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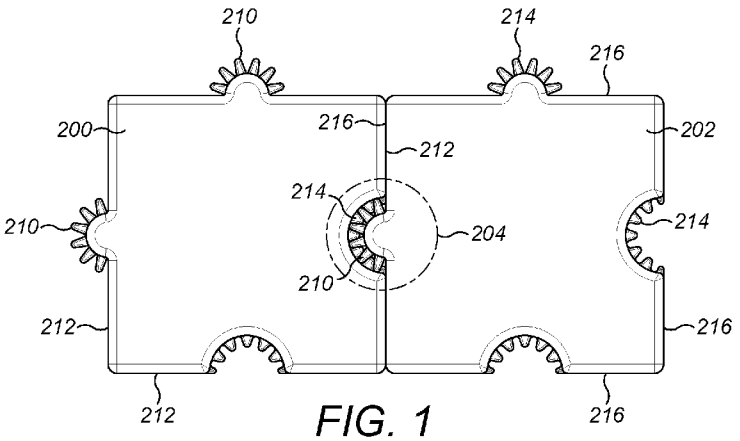


FIG. 1

(57) Abstract: A constructional toy comprising a first element (10) and a second element (12). The first element (10) has a first engagement surface (14) and a first engagement feature (16) located adjacent the first engagement surface (14). The second element (12) has a second engagement surface (24) and a second engagement feature (26) located adjacent the first engagement surface (24). The engagement feature (16,26) are configured such that the act of urging the engagement feature (16,26) of one element (10,12) into engagement with the engagement feature (16,26) of the other element (10,12) biases the engagement surfaces (14,24) into frictional engagement with one another.

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# Constructional Toy

The present disclosure relates to a constructional toy.

In particular the disclosure is concerned with a constructional toy comprising a first element and a second element.

Constructional toys having separate building elements are well known in the art. For example UK Patent Application GB2224953 describes a constructional toy comprising a plurality of main building elements having dovetail grooves and dovetail connecting members. These can be combined to construct a shape for the enjoyment and education of children. WO97/01383 describes an alternative construction toy of the same kind but with splines provided as engagement features.

Such toys are typically made out of injection moulded plastic. Material properties which lead to a variation in shrinkage rates and distortions make it difficult to manufacture a combination of elements which fit together well enough to maintain their shape and which are easy enough for a child to assemble and build with. For example, if gaps between the splines of the female engagement features are over large, and splines of the male engagement features are undersized, then the join between the two features will be loose which may result in the parts of the toy coming apart too easily. Alternatively if any of the splines of the female engagement features are oversized and the corresponding splines of the male engagement features are oversized then the join between the splines of the components will be too tight, and may be too difficult for children to fit together and/or take apart.

Additionally, since satisfying assembly and disassembly of the toy elements relies on frictional contact between all of the splines, any irregularities in the surface of the splines may lead to the elements being too difficult to assemble and disassemble. For this reason, irregularities introduced by an injection moulding injection point for delivery of plastic cannot conventionally be located on or adjacent a spline, and is normally placed on the outer side of the bricks, which may be unsightly.

With plastic materials and conventional manufacturing processes it is hard to consistently manufacture parts to within a narrow tolerance range. Additionally, sizes of different moulds and cutting tools for the same or similar parts vary due to

manufacturing variations of the moulds and tooling. Hence a part made with a first combination of moulds and tooling may have different dimensions to the same part made on a second combination of moulds and tooling which are of nominally the same design dimensions as the first combination. Additionally, the moulding and tool dimension will change with use as the parts wear and change due to thermal and mechanical cycles. These combined variations cause severe joining problems. Additionally, if a mould or tooling becomes unacceptable, it may have to be scrapped entirely.

Hence a significant proportion of parts in a manufacturing run may have oversized or undersized engagement features. Thus either unsatisfactory parts may be delivered to a customer and/or the manufacturer must thoroughly check parts for quality, rejecting and disposing of finished elements which do not meet the required standard, thereby adding to the time and cost for manufacture. Quality assurance checks are further complicated by the fact that plastic changes in size over several hours after the manufacturing steps have been completed, hence a component that meets quality standards immediately following manufacture may not meet standards several hours later.

Thus a constructional toy designed to avoid these tooling and manufacturing problems, making tooling and manufacturing easier and thereby providing a product with a reliable and consistent assembly and disassembly resistance, as well as an improved aesthetic appearance, is highly desirable.

## Summary

According to the present invention there is provided a constructional toy and method of manufacture as set forth in the appended claims. Other features of the invention will be apparent from the dependent claims, and the description which follows.

There may be provided a constructional toy comprising : a first element and a second element; the first element having a first engagement surface and a first engagement feature; the second element having a second engagement surface and a second engagement feature; the engagement features being configured such that the act of urging the engagement feature of one element into engagement with the engagement feature of the other element biases the engagement surfaces into frictional engagement with one another.

The first engagement feature may comprise : a wall which defines a recess which extends beneath the first element engagement surface; and a first spline which extends from the recess wall part way, but not the whole way, across the recess; the first spline having an inner surface which faces into the recess and an outer surface which faces out of the recess; and the second engagement feature comprises : a second spline which extends above the second element engagement surface; the second spline having an inner surface which faces towards the second element engagement surface and an outer surface which faces away from the second element engagement surface; such that when the second spline is entered in the recess, and the inner surfaces of the splines are urged into engagement with one another, engagement surfaces of the first element and second element are biased into frictional engagement with one another.

The first element engagement spline and second element engagement spline may be configured to contact one another at a point along their respective inner surfaces.

Prior to assembly, the contact point on the first element engagement spline may be a first distance (x) from the first element engagement surface, and the contact point on the second element engagement spline is a second distance (y) from the second element engagement surface, the second distance (y) being less than the first distance (x).

At least one of the engagement features may be is elongate and extends in a substantially straight line.

The first element may comprise a third spline substantially the same as the first spline, which extends from the recess wall part way, but not the whole way, across the recess towards the first spline; the second element may comprise a fourth spline substantially the same as the second spline, which extends from the second element engagement surface in a direction away from the second spline; such that when the fourth spline is entered in the recess, and the inner surfaces of the splines are urged into engagement with one another, the first element engagement surface and the second element engagement surface are brought into frictional engagement with one another.

The first engagement feature may comprise additional splines which extend from the wall of the recess.

The second engagement feature may comprise additional splines which extend from the second element engagement surface.

The first engagement feature may comprise additional splines which extend from the wall of the recess; the second engagement feature may comprise additional splines which extend from the second element engagement surface; and the first element engagement feature splines may be spaced apart by a distance greater than the width of the second element engagement feature splines such that when the second element engagement splines are entered in the recess, the inner surfaces of some of the first element engagement splines are urged into engagement with the inner surfaces of some of the second element engagement splines, the engaged second element engagement feature splines are each substantially in contact with only one of the first element engagement feature splines, the remaining second element engagement feature splines being spaced apart from the remaining first element engagement feature splines.

The constructional toy may be configured such that, when the second element engagement feature splines are entered in the recess, and the inner surfaces of some of the first element engagement splines are urged into engagement with the inner surfaces of some of the second element engagement splines, at most four of the second element engagement feature splines are each substantially in contact with only one of the first element engagement feature splines, the remaining second element engagement feature splines being spaced apart from the remaining first element engagement feature splines.

The constructional toy may be configured such that, when the second element engagement feature splines are entered in the recess, and the inner surfaces of some of the first element engagement splines are urged into engagement with the inner surfaces of some of the second element engagement splines, at most two of the second element engagement feature splines are each substantially in contact with only one of the first element engagement feature splines, the remaining second element engagement feature splines being spaced apart from the remaining first element engagement feature splines.

The first element engagement feature splines may be shorter than the second element engagement feature splines.

The first element engagement feature splines closest to the first element engagement surface may be are shorter than the first element engagement feature splines furthest from the first element engagement surface.

The second element engagement feature splines closest to the second element engagement surface may be longer and/or wider than the second element engagement feature splines furthest from the second element engagement surface.

The elements of the constructional toy may have an exterior wall; and the engagement surfaces are provided on the exterior wall.

The first element engagement surface may be provided on a first engagement feature spline which extends from the first element; the second element engagement surface may be provided on a second element engagement spline which extends from the second element; the first element engagement feature being provided in a region between additional first element engagement feature splines; and the second element engagement feature being the end of a push spline that extends from the second element to push against the first element engagement feature.

The second element push spline may be a longer spline than the splines that define the second element engagement surface.

The first element engagement spline comprising the first element engagement surface may be longer and/or wider than the additional first element engagement feature splines.

The first element splines may be spaced apart by a distance greater than the width of the second element splines.

The first engagement feature spline comprising the first element engagement surface may be wider in the region of the first element engagement surface than the other first element engagement splines such that the act of urging the first element engagement

splines between the second element engagement splines biases the engagement surfaces of the splines into frictional engagement with one another.

A protrusion may extends above the second ele ment engagement surface; and the second element engagement feature spline(s) extend from the protrusion.

The recess and protrusion may be complementary in shape.

The recess may be concave in cross section, and the protrusion may be convex in cross section.

The recess and protrusion may be arcuate in cross section.

The constructional toy may further comprise a third element for engagement with the first element ; the third element comprising a core shaft and a plurality of splines extending from the shaft for engagement with the at least one engagement feature of the first element.

There may also be provided a method of manufacture of the constructional toy of the present disclosure comprising the steps of : constructing an injection mould for an element of the toy; configuring the mould such that the injection point for the material of manufacture is adjacent a feature of the mould which defines a spline such that in the finished element, the injection point is adjacent the base of a spline or substantially at a top of a spline.

The device and method of manufacture of the present disclosed are further described in the following paragraphs.

There may be provided a constructional toy comprising : a first element and a second element; each of the elements having at least one engagement surface, and at least one engagement feature located adjacent at least one engagement surface; the engagement features being configured such that the act of urging the engagement feature of one element into engagement with the engagement feature of the other element brings the engagement surfaces into frictional engagement with one another. Hence there is provided a constructional toy in which the performance of the elements are less sensitive to manufacturing tolerances than in the related art. To achieve this

improved performance, the constructional toy has two modes of engagement. The engagement features attach the first and second elements together and draw the sides of the first and second elements together such that an interference fit is formed between their contact/engagement surfaces adjacent the engagement features.

The first engagement feature may comprise a wall which defines a recess which extends beneath the first element engagement surface; and a first spline which extends from the recess wall part way, but not the whole way, across the recess; the first spline having an inner surface which faces into the recess and an outer surface which faces out of the recess; and the second engagement feature comprises : a protrusion which extends above the second element engagement surface; a second spline which extends from the protrusion; the second spline having an inner surface which faces towards the second element engagement surface and an outer surface which faces away from the second element engagement surface; such that when the protrusion is entered in the recess, and the inner surfaces of the splines are urged into engagement with one another, the engagement surfaces of the first element and second element are brought into frictional engagement relationship with one another. Thus the splines of the engagement features act to draw the engagement surfaces of the elements together such that an interference fit is formed between their contact/engagement surfaces adjacent the engagement features.

The first and second splines may be configured to contact one another at a point along their respective inner surfaces. Prior to assembly, the contact point on the first spline is a first distance to the first engagement surface, and the contact point on the second spline is a second distance to the second contact surface, the second distance being less than the first distance.

The recess and protrusion may be complementary in shape. The recess may be concave in cross section, and the protrusion may be convex in cross section. The recess and protrusion may be arcuate (i.e. curved, having a fixed or varying radius) in cross section. At least one of the engagement features may be elongate and extend in a substantially straight line.

The first element may comprise a third spline substantially the same as the first spline, which extends from the recess wall part way, but not the whole way, across the recess towards the first spline; the second element may comprise a fourth spline

substantially the same as the second spline, which extends from the protrusion in a direction away from the second spline; such that when the protrusion is entered in the recess, and the inner surfaces of the splines are urged into engagement with one another, the engagement surfaces of the first element and second element are brought into a frictional/interference engagement relationship with one another.

The first engagement features may comprise additional splines which extend from the wall of the recess. The second engagement feature may comprise additional splines which extend from the protrusion.

The first engagement feature may comprise additional splines which extend from the wall of the recess; the second engagement feature comprises additional splines which extend from the protrusion; and the first element splines are spaced apart by a distance greater than the width of the second element splines; such that when the protrusion is entered in the recess, and the inner surfaces of the splines are urged into engagement with one another, at least some of the second element splines are each substantially in contact with only one of the first element splines, the remaining second element splines being spaced apart from the remaining first element splines. This provides the advantage that the engagement surfaces of the element are drawn together by the splines which are in contact. It also allows for the splines which are not in contact with another spline, but which might be required for locating the elements together, to move freely past one another without increasing the amount of force required to assemble the elements of the toy.

The first element splines may be shorter than the second element splines. The splines of the first element closest to the first element engagement surface may be shorter than the first element splines furthest from the second element engagement surface. The splines of the second element closest to the second element engagement surface may be longer and/or wider than the second element splines furthest from the second element engagement surface.

The constructional toy may further comprise a third element for engagement with the first element; the third element comprising a core shaft and a plurality of splines extending from the shaft for engagement with the at least one engagement feature of the first element. This provides a manufacturing advantage which is only possible because of configuration of the engagement features of the present disclosure.

There may also provided a method of manufacture of the constructional toy of as described above comprising the steps of constructing an injection mould for an element of the toy; configuring the mould such that the injection point for the material of manufacture is adjacent a feature of the mould which defines a spline such that in the finished element, the injection point is adjacent the base or top of a spline. This provides the advantage that the injection moulding point is in part concealed from the user. This leaves a smoother finish, which is both aesthetically and ergonomically more pleasing for the user than if the injection point was on an external surface, as in related art manufacturing methods.

**Brief description of the drawings**

Examples of the present disclosure will now be described with reference to the accompanying drawings in which;

Figures 1 to 6 show constructional toys with interlocking features;

Figure 7 shows a constructional toy of the present disclosure having engagement features which link elements of the constructional toy together;

Figure 8 shows an alternative example of a constructional toy of the present disclosure having engagement features;

Figure 9 shows a variety of examples of geometries to which the features of present disclosure may be applied;

Figure 10 shows a first element with a recessed engagement feature according to the present disclosure;

Figure 11 shows a second element having a male engagement feature for engagement with the engagement feature of Figure 10;

Figure 12 shows the engagement features of the first element and second element shown in Figure 10 and Figure 11 respectively when urged into engagement with one another;

Figure 13 shows an enlarged view of the interlocking engagement features as shown in Figure 12;

Figure 14 shows a cross-sectional view of the engagement features of an alternative example to that shown in figure 13, with some detail removed for clarity;

Figure 15 shows elements of a constructional toy linked together by alternative engagement features;

Figure 16 shows an enlarged view of the engagement features of the constructional toy elements of figure 15;

Figure 17 shows elements of a constructional toy similar to that of figure 15, but having a different shape;

Figures 18 and 19 show perspective views of the constructional toy shown in figure 17;

Figure 20 shows an example of two different shaped elements of the constructional toy linked together using engagement features of the present disclosure;

Figure 21 shows an alternative male engagement feature;

Figure 22 shows a further alternative element of the constructional toy;

Figure 23 an example of different shaped elements of a constructional toy linked together by engagement features, according to the present disclosure; and

Figure 24 and Figure 25 shows examples of injection moulding locations according to the present disclosure.

**Detailed description**

Figures 1 to 6 are provided as background to the understanding of the constructional toy of the present disclosure and would, if made, suffer the disadvantages of the related art. Figure 1 shows elements 200, 202 of a constructional toy, joined by interlocking features shown generally at 204. The elements 200, 202, are toy bricks, with features on each side for interlocking engagement with features of other elements. The elements have a square cross-section. Similar elements 206, 208 are shown in figure 2. An enlarged view of the interlocking features 204 are shown in figures 3 and 4. The interlocking features 204 comprise a number of splines 210 provided on the sides 212 of one element and splines 214 provided on the sides 216 of the other element. As shown in figure 4, when the splines 210, 214 are slid together so that they make up the interlocking arrangement, each of the splines is in frictional engagement with another spline, and some of the splines are in frictional engagement with two other splines. The splines 210, 214 hold the elements together, such that the side/faces 212, 216 of the elements maintain a loose touching relationship and are free to move relative to one another.

Likewise in the examples of figure 5 and figure 6, elements 220 and 224 are coupled together by interlocking arrangement 204, and the interlocking arrangement 204 comprises splines 226 on one element and splines 228 on the other element 224. The means for interlocking is as in the previous figures. When the splines 226 are entered in the gaps provided between the splines 228, the splines 226 are essentially trapped and the elements 220, 224 are held together by virtue of the frictional contact between the splines 226, 228. While the sides/faces of the elements 212, 216 may touch, they are only loosely/lightly in contact.

That is to say, the splines of the examples of Figure 1 to 6 are sized such that when all the splines of two elements are engaged, frictional contact between the splines holds the blocks together. There is no frictional engagement between the surfaces/sides of the block.

The examples of the constructional toy of the present disclosure herein described are configured such that the splines of different toy elements will co-operate and interact

differently, that is to say, have a different contact and engagement relationship and pattern, to those shown in Figures 1 to 6, and the related art.

Figure 7 and 8 show examples of a constructional toy comprising a first element 10 and a second element 12 according to the present disclosure. Similar features are described using common reference numerals. The first element and second element are shown as sections of substantially polygonal components. However the disclosure is not limited to such shapes. Shown in Figure 9 is a plurality of examples of different shapes to which engagement surfaces and engagement features herein described may be applied. For example, elements according to the present disclosure may be essentially square and have the shape of examples “J”, “K”, ”L”. Alternatively the elements may be triangular and comprise complementary elements such as examples ”M” and “Q”. Figure 9 shows further examples of constructional elements of the present disclosure, which will be referred to and described later. Additionally one or more of the shaped elements may be circular, as shown in Figures 20,23,24,25.

Figure 10 shows a first element 10 of a constructional toy. Figure 11 shows a second element 12 of the same constructional toy. The elements can be assembled together to form a variety of three dimensional structures. The first element 10 has an engagement surface 14 and an engagement feature 16 located adjacent to the engagement surface 14. Although not shown in detail, the first element 10 also has an additional engagement surface 14 on a different side of the element 10, as well as an additional engagement feature 16.

The second element 12 has an engagement surface 24 and an engagement feature 26 located adjacent the engagement surface 24. As with the first element, the second element 12 also has at least one additional engagement surface 24 and additional engagement feature 16.

In both cases the engagement feature 16,26 is flanked by engagement surfaces 14, 24. That is to say, there is an engagement surface 14,24 to either side of the engagement features 16,26. Put another way, on each side of the element 10,12 there may be at least two engagement surfaces 14,24 associated with each engagement feature 16,26. The engagement surfaces 14,24 may be substantially flat (i.e. planar).

The first engagement feature 16 comprises a wall 28 which defines a recess 30 which extends beneath the level of the first element engagement surface 14. That is to say, the first engagement feature 16 comprises a groove formed in the wall which defines the outer periphery of the first element 10. Put another way, the first engagement feature 16 comprises a groove set into the wall of the first element 10 below the level of the engagement surface 14. The first engagement feature 16 further comprises a first spline 32 which extends from the wall of the recess 30 part way, but not the whole way, across the recess 30. The first spline 32 has an inner surface 34 which faces into the recess 30, and an outer surface 36 which faces out of the recess 30.

The second engagement feature 26 comprises a protrusion 40 which extends above (that is to say, away from) the second element engagement surface 24. A second spline 42 extends from the protrusion 40. The second spline 42 has an inner surface 44 which faces towards the second element engagement surface 24, and an outer surface 46 which faces away from the second element engagement surface 24.

As shown in Figures 10 and 11 the recess 30 and protrusion 40 are complementary in shape. In the example shown the recess 30 is concave in cross section, and the protrusion 40 is convex in cross section. In addition, the recess 30 is shown as being arcuate in cross section, and the protrusion 40 is shown as being arcuate in cross section. However, these are merely examples and the recess and protrusion may have different shapes for example, they may be polygonal in nature. At least one of the engagement features 16, 26 is elongate and extends in a substantially straight line. That is to say as shown in Figures 10 and 11 the recess and/or protrusion 26 may extend into and or out of the page.

As shown in Figures 10 and 11 the first and second elements 10, 12 may comprise a plurality of additional splines. That is to say, each of the first and second elements 10,12 may comprise at least two splines. For example, the first element 10 comprises a third spline 50 substantially the same as the first spline 32, where the third spline 50 extends from the wall of the recess 30 part way, but not the whole way, across the recess 30 towards the first spline 32. The second element 12 likewise comprises a fourth spline 52 substantially the same as the second spline 42 where the fourth spline 52 extends from the protrusion 40 in a direction away from the second spline 42.

The first engagement feature 10 comprises additional splines 54, 56, 58, 60, 62 which extend from the wall of the recess 30 between the first and third splines 36,50. The second engagement feature 26 comprises additional splines 64, 66, 68, 70 which extend from the protrusion 40 between second and fourth splines 42,52.

The positions of the splines on the recess wall 28 and the protrusion 40 are shown as examples only. For example, although the first and third splines 36,50 are shown as being flush with the engagement surface 14, they may in fact be located spaced apart from the engagement surface, for example in a location similar to that of the splines 54,62.

It is essential that the first and second elements 10, 12 each comprise at least one spline. Preferably, and as described above, they comprise a second spline substantially opposite the first on their respective engagement feature. That is to say preferably the first element 10 has the first spline 32 on one side of the recess 30, and the additional spline 50 on the other side of the recess 30. Correspondingly, preferably the second element comprises the first spline 42 on one side of the protrusion 40 and the additional spline 52 substantially opposite it on the other side of the protrusion 40.

As shown in Figures 12 the first element 10 and second element 12 are shown engaged with one another via their engagement features 16, 26 respectively. An enlarged view of the engagement features 16, 26 is shown in Figure 13.

At least two splines, one from either element 10,12 are configured to contact one another at a point along their respective inner surfaces. For example, as most clearly shown in Figure 13, spline 62 of the first element 10 is configured to contact spline 70 of the second element, and spline 54 of the first element 10 is configured to contact spline 64 of the second element 12. Additionally, the first and second splines 32,42 may be configured to contact one another at a point along their respective inner surfaces.

The contact point on the first element splines is indicated by reference numeral 38. The contact point on the second element splines is indicated by reference numeral 48. The term “contact point” is intended to mean a region or area. Prior to assembly, the

contact point 38 on the first element spline 62 is a first distance "$x_1$" to the first engagement surface 14, and the contact point 48 on the second element spline 70 is a second distance "$y_1$" to the second contact surface 24. Additionally, and optionally, prior to assembly, the contact point 38 on the first element spline 32 may be a first distance "$x_2$" to the first engagement surface 14, and the contact point 48 on the second element spline 42 is a second distance "$y_2$" to the second contact surface 24.

The second distance "$y_{1,2}$" is less than the first distance "$x_{1,2}$".

In the examples shown, elements are configured such when the protrusion 40 is entered in the recess 30 the third and fourth splines 50,52, also have a contact point, the position of the contact point on each spline being chosen to bring the engagement surfaces of their respective elements into frictional contact. Likewise, splines 54 and 64 and splines 62 and 70 may also have a contact point, the position of the contact point on each spline being chosen to bring the engagement surfaces of their respective elements into frictional contact. That is to say at least two of the second element splines 42, 52, 64, 70 are each substantially in contact with one of the first element splines 32, 50, 54, 62 respectively. The splines are also configured such that the remaining second element splines 66, 68 are spaced apart from the first element splines 56, 58, 60 respectively. Put another way, at least some, but not all, of the second element splines are each substantially in contact with a corresponding first element spline, an interspace (or clearance) being substantially provided between the remainder of the second element splines and their corresponding first element splines. Additionally, the splines which contact one another will only contact one another at the contact points/regions 38,48, with an interspace (or clearance, or gap) substantially provided between the respective outer surfaces of the splines. That is to say, the splines which are in contact with another spline are only in contact with one other spline, and hence are in contact with another spline on only one (but not both) of their sides.

Hence, and as shown in Figure 13, only some of the splines may be urged into engagement with one another. The example in Figure 13 is configured such that at most four of the second element splines (i.e. splines 42,52,64,70) are each substantially in contact with only one of the first element splines (i.e. splines 32,50,54,62) respectively, the remaining second element splines being spaced apart from the remaining first element splines.

In an alternative example, the splines and elements are configured such that at most two of the second element splines are each substantially in contact with only one of the first element splines, the remaining second element splines being spaced apart from the remaining first element splines, as shown in figure 14.

Figure 14 shows a similar view to that shown in figure 13, except in this example, it can be seen that the splines 42, 52, of the second element 12 are in contact with splines 32, 50 of the first element 10, and that none of the other splines are in contact with one another. However, the interaction of the splines which are in contact biases the engagement services 14, 24 into frictional engagement with one another. The splines which are in contact with another spline are only in contact with one other spline, and thus only one side of each of the contacting splines is in contact with another spline.

The first element splines 32, 54, 56, 58, 60, 62 are shorter than the second element splines 42, 52, 64, 66, 68, 70. That is to say, the distance from the wall of the recess 30 to the highest/distal point on the splines of the first element 10 is less than the distance from the wall of the protrusion 40 to the highest/distal point on the splines of the second element 12. The splines of the second element closest to the second element engagement surface are longer and/or wider than the splines furthest from the second element engagement surface.

The engagement features 16, 26 are configured such that, when urged into engagement with one another, the engagement surfaces 14, 24 are urged into a frictional/interference engagement relationship with one another. That is to say when the protrusion 26 is entered in the recess 30, and the inner surfaces 34, 44 of the splines (see figures 10,11) are urged into engagement with one another, the engagement surfaces 14, 24 of the first element 10 and the second element 12 respectively are brought into a frictional interference engagement relationship with one another.

Put another way, the contact points of the contacting splines of each element are spaced from the engagement surface of their respective element by a distance such that, when the splines are engaged with one another, the engagement surfaces of the elements are forced or urged together.

Any errors or variations in shape of the middle splines, as shown in Figure 13 or figure 14, that is to say splines 56,58,60 and 66,68 do not effect the engagement performance of the engagement features. There is thus provided a pull-fit type arrangement, where the engagement surfaces 14, 24 of the elements are drawn together by the action of the splines of the engagement features.

Figures 15 to 19 show an alternative arrangement for coupling constructional toy elements 10, 12 to one another. As can be seen in figure 15, each element comprises male splines extending away from engagement surfaces 14, 24 of the elements 10, 12, and further comprises female splines in a recess 30 for receiving the male splines.

Figure 16 shows an enlarged view of the engagement region. The recess 30 is provided in the engagement surface 14 of the first element 10 and comprises first element engagement splines 32a, 50a (akin to splines 32, 50 shown in figures 10 to 14). A further spline 58a is provided extending outwards from the wall of the recess. The second element 12 is provided with splines 42a, 52a which extend from an engagement surface 24 of the second element 12. The splines are akin to second element engagement splines 42, 52 shown in figures 10 to 14. The size and spacing of the engagement splines are configured such that the act of urging the second element engagement splines 42a, 52a into engagement with the first element engagement splines 32a, 50a, 58a biases the engagement surfaces 14, 24 against one another. That is to say, the splines of the example shown in figure 16, are sized, located and configured such that when they are pushed together, the surfaces 14, 24 of the elements 10, 12 are drawn together, and actively forced into frictional engagement with one another

Figure 17 shows an alternatively shaped element (triangular) to that shown in figures 15, 16. Figures 18 and 19 show a perspective view of the elements shown in figure 17.

Figure 20 shows a further example of a constructional toy according to the present disclosure. The first element 10 (in this example shown as a circular element) is linked to a second element 12 (in this example shown as a polygonal shaped element). Because of the first element 10 is circular, its outer surface 14A will not come into contact with the outer surface 24 of the second element 12. Hence in this example, a

first element engagement surface 71 is provided on a first engagement feature spline 54,62 which extends from the first element 10. A second element engagement surface 73 is provided on a second element engagement spline 64,70 which extends from the second element 12. A first element engagement feature 75 is provided in a region between additional first element engagement feature splines 56A, 58A, 60A. A second element engagement feature 77 is provided as the end of a push spline 66A, 68A, that extends from the second element 12 to push against the first element engagement feature 75

The second element push splines 66A, 68A are longer, and may be narrower, than the splines 64, 70 that define the second element engagement surface 73.

The first element engagement splines 54,62 which comprises the first elements engagement surface 71, are longer, and may be wider, than the additional first element engagement feature splines 56A, 58A, 60A.

The first element splines 54, 56A, 58A, 60A, 62 are spaced apart by a distance greater than the width of the second element splines 52, 64, 66A, 68A, 70, 42.

The first element engagement spline 54, 62 comprising the first element engagement surface 71 may be wider in the region of the first element engagement surface 71 than the distance between the second element engagement splines 52, 64, 66A, 68A, 70, 42.

The first element engagement spline 54, 62 comprising the first element engagement surface 71 may be wider in the region of the first element surface 71 than the other first element engagement splines (56A, 58A, 60A) in equivalent regions.

Hence, with this configuration, the act of urging the first element engagement splines 54, 56A, 58A, 60A, 62 between the second element engagement splines 52, 64, 66A, 68A, 70, 42 biases the engagement surfaces, 71, 73 of the splines 54, 64; 62, 70 into frictional engagement with one another.

In the example of figure 20, the longer splines 66A, 68A of the second element cause the splines 64, 70 of the second element 12 to be biased into frictional engagement with the splines 54, 62, of the first element 10, without themselves being in frictional

contact with first element splines. The first element engagement splines 54, 62 and second element engagement splines 64, 70 thus provide engagement surfaces which are biased into frictional engagement with one another when the engagement features 66A, 68A of the first element (push splines 66A, 68A) push against the engagement features of the second element (the recesses between splines 56A, 58A, 60A of the first element).

Figure 21 shows an alternative shaped element 70, which differs from the first element 10 in that the engagement surfaces 24 are truncated compared to that of the example of Figure 11, the design of the splines and the mode of operation the same as previously described.

Figure 22 shows a third element 80 for engagement with the first element 10, and other such elements having a female engagement feature/recess 30. Side views of different examples of the element 80 are shown in Figure 9 (see examples “A”, “B”, “C”, ”D”, ”E”). The third element 80 comprises a core shaft 82 and a plurality of splines 84 which extend from the shaft 82 for engagement with the engagement feature of the first element 10. The third element shown in Figure 22 is essentially cylindrical in nature and extends into and out of the page as shown in Figure 22. The third element 80 has an outer diameter defined by the radially outer most point of the splines 84. The tooling for manufacturing the shaft is configured to perform an injection moulding operation to produce the shaft shape.

The example shown in figure 23 shows a first element 10 and a second element 12A of a constructional toy of the present disclosure linked by a third element 80 as discussed with reference to figure 22. All of the splines 80 are essentially identical in design. However the splines of the first element 10, and second element 12A are dimensioned as described with reference to figure 20 and elements 10,12. That is to say the engagement splines 54,62 of each element 10,12 are longer, and may be wider than, the additional splines 56A, 58A, 60A.

The constructional toy herein described may be manufactured by injection moulding as previously discussed. In injection moulding a die defining the shape of the component to be formed is constructed. Injection moulding holes are provided in the mould. In the method of manufacture of the constructional toys herein described the mould is configured such that the injection point for the material of manufacture is

adjacent a feature of the mould which defines a spline such that in the finished element, the injection point 90 is adjacent the base of a spline, for example spline 58, as shown in Figure 24. In this context "base" refers to the surface/substrate from which the spline extends. Hence for example the injection point may be located between two of the splines, for example splines 58,60 and/or 66,68.

Alternatively the mould may be configured such that the injection point for the material of manufacture is adjacent a feature of the mould which defines a spline such that in the finished element, the injection point 90 is towards or at the top of the spline, as shown in Figure 25. In this context "top" refers to the end of the spline distal to the base of the spline.

Locating the injection moulding at this point is possible only because, as described above in relation to the examples of figures 13,14 at least, the centre splines (in the example shown splines 66,68 and 58,60) are configured and sized such that there is an interspace (i.e. clearance or gap) between them when the toy elements are assembled. Hence any irregularity in the surface of the material due to the injection point is accommodated. That is to say, in examples where the surfaces of the splines 58,60, 66,68 do not frictionally engage with one another in operation, the location of an injection moulding mark on the surface of these splines, especially at their base or top, will not interfere with the operation of the elements.

Hence there is provided a constructional toy made of a plurality of elements which can be assembled easily by a user, for example a child, but which are also configured to stay together. That is to say the plastic of the elements of the constructional toy touches in enough places to frictionally engage so that the elements do not slide or fall apart, but are not so firmly engaged that the elements are jammed together so that the child cannot easily separate them. As described above, in operation some, but not all, of the splines contact a corresponding spline. With this small number of contact surfaces (compared to the related art) errors in manufacture have only a small effect on overall operability. Additionally, as fewer splines are required for engagement of the elements, the load per spline is increased, hence each spline may be inclined to bend/flex, thus further accommodating variations in manufacturing tolerances.

Where references are made to relative dimensions of features of the present disclosure, for example the width and length of splines, the corresponding figures may

show exaggerated differences in size, although in practice the differences are small. However, it should be noted that although the differences are very small, they have great practical significance. Features of the present disclosure cannot be scaled or inferred from the drawings.

Although preferred embodiment(s) of the present invention have been shown and described, it will be appreciated by those skilled in the art that changes may be made without departing from the scope of the invention as defined in the claims.

## CLAIMS

1 A constructional toy comprising :

a first element (10) and a second element (12);

the first element (10) having a first engagement surface (14) and a first engagement feature (16);

the second element (12) having a second engagement surface (24) and a second engagement feature (26);

the engagement features (16,26) being configured such that the act of urging the engagement feature (16,26) of one element (10,12) into engagement with the engagement feature (16,26) of the other element (10,12) biases the engagement surfaces (14,24) into frictional engagement with one another.

2. A constructional toy as claimed in claim 1 wherein

the first engagement feature (16) comprises :

a wall (28) which defines a recess (30) which extends beneath the first element engagement surface (14); and

a first spline (32) which extends from the recess (30) wall part way, but not the whole way, across the recess (30);

the first spline (32) having an inner surface (34) which faces into the recess (30) and an outer surface (36) which faces out of the recess (30); and

the second engagement feature (26) comprises :

a second spline (42) which extends above the second element engagement surface (24);

the second spline (42) having an inner surface (44) which faces towards the second element engagement surface (24) and an outer surface (46) which faces away from the second element engagement surface (24);

such that when the second spline (42) is entered in the recess (30), and the inner surfaces (34,44) of the splines (32,42) are urged into engagement with one another, engagement surfaces (14,24) of the first element (10) and second element (12) are biased into frictional engagement with one another.

3 A constructional toy as claimed in claim 2 wherein the first element engagement spline (32) and second element engagement spline (42) are configured to contact one another at a point (38, 48) along their respective inner surfaces (34,44).

4 A constructional toy as claimed in claim 3 wherein, prior to assembly, the contact point on the first element engagement spline (32) is a first distance (x) from the first element engagement surface (14), and the contact point on the second element engagement spline (42) is a second distance (y) from the second element engagement surface (24), the second distance (y) being less than the first distance (x).

5 A constructional toy as claimed in any one of the preceding claims wherein at least one of the engagement features (16,26) is elongate and extends in a substantially straight line.

6 A constructional toy as claimed in any one of claims 2 to 5 wherein :

the first element (10) comprises a third spline (50) substantially the same as the first spline (32), which extends from the recess wall part way, but not the whole way, across the recess (30) towards the first spline (32);

the second element (12) comprises a fourth spline (52) substantially the same as the second spline (42), which extends from the second element engagement surface (24) in a direction away from the second spline (42);

such that when the fourth spline (52) is entered in the recess (30), and the inner surfaces of the splines are urged into engagement with one another, the first element engagement surface (14) and the second element engagement surface (24) are brought into frictional engagement with one another.

7 A constructional toy as claimed in any one of claims 2 to 7 wherein the first engagement feature (16) comprises additional splines which extend from the wall of the recess (30).

8 A constructional toy as claimed in claims 2 to 6 wherein the second engagement feature (26) comprises additional splines which extend from the second element engagement surface (24).

9 A constructional toy as claimed in any one of claims 2 to 6 wherein

the first engagement feature (16) comprises additional splines which extend from the wall of the recess (30);

the second engagement feature (16) comprises additional splines which extend from the second element engagement surface (24); and

the first element engagement feature splines are spaced apart by a distance greater than the width of the second element engagement feature splines such that when the second element engagement splines are entered in the recess (30), the inner surfaces of some of the first element engagement splines are urged into engagement with the inner surfaces of some of the second element engagement splines, the engaged second element engagement feature splines are each substantially in contact with only one of the first element engagement feature splines, the remaining second element engagement feature splines being spaced apart from the remaining first element engagement feature splines.

10 A constructional toy as claimed in claim 9 configured such that, when the second element engagement feature splines are entered in the recess (30), and the inner surfaces of some of the first element engagement splines are urged into engagement with the inner surfaces of some of the second element

engagement splines, at most four of the second element engagement feature splines are each substantially in contact with only one of the first element engagement feature splines, the remaining second element engagement feature splines being spaced apart from the remaining first element engagement feature splines.

11 A constructional toy as claimed in claim 9 configured such that, when the second element engagement feature splines are entered in the recess (30), and the inner surfaces of some of the first element engagement splines are urged into engagement with the inner surfaces of some of the second element engagement splines, at most two of the second element engagement feature splines are each substantially in contact with only one of the first element engagement feature splines, the remaining second element engagement feature splines being spaced apart from the remaining first element engagement feature splines.

12 A constructional toy as claimed in any one of claims 2 to 11 wherein the first element engagement feature splines are shorter than the second element engagement feature splines.

13 A constructional toy as claimed in any one of claims 2 to 12 wherein the first element engagement feature splines closest to the first element engagement surface (14) are shorter than the first element engagement feature splines furthest from the first element engagement surface (14).

14 A constructional toy as claimed in any one of claims 12 to 13 wherein the second element engagement feature splines closest to the second element engagement surface (24) are longer and/or wider than the second element engagement feature splines furthest from the second element engagement surface (24).

15 A constructional toy as claimed in any one of the preceding claims wherein :

the elements of the constructional toy have an exterior wall; and

the engagement surfaces (14,24) are provided on the exterior wall.

16 A constructional toy as claimed in claim 1 wherein :

the first element engagement surface (71) is provided on a first engagement feature spline (54,62) which extends from the first element (10);

the second element engagement surface (73) is provided on a second element engagement spline (64,70) which extends from the second element;

the first element engagement feature (75) being provided in a region between additional first element engagement feature splines (56,58,60); and

the second element engagement feature (77) being the end of a push spline (66A,68A) that extends from the second element (12) to push against the first element engagement feature (75).

17 A constructional toy as claimed in claim 16 wherein the second element push spline (66A, 68A) is a longer spline than the splines (64, 70) that define the second element engagement surface (73).

18 A constructional toy as claimed in any one of claims 16 to 17 wherein the first element engagement spline (54,62) comprising the first element engagement surface (71) is longer and/or wider than the additional first element engagement feature splines (56A,58A,60A).

19 A constructional toy as claimed in any one of claims 16 to 18 wherein the first element splines (54,56,58,60,62) are spaced apart by a distance greater than the width of the second element splines (52,64,66A,68A,70,42).

20 A constructional toy as claimed in any one of claims 16 to 19 wherein the first engagement feature spline (54, 62) comprising the first element engagement surface (71) is wider in the region of the first element engagement surface (71) than the other first element engagement splines (56A, 58A, 60A) such that the act of urging the first element engagement splines (54,56A,58A,60A,62) between the second element engagement splines (52,64,66A,68A,70,42)

biases the engagement surfaces (71,73) of the splines (54,64;62,70) into frictional engagement with one another.

21 A constructional toy as claimed in any one of the preceding claims wherein a protrusion (40) extends above the second element engagement surface (24); and the second element engagement feature spline(s) extend from the protrusion (40).

22 A constructional toy as claimed in claim 21 wherein the recess (30) and protrusion (40) are complementary in shape.

23 A constructional toy as claimed in any one of claims 21 to 22 wherein the recess (30) is concave in cross section, and the protrusion (40) is convex in cross section.

24 A constructional toy as claimed in any one of claims 21 to 23 wherein the recess (30) and protrusion (40) are arcuate in cross section.

25 A constructional toy as claimed in any one of the preceding claims further comprising a third element (80) for engagement with the first element (10); the third element (80) comprising a core shaft (82) and a plurality of splines (84) extending from the shaft (82) for engagement with the at least one engagement feature (16) of the first element (10).

26 A method of manufacture of the constructional toy of any one of claims 2 to 25 comprising the steps of :

constructing an injection mould for an element of the toy;

configuring the mould such that the injection point for the material of manufacture is adjacent a feature of the mould which defines a spline such that in the finished element, the injection point is adjacent the base of a spline or substantially at a top of a spline.

27 A constructional toy substantially as hereinbefore described and/or as shown in the accompanying Figures 7 to 25.

28 A method of manufacture of the constructional toy substantially as hereinbefore described and/or as shown in the accompanying Figures 7 to 25.

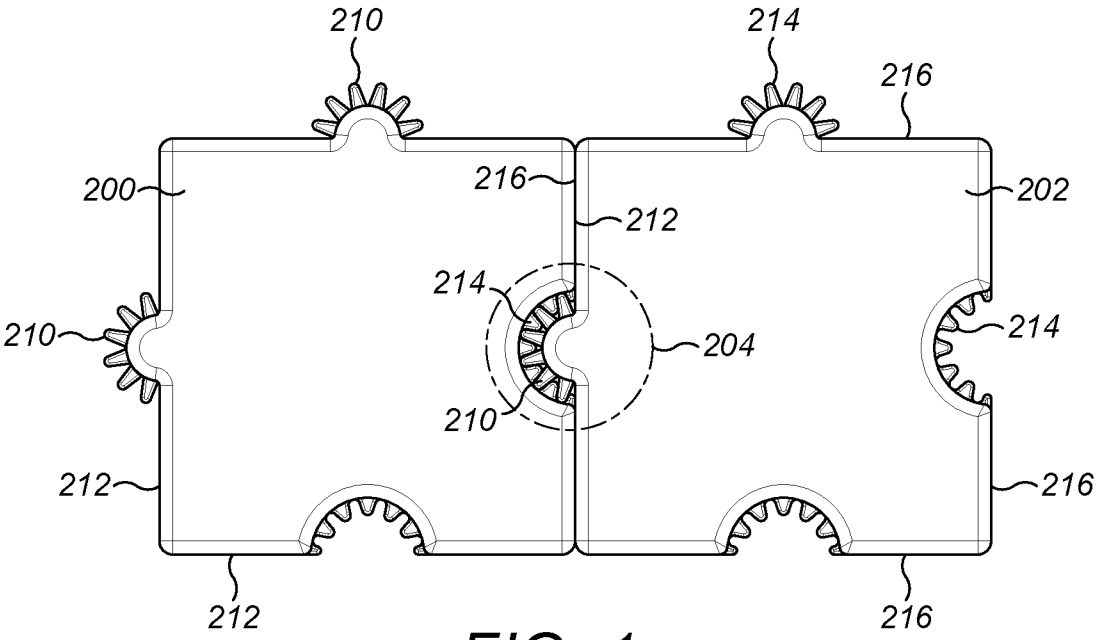
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FIG. 1

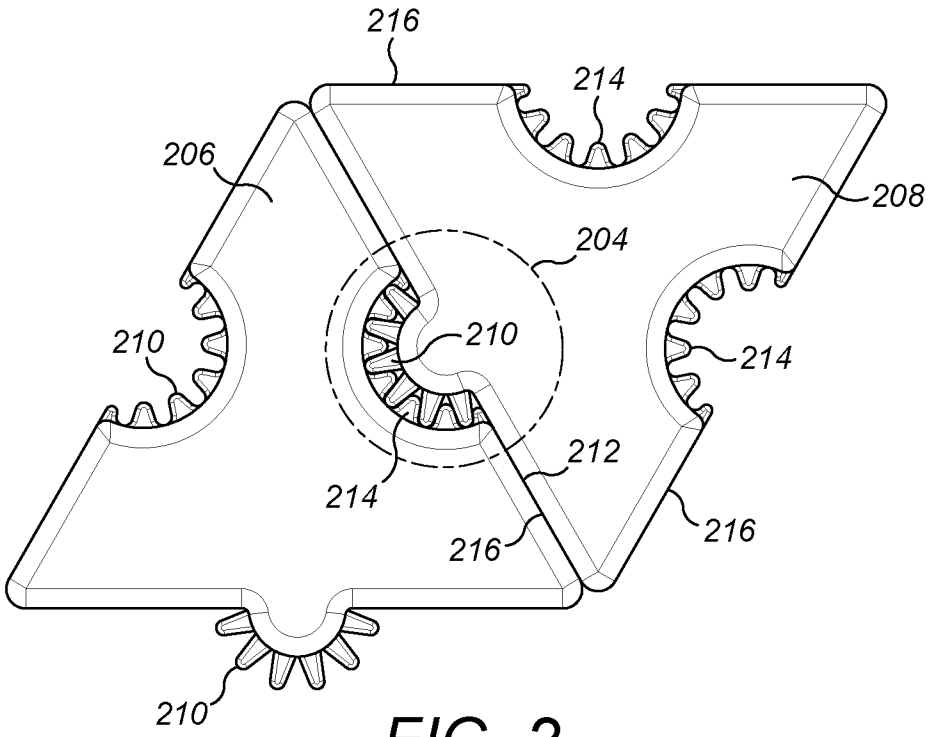
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FIG. 2

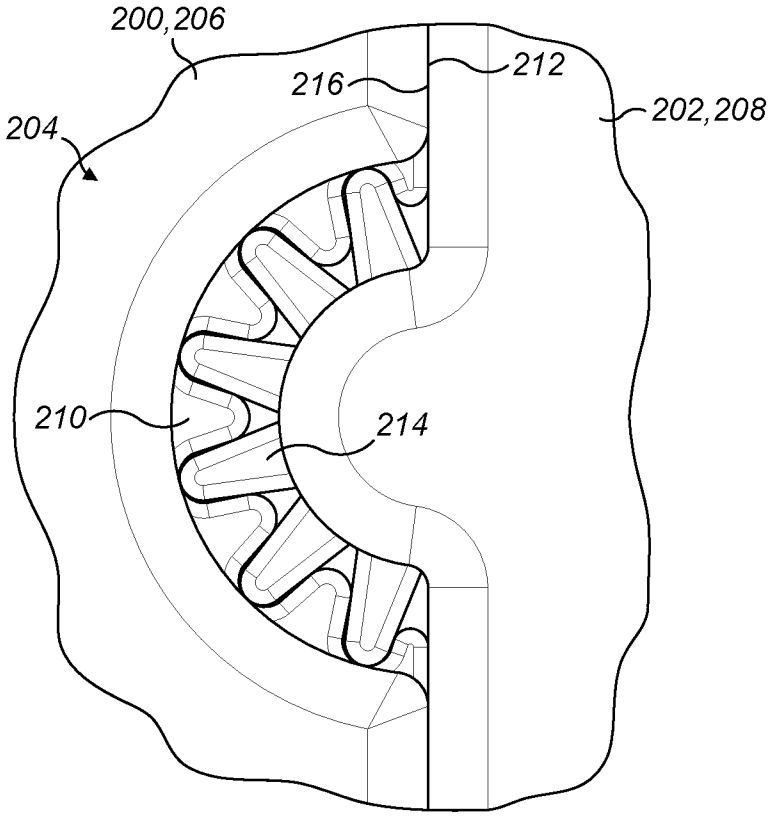



FIG. 3

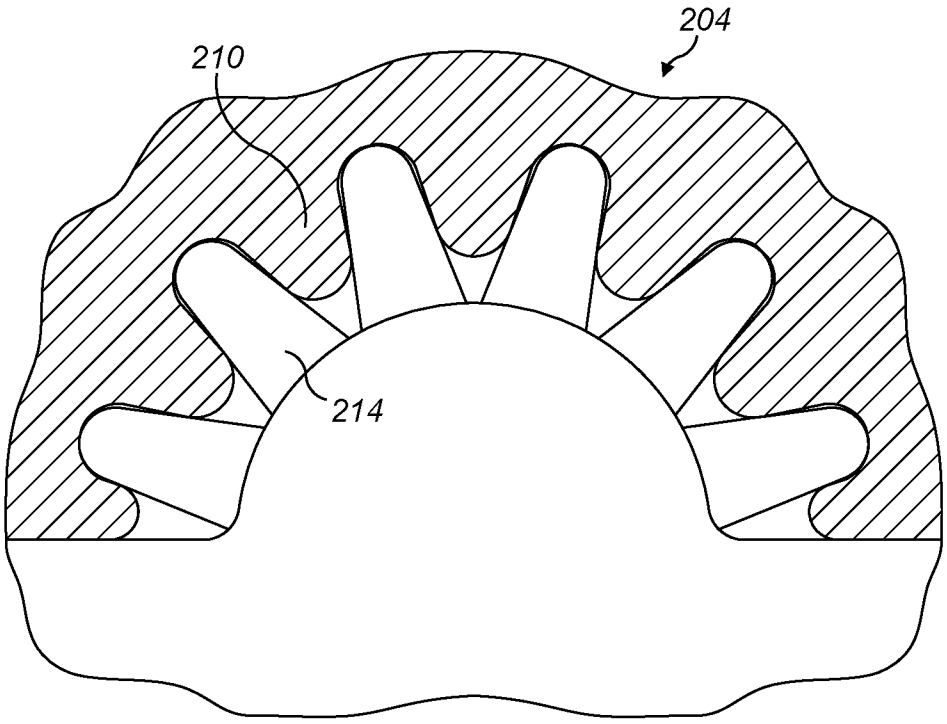



FIG. 4

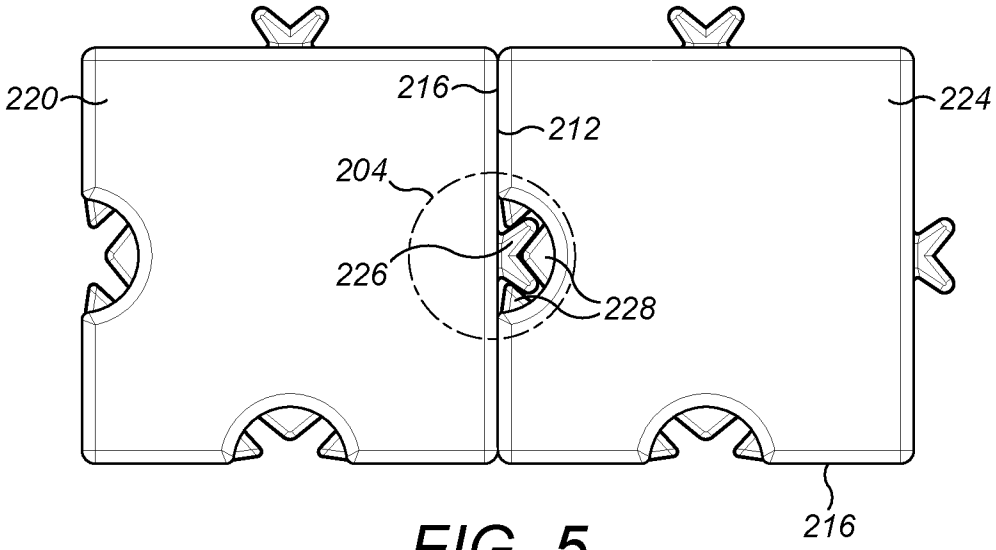



FIG. 5

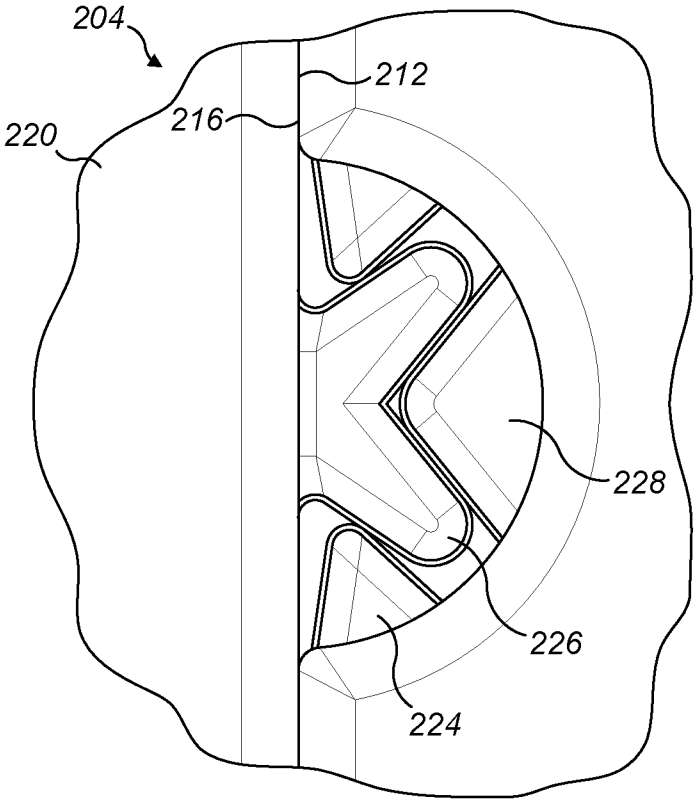



FIG. 6

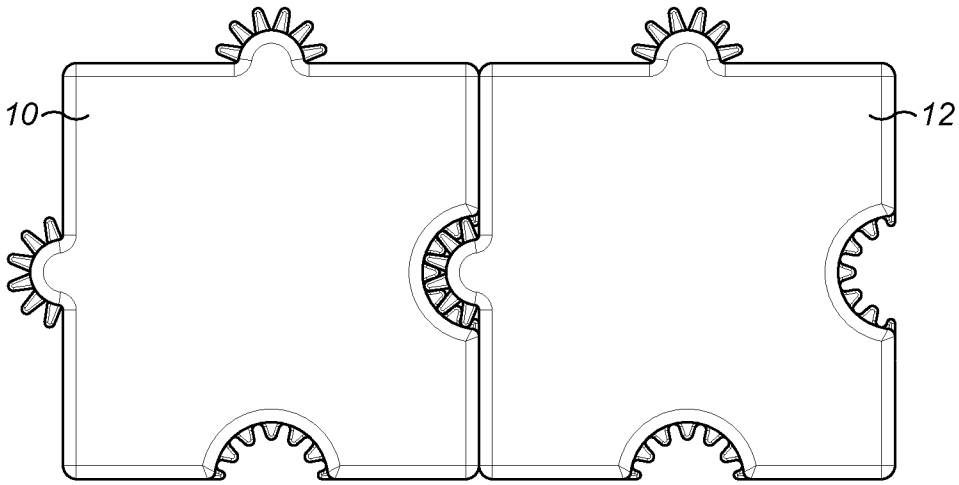



FIG. 7

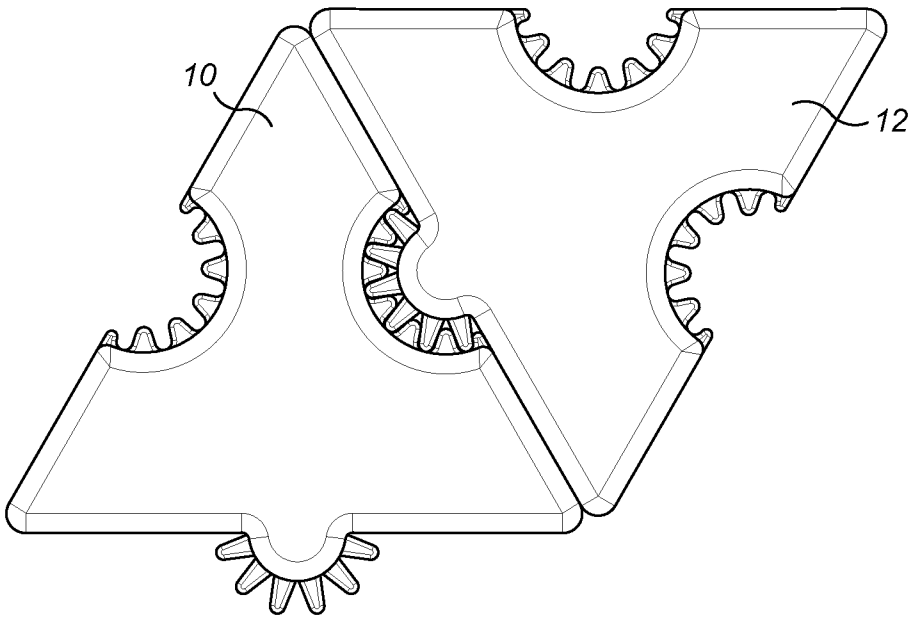



FIG. 8

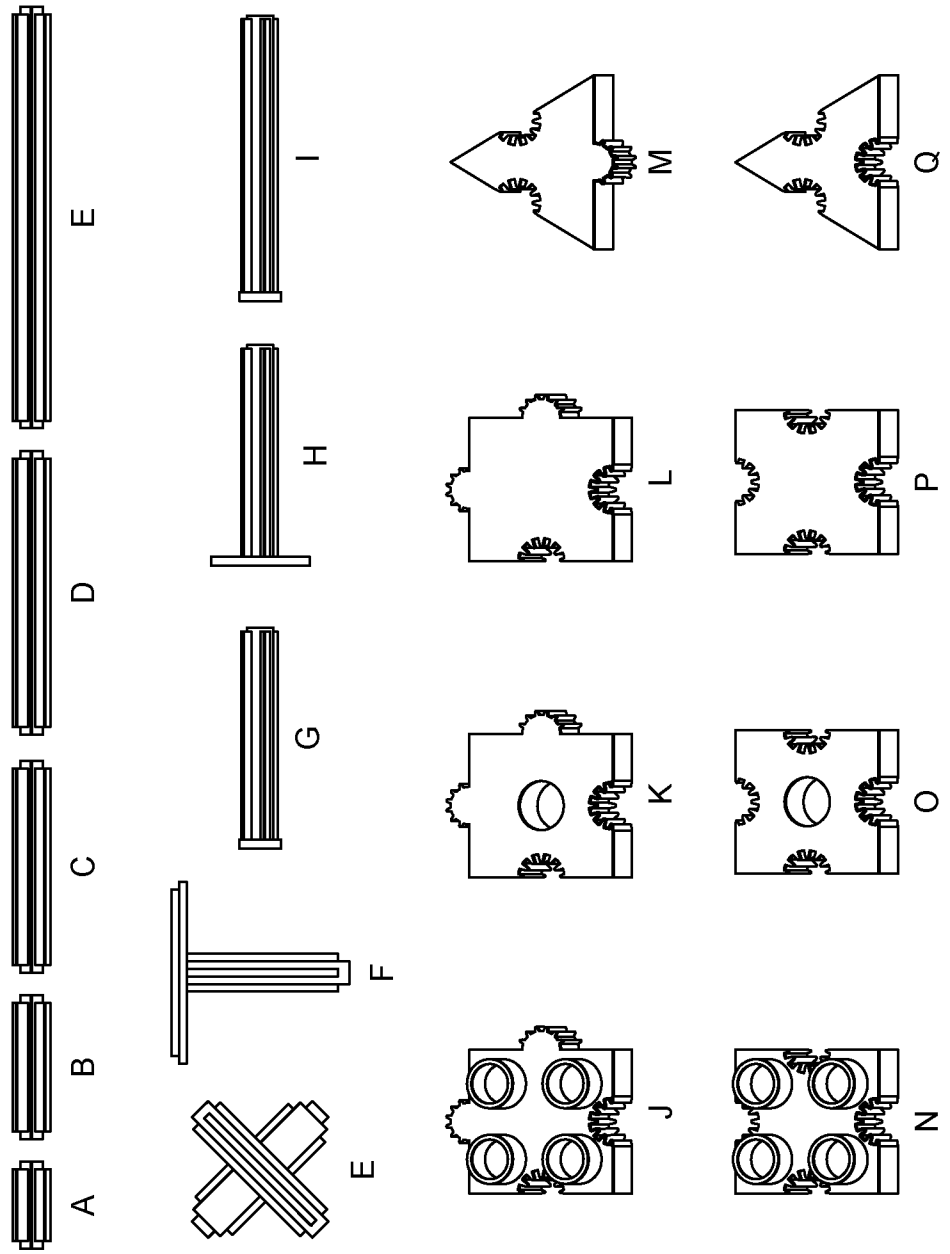
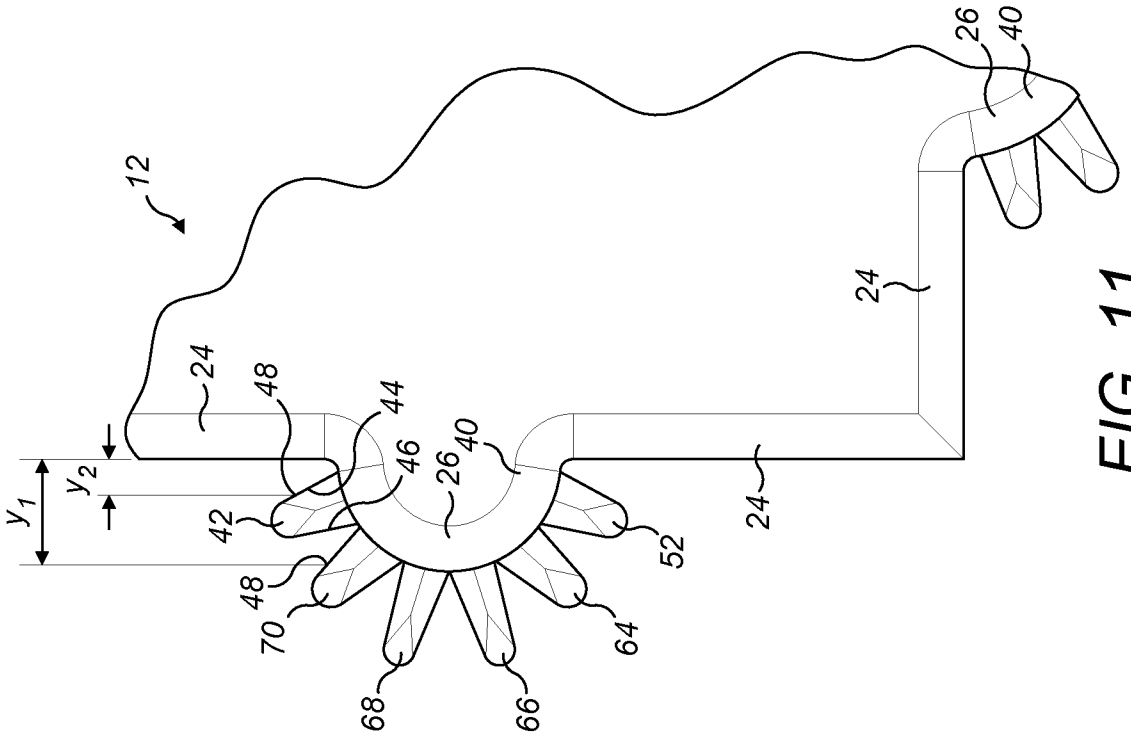



FIG. 9


12
24
48
44
46
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26
42
52
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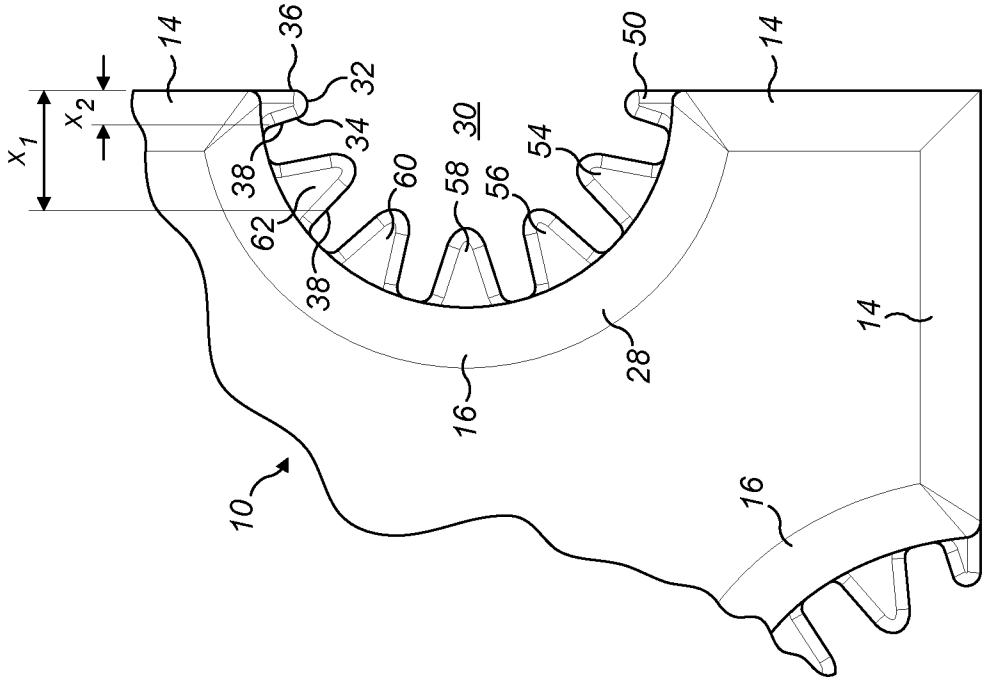
40
24
$y_1$
$y_2$
70
64
68
66

FIG. 11


14
36
32
34
30
38
60
58
56
54
50
14
62
38
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14
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16
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$x_1$
$x_2$

FIG. 10

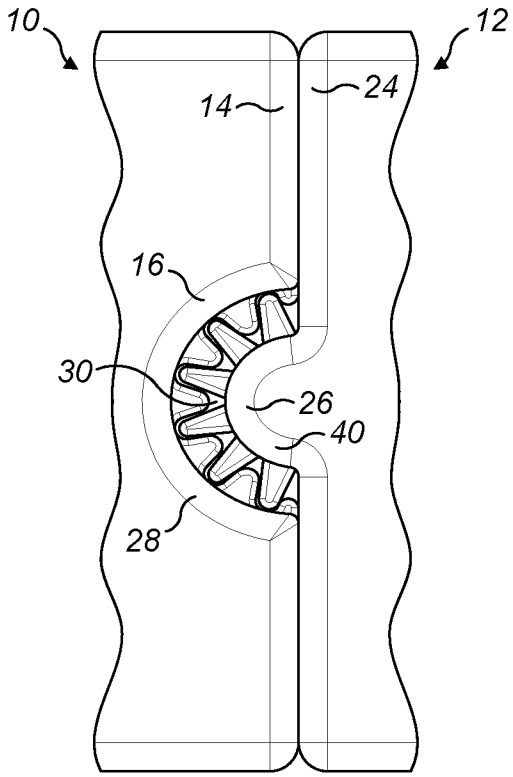
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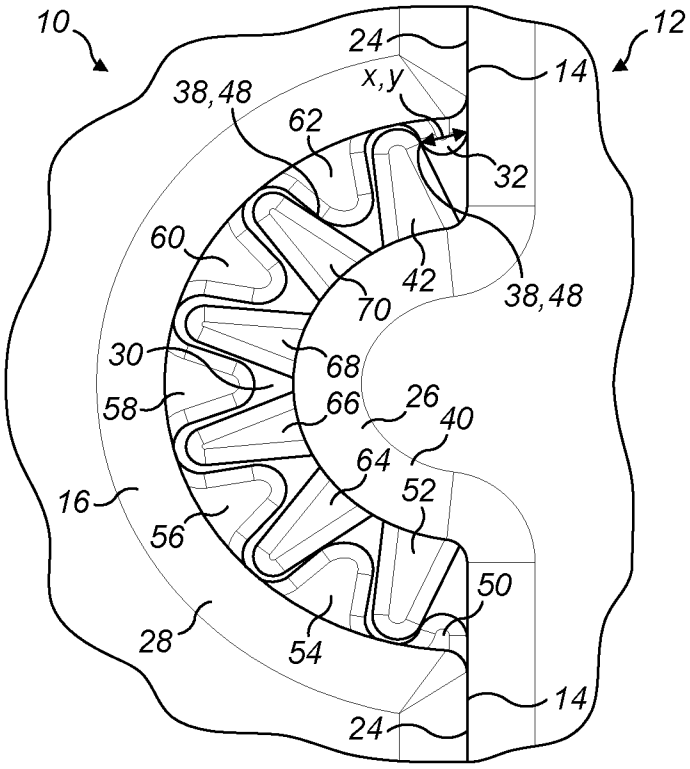
FIG. 12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12
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x,y
14
38,48
62
32
60
42
38,48
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16
56
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54
14
24

FIG. 13

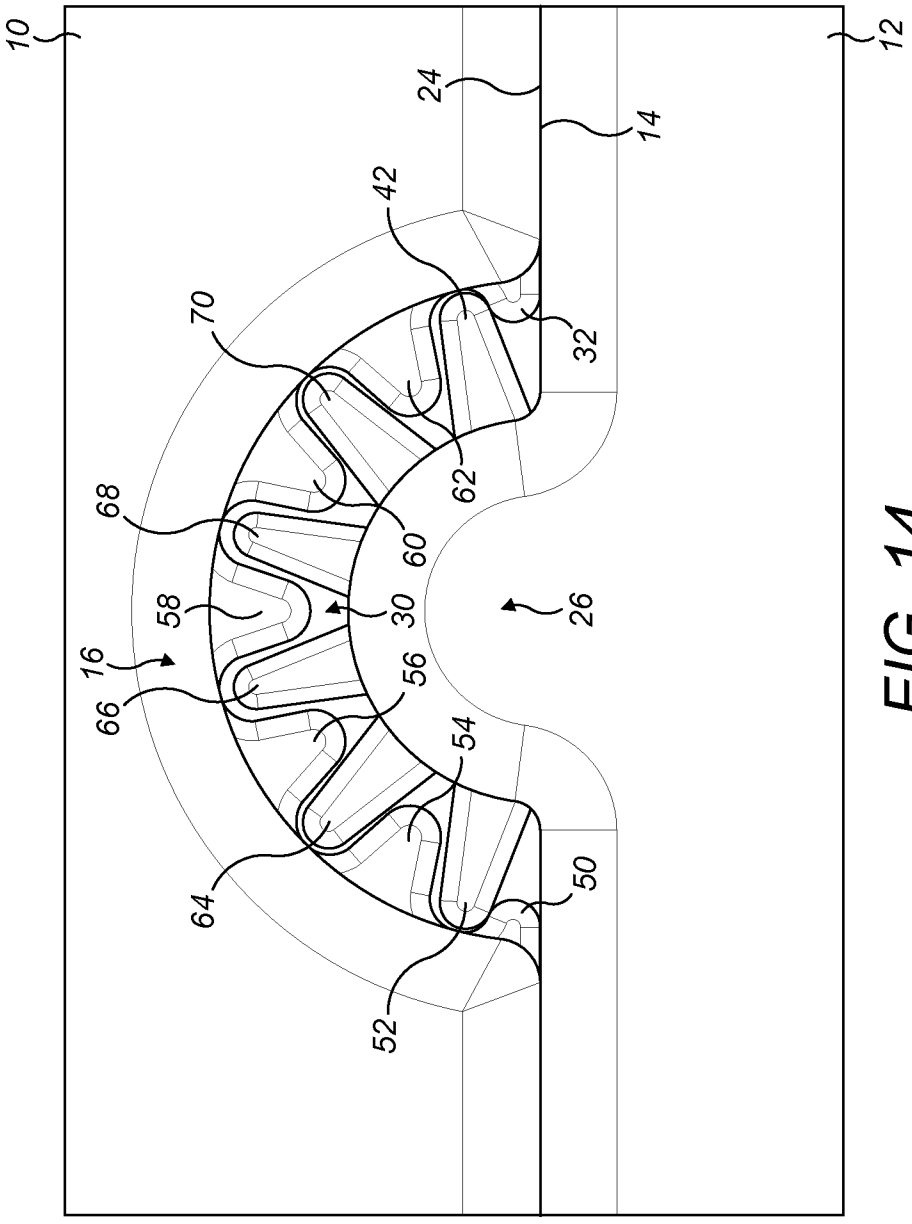



FIG. 14

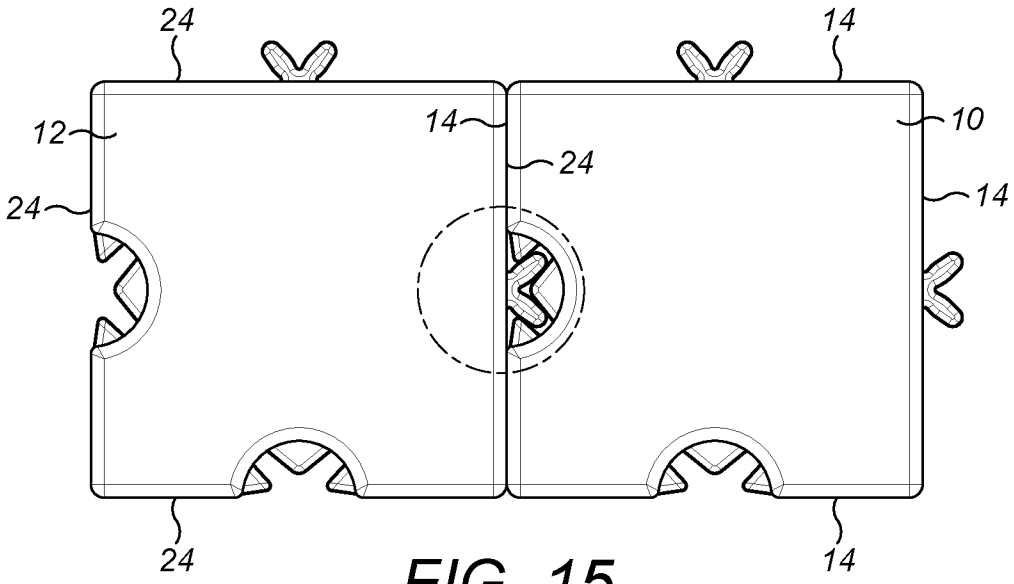



FIG. 15

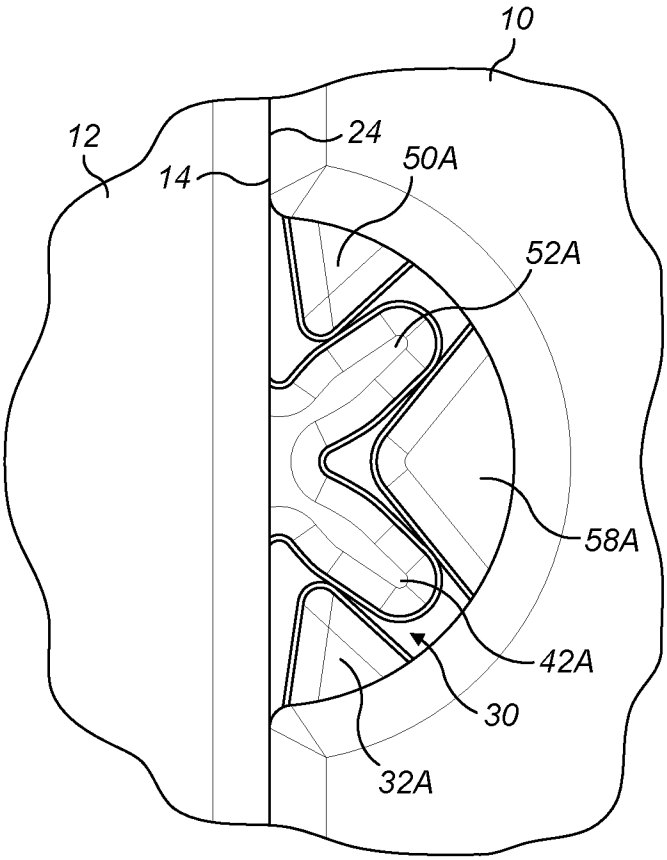



FIG. 16

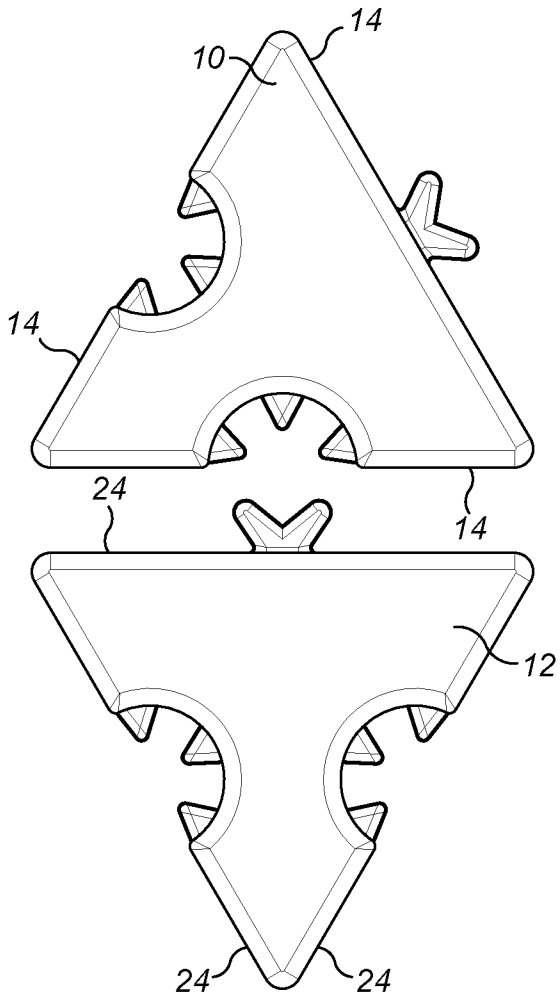



FIG. 17

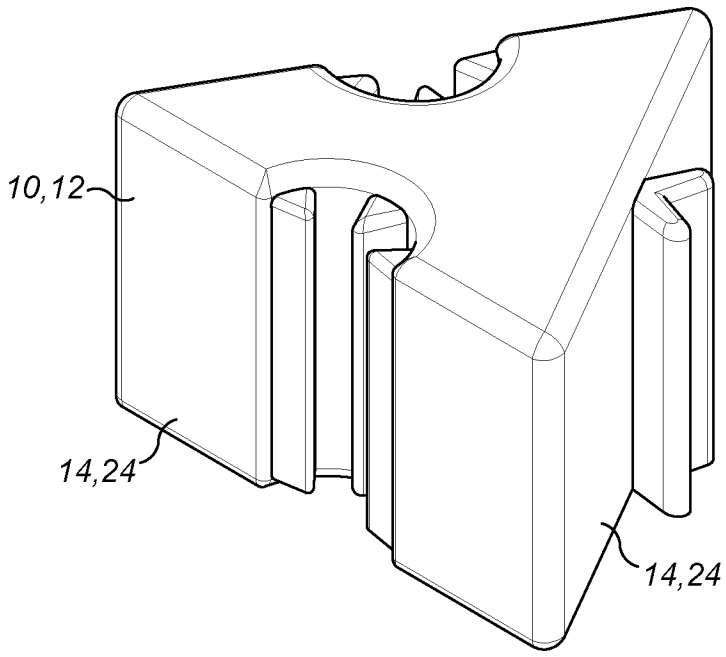



FIG. 18

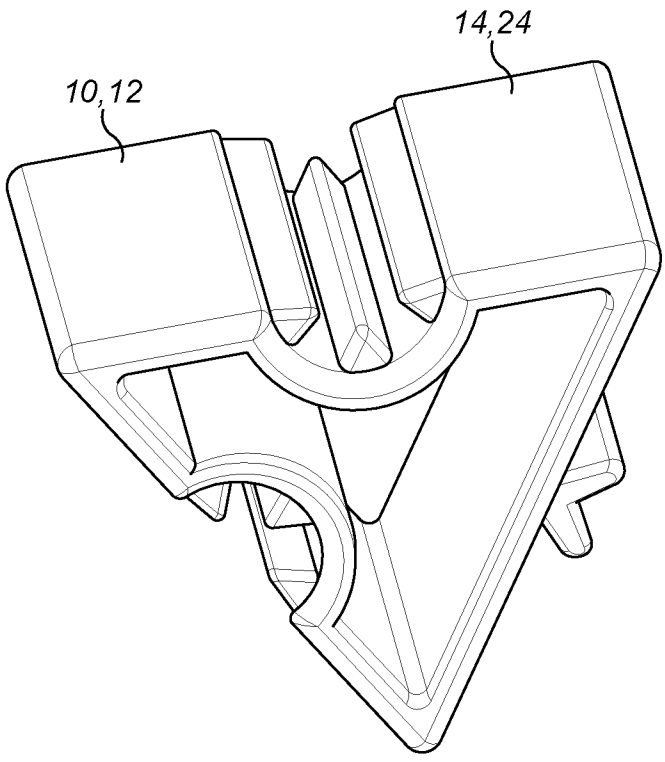
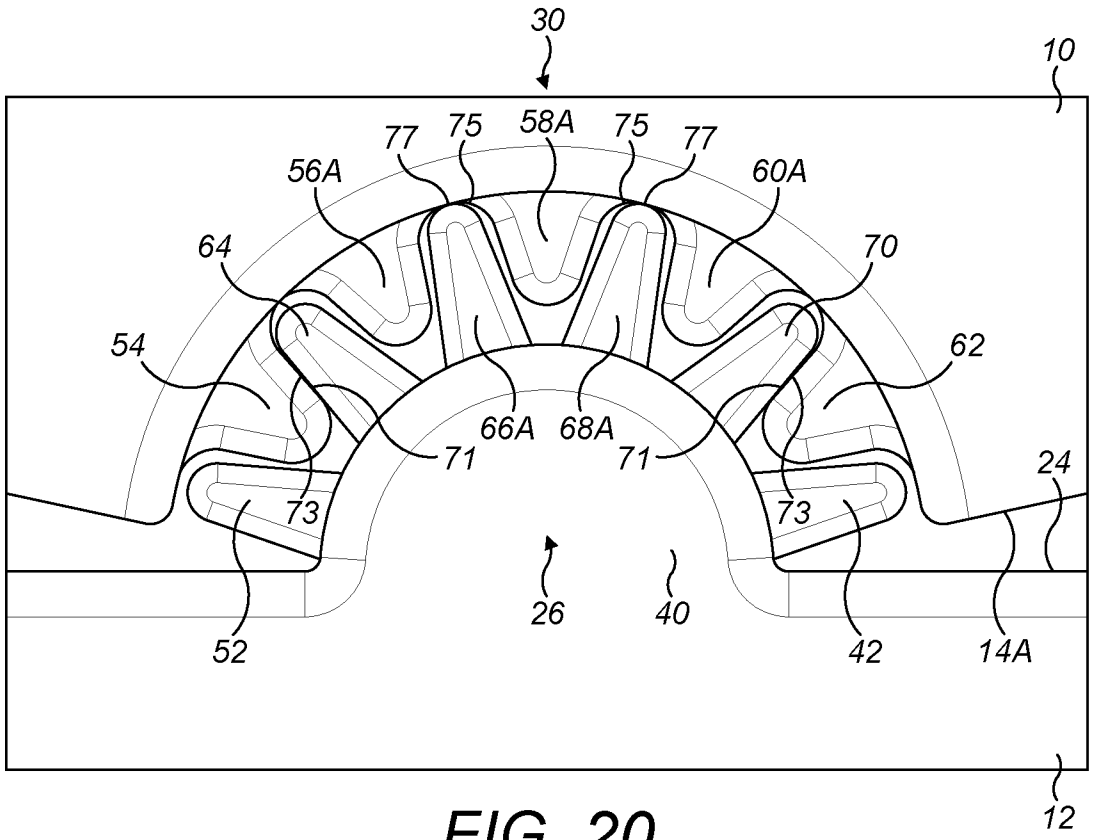



FIG. 19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75
58A
75
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56A
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52
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14A
12

FIG. 20

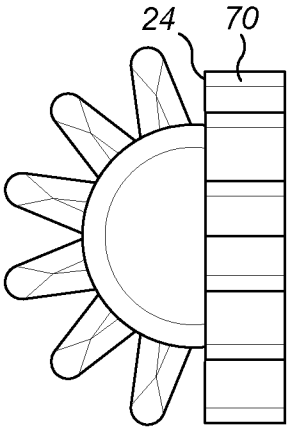


FIG. 21

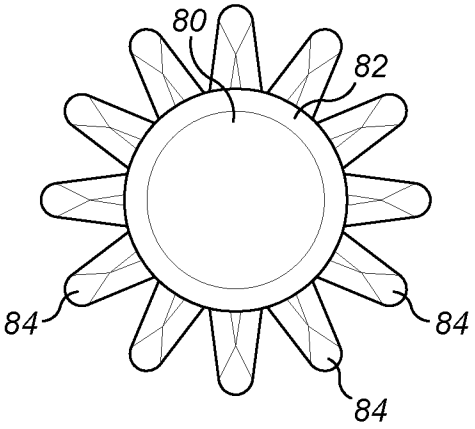


FIG. 22

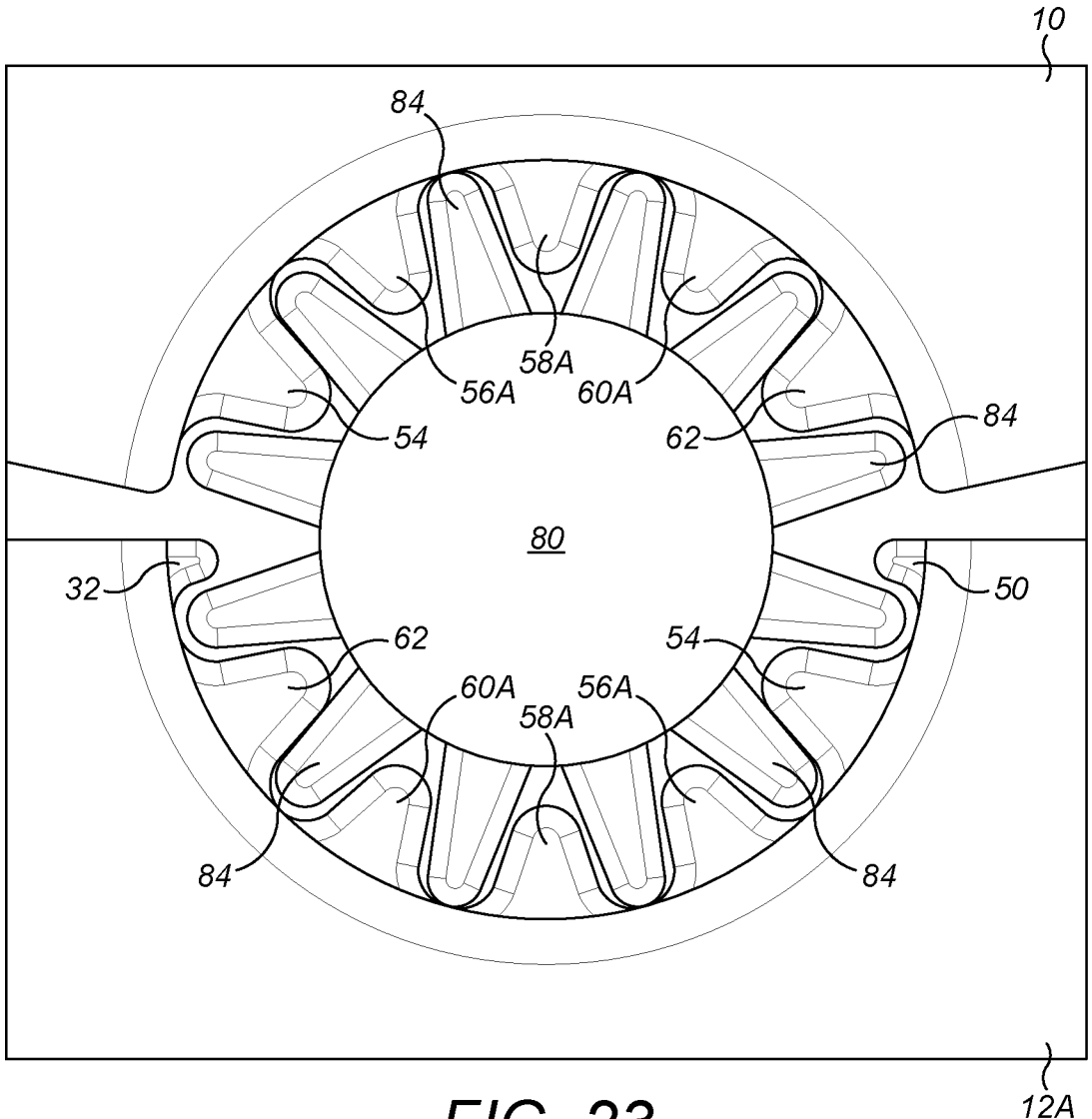


FIG. 23

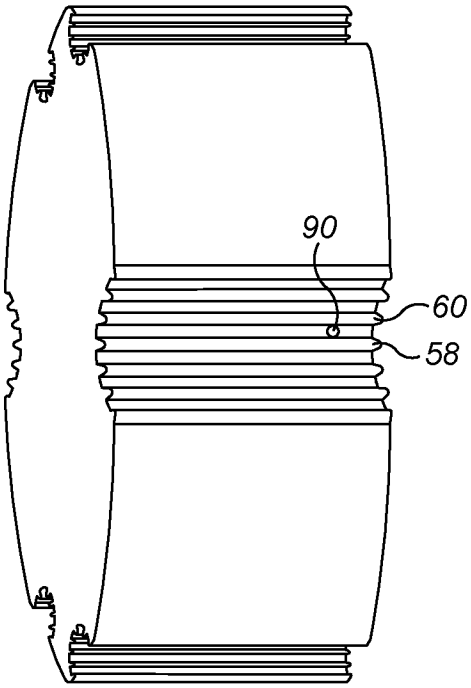


FIG. 24

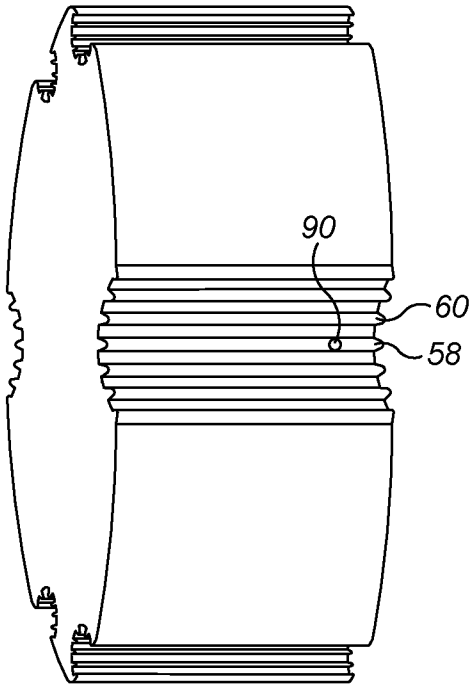


FIG. 25

# INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2014/050564

A. CLASSIFICATION OF SUBJECT MATTER
INV. A63H33/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A63H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | WO 97/01383 A1 (MORPHUN RESEARCH LTD [GB]; MOTT JONATHAN CHRISTOPHER [GB])<br>16 January 1997 (1997-01-16)<br>cited in the application | 1,2,5-8,<br>12-26 |
| A | page 4, line 11 - page 7, line 3; figures | 3,4,9-11 |
| | ----- | |
| X | GB 2 369 782 A (SIMONDS COLIN DUNCAN [GB])<br>12 June 2002 (2002-06-12) | 1,2,5-8,<br>12-24,26 |
| A | page 4, line 11 - page 7, line 3; figures | 3,4,<br>9-11,25 |
| | ----- | |
| A | FR 596 752 A (BASCOU)<br>31 October 1925 (1925-10-31)<br>figures | 1-26 |
| | ----- | |
| A | US 2 565 823 A (CLARENCE POOL)<br>28 August 1951 (1951-08-28)<br>figures | 1-26 |
| | ----- | |
| | -/-- | |

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 23 May 2014 | 02/06/2014 |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016 | Lucas, Peter |

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# INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2014/050564

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | CN 201 008 754 Y (YIGUANG CAI [CN])<br>23 January 2008 (2008-01-23)<br>the whole document<br>----- | 1-26 |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2014/050564

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| WO 9701383 A1 | 16-01-1997 | AT 184208 T | 15-09-1999 |
| | | AU 707434 B2 | 08-07-1999 |
| | | BR 9609463 A | 27-07-1999 |
| | | CA 2225747 A1 | 16-01-1997 |
| | | CN 1193287 A | 16-09-1998 |
| | | DE 69604182 D1 | 14-10-1999 |
| | | DE 69604182 T2 | 09-03-2000 |
| | | EP 0837724 A1 | 29-04-1998 |
| | | ES 2136413 T3 | 16-11-1999 |
| | | JP 3872816 B2 | 24-01-2007 |
| | | JP H11508169 A | 21-07-1999 |
| | | NZ 310531 A | 28-01-1999 |
| | | US 5938497 A | 17-08-1999 |
| | | WO 9701383 A1 | 16-01-1997 |
| GB 2369782 A | 12-06-2002 | NONE | |
| FR 596752 A | 31-10-1925 | NONE | |
| US 2565823 A | 28-08-1951 | NONE | |
| CN 201008754 Y | 23-01-2008 | NONE | |