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Description

[0001] The present disclosure relates to a constructional toy.

[0002] In particular the disclosure is concerned with a constructional toy comprising a number of elements which can be assembled together to form a variety of three dimensional structures.

Background

[0003] Constructional toys having separate building elements are well known in the art. The building elements can be combined to construct a shape for the enjoyment and education of children. US2001/0056964A1 (Colin Duncan Simonds) describes a constructional toy according to the preamble of claim 1. US2013/0012098A1 (Jean-Michel Meys) describes another example of the related art.

[0004] European Patent Application 0837724 (J C Mott, Morphon Research Limited) describes a constructional toy comprising a plurality of main building elements having splines provided as engagement features. The problem with this arrangement is that the building elements cannot vary much in size, as each element must be large enough to accommodate splined engagement features complementary in shape to the other building elements. Thus any resultant assembly of building elements will be of limited variety.

[0005] Although difficult to appreciate, extensive engineering skill and precision is involved in the production of a constructional toy joined by splined engagement features. The size, shape, resilience, and properties relative to cooperating features must all be taken into account in order to provide a toy which is easily assembled and disassembled by a child, whilst still providing a positive engagement while the elements are assembled.

[0006] Hence in order to maintain a quality interaction between building elements of different sizes, conventionally the same size and configuration of splined arrangements for both large and small elements are used. To do so is actually desirable, as the manufacture and production of elements with different spline arrangements increases design and manufacture complexity, and hence cost.

[0007] However for elements of different sizes, the size of the smallest element is limited by the size of the splined arrangement applied to it. This is because a certain amount of foundation material is required for the splined arrangement to be attached to, as well as offering the user a conveniently sized element to hold whilst engaging and disengaging the elements from one another.

[0008] Alternatively, all of the building elements may use a small spline engagement feature on all of the building elements of different sizes, however this would mean that larger building elements would not be held together as securely as if they used larger splined engagement features.

[0009] Hence a constructional toy comprising a plurality of elements of different sizes which can be engaged and disengaged with the required ease and satisfaction by a child is highly desirable.

Summary

[0010] According to the present invention there is provided a constructional toy as set forth in the appended claims. Other features of the invention will be apparent from the dependent claims, and the description which follows.

[0011] Accordingly there may be provided a constructional toy comprising a plurality of elements of at least two different types which can be assembled together to form a variety of three dimensional structures, said elements including : a main element comprising : a first engagement feature having N splines, where N is an integer not less than three; a second engagement feature having N' splines, where $N' < N$.

[0012] The main element may comprise a third engagement feature which is complementary in shape to, and configured to engage with, engagement features of the same design as the first or second engagement features, but not both.

[0013] The main element may comprise a third engagement feature, different to the first and second engagement features, and having $(N' + 1)$ splines.

[0014] The main element may comprise a fourth engagement feature comprising at least one of a stud, a plain aperture or a splined aperture.

[0015] The toy further may further comprise : an additional element comprising : an engagement feature complementary in shape to, and configured to engage with one of the first, second, third or fourth engagement features of the main element.

[0016] The additional element may have at least two surfaces, and be provided with engagement features of substantially the same form, shape and size on two surfaces, the engagement feature on one surface being provided at an angle to the engagement feature on the other surface.

[0017] The additional element may comprise a further engagement feature different to the other engagement feature of the additional element.

[0018] The further engagement feature may comprise at least one of a stud, a plain aperture or a splined aperture.

[0019] One or more of the main or additional elements may be in the form of a building block having a plurality of flat side surfaces, at least one of said surfaces being provided with at least one of the first, second or third engagement features, or an engagement feature complementary in shape to, and configured to engage with one of the first, second or third engagement features.

[0020] The main elements may be provided in the form of a building block having a plurality of flat side surfaces, wherein at least one of the first, second or third engage-

ment features, or an engagement feature complementary in shape to, and configured to engage with one of the first, second or third engagement features, is provided on at least one of the surfaces; and a different one of the first, second or third engagement features, or engagement feature complementary in shape to, and configured to engage with one of the first, second or third engagement features is provided on the same or another one of said surfaces. A transitional element may be provided as a splined shaft, one end of the shaft being provided with M splines which extend radially outwards from the shaft and being complementary in shape to, and configured to engage with, an engagement feature of a constructional element, the other end of the shaft being provided with a recess with M' splines which extend radially inward from an inner surface of the recess, where M is an integer of different value to M'. A transitional element may be provided as a splined shaft, one end of the shaft being provided with a first recess with M splines which extend radially inward from an inner surface of the first recess, the other end of the shaft being provided with a second recess with M' splines which extend radially inward from an inner surface of the recess, where M is an integer of different value to M'. A transitional element may be provided as a splined shaft, one end of the shaft being provided with a first recess with M splines which extend radially inward from an inner surface of the first recess, the other end of the shaft being provided with a "T" piece having a number of splines M' extending therefrom and being complementary in shape to, and configured to engage with, an engagement feature of a constructional element, where M is an integer of different value to M'. A transitional element may be provided as a splined shaft, one end of the shaft being provided with M splines which extend radially outwards from the shaft, the other end of the shaft being provided with a "T" piece having a number of splines M' extending therefrom, each end of the shaft being complementary in shape to, and configured to engage with, a different engagement feature of a constructional element, where M is an integer of different value to M'.

[0021] The splined shaft may be provided as an articulated shaft, the articulation being provided by a universal joint provided at a region between the ends of the shaft.

[0022] M may be an integer having a value greater than N; and M' may be an integer having a value greater than N' but less than N. N may equal 6; N' may equal 2; M' may equal 4; and M may equal 12.

[0023] Hence there is provided a constructional toy in which the elements have engagement features of different sizes, and the toy comprises a number of main transition elements which have engagement features common to sizes and configurations of other elements of the constructional toy.

Brief Description of the Drawings

[0024] Examples of the present disclosure will now be

described with reference to the accompanying drawings, in which:

Figures 1 to 4 show a variety of views of a first example of a main element according to the present disclosure;

Figures 5 to 6 show a variety of views of a second example of a main element according to the present disclosure;

Figures 7 to 10 show a variety of views of a third example of a main element according to the present disclosure;

Figures 11 to 14 show a variety of views of a fourth example of a main element according to the present disclosure;

Figures 15 to 18 show a variety of views of a fifth example of a main element according to the present disclosure;

Figures 19 to 22 show a variety of views of a combination of the main element of figures 1 to 4 and additional elements according to the present disclosure;

Figures 23 to 26 show a variety of views of one of the additional elements as shown in Figures 19 to 22 according to the present disclosure;

Figures 27 to 30 show a variety of views of one of the additional elements as shown in Figures 19 to 22 according to the present disclosure;

Figures 31 to 34 show a variety of views of another example of an additional element according to the present disclosure;

Figures 35 to 37 show a variety of views of a further example of an additional element according to the present disclosure;

Figures 38 to 40 show a variety of views of a further example of an additional element according to the present disclosure;

Figures 41 to 43 show a variety of views of an additional shaft element according to the present disclosure;

Figures 44 to 46 show a variety of views of an alternative additional shaft element according to the present disclosure;

Figures 47 to 50 show a variety of views of a sixth example of a main element according to the present

disclosure;

Figures 51 to 52 show a variety of views of the main element of Figures 47 to 50 in combination with additional elements similar to those of figures 23 to 26 according to the present disclosure;

Figures 53 to 55 show a variety of views of a further example of an additional element according to the present disclosure;

Figures 56 to 59 show a variety of views of a further example of an additional element according to the present disclosure;

Figure 60 to 63 show a variety of views of the additional element of Figures 53 to 55 in combination with additional elements shown in Figures 27 to 30 according to the present disclosure;

Figures 64 to 67 show examples of a transitional element in the form of an articulated shaft according to the present disclosure;

Figures 68 to 71 show a variety of views of a further example of an articulated shaft according to the present disclosure;

Figures 72 to 77 show a variety of views another example of an articulated shaft according to the present disclosure; and

Figures 78 to 80 show a variety of views the articulated shaft examples of Figures 64 to 77 in combination.

Detailed Description

[0025] Figures 1 to 4 show a variety of views of a first example of a main (or "transitional") element of a constructional toy according to the present disclosure. The element 10 is polygonal in cross section and has five substantially flat external surfaces 12, 14, 16, 18 and 20. Many of the examples of the toy elements of the present disclosure are polygonal in cross section and have four or five substantially flat external surfaces, as is apparent from the figures in which they are represented. The main elements are optionally termed "transitional" elements as they enable the joining of blocks of different sizes having different joining (or "engagement") features. That is to say, the main elements provide a transition from one size of constructional element to another.

[0026] Figures 1 to 3 show the five substantially flat surfaces 12, 14, 16 of element 10. Figure 4 shows an underside/inner view of the element 10, and shows that the five surfaces 12, 14, 16, 18 and 20 are defined by walls which define an open cavity 22 within which are located three hollow and open cylindrical pedestals 24.

The pedestals 24 extend from the underside of the wall which defines surface 20.

[0027] The element 10 comprises a first engagement feature 30 having a number of splines 32, for example N splines where N is an integer not less than 3. The splines 32 extend from a semi-circular base (or protrusion) 34 which extends from the surface 12 of the element 10.

[0028] The main (or "transitional") element 10 is also provided with a second engagement feature 40 having a number of splines 42, for example N' splines. In the example shown the first engagement feature 30 is provided with 6 splines and the second engagement feature is provided with 2 splines. N and N' are both integers, and N' is a value less than N.

[0029] The main (or "transitional") element 10 further comprises a third engagement feature 50, different to the first and second engagement features, having a number of splines 52, for example (N' + 1) splines. In the example shown the third engagement feature 50 is complementary in shape to, and configured to engage with, engagement features of the same design as (i.e. identical to) the second engagement feature 40. Alternatively the third engagement feature may be provided with engagement features complementary in shape to, and configured to engage with, engagement features of the same design as (i.e. identical to) the first engagement feature.

[0030] The splines 42 of the second engagement 40 feature extend directly from the surface 14 of the main (or "transitional") element 10. The splines 52 of the third engagement feature 50 extend directly from the wall of a recess 54 in the surface 18 of the main (or "transitional") element 10. In the examples shown in Figures 1 to 4, there are provided a further two third engagement features 50, which are both provided on the surface 16 of the main (or "transitional") element 10.

[0031] The engagement features 30, 40 are termed "male" engagement features, and the engagement features 50 are termed "female" engagement features.

[0032] Although in the example of Figures 1 to 4 there are shown one male second engagement feature 40 and three equivalent female features 50, the element 10 may be provided with a different number of/and combination of male and female engagement features 40, 50. Likewise, any of the examples of the present disclosure may be provided with a different number, combination and relative size of engagement features to those presented in the figures.

[0033] The pedestals 24, as shown in Figure 4, are shown as comprising a stud which extends away from the wall which defines the surface 20 and further comprises a plain aperture 60, although a splined aperture could be provided instead. The aperture 60 is closed at the end closest to the wall which defines surface 20.

[0034] A variety of views of a second example of a main (or "transitional") element 62 is shown in Figures 5 to 6. The main element 62 is identical to the example shown in Figures 1 to 4 except that studs 66 are provided on the surface 20 of the element 62. The studs 66 are

cylindrical and closed at their end distal to the surface 20.

[0035] A variety of views of a third example of a main element 64 is shown in Figures 7 to 10. The main element 64 is identical to that shown in Figures 1 to 4, except that instead of a male first engagement feature 30 being provided on a cylindrical protrusion 34, shown in Figures 1 to 4, there is provided a female first engagement feature 30' comprising a number of splines, for example $N+1$ splines 32, which extend from a recess 34' (or groove) in the surface 12 of the main element 64. In the example shown there are seven splines.

[0036] Figures 11 to 14 show a variety of views of a fourth example of a main (or "transitional") element 70 similar to that shown in Figures 1 to 4, the only difference being that the main element is provided with a square cross section rather than a rectangular cross section, and there being provided fewer tertiary engagement features 50 having a number of splines, for example $(N'+1)$ splines. Additionally, the cavity 22 of main element 70 is provided with a hollow stud like pedestal 24 as described in relation to Figure 4.

[0037] The fifth example of a main (or "transitional") element 80 shown from variety of angles in Figures 15 to 18, are identical to that shown in Figures 11 to 14 except that the elements comprise the pedestals/studs 66 extending from the surface 20 of the element 80, as described with reference to the example of Figure 5.

[0038] Figures 19 to 22 show a variety of views of the main element 10, as shown in Figures 1 to 4, assembled with additional elements 90, 92. Of these, the additional element 90 comprises engagement features 94 complementary in shape to, and configured to engage with the first engagement feature 30 of the main element 10. In the example shown the additional element 90 comprises two engagement features 94 which are complementary in shape to and configured to engage with the engagement features 30 of the main element 10, and is also provided with two engagement features 30 which are identical to engagement features 30 of the main element 10. In the example shown, the additional element 90 has a side the same length as surface 12 of the main element 10, and has a greater depth. The additional element 90 is engaged with the main element 10 by sliding the female engagement feature 94 into engagement with the male first engagement feature 30 of the main element 10.

[0039] In the example shown in Figures 19 to 22 a smaller additional element 92 is also shown in engagement with the main element 10. In the example shown, the smaller additional element 92 has a side about half the length of the surface 12 of the main element 10. As later described in relation to Figures 27 to 30, spline arrangements are provided as male and female engagement features on the smaller element 92, which are identical to those of the second and third engagement features 40, 50 of the main element 10. For example, the smaller additional element 92 comprises an engagement feature 96 complementary in shape to, and configured to engage with, the third engagement feature 50 of the

main element 10.

[0040] A second additional element 92 is engaged with engagement features provided on the other element 92 and with the third engagement feature 50 of the main element 10. As with the larger additional element 90 the smaller additional elements 92 are engaged with the engagement features having N' splines by sliding them into engagement with the engagement feature 50 of the main element 10.

[0041] Figures 21 and 22 show different views of the same arrangement, with Figure 22 showing the underside, or "inner view", of the assembled elements 10, 90, 92.

[0042] Figures 23 to 26 show a variety of views of an alternative example of an additional element 91 similar to that of additional element 90 shown in Figures 19 to 22. The additional element 91 is identical to additional element 90 except for studs 100 which are provided on an upper surface 102. The studs 100 extend away from the surface 102, and the studs 100 are open at the end of the stud 100 which is distal to the surface 102. The additional element 91 is provided with male engagement features 30 and female engagement features 94 as previously described with reference to Figure 19 and the various examples of the main (or "transitional") element. As shown in Figures 25 and 26 the underside of the additional element 90, 91 comprises a hollow cylindrical element 104 which extends the full depth of the hollow additional element 90, 91. A number of guides 106 are provided extending from the walls of the element and the centre pedestal 104, the ends of the guide features 106 being distal to the surfaces from which they extend, and are spaced apart such that they will neatly engage with and frictionally engage with studs 100 provided on other elements.

[0043] Figures 27 to 30 show a variety of views of the smaller additional element 92 shown in figures 19 to 22. The engagement features of the smaller element 92 are identical to the second engagement features having a number of splines, for example N' splines, and third engagement features having a number of splines, for example $(N'+1)$ splines, shown as engagement features 40, 50 in figures 1 to 4. Additionally the underside of the block element 94 is similar to that of the examples of figures 1 to 4 in that a hollow cylindrical pedestal 24 open at one end is provided in the centre of the block and extends away from the large flat surface of the element 92. Of course, the pedestal/stud 24 may be of a different size to that of the example shown in figures 1 to 4. The stud 24 further comprises a plain aperture 60, although a splined aperture could be provided instead. The aperture 60 is closed at the end closest to the wall which defines.

[0044] A further example of an additional element 93, shown from a variety of angles, is shown in Figures 31 to 34, and is identical to the additional element 92 shown in figures 27 to 30 other than stud/pedestals 66 are provided on the large flat surface of the element 93.

[0045] Figures 35 to 37 show a variety of views of a further alternative example of an additional element 95 which is identical to the example of Figures 27 to 30 other than a splined aperture 97 is provided in the centre of the element 95. The splined aperture 97 extends the full height of the element 95, and is in the form of a splined hollow cylinder open at both ends. In the example shown the aperture is provided with 6 splines, but a different number of splines may be provided, depending on the shape and form of the element it is required to be joined with.

[0046] A further alternative example of an additional element 120 is shown, from various angles, in figures 38 to 40. This is similar to the example shown in figures 27 to 30, and instead of a polygonal cross section element 92 the element 120 is triangular in cross section. It is provided with engagement features akin to second and third engagement features 40, 50 on three of its surfaces, as described with reference to the example element 92 of Figures 27 to 30. As with any of the examples of the present disclosure, there may also be provided an element with a different number, combination and/or relative size of engagement features to those presented in the figures.

[0047] Figures 41 to 43 show a variety of views of another example of an additional element 130. The additional element 130 comprises a splined shaft complementary in shape and configured to engage with the female first engagement feature 32' of the third main element example 64 of Figures 7 to 10. That is to say, the splines of the shaft 130 are configured to be complementary in shape and spacing to the recess 34 of the main element 64 such that the shaft 130 may slide into and engage with the recessed splines 32'. The shaft 130 is also configured to fit inside the pedestal/stud 24 common to the examples of figures 1 to 15.

[0048] Figures 44 to 46 show a variety of views of an alternative splined shaft 140 having the same dimension and spacing as the second engagement feature 40 of the main element examples shown in Figures 1 to 18. The additional shaft element 140 has splines 42 which are configured to be complementary in shape and to engage with the third engagement feature 50 as shown in figures 1 to 18. That is to say, the shaft 140 is configured to slide into and engage with the splines 52 extending from the recess 54 of the third engagement feature 50. The additional element 140 is also configured to fit within the hollow stud/pedestal of the smaller additional elements shown in figures 23 to 34, and also to be complementary in shape and to engage with the splines of the aperture/stud 24 of the additional element 95 shown in figures 35 to 37. The additional element 140 is also configured to engage with the female engagement features shown in the additional element 120 of figure 38 to 40.

[0049] Hence the additional shaft element 130 is configured to link elements having a female engagement feature 30' of the main and additional elements, thereby providing a means for the main and additional elements to

be fitted together. Hence assemblies of the constructional toy elements may extend in a direction away from the direction of build as shown in figures 19 to 22. That is to say the additional element 130 would allow for elements to be added to the example shown in figure 20 such that the constructional toy assembly extends into and/or out of the page.

[0050] Likewise the additional shaft element 140 could be used to extend the constructional build by attaching the smaller additional elements having female engagement features 50 which are complementary in shape to that of the shaft 140 such that they too extend into and out of the page as shown in figure 20.

[0051] Figures 47 to 50 show a variety of views of a sixth example of a main/transitional element 150. This main element 150 comprises similar features to that of the examples of figures 1 to 18, having a male first engagement feature 30, a male second engagement feature 40 and a female engagement feature 50, where the first engagement feature 30, second engagement feature 40 and third engagement feature 50 have a different numbers of splines. However, in this example while the first engagement feature 30 has a number of spline, for example N splines, where N is an integer not less than three, and in the example shown N=6, the splines 32 of this example are smaller than those of the examples shown in figures 1 to 18. Additionally the protrusion 34 shown in the example of figures 47 to 50 is smaller than that shown in 1 to 18.

[0052] On the reverse side of element 150, as shown in figures 49, 50, there is provided a fourth engagement feature 152 provided as a cylinder which is open at one end with splines 154 extending from the inner surface from the cylinder 152 towards the centre of the cylinder 152. This is for engagement with, and is complementary in shape to, the shaft 140 shown in figures 44 to 46.

[0053] Figures 51 to 52 show a variety of views of a main element 150 coupled to an additional element 160 by virtue of the first engagement features 30 and second engagement features 30'. This example of the additional element 160 is akin to element 90 shown in figures 19 to 22, however it may have a different size, for example be half or a quarter of the size of the element 90.

[0054] The additional element 170 shown in figures 53 to 55 is akin to that shown in figures 11 to 14, having engagement features of the same shape and configuration, namely those as described with reference to figures 1 to 18. That is to say, the additional element 170 has engagement features 40 similar to those of the second engagement features 40 having splines 42 as shown in figures 1 to 18. The engagement features 14 provided on all or some of the surfaces of the block 170 are of substantially the same form, shape and size as each other. However, the engagement feature on one surface is provided at an angle (for example shown at a right angle, perpendicular to) the engagement feature on another surface.

[0055] Likewise in the example of figures 56 to 59 there

are presented various views of an additional element 180 in the form of a polygonal plate 182 having an upper surface 184 and an opposite surface 186, as well as splines 42 providing an engagement feature 40 common in design to the examples of figures 1 to 18. Hence the engagement features 40 are substantially the same form, shape and size on both surfaces 184, 186, however the engagement feature on one surface is provided at an angle to the engagement feature on the other surface, and in the example shown, the engagement feature on one surface is provided at right angles the engagement feature on the other surface.

[0056] The example assembly shown in figures 60 to 63 show an element 170 coupled to an element 92 (as shown in figures 27 to 30). Hence the arrangement of the splines 42 on block 170 allow for one of the additional elements 92 to extend in one direction away from the additional block 170, and the arrangement of splines on the block 170 is such that the other element 92 can extend in a different direction away from the block 170, for example perpendicular (as shown). This increases the constructional capabilities of a constructional toy according to the present disclosure allowing for a robust and easily engagable and disengagable coupling which can extend in different directions allowing shapes to be built up in three dimensions.

[0057] Clearly other elements can be added to this construction, for example the examples of figures 1 to 52 in any combination provided the male and female engagement features are engaged and coupled appropriately. That is to say, provided the correct male engagement feature is coupled and engaged with the appropriate female engagement feature, then the constructional toy can be assembled.

[0058] Figures 64 to 67 show a variety of views of a further example of a transitional element 190. In this example the element 190 is an articulated shaft. The articulation is provided by a universal joint 192 provided at a region between ends 194, 196 of the shaft. A first portion 198 of the shaft is provided with a number of splines which extend radially outwards from the shaft, similar in configuration to the splines 32 for the additional shaft element 130. A second portion 199 of the shaft 190, on the opposite side of the articulation 192 to the first portion, is provided with a female engagement feature having a different number of splines. That is to say, the second portion 199 is provided with a cylindrical recess 197 with splines 193 which extend radially inward from an inner surface 195 of the recess 197. Put another way, the transitional element may be provided as a splined shaft, one end of the shaft being provided with M splines which extend radially outwards from the shaft and being complementary in shape to, and configured to engage with, an engagement feature of one of the main or additional element, the other end of the shaft being provided with a recess with M' splines which extend radially inward from an inner surface of the recess, where M is an integer of different value to M'. The recess 197 and spline 193 are

configured to be complementary in shape and to engage with the additional shaft 140 as shown in figures 44 to 46. Hence the articulated shaft 190 can be used to attach a constructional toy element having a first engagement feature 30, 30', as shown in figure 7 to 10 to a block element having a female third engagement feature 50. Alternatively, of course, other constructional elements may be added to the end of the shaft element 140 after it has been inserted in the end 196 of the articulated shaft 190.

[0059] Figures 68 to 71 show a variety of views of an alternative transitional articulated shaft 200 which is similar to the articulated shaft 190 shown in figures 64 to 67 except that instead of a male splined shaft and a female splined shaft, the articulated shaft 200 is provided with two female splined shafts. That is to say, the transitional shaft element 200 may be provided as a splined articulated shaft, one end 202 of the shaft being provided with a first recess 201 with splines 205 which extend radially inward from an inner surface 203 of the first recess 201, the other end 204 of the shaft being provided with a second recess 206 with a different number of splines 207 which extend radially inward from an inner surface 209 of the recess. Put another way, the transitional element may be provided as a splined shaft, one end of the shaft being provided with a first recess with M splines which extend radially inward from an inner surface of the first recess, the other end of the shaft being provided with a second recess with M' splines which extend radially inward from an inner surface of the recess, where M is an integer of different value to M'. The end 202 of the articulated shaft is configured to be compatible for receiving a splined shaft 130 as shown in figures 41 to 43, and the other end 204 is configured to be compatible for receiving a splined shaft as shown in figures 44 to 46.

[0060] A further example of a transitional articulated shaft element 210 is shown in figures 72 to 77. As in the examples of Figures 64 to 71, the shaft has an articulation 192 in the form of a universal joint. One end of the shaft 212 is provided with a female engagement feature 214 having a spline configuration compatible with the additional shaft 130 shown in figures 41 to 43. That is to say, end 212 of the shaft 210 is provided with a first recess 201 with splines 205 which extend radially inward from an inner surface 203 of the first recess 201. The other end of the shaft 210, on the opposite side of the articulation 192 to the end 212, is provided as a splined "T" piece 220 having splines 222 compatible with the third engagement feature 50 as shown in figures 1 to 40. In the example shown there are two splines 222, which extend substantially at right angles to one another, and at 45deg to their base 224. Put another way, the transitional element may be provided as a splined shaft, one end of the shaft being provided with a first recess with M splines which extend radially inward from an inner surface of the first recess, the other end of the shaft being provided with a "T" piece having a number of splines extending therefrom and being complementary in shape to, and config-

ured to engage with, an engagement feature of one of the main or additional element.

[0061] The transitional element may alternatively be provided as a splined shaft, one end of the shaft being provided with M splines which extend radially outwards from the shaft, the other end of the shaft being provided with a "T" piece having a number of splines extending therefrom, each end of the shaft being complementary in shape to, and configured to engage with, a different engagement feature of the main and/or additional element.

[0062] Hence engagement of transitional shaft element 210 in a combination with a main element part such as that shown in figures 7 to 10 allows for an extension of the structure under construction by the user/child to be flexible and to link to other structures.

[0063] Additionally, and as shown in figures 78 to 80, the flexible/articulated shafts 190, 200 and 210 may be assembled together.

[0064] Hence there is provided a constructional toy according to the present disclosure where some of the elements are in the form of a building block having a plurality of flat sided surfaces, at least one of said surfaces, and generally more than one of said surfaces, being provided with an engagement feature. The elements may be generally polygonal in cross section.

[0065] Both the main/transitional elements and the additional elements may be provided as a building block.

[0066] That is to say, the main elements may be provided in the form of a building block having a plurality of flat side surfaces 12, 14, 16, 18 and 20, wherein at least one of the first 30, second 40 or third 50 engagement features, or an engagement feature complementary in shape to, and configured to engage with one of the first 30, second 40 or third 50 engagement feature, is provided on at least one of the surfaces 12, 14, 16, 18 and 20. A different one of the first 30, second 40 or third 50 engagement features, or engagement feature complementary in shape to, and configured to engage with a different one of the first 30, second 40 or third 50 engagement features, is provided on the same or another one of said surfaces 12, 14, 16, 18 and 20. The different engagement features provided on the main/transitional element may be of different overall size to one another, to thereby facilitate the joining together of building elements of different overall size. Put another way, each main element comprises a first engagement feature which is sized and shaped to engage with a complementary engagement feature of another element, and also comprises a second engagement feature which is of different size and/or shape to the first engagement feature and configured to engage with a complementary engagement feature of a further element which is different to, and incompatible with, the first engagement feature. The main element and elements joined to it may be of different sizes, the engagement features and complementary engagement features being sized appropriately to the size of the element.

[0067] The additional elements may be provided in the

form of a building block having a plurality of flat side surfaces 12, 14, 16, 18 and 20, at least one of said surfaces being provided with at least one of the first 30, second 40 or third 50 engagement features, or an engagement feature complementary in shape to, and configured to engage with one of the first 30, second 40 or third 50 engagement features.

[0068] Alternatively both the main elements and the additional elements may be provided as a splined shaft, where different ends of the shaft are provided with splines of a different configuration for engagement with other splined arrangements.

[0069] Where examples are described as having male engagement features, they may also be alternatively provided as female engagement features with compatible splined arrangements.

[0070] Hence there is provided a constructional toy comprising a plurality of elements as described in the preceding description and shown in the accompanying figures. The elements of the constructional toy comprise at least two different types which can be assembled together to form a variety of three dimensional structures. The elements of the constructional toy comprise main elements and additional elements. The main elements comprise engagement features of different and incompatible splined arrangements. They may comprise female splined arrangements arranged and configured to receive male splined arrangements which are incompatible with other male and or female splined arrangements present on the same element. That is to say, each main element can be coupled to a further element having a first type of splined arrangement, and also coupled to a different element having a different splined arrangement which is incompatible to that of the other splined arrangement. Hence elements of the same design may be joined to one another and to elements of a different design.

[0071] As described above, this has the advantage that elements of different sizes, and by necessity different splined arrangements of different overall sizes, can be joined together to increase the variety, complexity and variation in granularity of designs being built by the user.

[0072] The additional elements of the present disclosure may have a variety of different shapes, and as described, may have splined arrangements which are identical and compatible, may be female or male, and may be arranged at an angle to one another such that the coupling of an additional element to a main element or another additional element means that the constructional toy can be extended in a variety of directions. Likewise the shafts and articulated shafts as described in relation to the present disclosure also allow for the constructional toy to be built up from a base main (or "transitional") element in different directions, and to be coupled to other main elements and additional elements in interesting, creative and fun ways.

[0073] In all cases the splined arrangements are sliding arrangements where one engagement feature must be engaged and slid into position relative to the correspond-

ing engagement features of a different element.

[0074] Additionally other additional elements may be added to the constructional toy.

[0075] Thus the constructional toy for the present disclosure provides an advantage over that of known constructional toys because of the complexity and flexibility of design that they allow.

Claims

1. A constructional toy comprising a plurality of elements (10, 62, 64, 70, 80, 90, 91, 92, 93, 94, 95, 120, 130, 140, 150, 170, 180, 190, 200, 210) of at least two different types which can be assembled together to form a variety of three dimensional structures, said elements including :

a main element (10, 62, 64, 70, 80, 150, 190, 200, 210) comprising :

a first engagement feature (30) having N splines (32), where N is an integer not less than three, the splines (32) extending from an external surface (12, 14, 16, 18) of the main element,

the first engagement feature (30) being complementary in shape to, and configured to engage with, an engagement feature (30') on another element;

a second engagement feature (40) having N' splines (42), where $N' < N$, **characterised in that** the second engagement feature (40) is complementary in shape to, and configured to engage with, an engagement feature (50) on a further element which is different to, and incompatible with, the first engagement feature (30) wherein the further element engagement feature (50) has splines (52) for engagement with the splines (42) of the second engagement feature (40).

2. A constructional toy as claimed in claim 1 wherein the main element (10, 62, 64, 70, 80, 150) comprises a third engagement feature (30', 50) which is complementary in shape to, and configured to engage with, engagement features of the same design as the first (30) or second (40) engagement features, but not both.
3. A constructional toy as claimed in claim 1 wherein the main element (10, 62, 64, 70, 80, 150) comprises a third engagement feature (50), different to the first (30) and second (40) engagement features, and having $(N' + 1)$ splines (52).

4. A constructional toy as claimed in any one of the preceding claims wherein the toy further comprises :

an additional element (90, 91, 92, 93, 94, 95, 120, 130, 140, 170, 180) comprising :

an engagement feature complementary in shape to, and configured to engage with one of the first (30), second (40) or third (50) engagement features of the main element.

5. A constructional toy as claimed in claim 4 wherein the additional element (170, 180) has at least two surfaces, and is provided with engagement features of substantially the same form, shape and size on two surfaces, the engagement feature on one surface being provided at an angle to the engagement feature on the other surface.

6. A constructional toy as claimed in any of claims 4 or 5 wherein the additional element (90, 91, 92, 93, 94, 95, 120, 130, 140) comprises a further engagement feature different to the other engagement feature of the additional element.

7. A constructional toy as claimed in any of claims 4 to 6 when dependent upon claim 2 wherein the main elements (10, 62, 64, 70, 80, 150) are provided in the form of a building block having a plurality of flat side surfaces, wherein at least one of the first, second or third engagement features (30, 40, 50), or an engagement feature complementary in shape to, and configured to engage with one of the first, second or third engagement features (30, 40, 50), is provided on at least one of the surfaces; and a different one of the first, second or third engagement features (30, 40, 50), or an engagement feature complementary in shape to, and configured to engage with a different one of the first, second or third engagement features (30, 40, 50) is provided on the same or another one of said surfaces.

8. A constructional toy as claimed in claim 4 wherein a transitional element (190) is provided as a splined shaft, one end of the shaft being provided with M splines (32) which extend radially outwards from the shaft and being complementary in shape to, and configured to engage with, an engagement feature of a constructional element, the other end of the shaft being provided with a recess (197) with M' splines (193) which extend radially inward from an inner surface of the recess, where M is an integer of different value to M'.

9. A constructional toy as claimed in claim 4 wherein a transitional element (200) is provided as a splined shaft, one end of the shaft being provided with a first recess (201) with M splines (205) which extend ra-

dially inward from an inner surface of the first recess, the other end of the shaft being provided with a second recess (206) with M' splines (207) which extend radially inward from an inner surface of the recess, where M is an integer of different value to M'.

10. A constructional toy as claimed in claim 4 wherein a transitional element (210) is provided as a splined shaft, one end of the shaft being provided with a first recess (201) with M splines (205) which extend radially inward from an inner surface of the first recess, the other end of the shaft being provided with a "T" piece (220) having a number of splines M' (222) extending therefrom and being complementary in shape to, and configured to engage with, an engagement feature of a constructional element, where M is an integer of different value to M'.

11. A constructional toy as claimed in claim 1 wherein a transitional element (210) is provided as a splined shaft, one end of the shaft being provided with M splines (32) which extend radially outwards from the shaft, the other end of the shaft being provided with a "T" piece (220) having a number of splines M' extending therefrom, each end of the shaft being complementary in shape to, and configured to engage with, a different engagement feature of a constructional element, where M is an integer of different value to M'.

12. A constructional toy as claimed in any of claims 8 to 11 wherein the splined shaft is provided as an articulated shaft, the articulation (192) being provided by a universal joint provided at a region between the ends of the shaft.

13. A constructional toy as claimed in any one of claims 8 to 12 wherein :

M is an integer having a value greater than N;
and
M' is an integer having a value greater than N' but less than N.

14. A constructional toy as claimed in any one of claims 1 to 13 where :

N = 6;
N' = 2.

15. A constructional toy as claimed in any one of claims 8 to 13 where :

M' = 4; and
M = 12.

Patentansprüche

1. Spielbausatz, umfassend eine Vielzahl von Elementen (10, 62, 64, 70, 80, 90, 91, 92, 93, 94, 95, 120, 130, 140, 150, 170, 180, 190, 200, 210) von mindestens zwei unterschiedlichen Typen, die miteinander zusammengebaut werden können, um eine Vielfalt von dreidimensionalen Strukturen zu bilden, wobei die Elemente einschließen:

ein Hauptelement (10, 62, 64, 70, 80, 150, 190, 200, 210), umfassend:

ein erstes Eingriffmerkmal (30) mit N Kerbverzahnungen (32), wobei N eine ganze Zahl nicht kleiner als drei ist,

wobei sich die Kerbverzahnungen (32) von einer Außenfläche (12, 14, 16, 18) des Hauptelements erstrecken, das erste Eingriffmerkmal (30) in der Form komplementär zu einem Eingriffmerkmal (30') auf einem anderen Element ist und ausgestaltet ist, um mit diesem in Eingriff zu kommen;

ein zweites Eingriffmerkmal (40) mit N' Kerbverzahnungen (42), wobei $N' < N$,

dadurch gekennzeichnet, dass

das zweite Eingriffmerkmal (40) in der Form komplementär zu einem Eingriffmerkmal (50) auf einem weiteren Element ist, das von dem ersten Eingriffmerkmal (30) verschieden und mit diesem inkompatibel ist, und ausgestaltet ist, um mit diesem in Eingriff zu kommen, wobei das Eingriffmerkmal (50) des weiteren Elements Kerbverzahnungen (52) zum Eingriff mit den Kerbverzahnungen (42) des zweiten Eingriffmerkmals (40) aufweist.

2. Spielbausatz nach Anspruch 1, wobei das Hauptelement (10, 62, 64, 70, 80, 150) ein drittes Eingriffmerkmal (30', 50) umfasst, das in der Form komplementär zu Eingriffmerkmalen desselben Designs wie das erste (30) oder zweite (40) Eingriffmerkmal ist, jedoch nicht zu beiden, und ausgestaltet ist, um mit diesem in Eingriff zu kommen.

3. Spielbausatz nach Anspruch 1, wobei das Hauptelement (10, 62, 64, 70, 80, 150) ein drittes Eingriffmerkmal (50) umfasst, das sich von dem ersten (30) und dem zweiten (40) Eingriffmerkmal unterscheidet und $(N' + 1)$ Kerbverzahnungen (52) aufweist.

4. Spielbausatz nach einem der vorhergehenden An-

sprüche, wobei das Spielzeug ferner umfasst:

ein zusätzliches Element (90, 91, 92, 93, 94, 95, 120, 130, 140, 170, 180), umfassend:

ein Eingriffmerkmal, das in der Form komplementär zu einem des ersten (30), zweiten (40) oder dritten (50) Eingriffmerkmals des Hauptelements ist und ausgestaltet ist, um mit diesem in Eingriff zu kommen.

5. Spielbausatz nach Anspruch 4, wobei das zusätzliche Element (170, 180) mindestens zwei Flächen aufweist und mit Eingriffmerkmalen von im Wesentlichen derselben Form, Gestalt und Größe auf zwei Flächen ausgestattet ist, wobei das Eingriffmerkmal an einer Fläche in einem Winkel zu dem Eingriffmerkmal auf der anderen Fläche bereitgestellt wird.
6. Spielbausatz nach einem der Ansprüche 4 oder 5, wobei das zusätzliche Element (90, 91, 92, 93, 94, 95, 120, 130, 140) ein weiteres Eingriffmerkmal umfasst, das sich von dem anderen Eingriffmerkmal des zusätzlichen Elements unterscheidet.
7. Spielbausatz nach einem der Ansprüche 4 bis 6 in Abhängigkeit von Anspruch 2, wobei die Hauptelemente (10, 62, 64, 70, 80, 150) in Form von Bauklötzen mit einer Vielzahl von flachen Seitenflächen bereitgestellt werden, wobei mindestens eines des ersten, zweiten oder dritten Eingriffmerkmals (30, 40, 50) oder ein Eingriffmerkmal, das in der Form komplementär zu einem von dem ersten, zweiten oder dritten Eingriffmerkmal (30, 40, 50) ist und ausgestaltet ist, um mit diesem in Eingriff zu kommen, auf mindestens einer der Flächen bereitgestellt wird; und ein anderes von dem ersten, zweiten oder dritten Eingriffmerkmal (30, 40, 50) oder ein Eingriffmerkmal, das in der Form komplementär zu einem anderen von dem ersten, zweiten oder dritten Eingriffmerkmal (30, 40, 50) ist und ausgestaltet ist, um mit diesem in Eingriff zu kommen, auf derselben oder einer anderen der Flächen bereitgestellt wird.
8. Spielbausatz nach Anspruch 4, wobei ein Übergangselement (190) als Kerbverzahnung aufweisender Schaft bereitgestellt wird, wobei ein Ende des Schafts mit M Kerbverzahnungen (32) ausgestattet ist, die sich von dem Schaft radial auswärts erstrecken und in der Form komplementär zu einem Eingriffmerkmal eines Bauelements sind und ausgestaltet sind, um mit diesem in Eingriff zu kommen, und das andere Ende des Schafts mit einer Vertiefung (197) mit M' Kerbverzahnungen (193) ausgestattet ist, die sich von einer Innenfläche der Vertiefung radial einwärts erstrecken, wobei M eine ganze Zahl mit einem anderen Wert als M' ist.

9. Spielbausatz nach Anspruch 4, wobei ein Übergangselement (200) als Kerbverzahnung aufweisender Schaft bereitgestellt wird, wobei ein Ende des Schafts mit einer ersten Vertiefung (201) mit M Kerbverzahnungen (205) ausgestattet ist, die sich von einer Innenfläche der ersten Vertiefung radial einwärts erstrecken, wobei das andere Ende des Schafts mit einer zweiten Vertiefung (206) mit M' Kerbverzahnungen (207) ausgestattet ist, die sich von einer Innenfläche der Vertiefung radial einwärts erstrecken, wobei M eine ganze Zahl mit einem anderen Wert als M' ist.
10. Spielbausatz nach Anspruch 4, wobei ein Übergangselement (210) als Kerbverzahnung aufweisender Schaft bereitgestellt wird, wobei ein Ende des Schafts mit einer ersten Vertiefung (201) mit M Kerbverzahnungen (205) ausgestattet ist, die sich von einer Innenfläche der ersten Vertiefung radial einwärts erstrecken, wobei das andere Ende des Schafts mit einem "T"-Stück (220) ausgestattet ist, das eine Anzahl von Kerbverzahnungen M' (222) aufweist, die sich davon erstrecken und in der Form komplementär zu einem Eingriffmerkmal eines Bauelements sind und ausgestaltet sind, um mit diesem in Eingriff zu kommen, wobei M eine ganze Zahl mit einem anderen Wert als M' ist.
11. Spielbausatz nach Anspruch 1, wobei ein Übergangselement (210) als Kerbverzahnung aufweisender Schaft bereitgestellt wird, wobei ein Ende des Schafts mit M Kerbverzahnungen (32) ausgestattet ist, die sich von dem Schaft radial auswärts erstrecken, wobei das andere Ende des Schafts mit einem "T"-Stück (220) ausgestattet ist, das eine Anzahl von Kerbverzahnungen M' aufweist, die sich davon erstrecken, wobei jedes Ende des Schafts in der Form komplementär zu einem anderen Eingriffmerkmal eines Bauelements ist und ausgestaltet ist, um mit diesem in Eingriff zu kommen, wobei M eine ganze Zahl mit einem anderen Wert als M' ist.
12. Spielbausatz nach einem der Ansprüche 8 bis 11, wobei der Kerbverzahnungen aufweisende Schaft als gelenkiger Schaft bereitgestellt wird, wobei die Artikulation (192) durch ein Kreuzgelenk bereitgestellt wird, das in einer Region zwischen den Enden des Schafts bereitgestellt wird.
13. Spielbausatz nach einem der Ansprüche 8 bis 12, wobei:
M eine ganze Zahl mit einem Wert größer als N ist; und
M' eine ganze Zahl mit einem Wert größer als N', aber kleiner als N ist.

14. Spielbausatz nach einem der Ansprüche 1 bis 13,

wobei:

$N = 6$;
 $N' = 2$.

15. Spielbausatz nach einem der Ansprüche 8 bis 13, wobei:

$M' = 4$ und
 $M = 12$.

Revendications

1. Jouet de construction comprenant une pluralité d'éléments (10, 62, 64, 70, 80, 90, 91, 92, 93, 94, 95, 120, 130, 140, 150, 170, 180, 190, 200, 210) d'au moins deux types différents qui peuvent être assemblés les uns aux autres pour former une variété de structures tridimensionnelles, lesdits éléments comportant :

un élément principal (10, 62, 64, 70, 80, 150, 190, 200, 210) comprenant :

un premier système d'engagement (30) ayant N cannelures (32), N étant un nombre entier supérieur ou égal à trois,

les cannelures (32) s'étendant depuis une surface extérieure (12, 14, 16, 18) de l'élément principal, le premier système d'engagement (30) ayant une forme complémentaire d'un système d'engagement (30') sur un autre élément, et étant configuré pour s'engager avec ce dernier ;

un deuxième système d'engagement (40) ayant N' cannelures (42), avec $N' < N$,

caractérisé en ce que

le deuxième système d'engagement (40) a une forme complémentaire d'un système d'engagement (50) sur un élément supplémentaire, qui est différent du premier système d'engagement (30) et qui est incompatible avec celui-ci, et est configuré pour s'engager avec le système d'engagement, le système d'engagement (50) de l'élément supplémentaire ayant des cannelures (52) prévues pour s'engager avec les cannelures (42) du deuxième système d'engagement (40).

2. Jouet de construction selon la revendication 1, dans lequel l'élément principal (10, 62, 64, 70, 80, 150) comprend un troisième système d'engagement (30'), 50 qui a une forme complémentaire de systèmes

d'engagement ayant la même conception que le premier (30) ou le deuxième (40) système d'engagement, mais pas les deux, et qui est configuré pour s'engager avec ceux-ci.

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3. Jouet de construction selon la revendication 1, dans lequel l'élément principal (10, 62, 64, 70, 80, 150) comprend un troisième système d'engagement (50), différent du premier (30) et du deuxième (40) système d'engagement, et ayant ($N' + 1$) cannelures (52).

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4. Jouet de construction selon l'une quelconque des revendications précédentes, dans lequel le jouet comprend en outre :

un élément supplémentaire (90, 91, 92, 93, 94, 95, 120, 130, 140, 170, 180) comprenant :

un système d'engagement ayant une forme complémentaire de l'un des premier (30), deuxième (40) ou troisième (50) systèmes d'engagement de l'élément principal et étant configuré pour s'engager avec l'un de ceux-ci.

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5. Jouet de construction selon la revendication 4, dans lequel l'élément supplémentaire (170, 180) présente au moins deux surfaces, et est pourvu de systèmes d'engagement ayant sensiblement la même forme et la même dimension sur deux surfaces, le système d'engagement sur une surface étant incliné d'un certain angle par rapport au système d'engagement sur l'autre surface.

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6. Jouet de construction selon l'une quelconque des revendications 4 ou 5, dans lequel l'élément supplémentaire (90, 91, 92, 93, 94, 95, 120, 130, 140) comprend un système d'engagement supplémentaire différent de l'autre système d'engagement de l'élément supplémentaire.

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7. Jouet de construction selon l'une quelconque des revendications 4 à 6 lorsqu'elles dépendent de la revendication 2, dans lequel les éléments principaux (10, 62, 64, 70, 80, 150) sont prévus sous la forme d'un bloc de construction ayant une pluralité de surfaces latérales plates, au moins l'un des premier, deuxième ou troisième systèmes d'engagement (30, 40, 50), ou un système d'engagement ayant une forme complémentaire de l'un des premier, deuxième ou troisième systèmes d'engagement (30, 40, 50) et configuré de manière à s'engager avec l'un de ceux-ci, étant prévu sur au moins l'une des surfaces ; et un système différent des premier, deuxième ou troisième systèmes d'engagement (30, 40, 50), ou un système d'engagement ayant une forme complémentaire d'un système différent des premier, deuxième ou troisième systèmes d'engagement (30, 40,

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50) et configuré pour s'engager avec l'un de ceux-ci, étant prévu sur la même desdites surfaces ou sur une autre desdites surfaces.

8. Jouet de construction selon la revendication 4, dans lequel un élément de transition (190) est prévu sous forme d'arbre cannelé, une extrémité de l'arbre étant pourvue de M cannelures (32) qui s'étendent radialement vers l'extérieur depuis l'arbre et ayant une forme complémentaire d'un système d'engagement d'un élément de construction, et étant configurée pour s'engager avec celui-ci, l'autre extrémité de l'arbre étant pourvue d'un renforcement (197) avec M' cannelures (193) qui s'étendent radialement vers l'intérieur depuis une surface intérieure du renforcement, M étant un nombre entier différent de M'.

9. Jouet de construction selon la revendication 4, dans lequel un élément de transition (200) est prévu sous forme d'arbre cannelé, une extrémité de l'arbre étant pourvue d'un premier renforcement (201) avec M cannelures (205) qui s'étendent radialement vers l'intérieur depuis une surface intérieure du premier renforcement, l'autre extrémité de l'arbre étant pourvue d'un deuxième renforcement (206) avec M' cannelures (207) qui s'étendent radialement vers l'intérieur depuis une surface intérieure du renforcement, M étant un nombre entier différent de M'.

10. Jouet de construction selon la revendication 4, dans lequel un élément de transition (210) est prévu sous forme d'arbre cannelé, une extrémité de l'arbre étant pourvue d'un premier renforcement (201) avec M cannelures (205) qui s'étendent radialement vers l'intérieur depuis une surface intérieure du premier renforcement, l'autre extrémité de l'arbre étant pourvue d'une pièce en "T" (220) ayant un certain nombre de cannelures M' (222) s'étendant depuis celle-ci et ayant une forme complémentaire d'un système d'engagement d'un élément de construction et étant configurée de manière à s'engager avec celui-ci, M étant un nombre entier différent de M'.

11. Jouet de construction selon la revendication 1, dans lequel un élément de transition (210) est prévu sous forme d'arbre cannelé, une extrémité de l'arbre étant pourvue de M cannelures (32) qui s'étendent radialement vers l'extérieur depuis l'arbre, l'autre extrémité de l'arbre étant pourvue d'une pièce en "T" (220) ayant un certain nombre de cannelures M' s'étendant depuis celle-ci, chaque extrémité de l'arbre ayant une forme complémentaire d'un système d'engagement différent d'un élément de construction, et étant configurée pour s'engager avec celui-ci, M étant un nombre entier différent de M'.

12. Jouet de construction selon l'une quelconque des revendications 8 à 11, dans lequel l'arbre cannelé

est pourvu d'un arbre articulé, l'articulation (192) étant assurée par un joint universel qui est prévu au niveau d'une région entre les extrémités de l'arbre.

13. Jouet de construction selon l'une quelconque des revendications 8 à 12, dans lequel :

M est un entier ayant une valeur supérieure à N ; et

M' est un entier ayant une valeur supérieure à N' mais inférieure à N.

14. Jouet de construction selon l'une quelconque des revendications 1 à 13, où :

N = 6 ;

N' = 2.

15. Jouet de construction selon l'une quelconque des revendications 8 à 13, où :

M' = 4 ; et

M = 12.

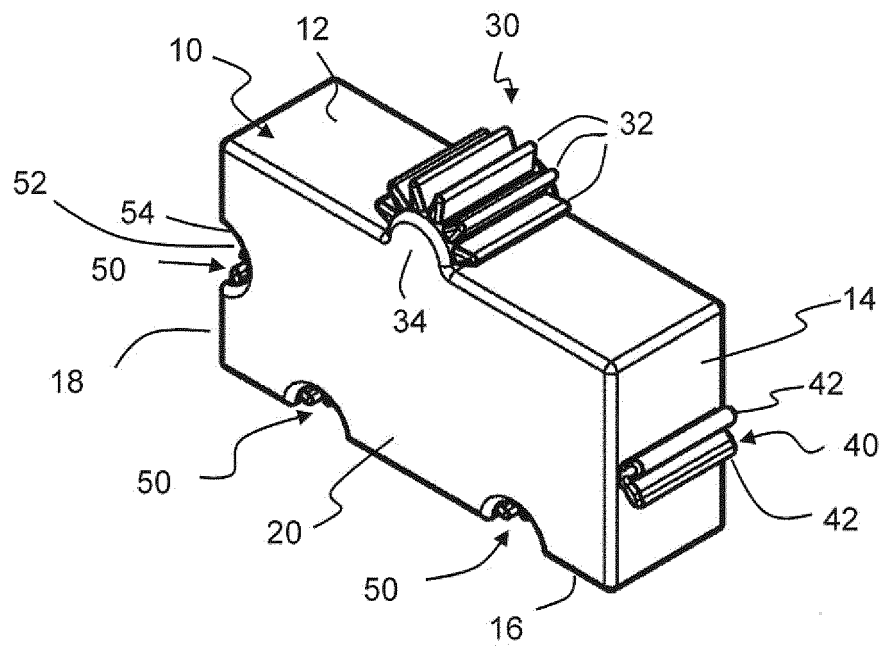


Figure 1

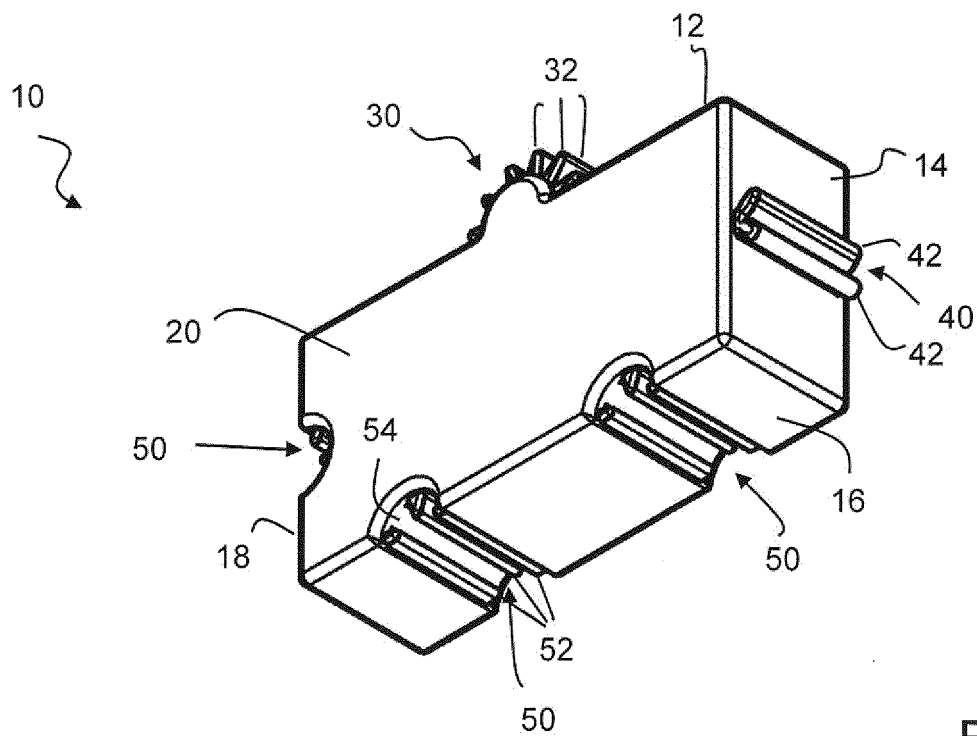


Figure 2

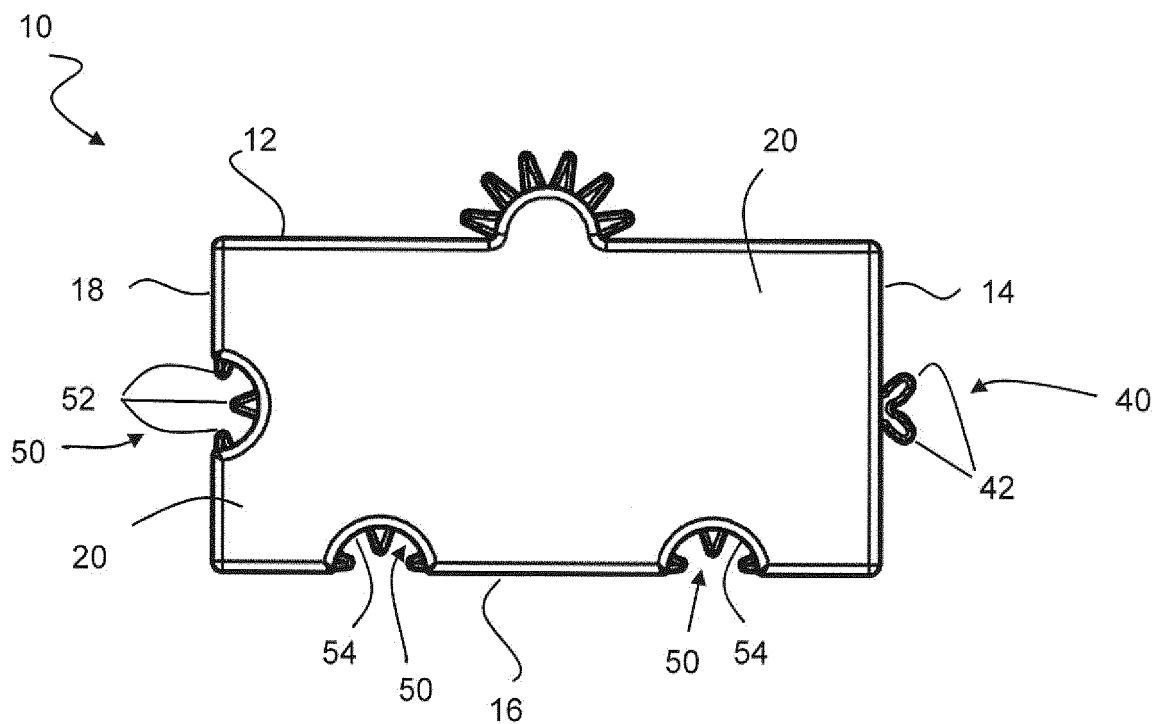


Figure 3

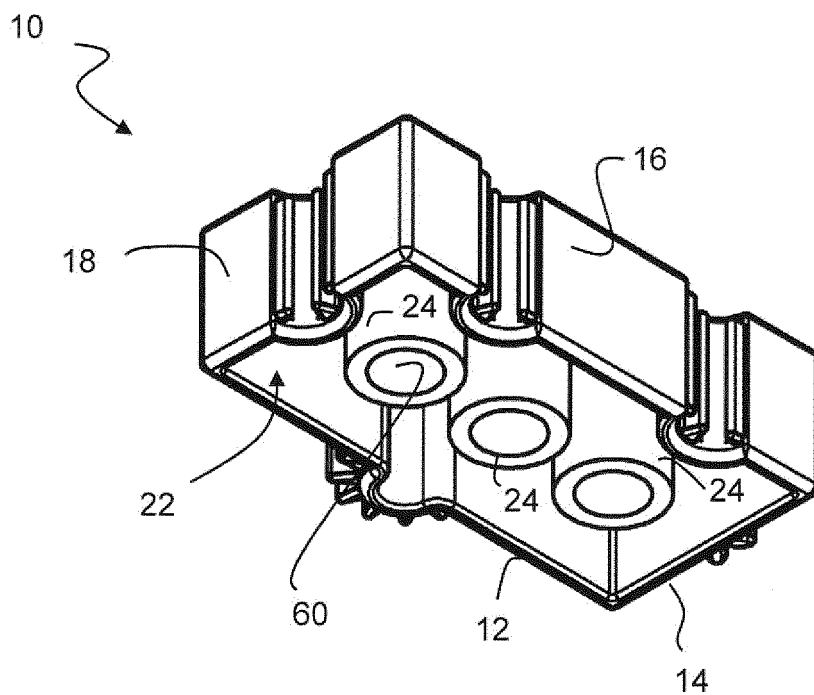


Figure 4

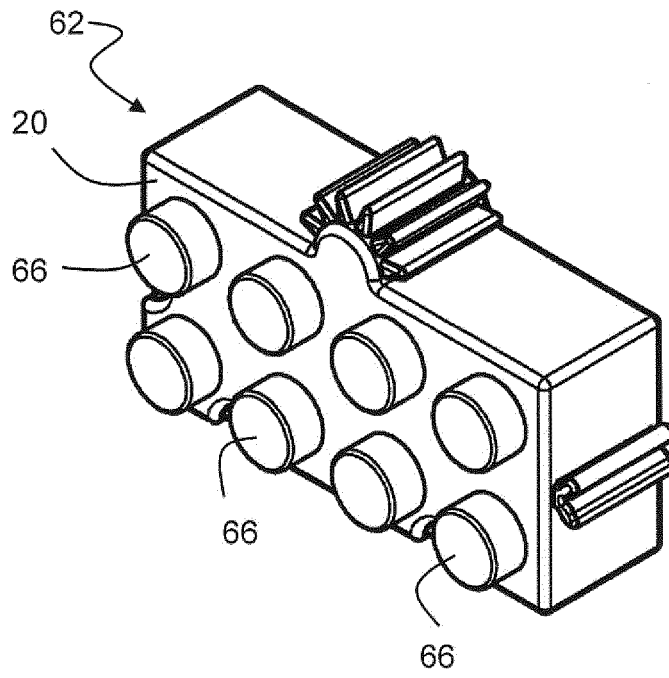


Figure 5

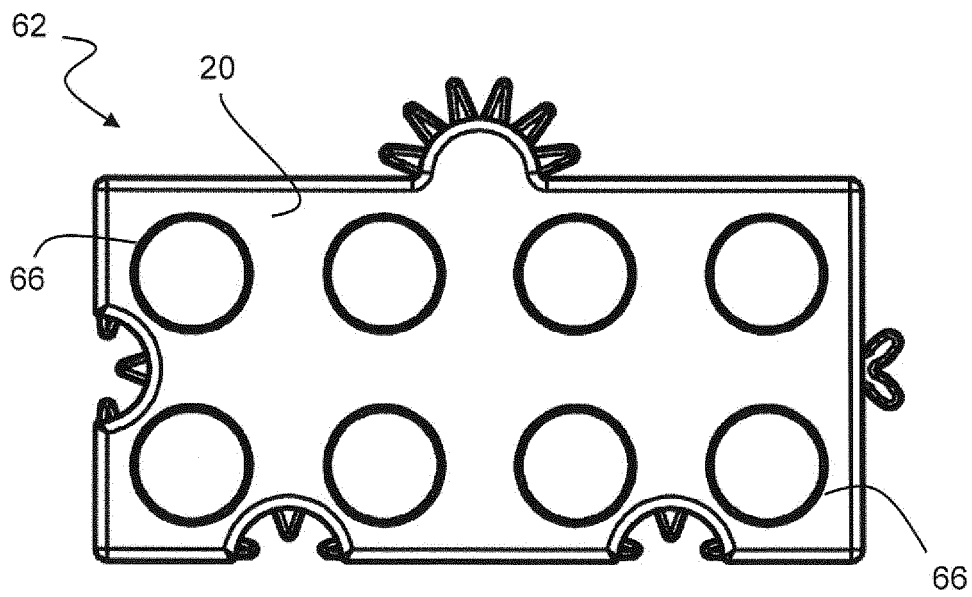


Figure 6

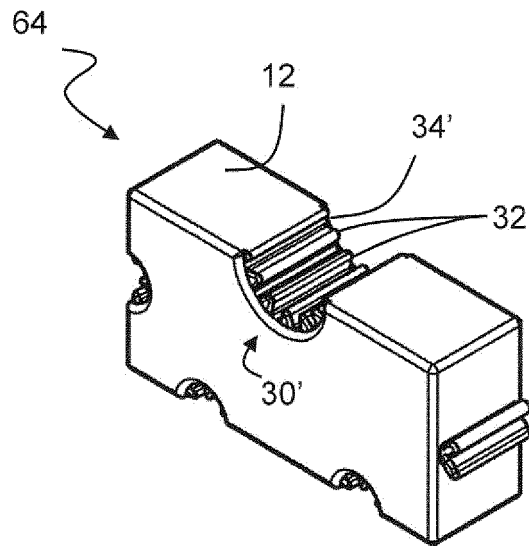


Figure 7

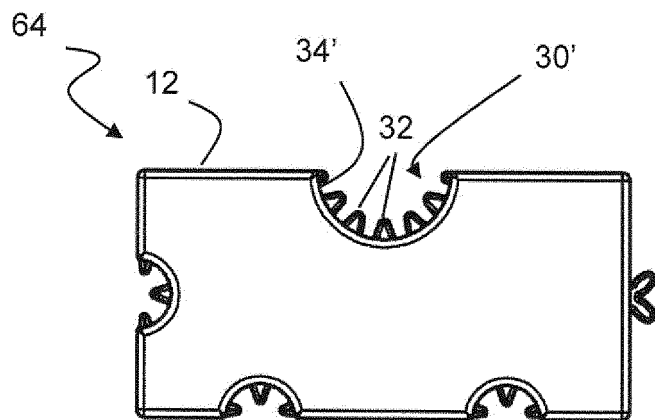


Figure 8

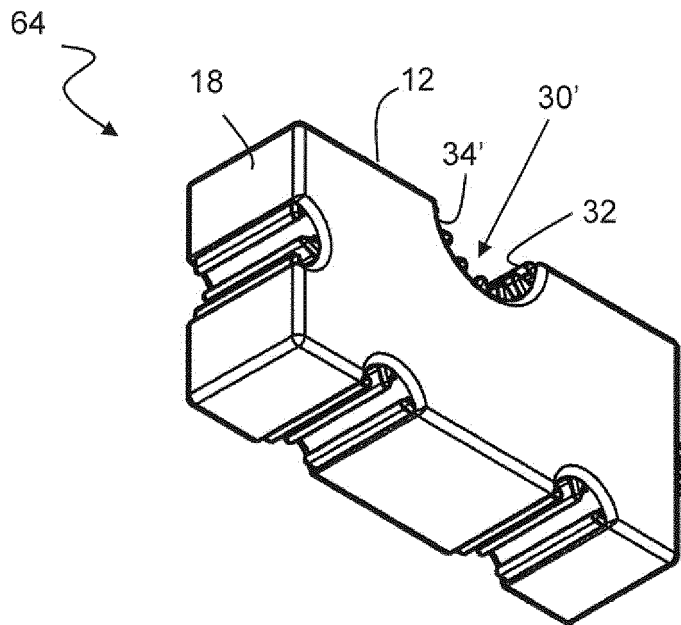


Figure 9

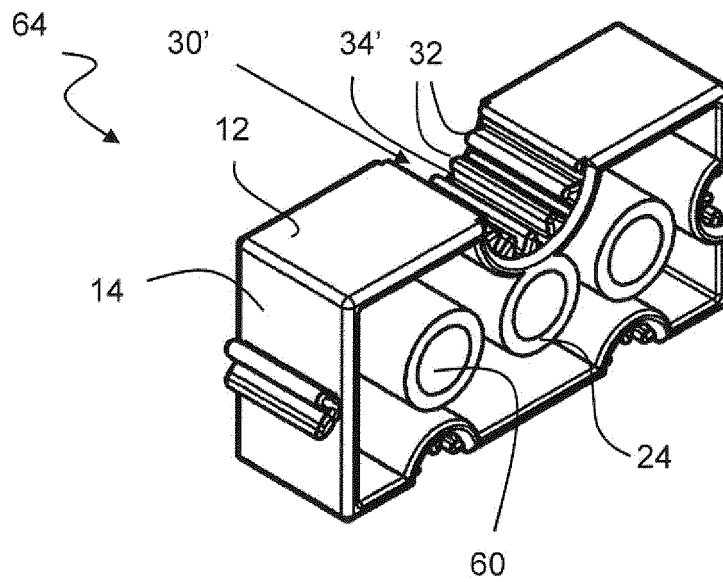


Figure 10

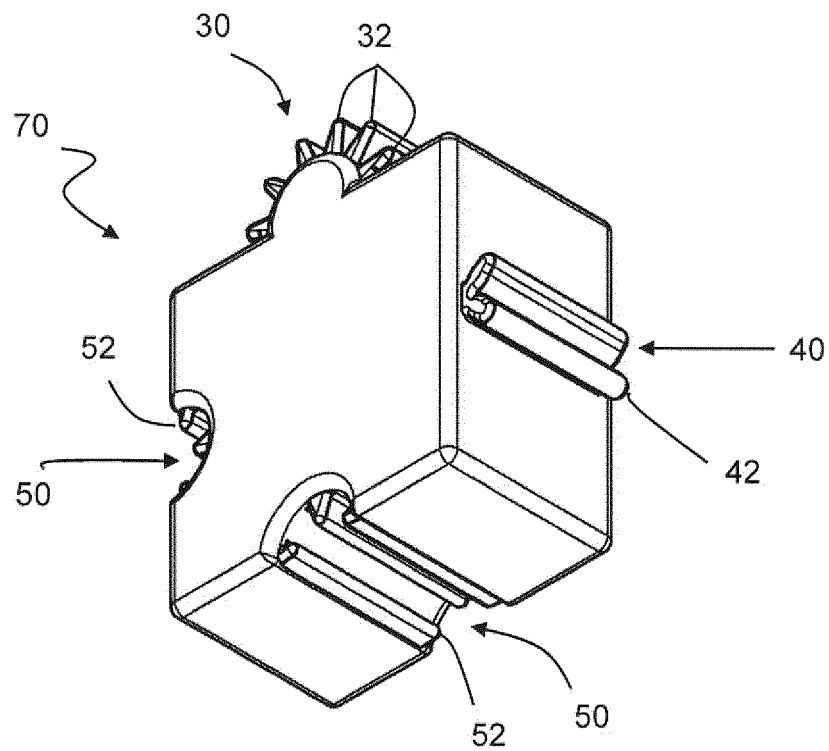


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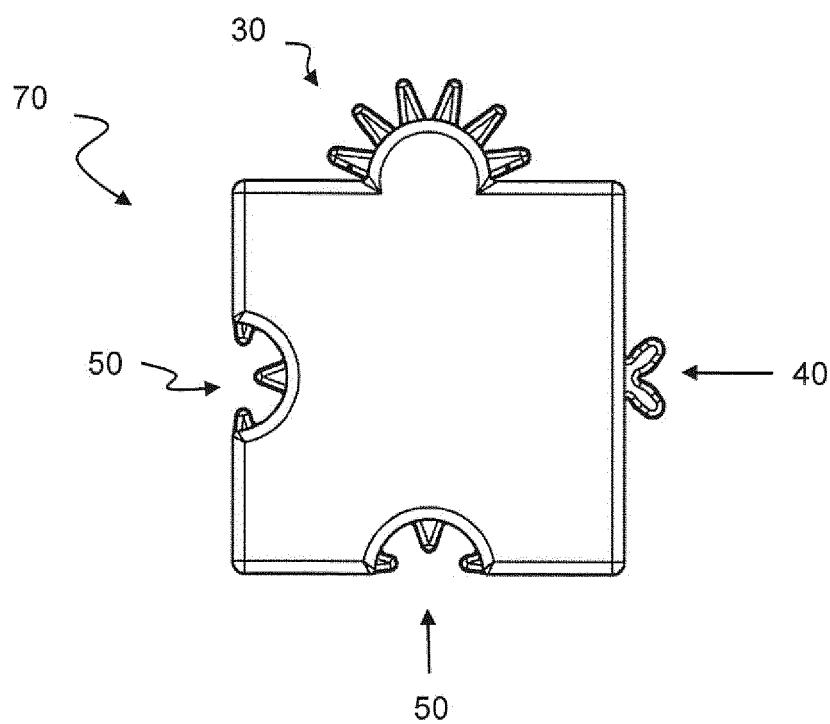


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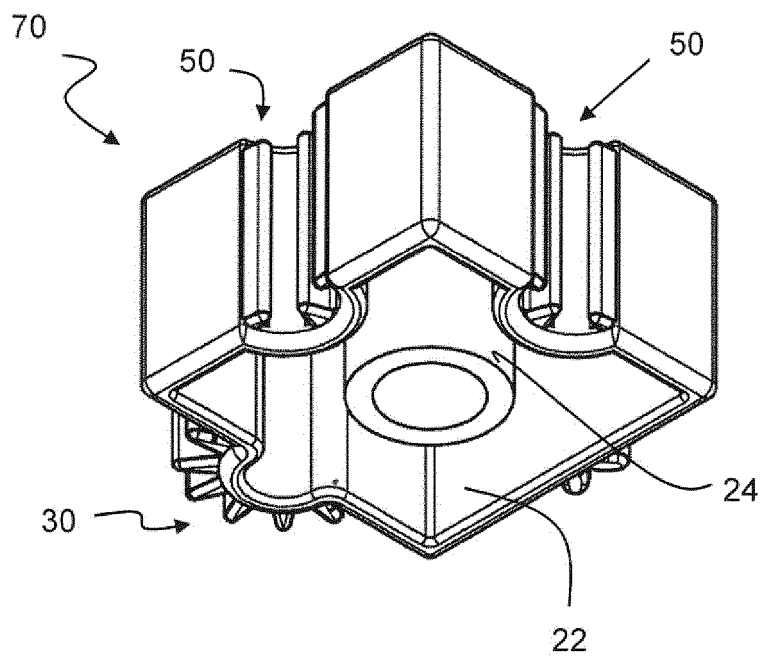


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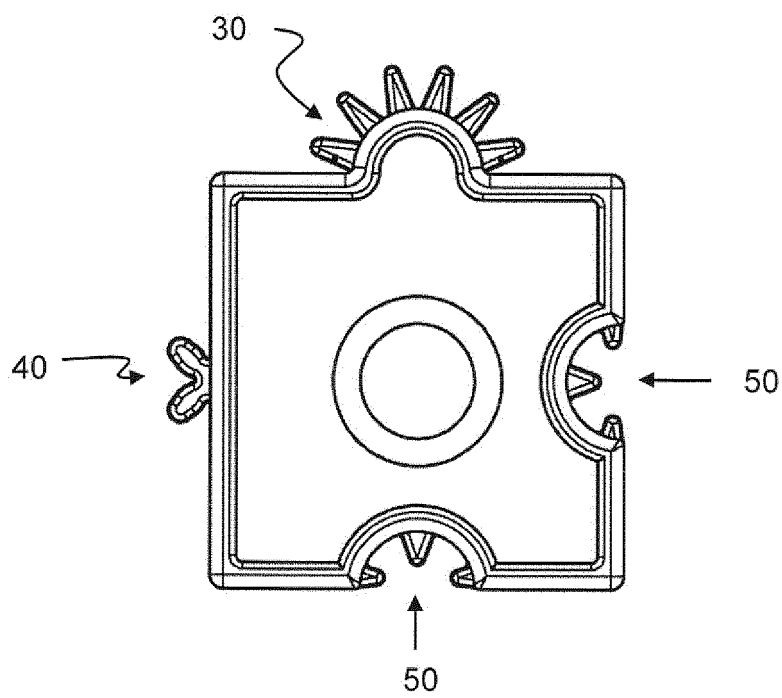


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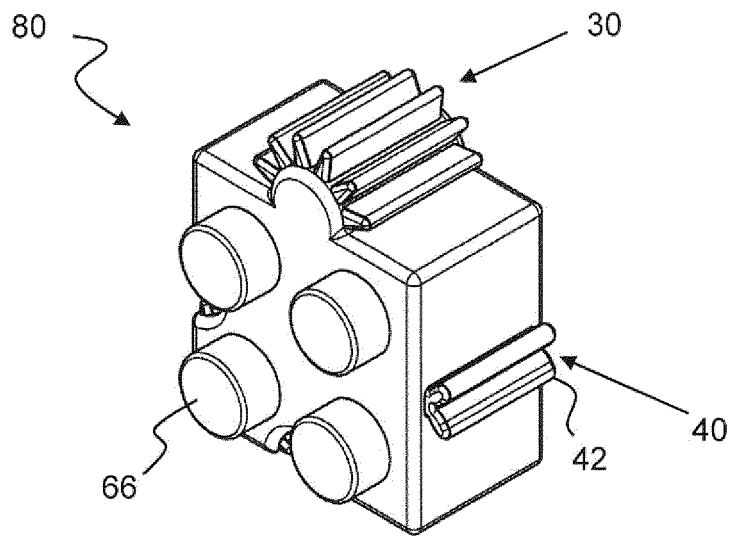


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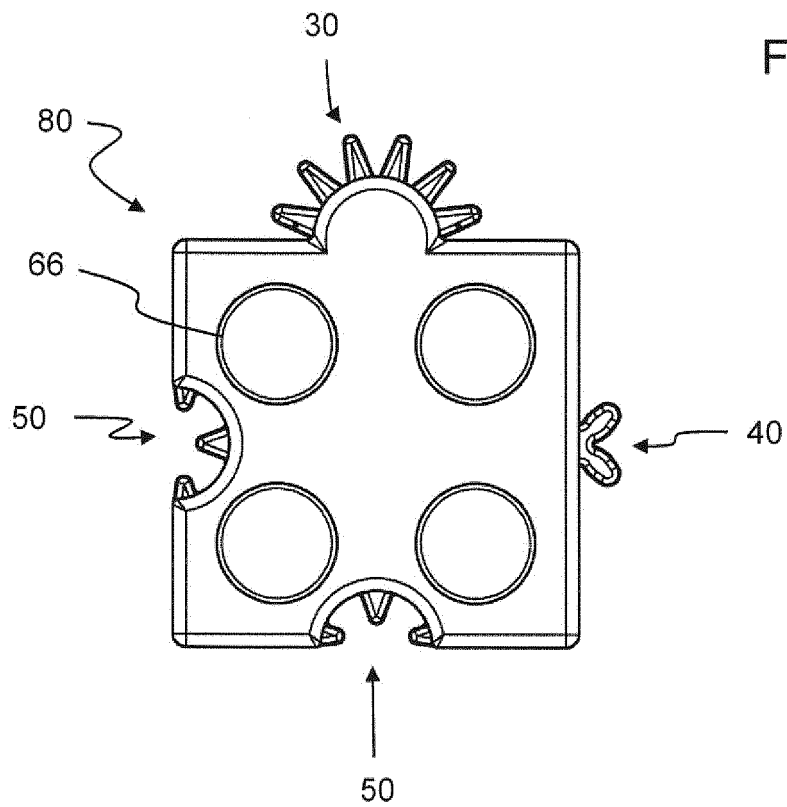


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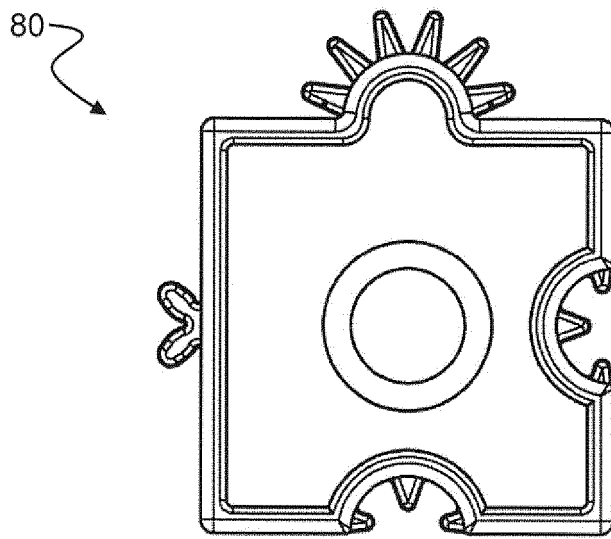


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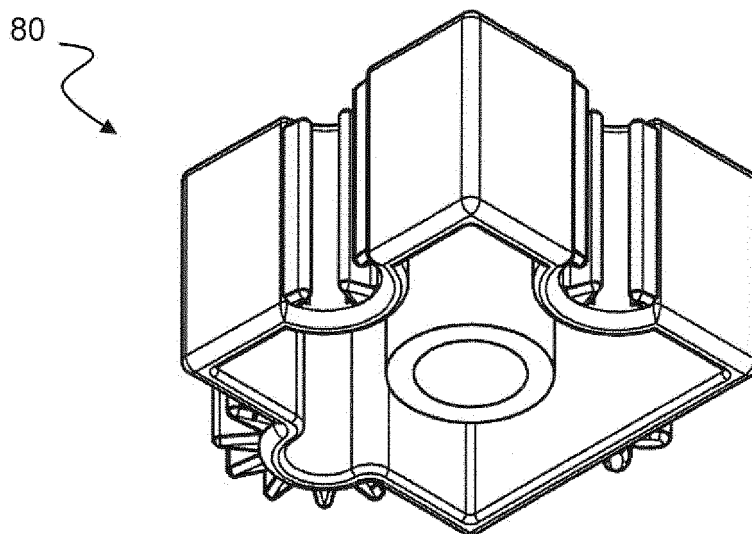


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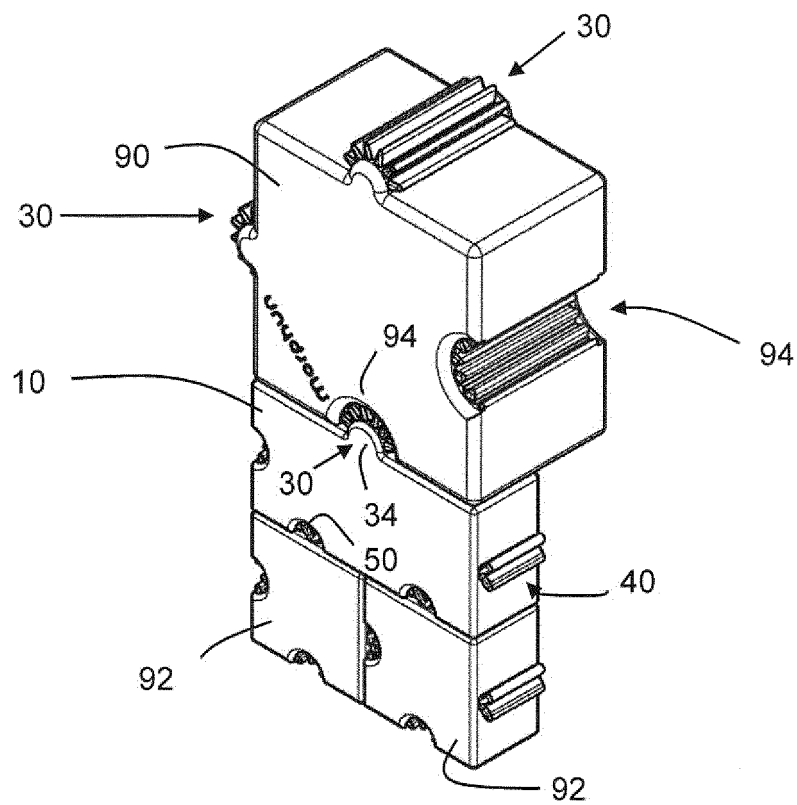


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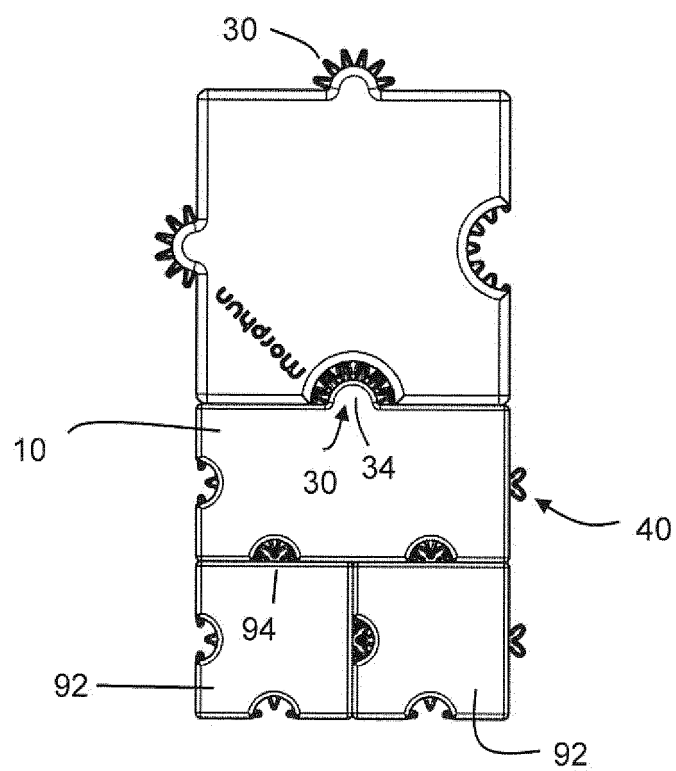


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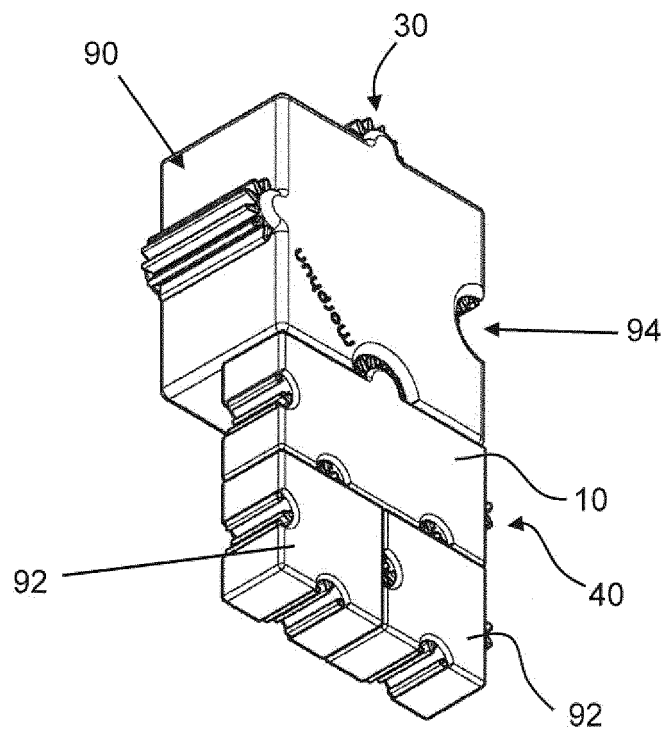


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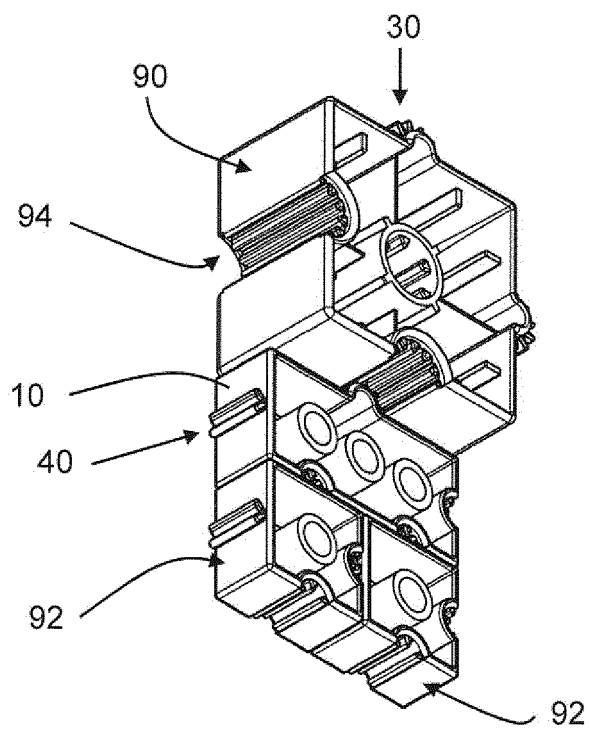


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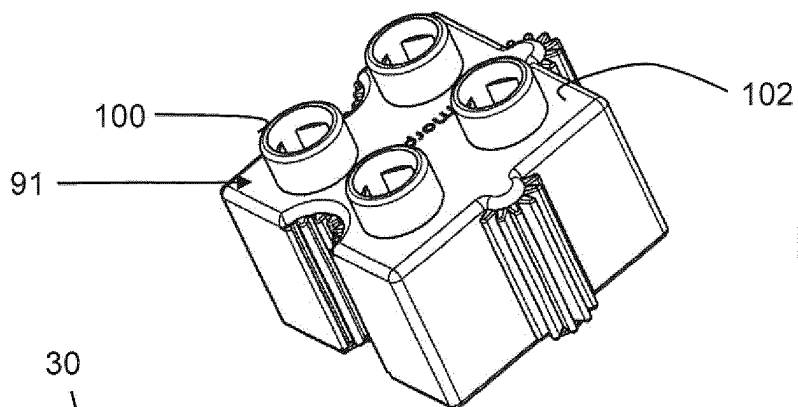


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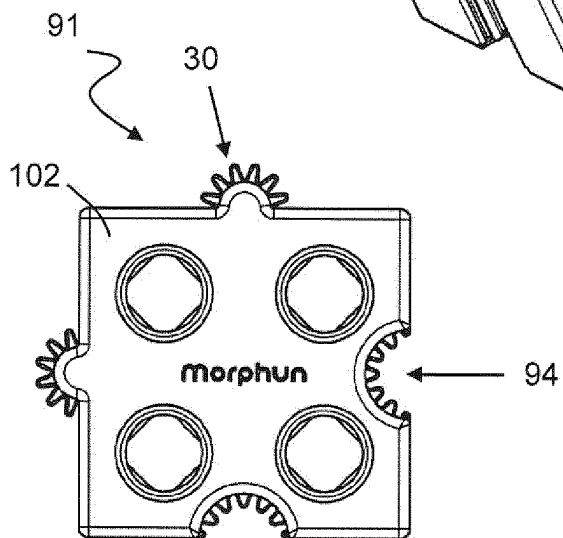


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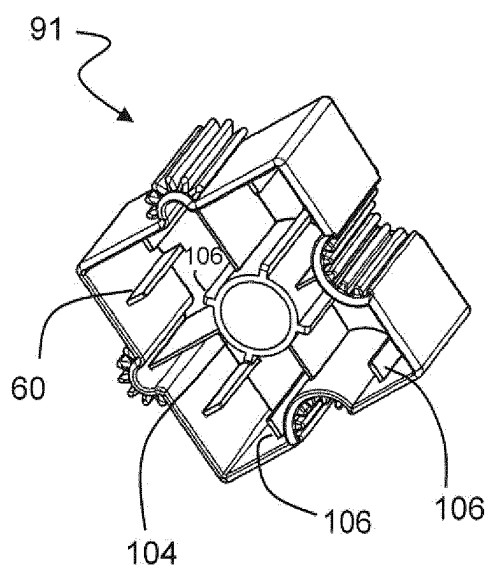


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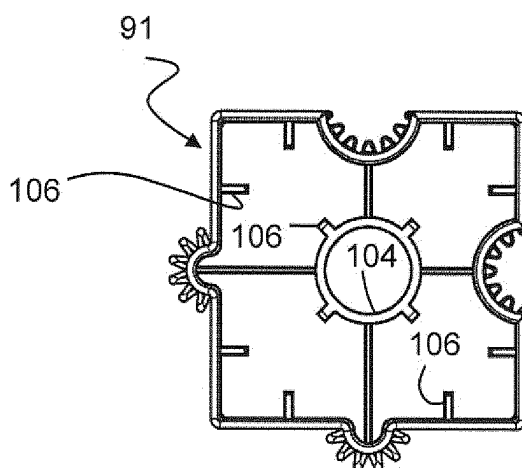


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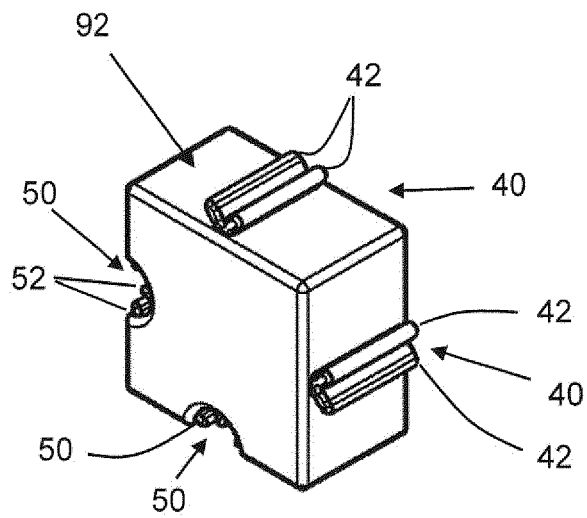


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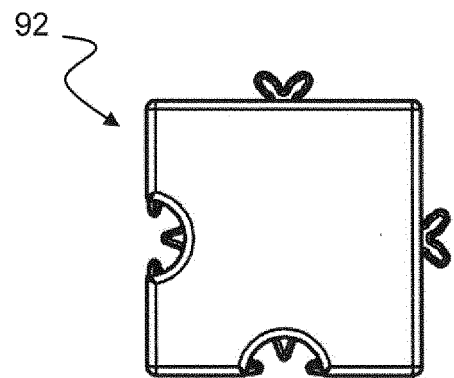


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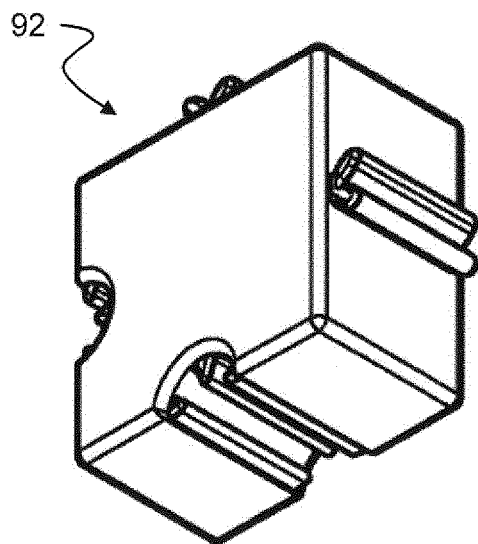


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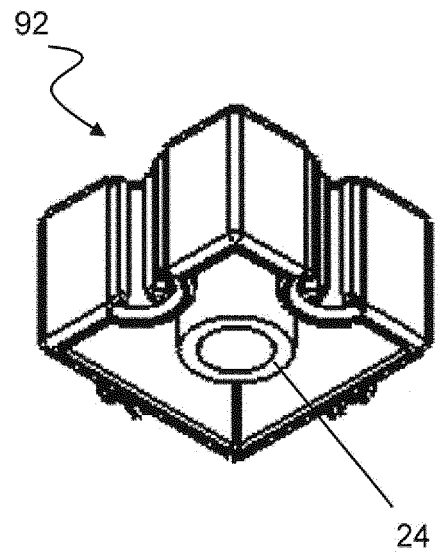


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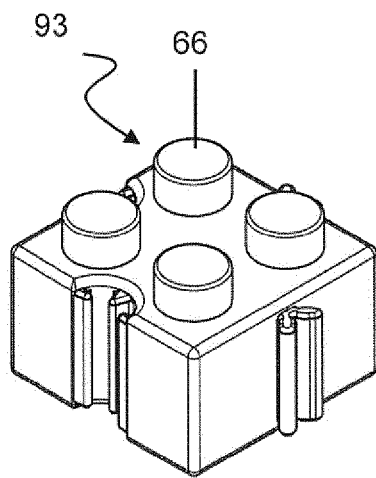


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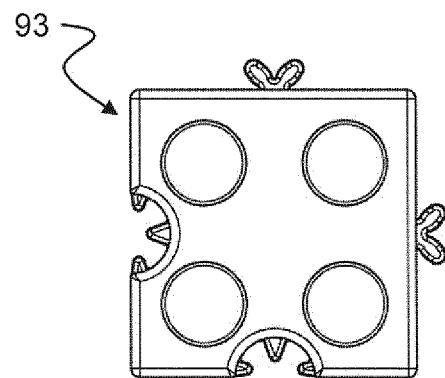


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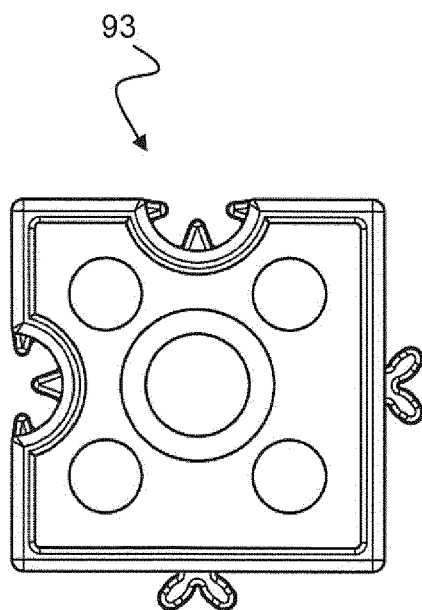


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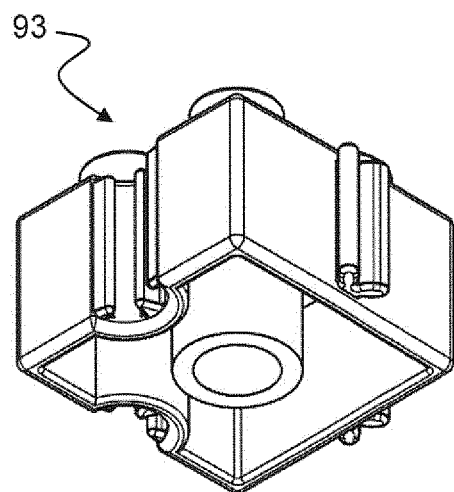


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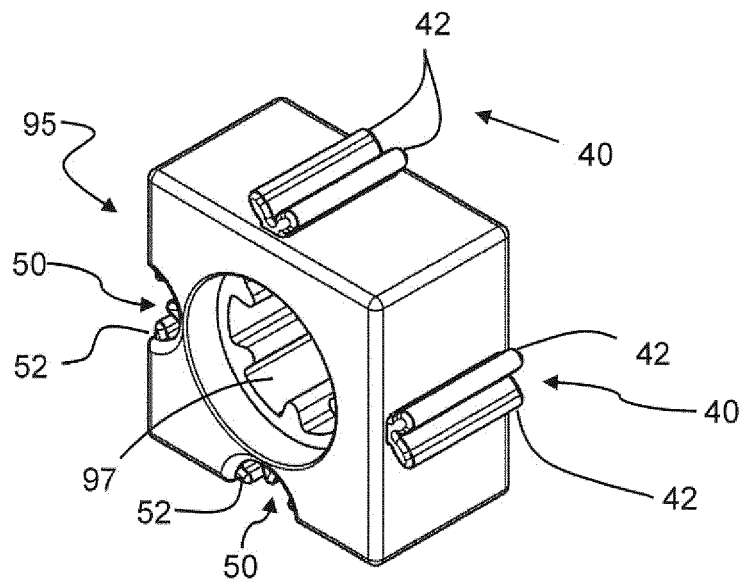


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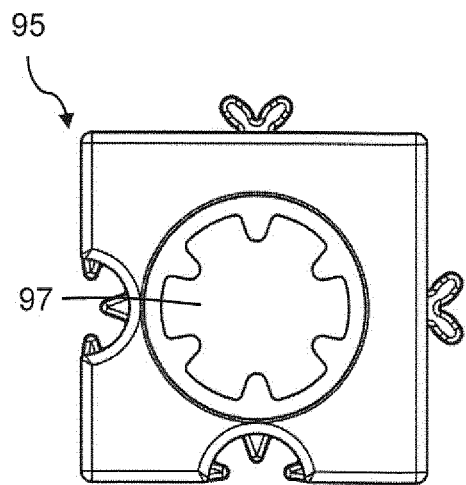


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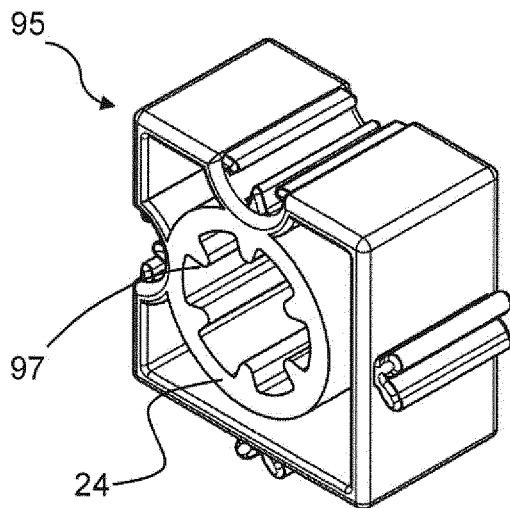


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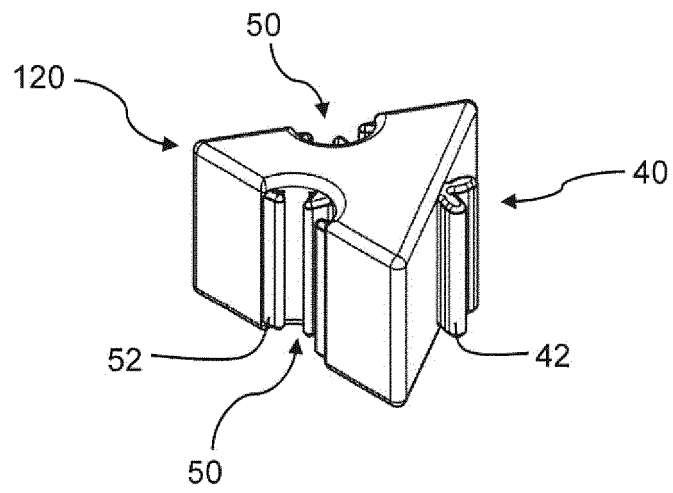


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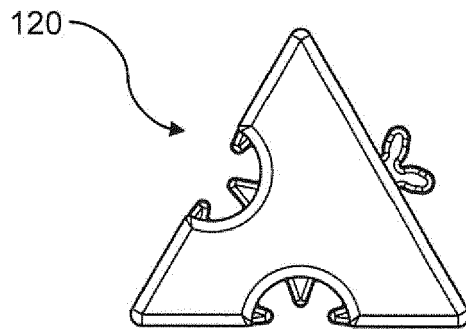


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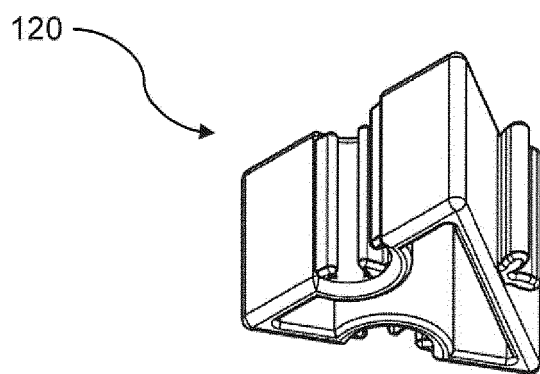


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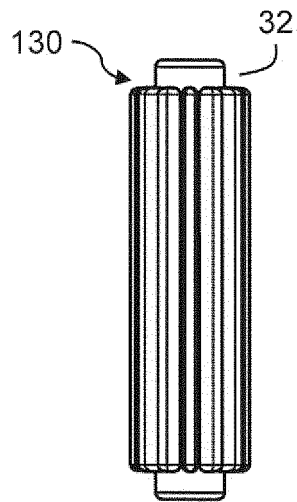


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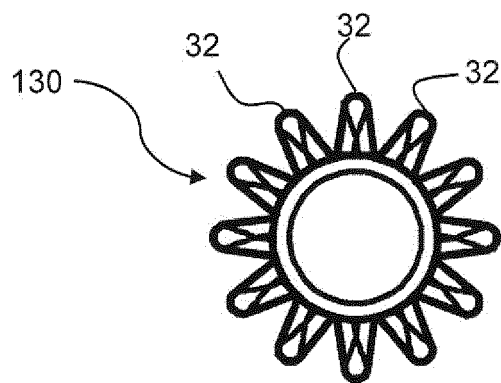


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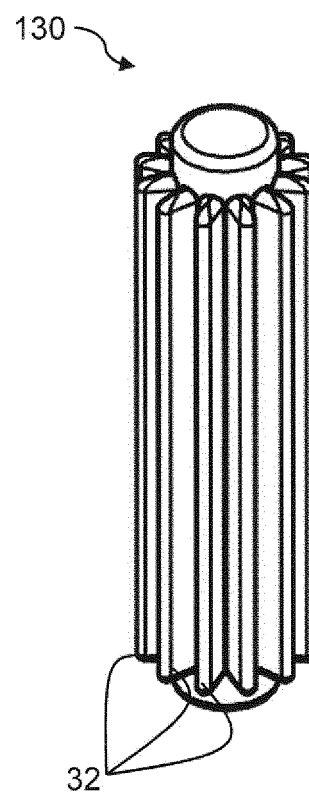


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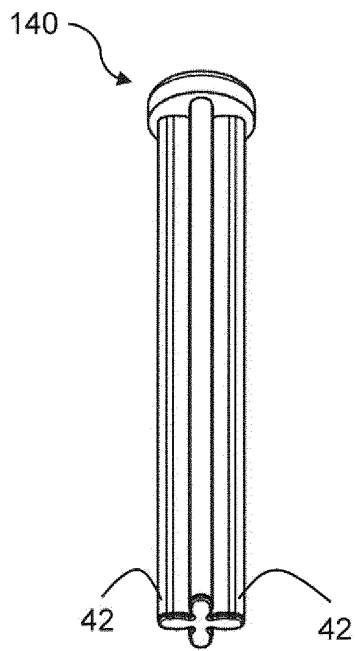


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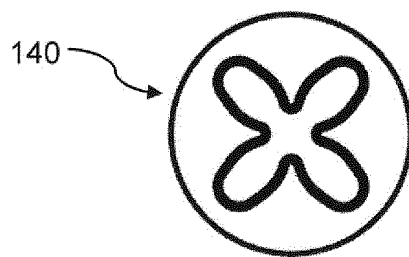


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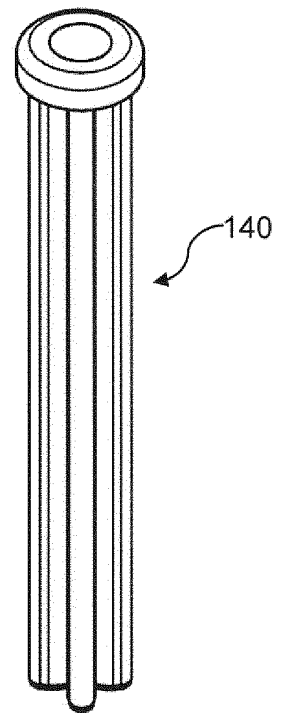


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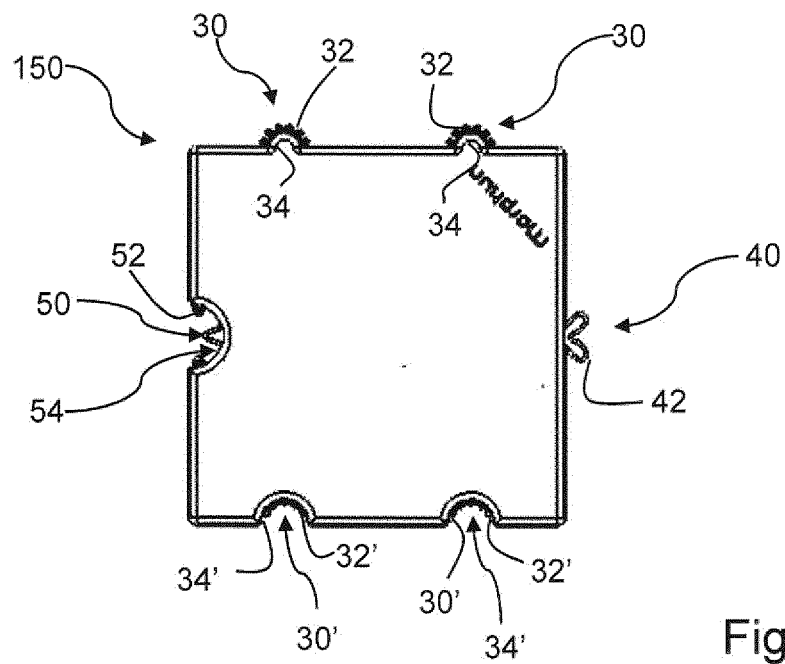


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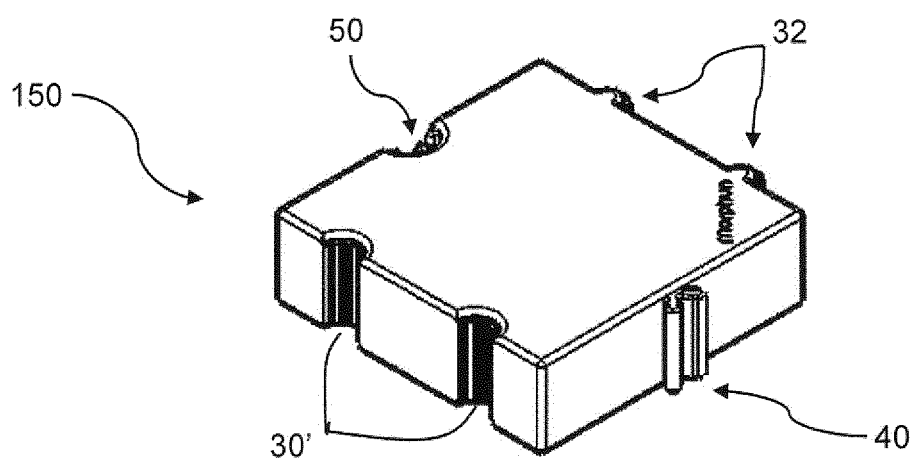


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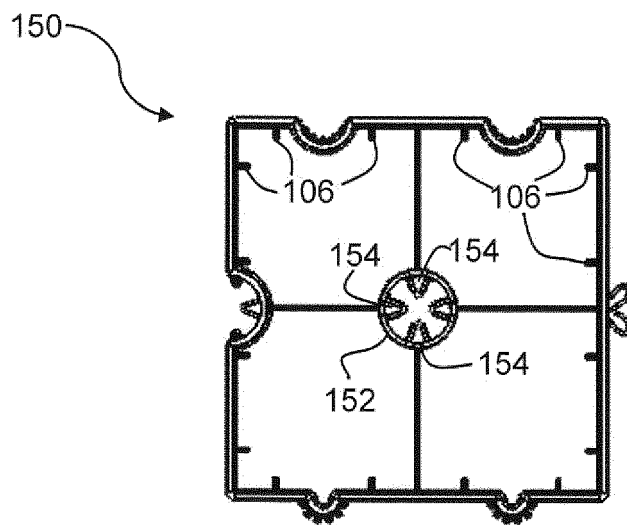


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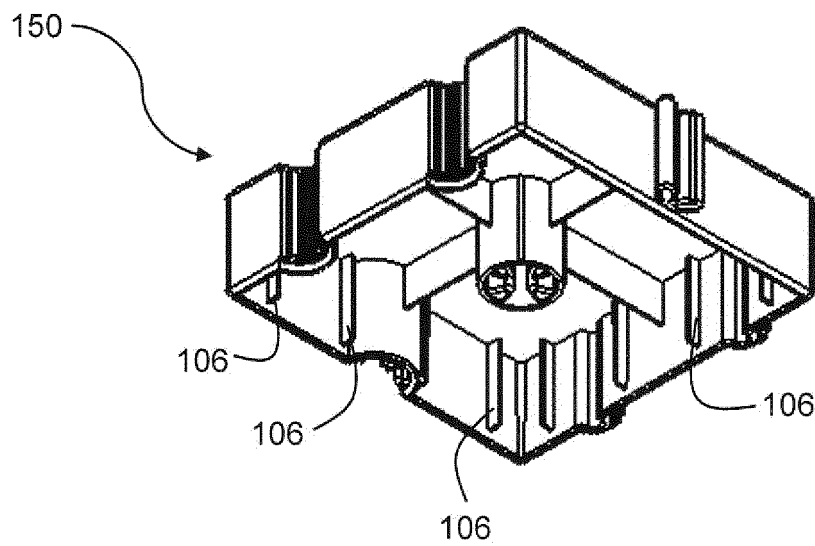


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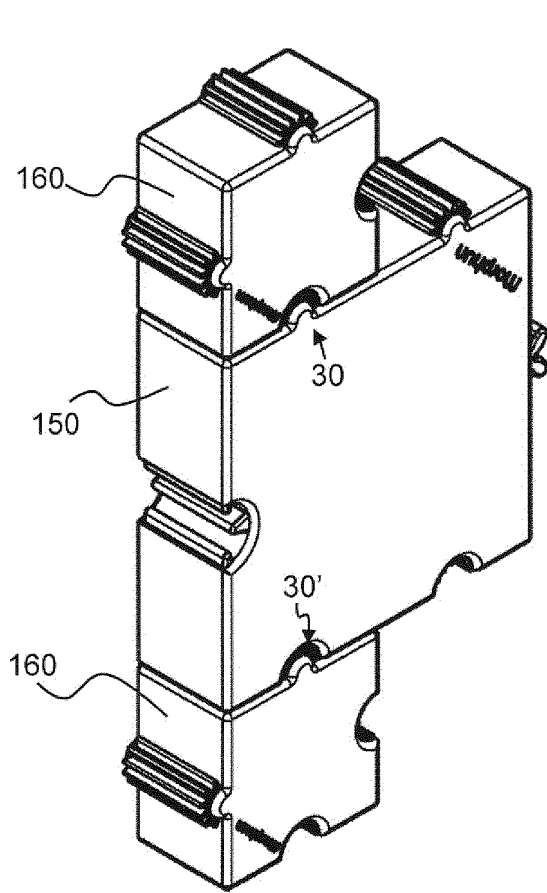


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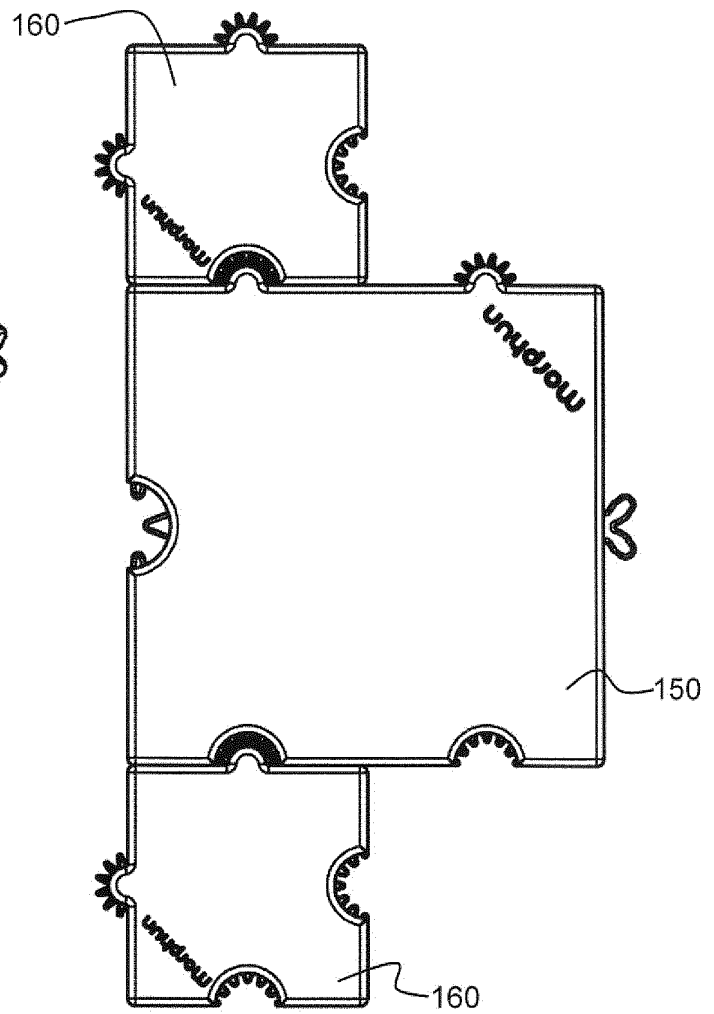


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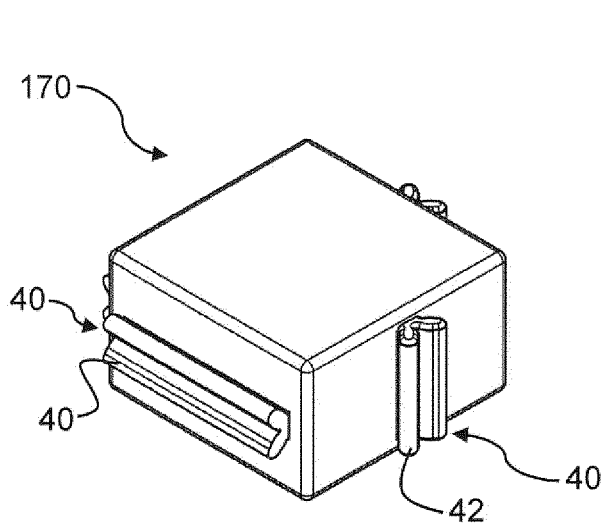


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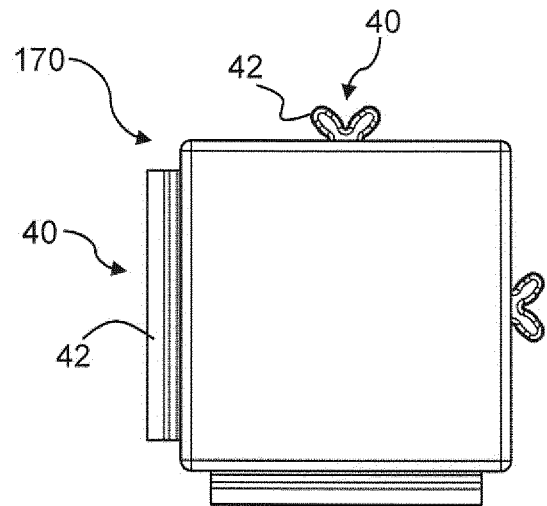


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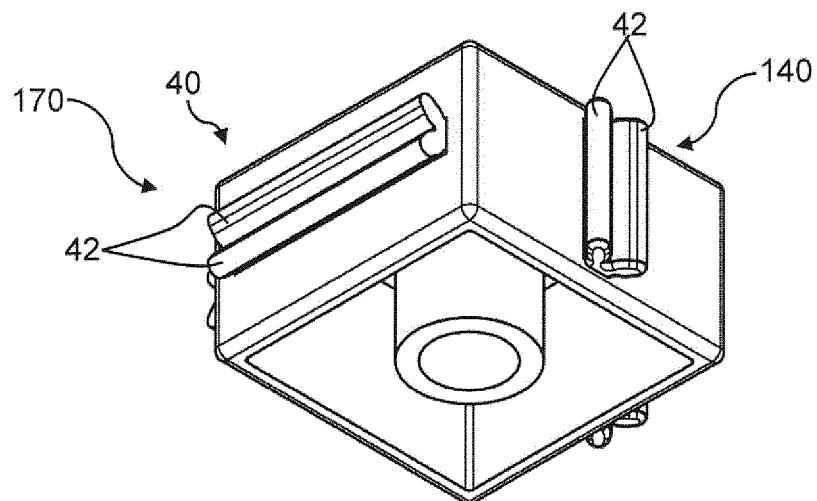


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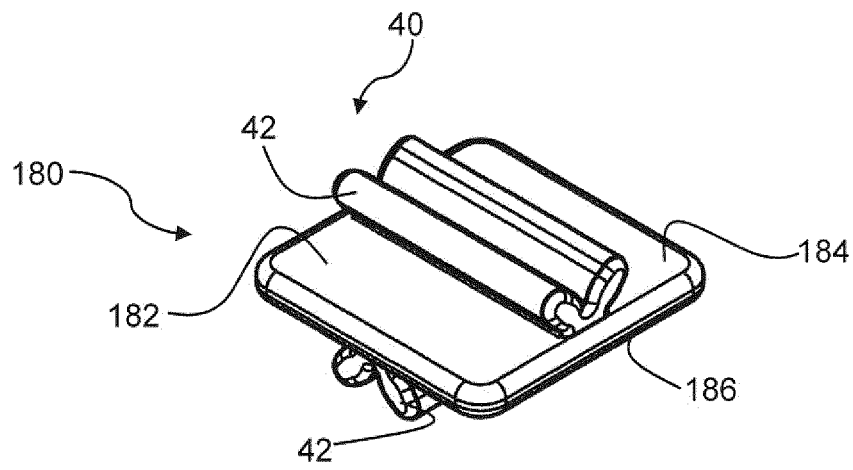


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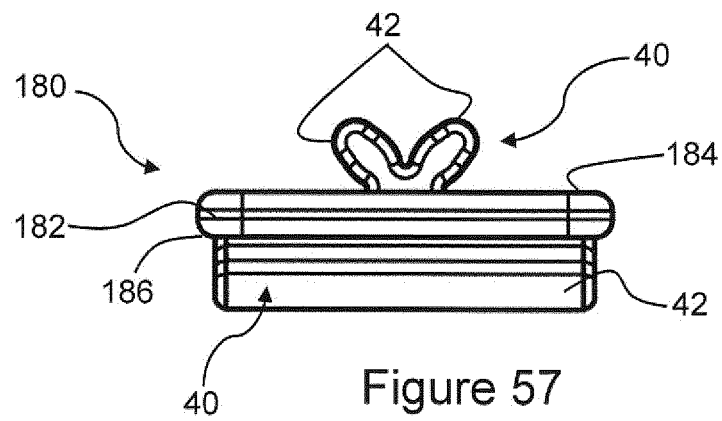


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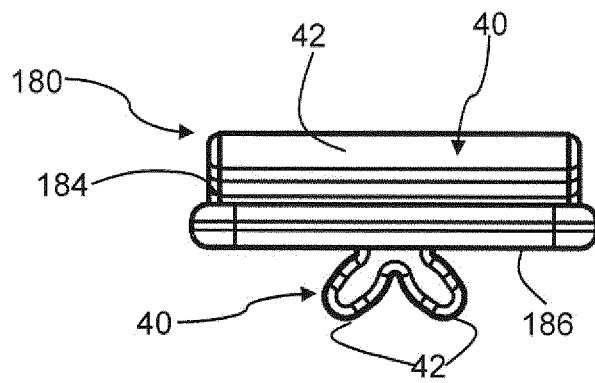


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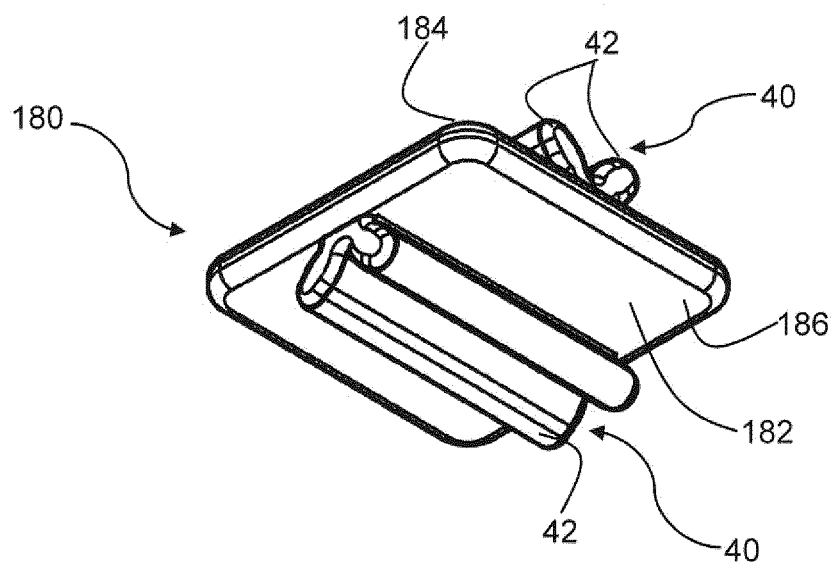


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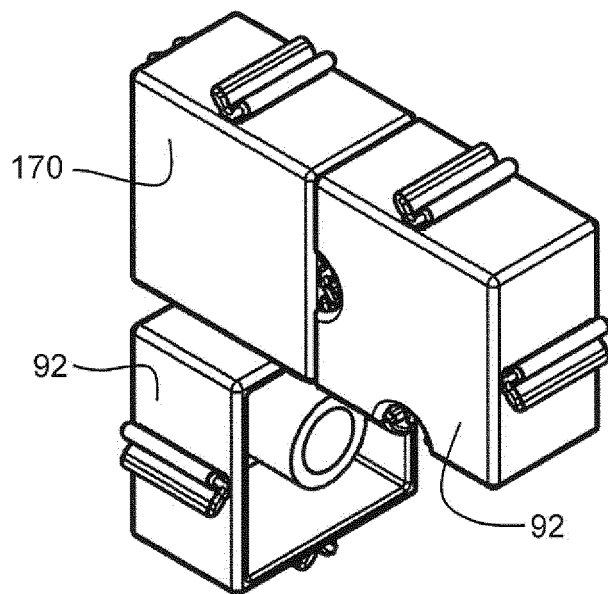


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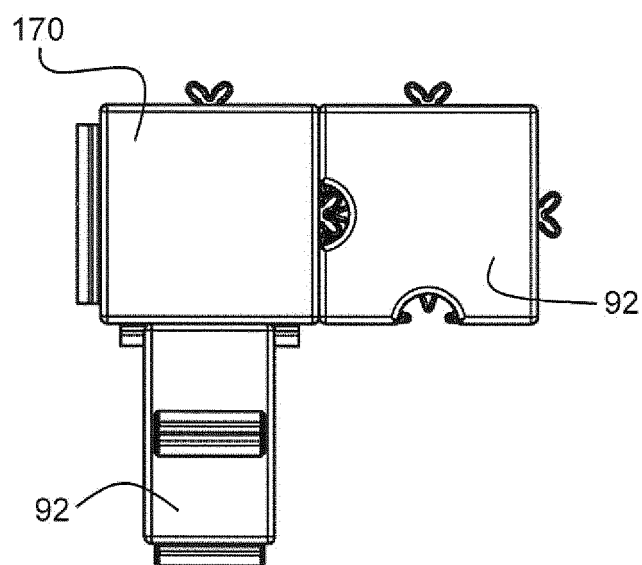


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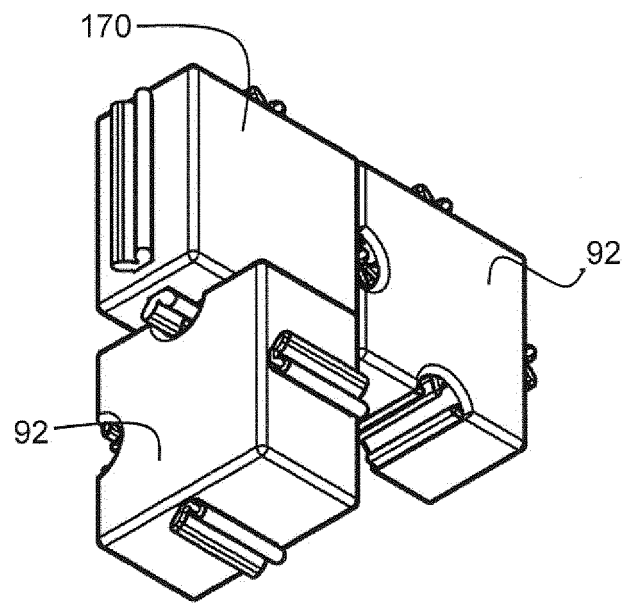


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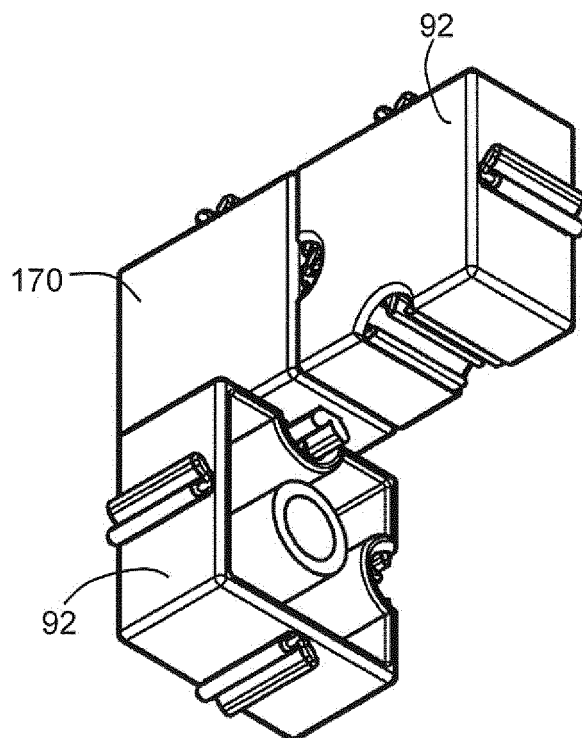


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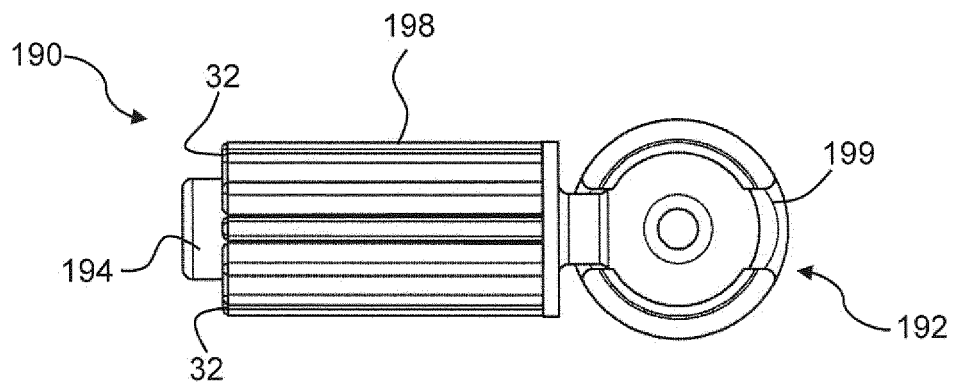


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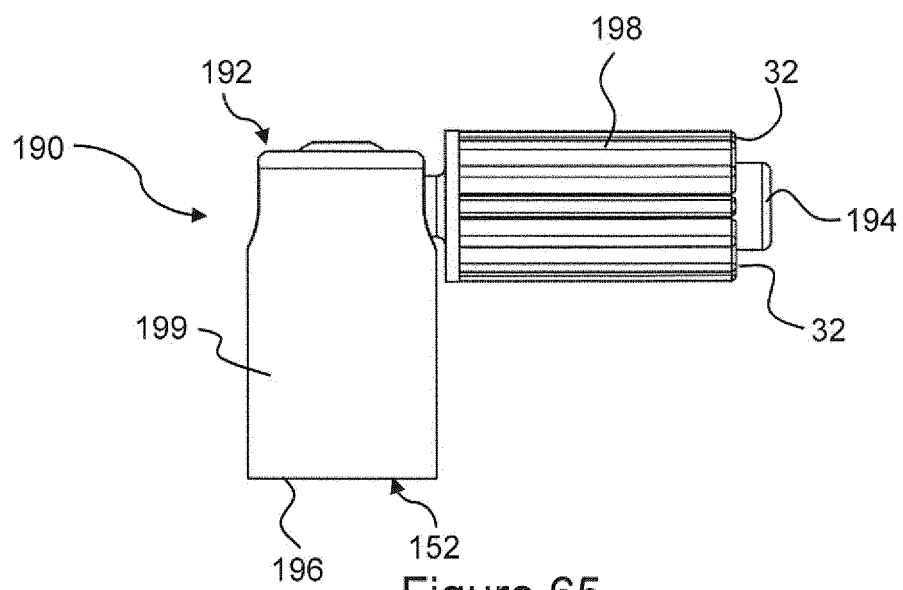


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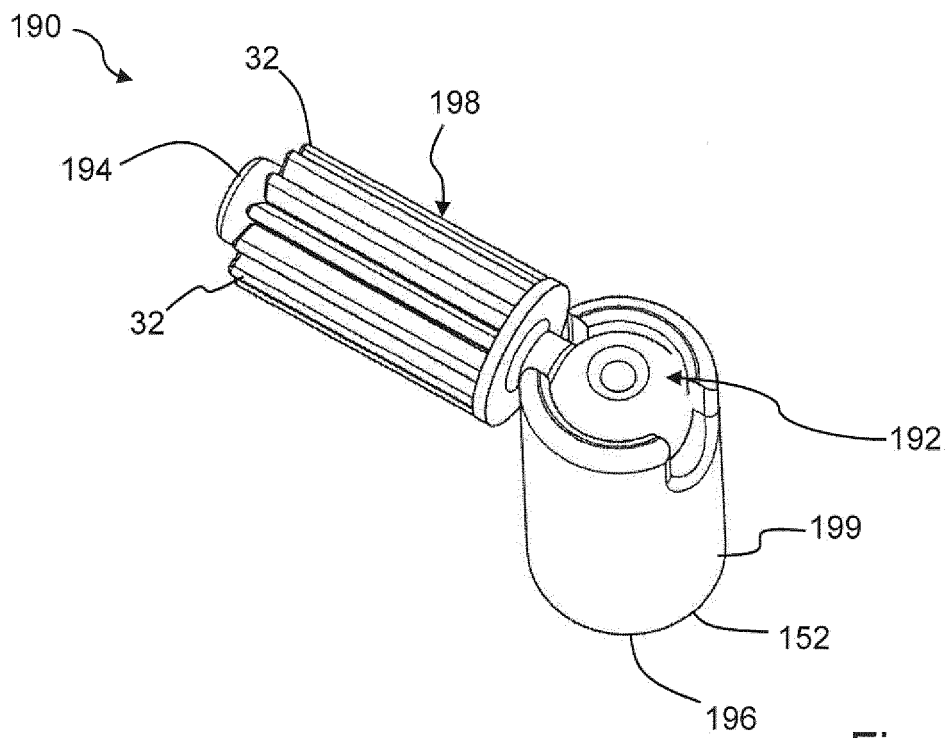


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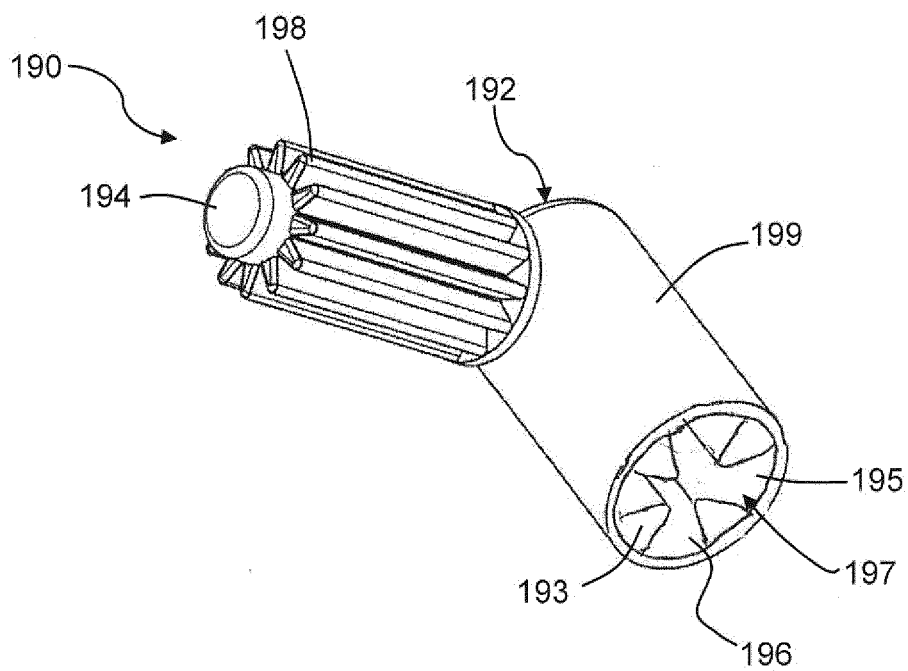


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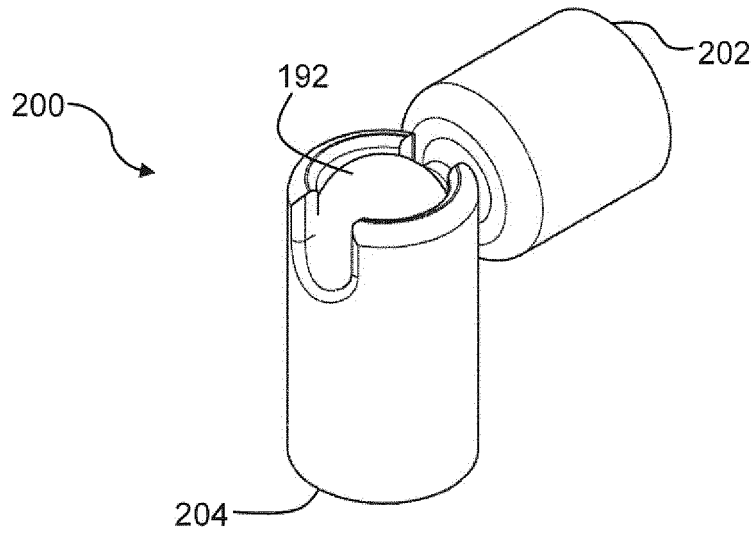


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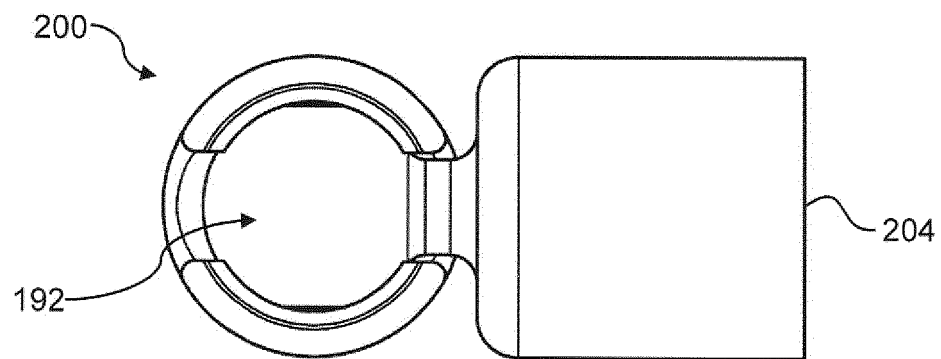


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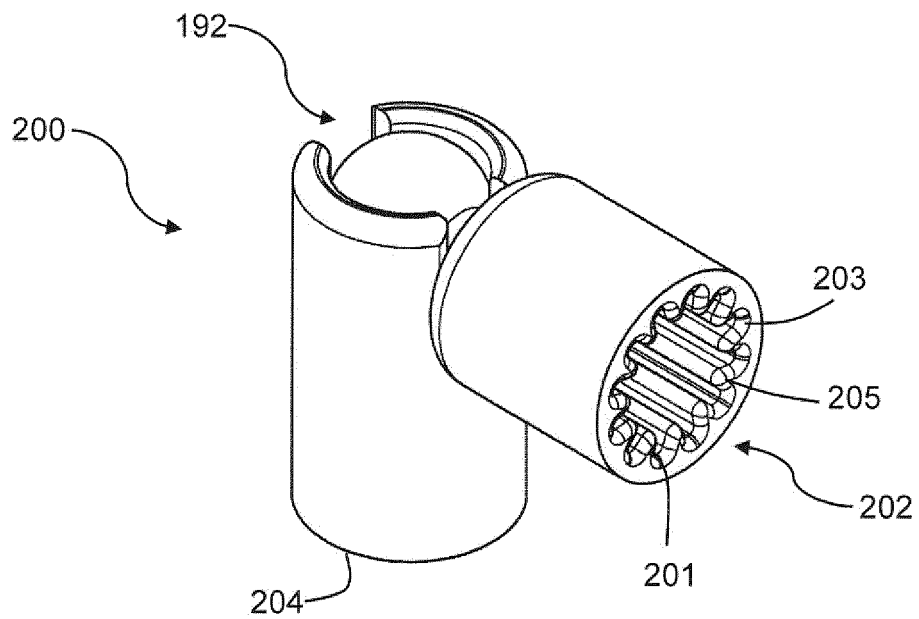


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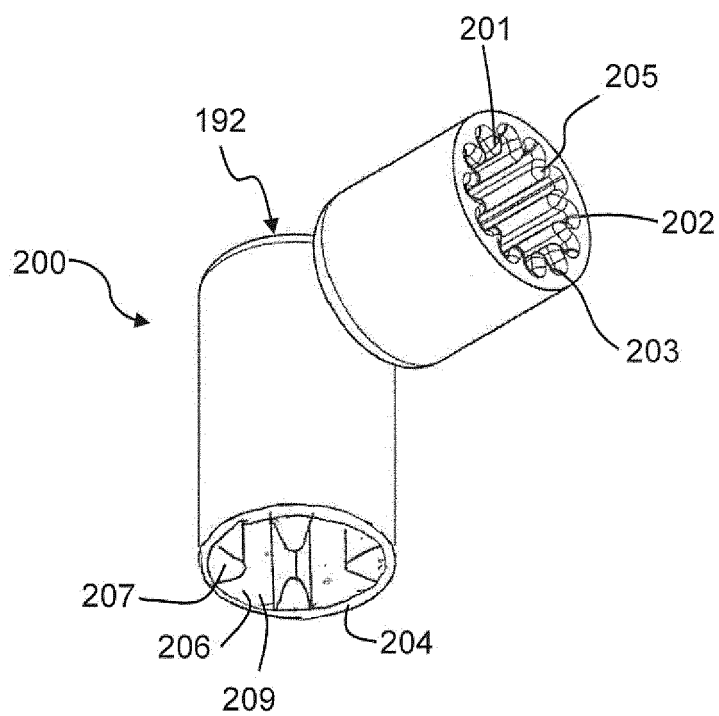


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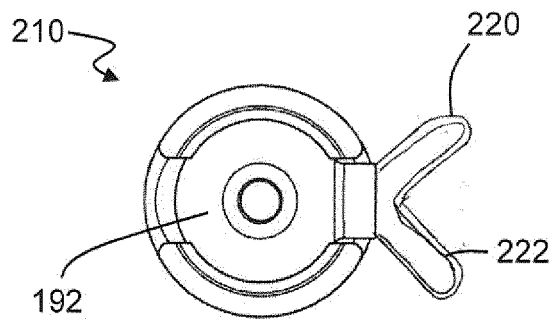


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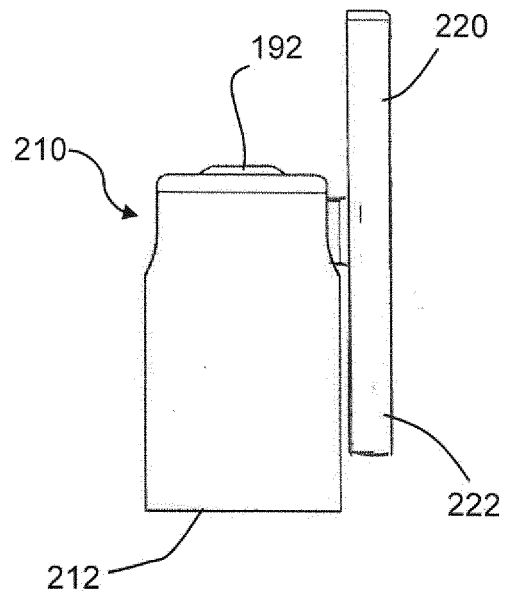


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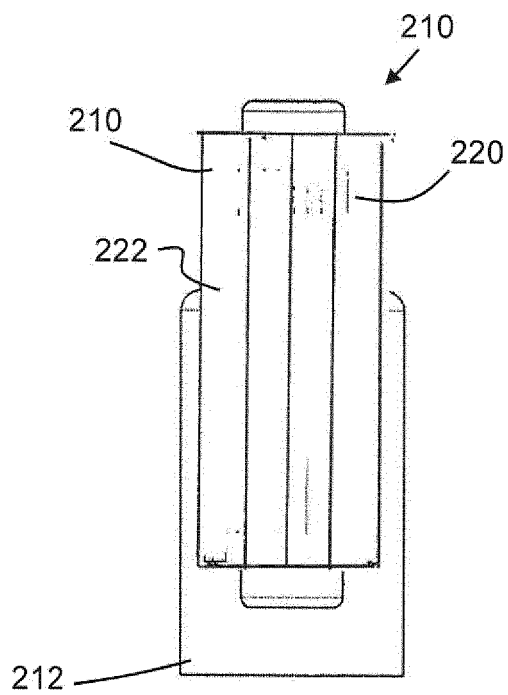


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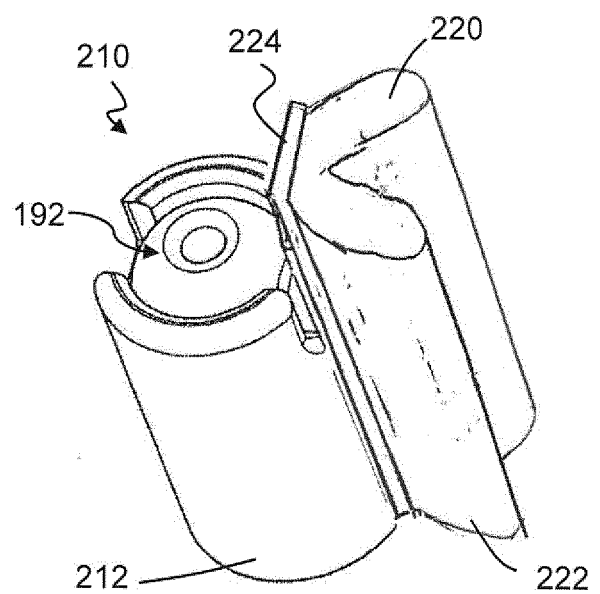


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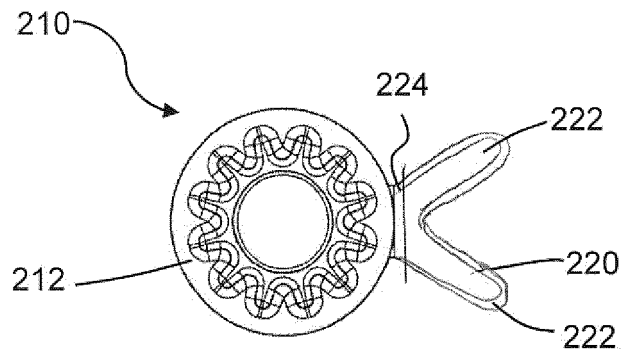


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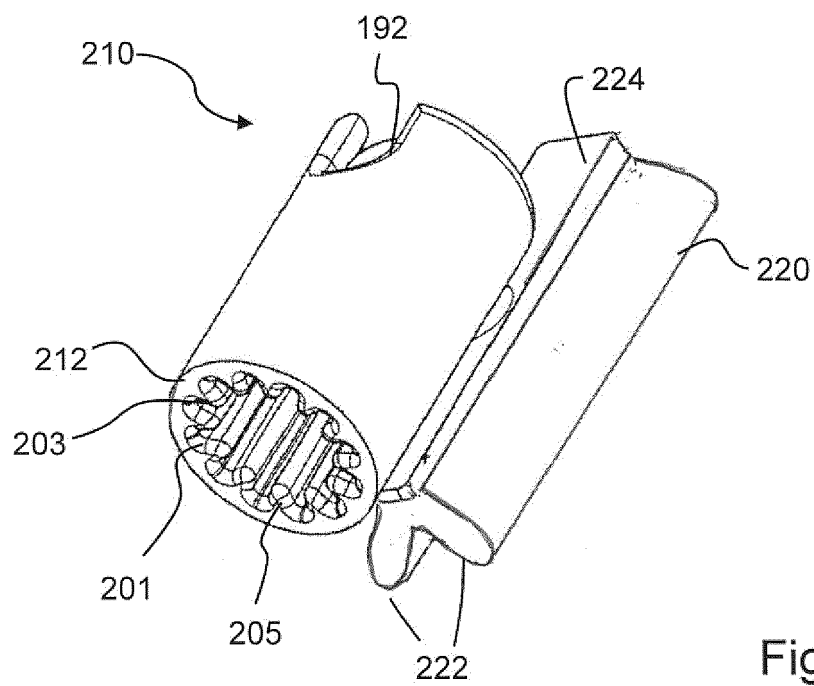


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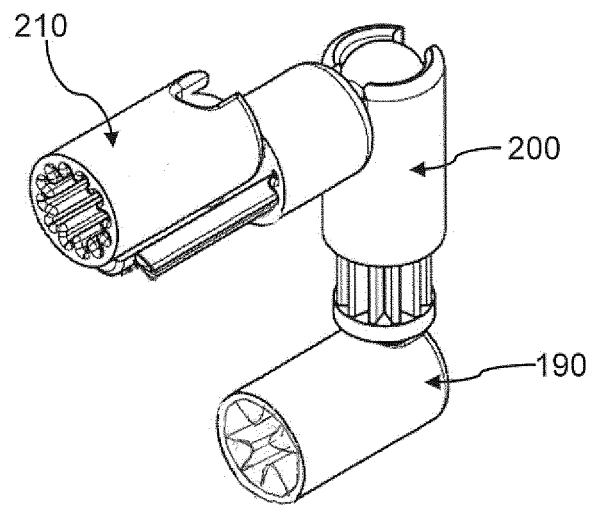


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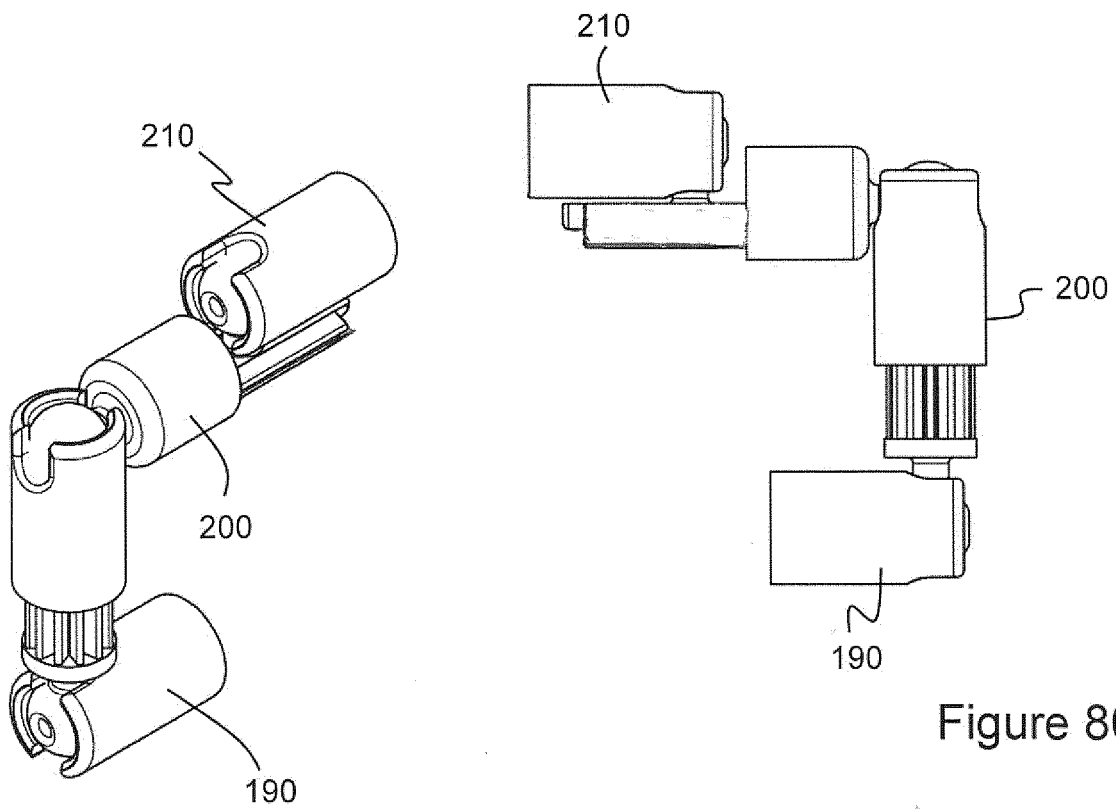


Figure 79

Figure 80

REFERENCES CITED IN THE DESCRIPTION

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