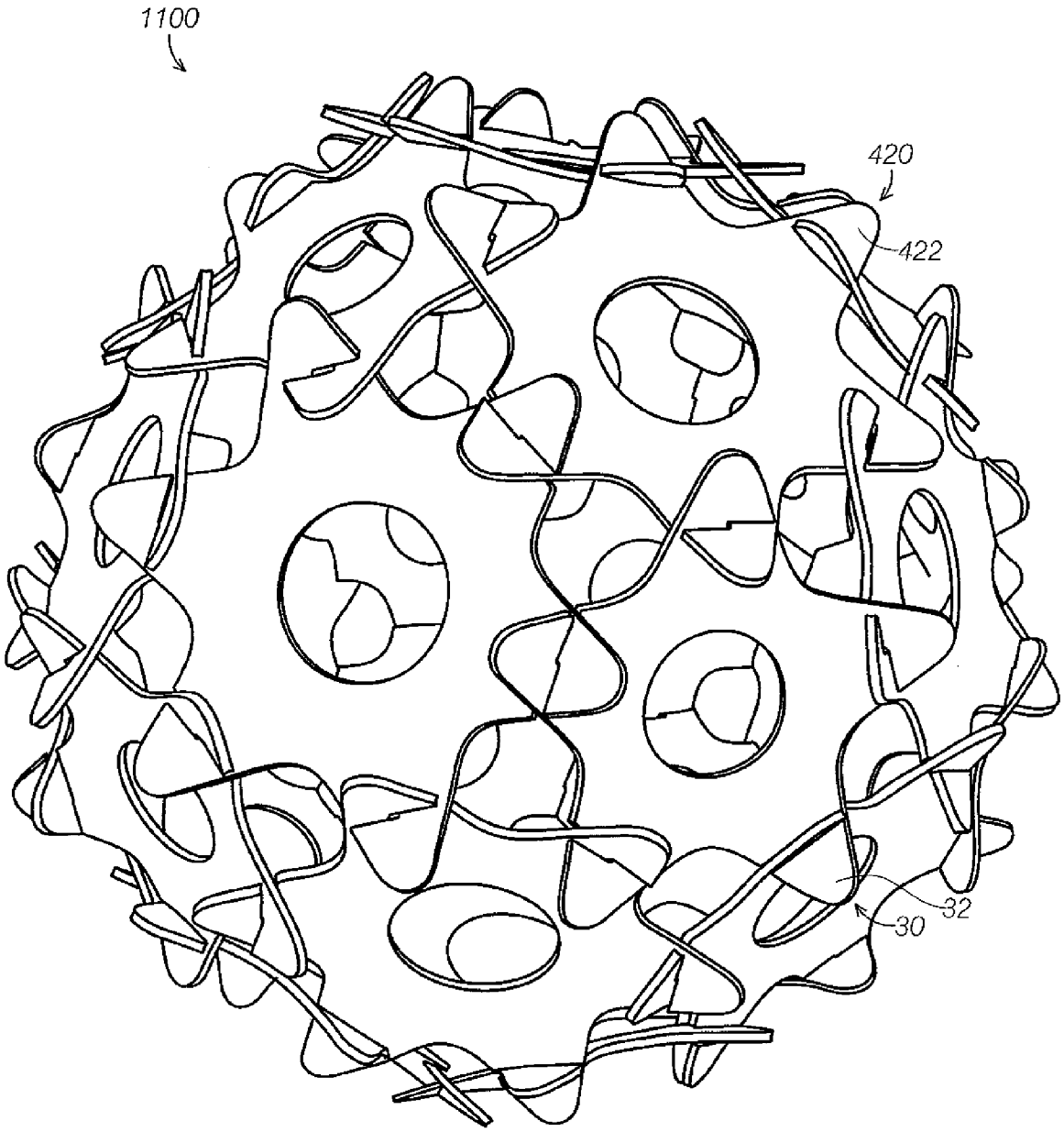


FIG.14

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 14 15 3309

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,D	US 5 593 337 A (LAPOINTE BRIAN [US]) 14 January 1997 (1997-01-14) * column 4, line 42 - column 5, line 40 * * column 7, line 6 - line 25; figures *	1-15	INV. A63H33/10 A63H33/08
A	US 3 564 758 A (WILLIS ARTHUR N) 23 February 1971 (1971-02-23) * column 2, line 5 - column 3, line 32; figures *	1-15	
A	US 6 149 487 A (PENG JUNG-CHIEH [TW]) 21 November 2000 (2000-11-21) * column 2, line 9 - line 35; figures *	1-15	
A	CN 202 410 178 U (HUIZHOU HUALI PACKING CO LTD) 5 September 2012 (2012-09-05) * abstract; figures *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC) A63H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 May 2014	Lucas, Peter

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 14 15 3309

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

12-05-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5593337 A	14-01-1997	NONE	
US 3564758 A	23-02-1971	NONE	
US 6149487 A	21-11-2000	NONE	
CN 202410178 U	05-09-2012	NONE	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 7469898 B **[0005]**
- US 5593337 A **[0005]**
- US 5489230 A **[0005]**
- US 20120164912 A **[0005]**