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(54) MAGNETIC TOY CONSTRUCTION MODULES WITH CORNER-ADJACENT MAGNETS

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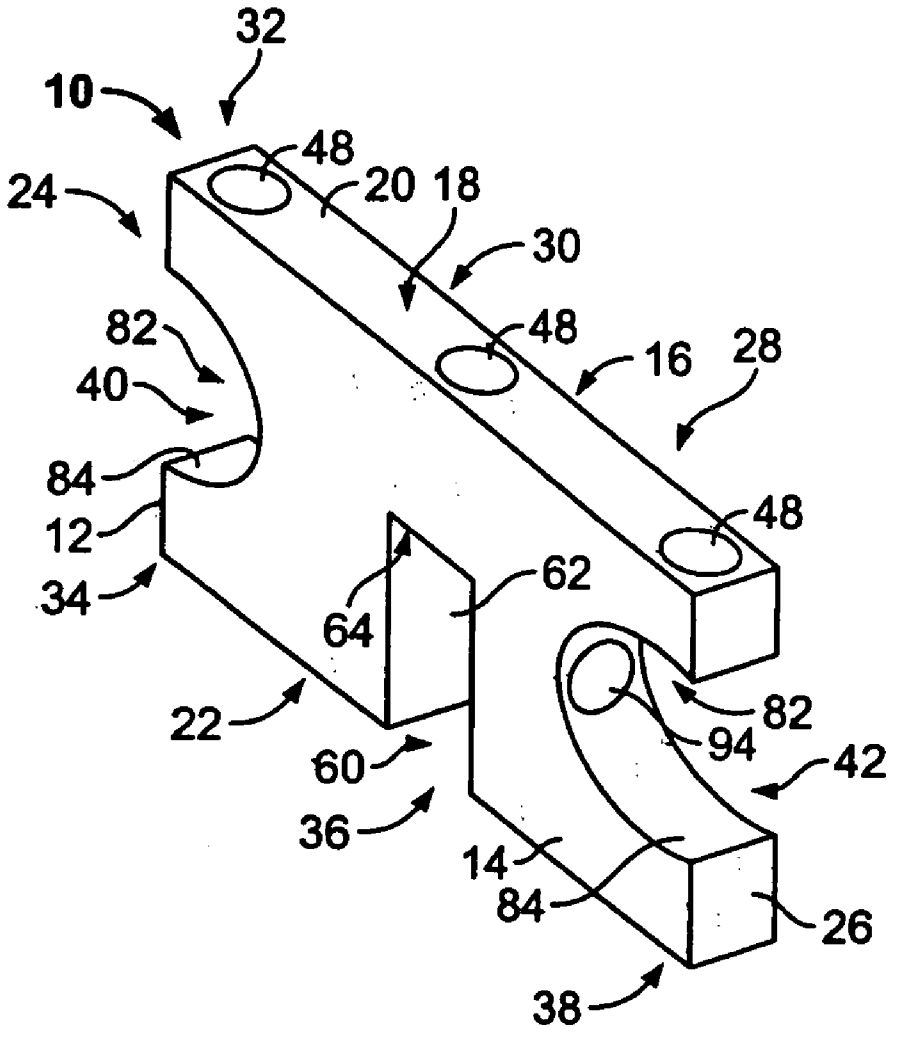
(57) **ABSTRACT**

Three-dimensional assemblies include substantially planar structural components having various two-dimensional generally polygonal shapes. Each such structural component includes a plurality of magnets positioned immediately adjacent the polygonal corners of the structural component and in other locations for use in connecting multiple instances of such structural components together, e.g., via the use of interconnecting ferromagnetic balls. Such structural components can also include one or more slots extending peripherally inward from the component edge for use in assembling corresponding structural components together in an interlocking fashion.



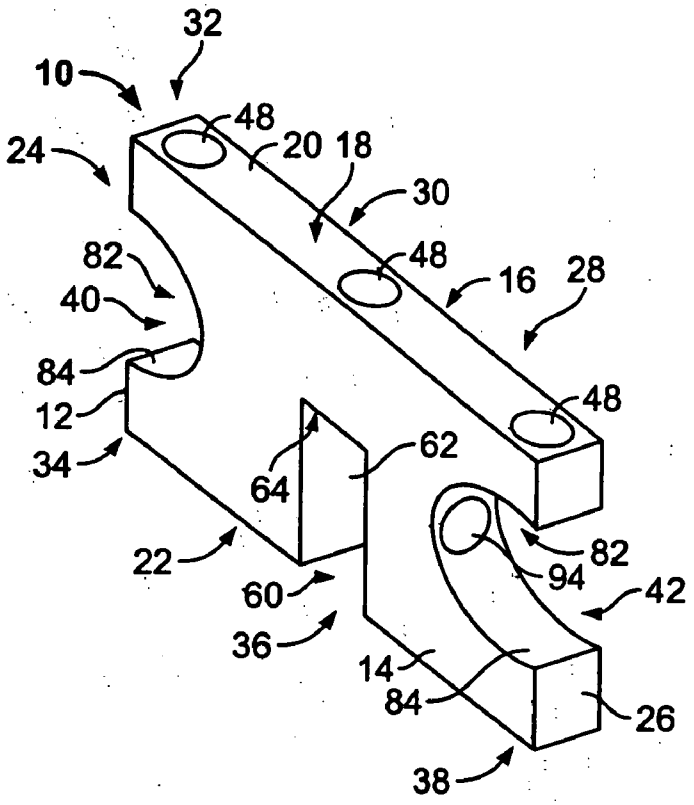


FIG. 1

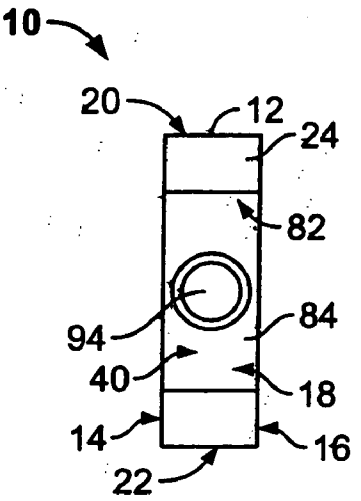


FIG. 3

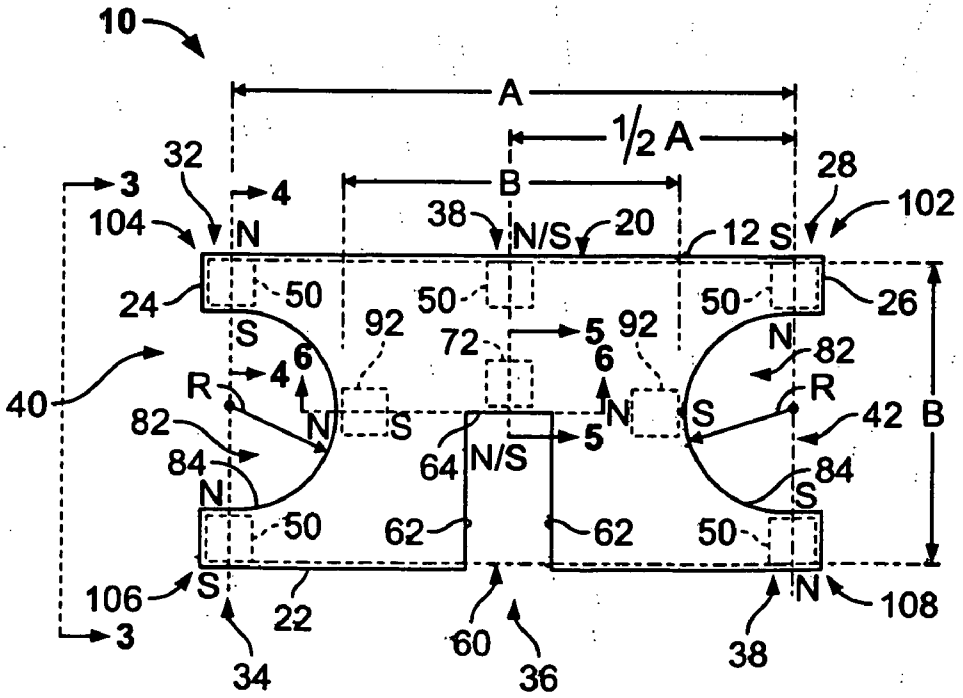
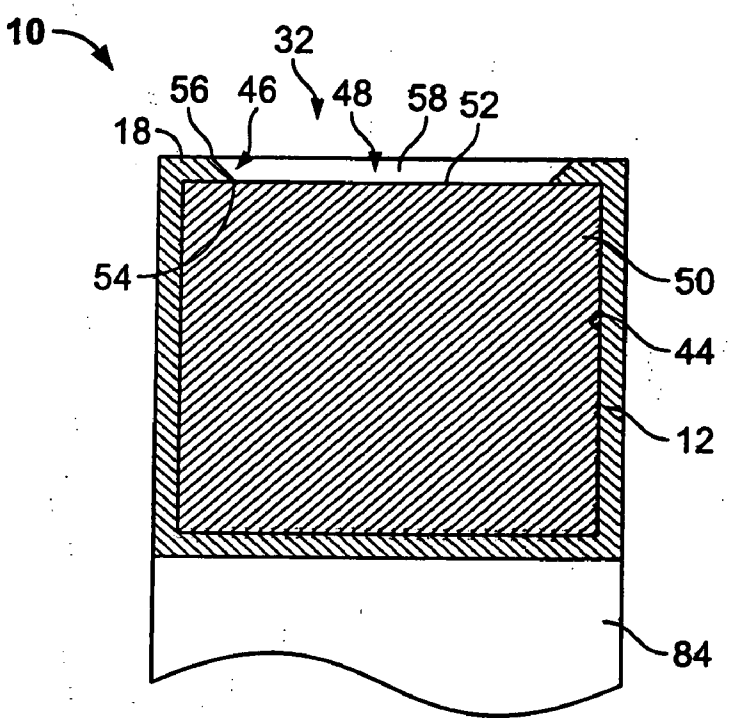


FIG. 2


10
32
56
46
48
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52
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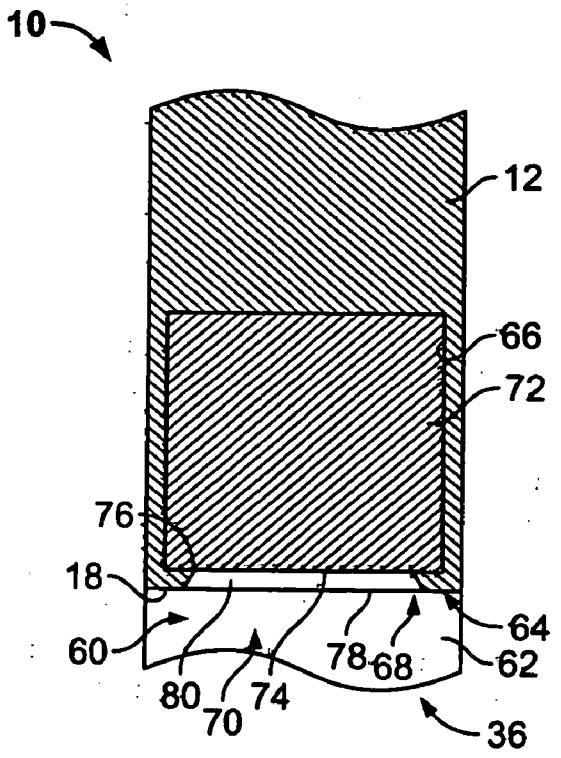
50
44
12
84

FIG. 4


10
12
66
72
76
18
64
60
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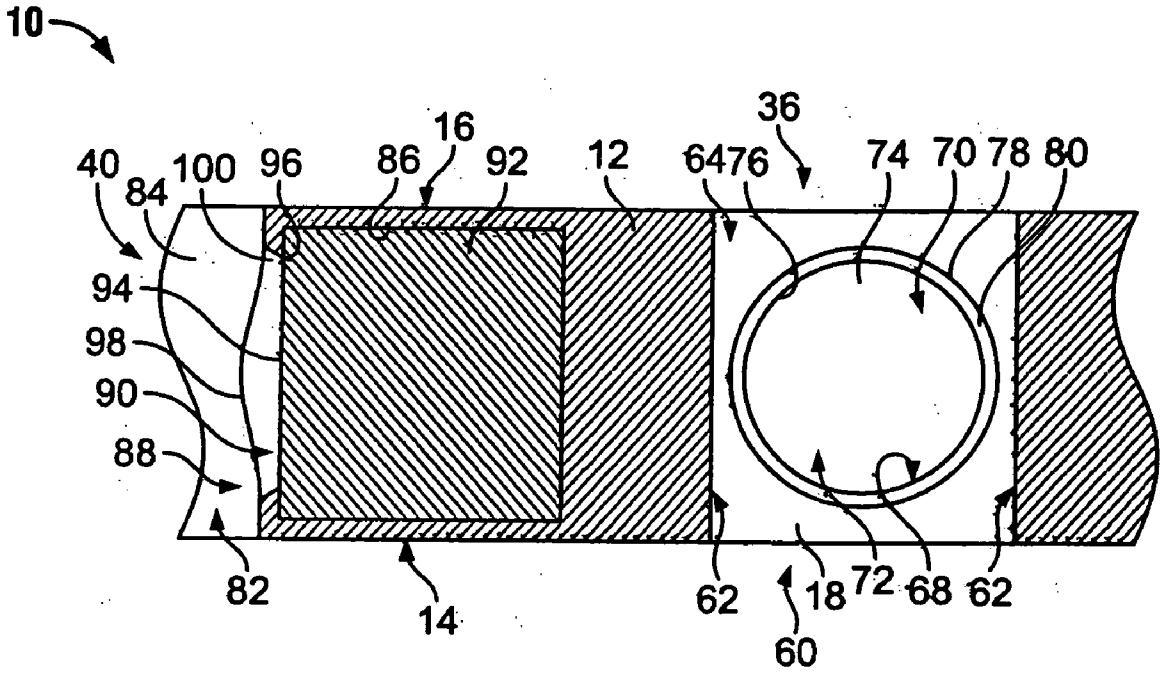
68
62
80
74
70
36

FIG. 5


10
16
36
40
84
100
96
86
92
12
64
76
74
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90
88
82
14
62
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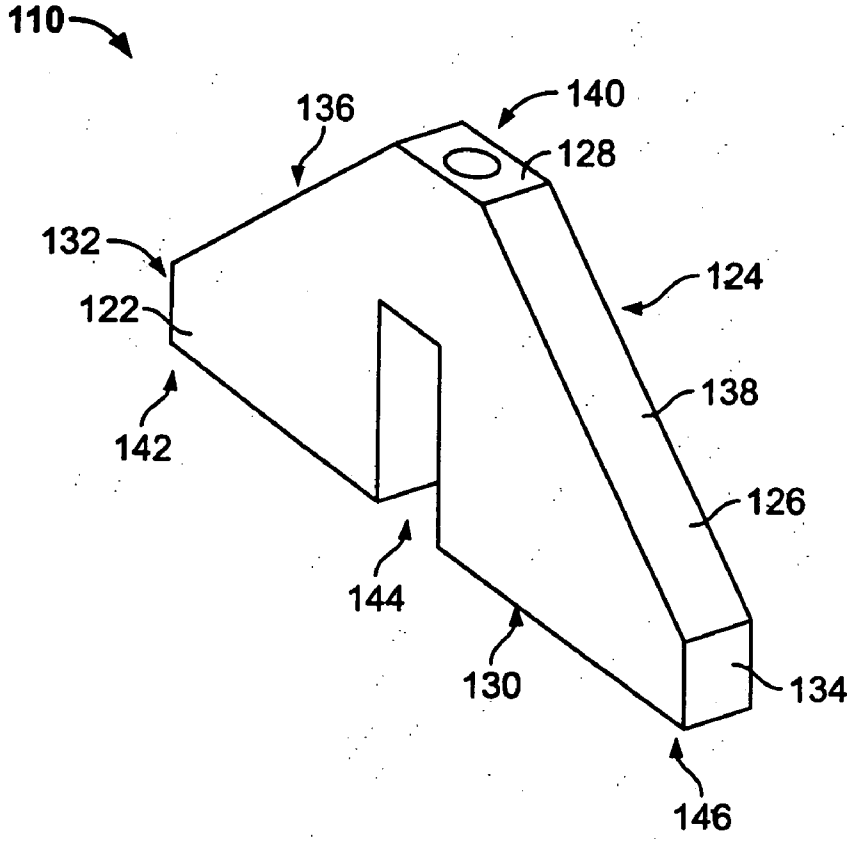
72
68
62
60

FIG. 6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134
146

FIG. 7

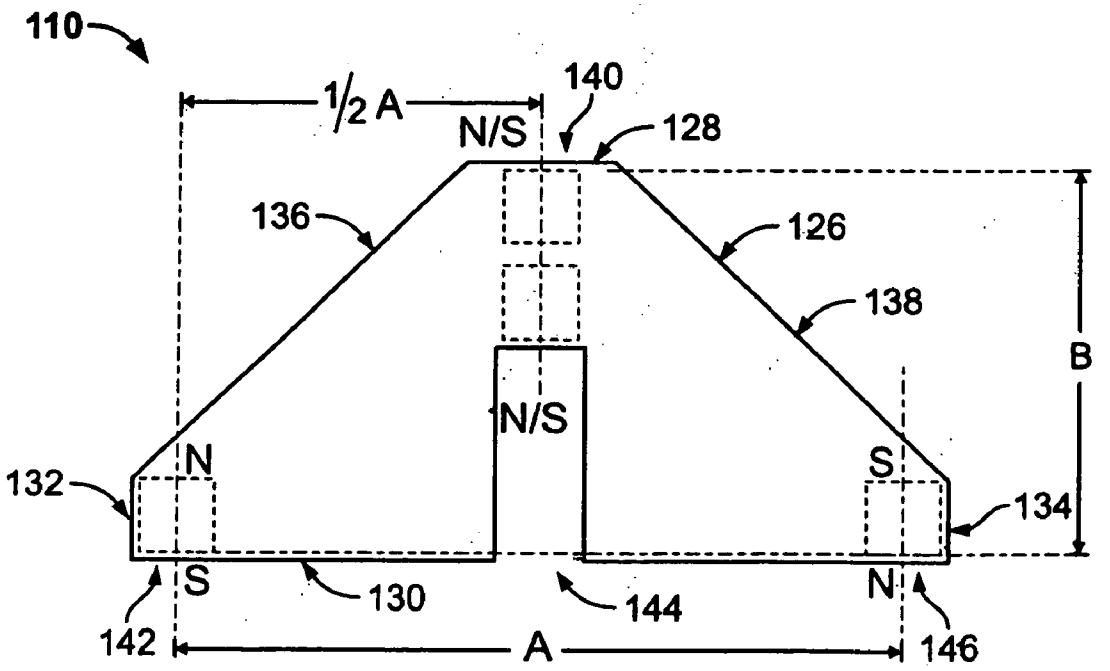

110
1/2 A
140
N/S
128
136
126
138
B
N/S
N
S
132
134
S
130
144
N
142
A
146

FIG. 8

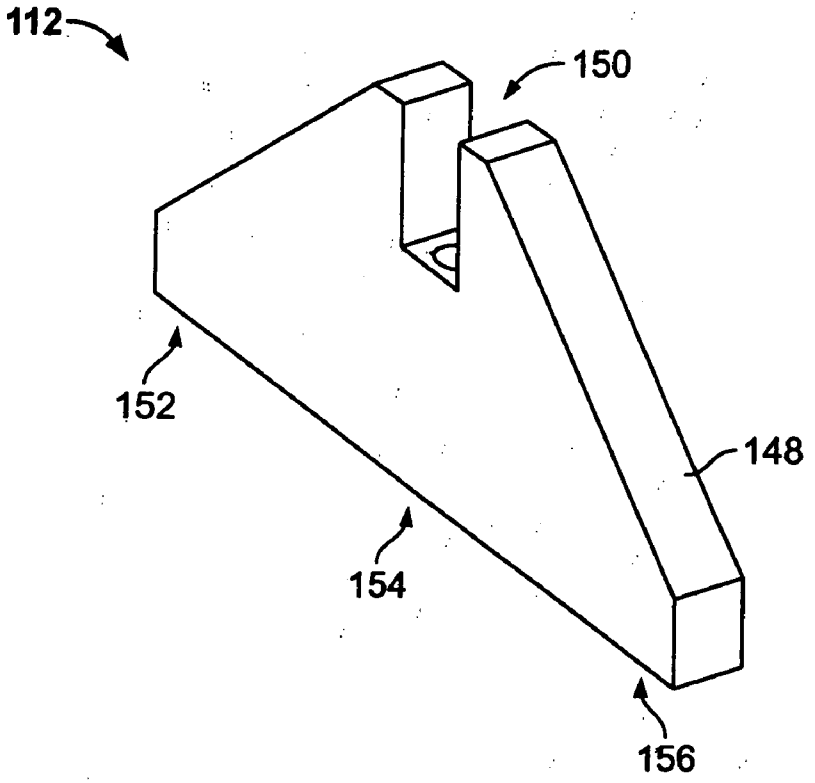


FIG. 9

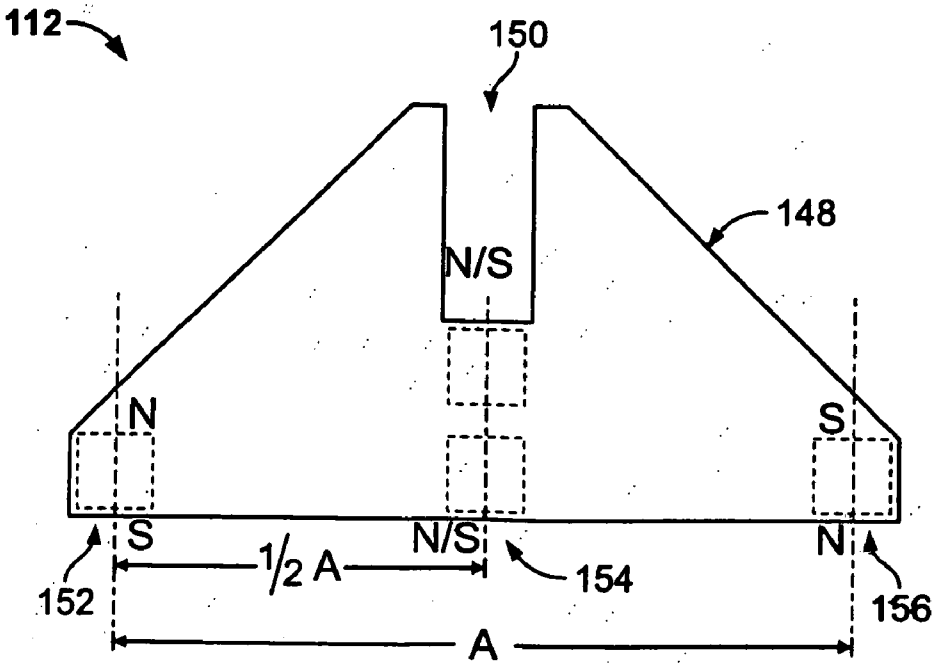
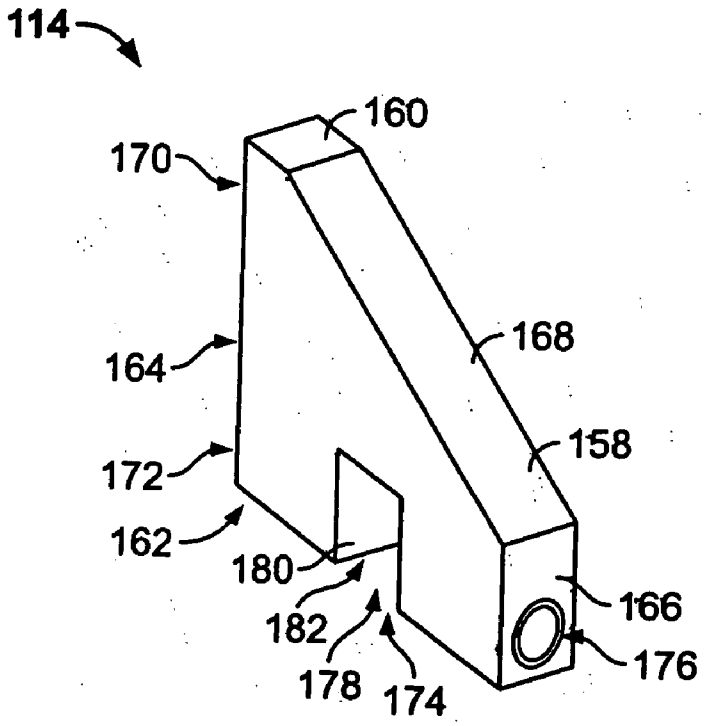


FIG. 10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174

FIG. 11

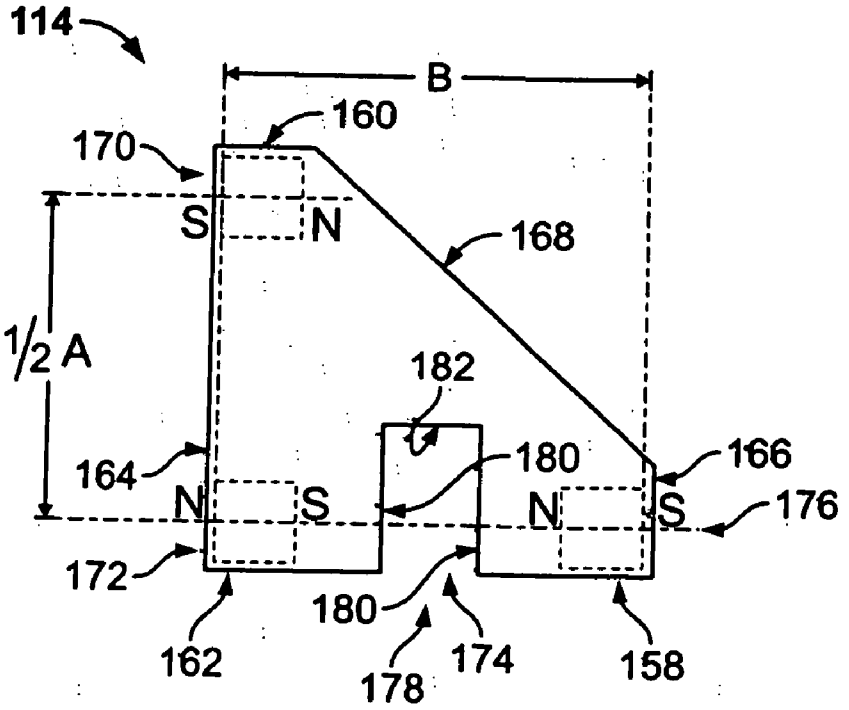
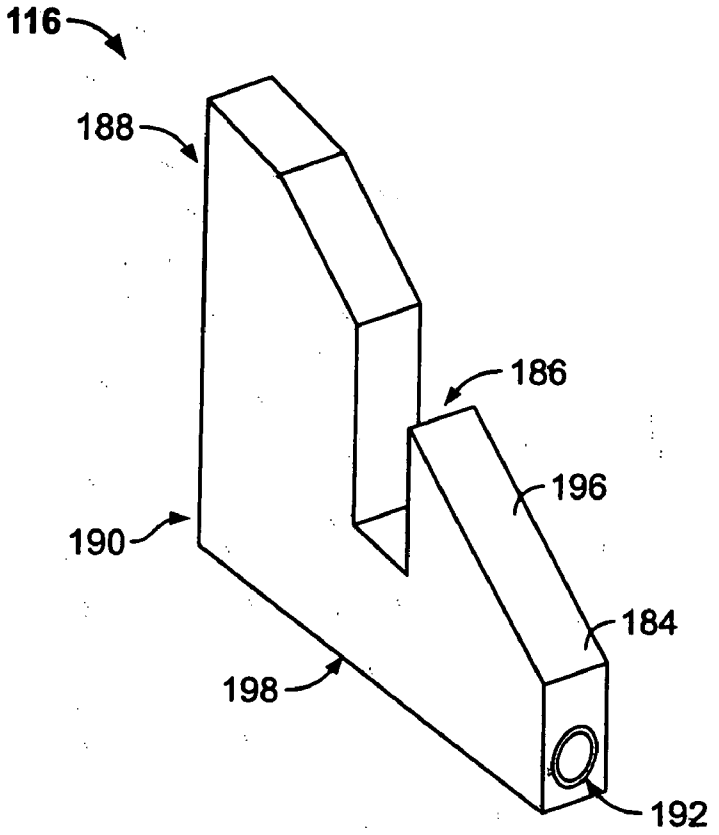

114
B
160
170
S
N
168
1/2 A
182
164
180
166
N
S
N
S
176
172
180
162
178
174
158

FIG. 12


116
188
186
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198
192

FIG. 13

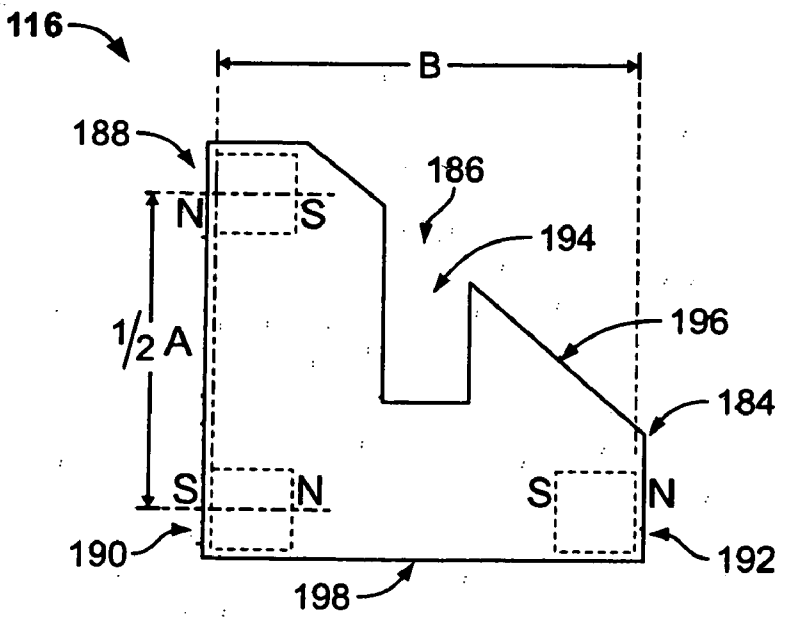

116
B
188
186
N
S
194
1/2 A
196
184
S
N
S
N
190
192
198

FIG. 14

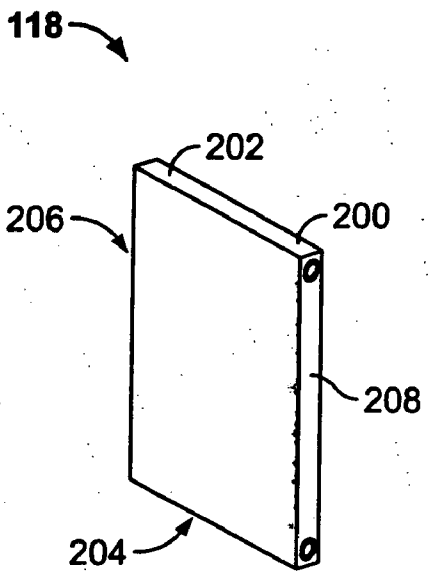


FIG. 15

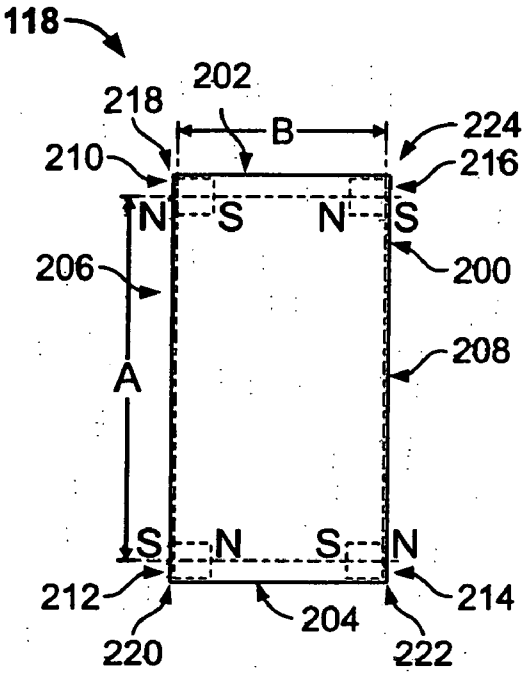


FIG. 16

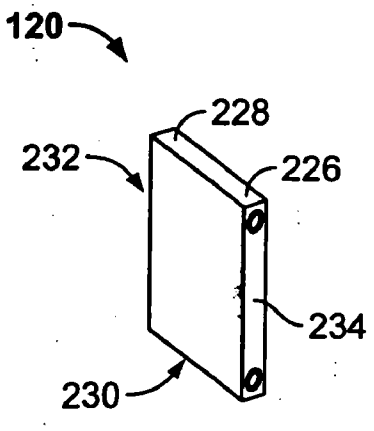


FIG. 17

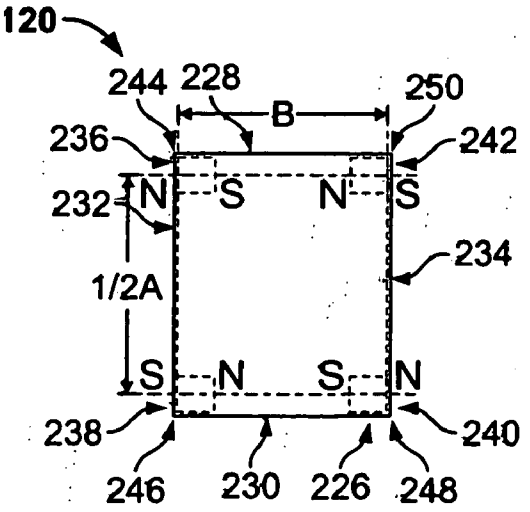


FIG. 18

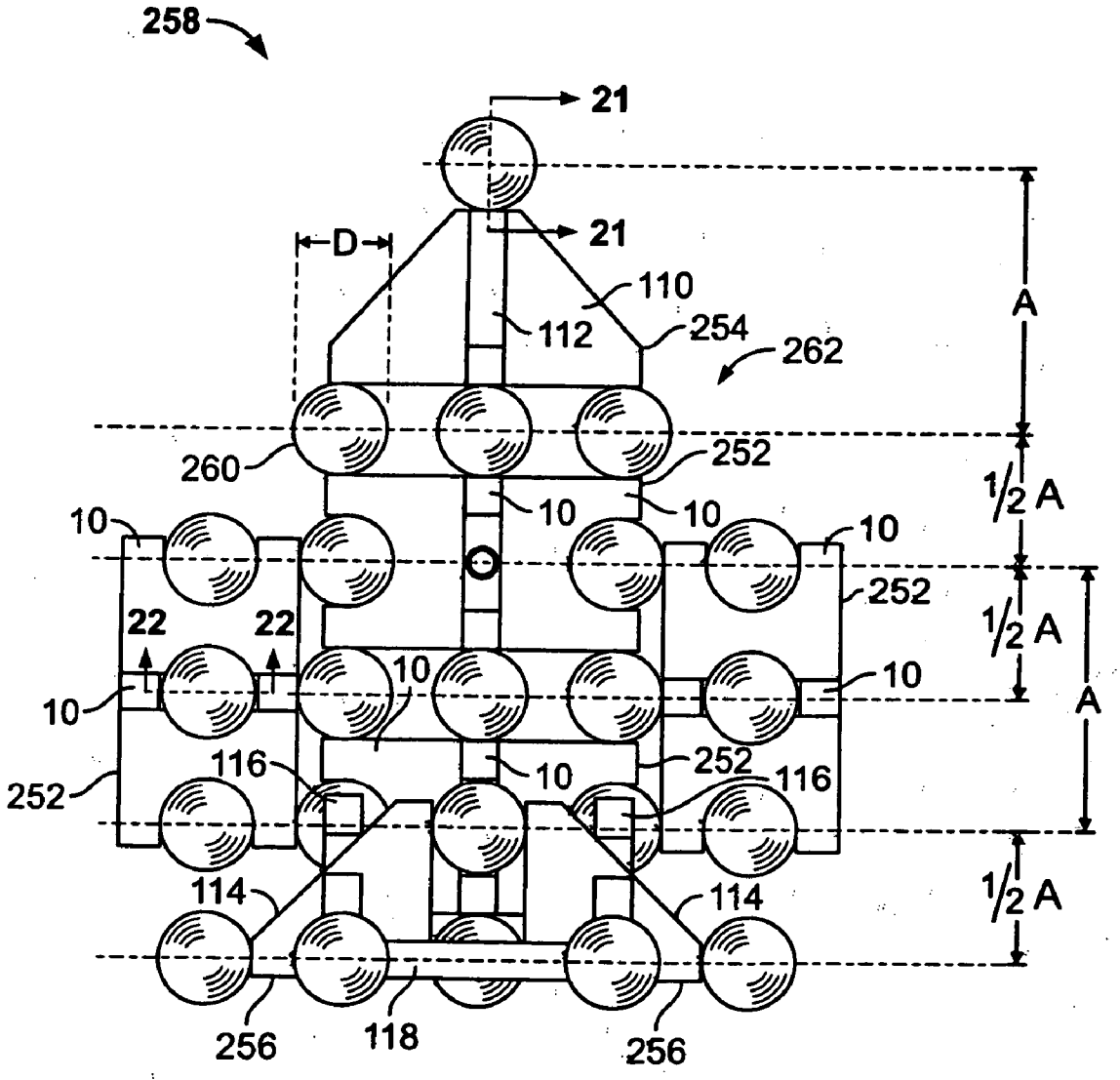
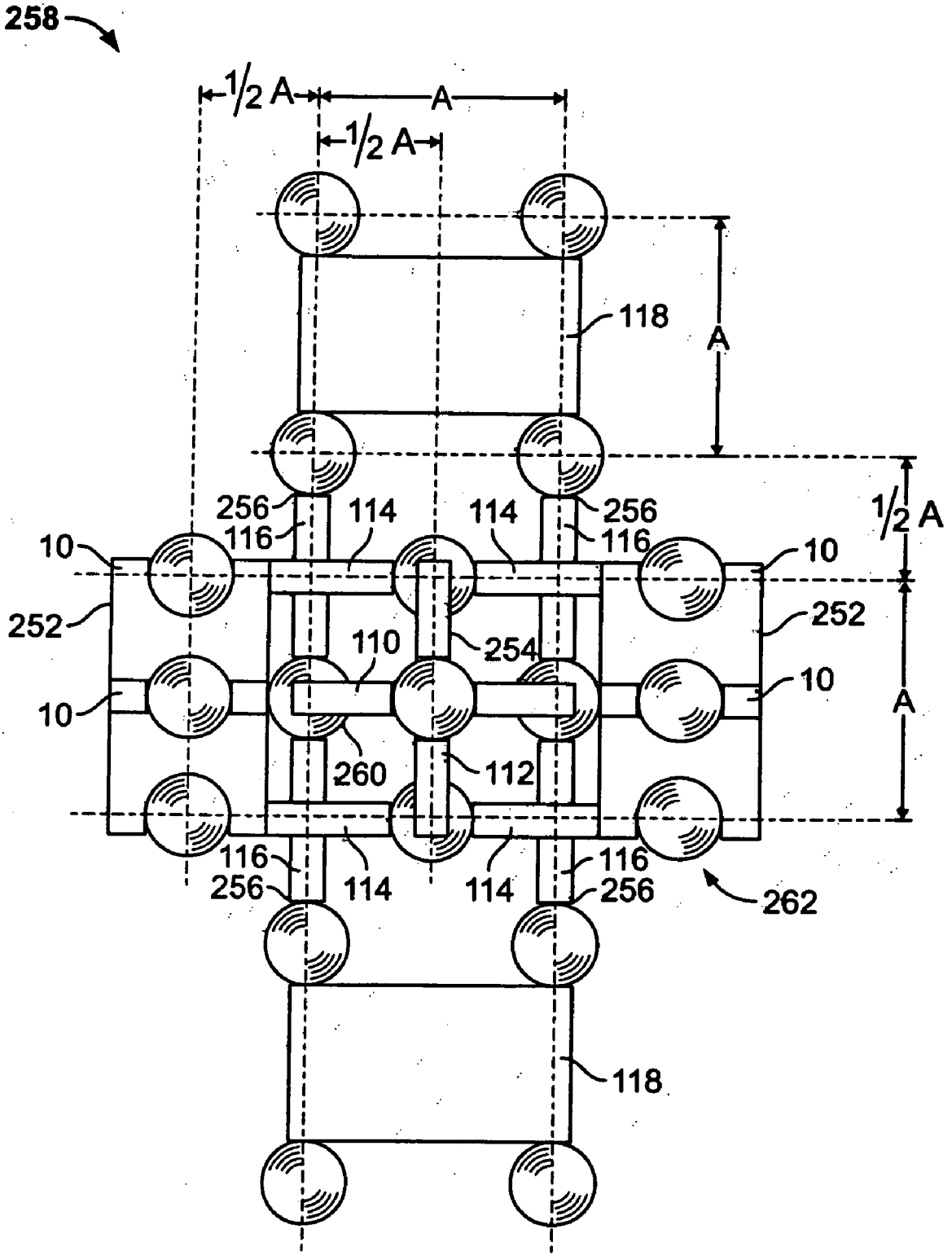

258
21
21
D
110
112
254
262
A
260
252
1/2 A
10
10
10
10
252
22
22
1/2 A
10
10
10
A
116
252
10
252
116
114
114
1/2 A
256
118
256

FIG. 19


258
1/2 A
A
1/2 A
118
A
1/2 A
256
116
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114
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FIG. 20

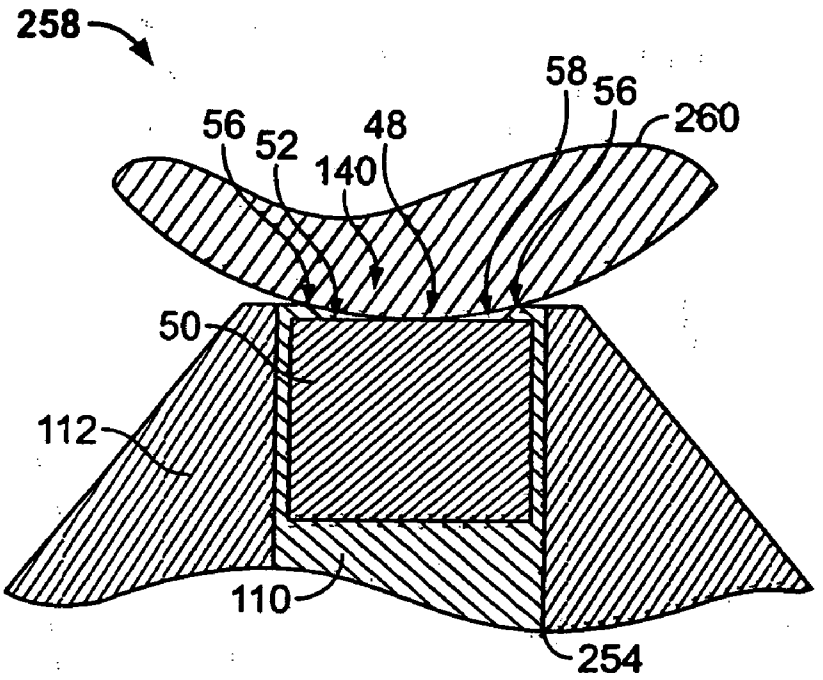


FIG. 21

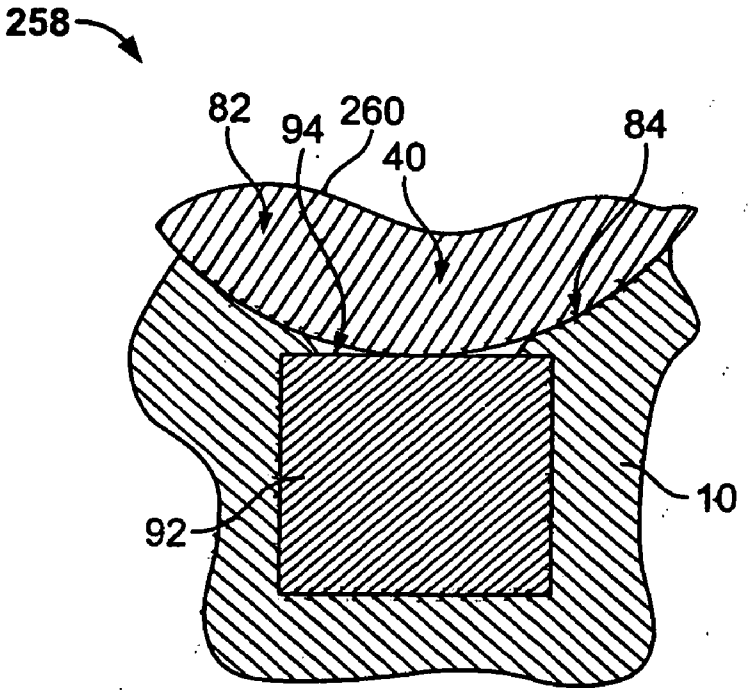
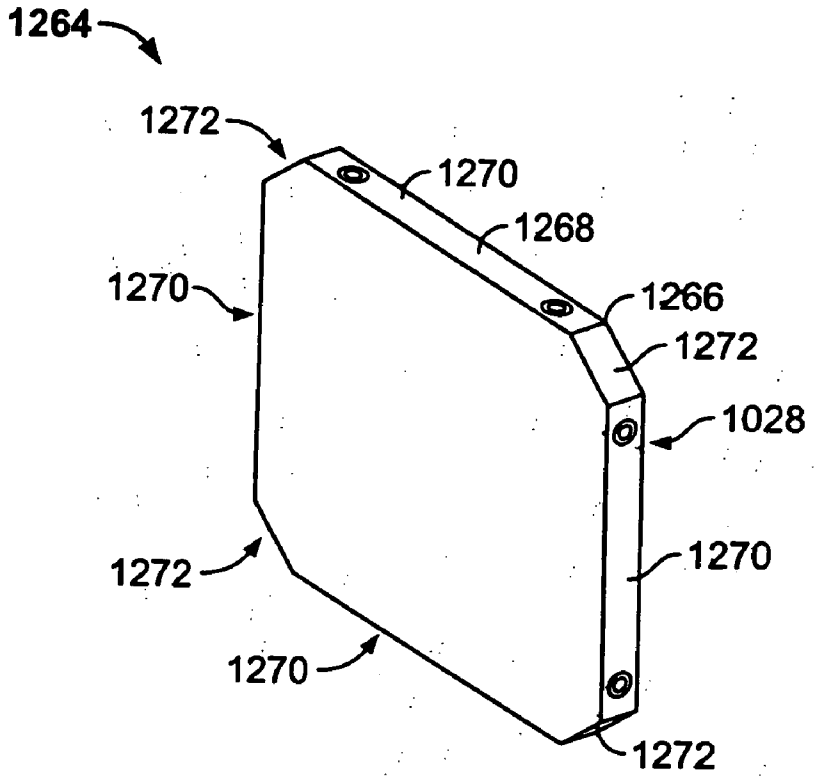


FIG. 22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1272
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1268
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1266
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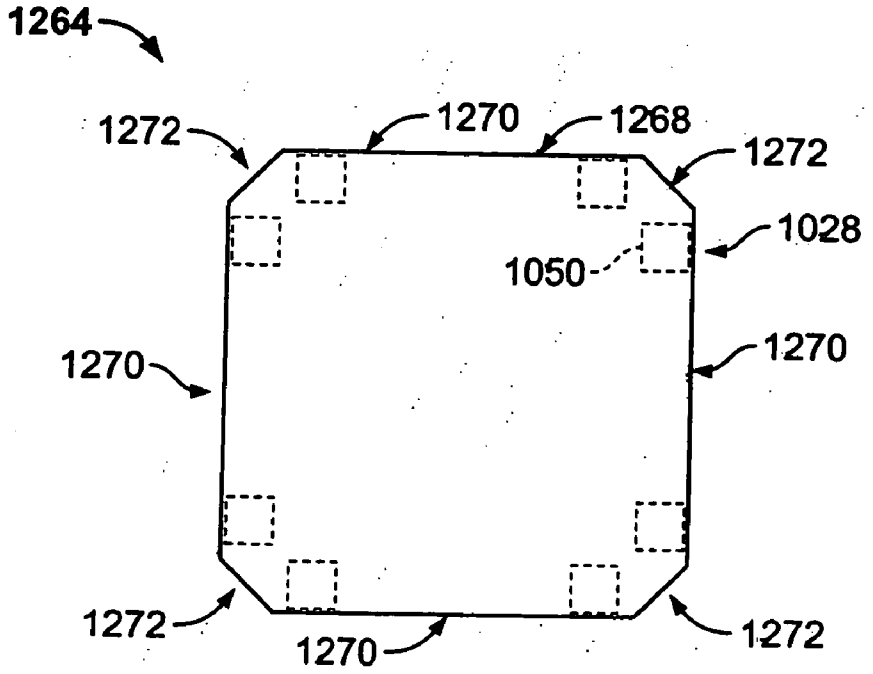
1272

FIG. 23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1272
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1268
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1272
1270
1272

FIG. 24

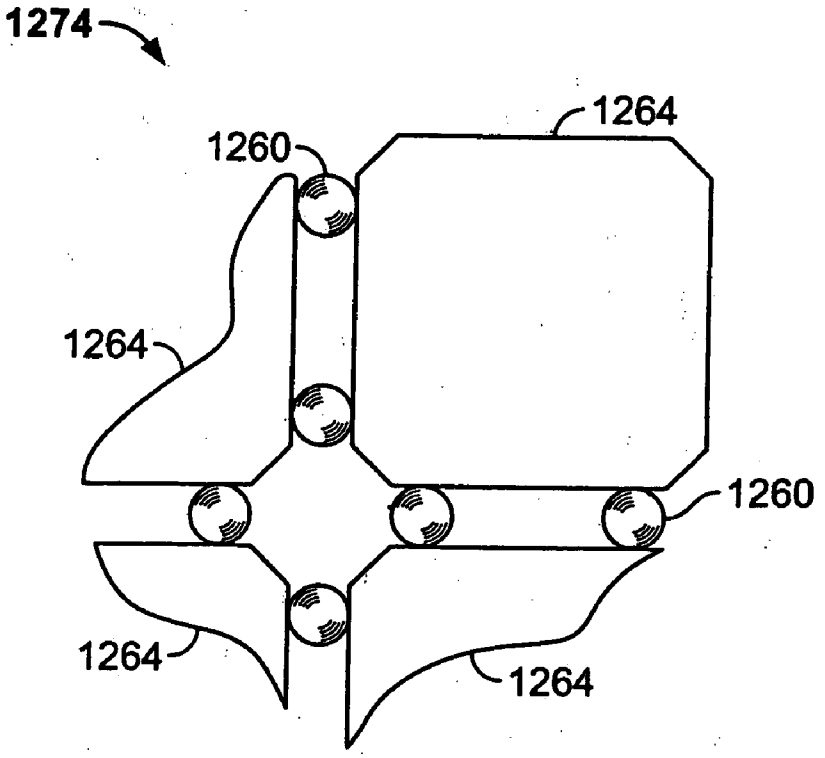
1274
1264
1260
1264
1260
1264
1264

FIG. 25

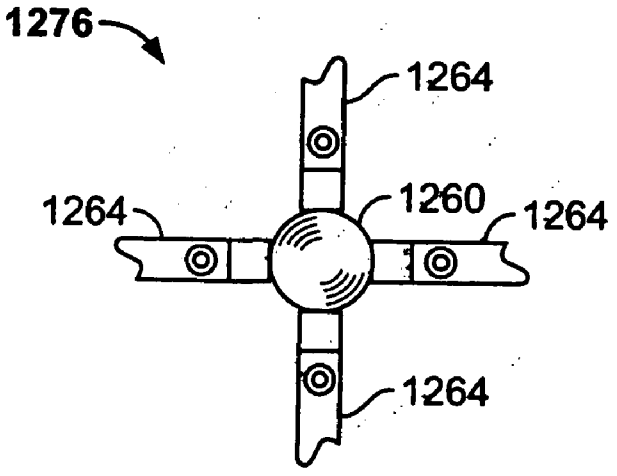
1276
1264
1264
1260
1264
1264

FIG. 26

MAGNETIC TOY CONSTRUCTION MODULES WITH CORNER-ADJACENT MAGNETS

[0001] This application claims the benefit of U.S. Provisional Application No. 60/635,150, filed Dec. 10, 2004, which is herein incorporated by reference in its entirety.

BACKGROUND

[0002] 1. Field of the Invention

[0003] The present invention is directed generally to puzzles and toys. More particularly, the present invention is directed to structural components having magnetic surfaces and which can be magnetically and/or mechanically coupled to form three-dimensional assemblies.

[0004] 2. Background of the Invention

[0005] Individuals often find enjoyment in the challenge of building aesthetic structural designs and/or functional structural models. Frequently, the utility associated with constructing such structures is found in the creative and/or problem solving process required to achieve a desired structural objective. Currently, construction assemblies that exploit magnetic properties to interlink various structural components and thereby form different two and/or three dimensional structures are known and can provide an added dimension of sophistication to the construction process (see, for example, the magnetic construction toy disclosed in Balanchi U.S. Pat. No. 6,626,727, the modular assemblies disclosed in Vicentielli U.S. Pat. No. 6,566,992, and the magnetic puzzle/toy disclosed in Smith U.S. Pat. No. 5,411,262). In addition, German Patent No. DE 202 02 183 U1 to Kretzschmar describes flat triangles, squares and rectangles used in conjunction with ferromagnetic balls to create a limited range of geometric constructions. The flat shapes disclosed in the Kretzschmar German Patent consist of magnets inserted in the corners of a triangular or square piece, or six magnets in a rectangular plate which can be attached to steel balls to create a limited number of three-dimensional shapes. Thus, conventional construction kits are appealing to persons of all ages in that they allow for both aesthetic and geometric creativity.

[0006] The above-noted magnet construction assemblies each contain a certain number of component parts, which can sometimes limit geometries and stable or secure connections. Thus, a need remains for a magnetic construction assembly that provides more flexibility in both aesthetic and geometric design, and, moreover, that provides an additional degree of design/construction sophistication.

BRIEF SUMMARY OF THE INVENTION

[0007] In accordance with the present invention, substantially planar structural components are provided having various two-dimensional generally polygonal shapes, such as rectangles and triangles. Each such structural component is sized for easy manipulation and includes a plurality of externally-oriented edge-mounted magnets positioned immediately adjacent (though preferably recessed slightly from the surface) the polygonal corners of the structural component and in other locations for use in connecting multiple instances of such structural components together, e.g., via the use of interconnecting ferromagnetic balls sized and configured for efficient interaction with such magnets. Such structural components can also include one or more slots extending peripherally inward from the component edge for use in assembling corresponding structural components together in an interlocking fashion, e.g., to form cruciform subassemblies, thereby increasing the stability and rigidity of the assembly. The spacing and orientation of the slots and magnets and the shapes of the structural components are coordinated so as to give one the option of keeping the center-to-center spacing of adjacent ferromagnetic balls substantially constant while at the same time drawing on one's imagination and creativity in building constructions having a broad variety of sizes, shapes, and/or configurations.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] For a better understanding of the present invention, reference is made to the following detailed description of various exemplary embodiments considered in conjunction with the accompanying drawings, in which:

[0009] **FIG. 1** is a perspective top view of a structural component constructed in accordance with a first exemplary embodiment of the present invention;

[0010] **FIG. 2** is a side elevational view of the structural component of **FIG. 1**;

[0011] **FIG. 3** is an edge elevational view of the structural component of **FIG. 1** taken along view line **3-3** shown in **FIG. 2**;

[0012] **FIG. 4** is a side-facing sectional view of the structural component of **FIG. 1** taken along the section line **4-4** shown in **FIG. 2**;

[0013] **FIG. 5** is a side-facing sectional view of the structural component of **FIG. 1** taken along section line **5-5** shown in **FIG. 2**;

[0014] **FIG. 6** is an upward-facing sectional view of the structural component of **FIG. 1** taken along the section line **6-6** shown in **FIG. 2**;

[0015] **FIGS. 7, 9, 11, 13, 15** and **17** are perspective top views of additional structural components constructed in accordance with the first exemplary embodiment of the present invention;

[0016] **FIGS. 8, 10, 12, 14, 16** and **18** are side elevational views of the structural components of **FIGS. 7, 9, 11, 13, 15** and **17**, respectively;

[0017] **FIG. 19** is a side elevational view of a construction made in accordance with the first embodiment of the present invention and including multiple instances of the structural components of **FIGS. 7, 9, 11, 13, 15** and/or **17**, the same being assembled and/or integrated using various interlocking and interconnection means;

[0018] **FIG. 20** is a top plan view of the construction of **FIG. 19**;

[0019] **FIG. 21** is a side-facing sectional view of the construction of **FIG. 19** taken along the section line **21-21** shown in **FIG. 19**;

[0020] **FIG. 22** is an upward-facing sectional view of the construction of **FIG. 19** taken along the section line **22-22** shown in **FIG. 19**;

[0021] **FIG. 23** is a perspective top view of a structural component constructed in accordance with a second exemplary embodiment of the present invention;

[0022] **FIG. 24** is a side elevational view of the structural component of **FIG. 23**;

[0023] **FIG. 25** is a top plan view of a construction made in accordance with the second embodiment of the present invention and including multiple instances of the structural component of **FIG. 23** assembled together using an interconnection means; and

[0024] **FIG. 26** is a top plan view of another construction made in accordance with the second embodiment of the present invention and including multiple instances of the structural component of **FIG. 23** assembled together using an interconnection means.

DETAILED DESCRIPTION OF THE INVENTION

[0025] Referring to **FIGS. 1-3**, there is shown a first structural component **10** constructed in accordance with a first embodiment of the present invention. The first structural component **10** includes a body **12**, which is substantially planar in configuration, and is substantially rectangular in general peripheral shape. The body **12** of the first structural component **10** includes a first major surface **14**, a second major surface **16** opposite and substantially parallel to the first major surface **14**, and a peripheral edge surface **18** disposed between and substantially perpendicular to the first and second major surfaces **14**, **16**. The peripheral edge surface **18** includes a top edge **20**, a bottom edge **22**, and first and second side edges **24**, **26**. Disposed along the peripheral edge surface **18** are a plurality of magnetic and mechanical interconnection elements, including respective first, second, and third interconnection elements **28**, **30**, **32** disposed along the top edge **20**, respective fourth, fifth, and sixth interconnection elements **34**, **36**, **38** disposed along the bottom edge **22**, a seventh interconnection element **40** disposed along the first side edge **24**, and an eighth interconnection element **42** disposed along the second side edge **26**. Though not clearly evident in all of the perspective views, the exposed surface of the magnet is preferably slightly recessed from its surrounding surface if he magnet is intended to attract a non-planer (e.g., spherical) component of the assembly. In this way the magnetic attraction pulls the non-planar component into engagement with the surrounding surface.

[0026] Referring to **FIGS. 2 and 4**, the first, second, third, fourth, and sixth interconnection elements **28**, **30**, **32**, **34**, **38** of the first structural component **10** are similarly configured and consist of a pocket **44** formed within the body **12**, a peripheral flange **46** formed in the edge surface **18** and defining an opening **48** to the pocket **44**, and a magnet **50** contained within the pocket **44** and having an outward-facing magnetic surface **52** adjacent to and coextensive with the opening **48** to the pocket **44** near the edge surface **18**. As best shown in **FIG. 4**, the outward facing magnetic surface is recessed from the edge surface **18**. As best shown in **FIG. 4**, the outward facing magnetic surface is recessed from the edge surface **18**. The peripheral flange **46** has a substantially planar configuration consistent with the local shape of the edge surface **18** and includes an inner rim **54** adjacent the magnetic surface **52** for retaining the magnet **50** within the pocket **44**, an outer edge **56** at the edge surface **18** having structure and function to be described hereinafter, and a beveled surface **58** disposed between the inner rim **54** and the outer edge **56**.

[0027] As shown in **FIGS. 1, 2, 5** and **6**, the fifth interconnection element **36** of the first structural component **10** consists of a slot **60** formed in the bottom edge **22** and oriented substantially perpendicularly to the otherwise planar local shape of the edge surface **18**. The slot **60** includes substantially straight, planar side walls **62** which are substantially parallel to each other, but substantially perpendicular to the bottom edge **22** and the first and second major surfaces **14**, **16**. A substantially planar bottom wall **64** is oriented perpendicular to the side walls **62** and parallel to the bottom edge **22**. Similar to the first, second, third, fourth and sixth interconnection elements **28**, **30**, **32**, **34**, **38**, the fifth interconnection element **36** includes a pocket **66** formed within the body **12**, a peripheral flange **68** formed in the edge surface **18** and defining an opening **70** to the pocket **66**, and a magnet **72** contained within the pocket **66** and having an outward-facing magnetic surface **74** adjacent to and coextensive with the opening **70** to the pocket **66** near the edge surface **18**. The peripheral flange **68** has a substantially planar configuration consistent with the local shape of the edge surface **18** (i.e., the bottom wall **64** of the slot **60**) and includes an inner rim **76** adjacent the magnetic surface **74** for retaining the magnet **72** within the pocket **66**, an outer edge **78** at the edge surface **18**, and a beveled surface **80** disposed between the inner rim **76** and the outer edge **78**.

[0028] Referring now to **FIGS. 1, 2, 3** and **6**, the seventh and eighth interconnection elements **40**, **42** of the first structural component **10** are similarly configured and consist of a recess **82** formed in the otherwise substantially planar local portions of the edge surface **18** comprising the respective first and second side edges **24**, **26**. The recess **82** includes a substantially cylindrical side wall **84** having a function to be explained hereinafter and which is substantially perpendicular to the first and second major surfaces **14**, **16**. The seventh and eighth interconnection elements **40**, **42** each include a pocket **86** formed within the body **12**, a peripheral flange **88** formed in the edge surface **18** (i.e., in the cylindrical side wall **84**) and defining an opening **90** to the pocket **86**, and a magnet **92** contained within the pocket **86** and having an outward-facing magnetic surface **94** adjacent to and coextensive with the opening **90** to the pocket **86** near the edge surface **18**. The peripheral flange **88** includes a substantially planar inner rim **96** adjacent the magnetic surface **94** for retaining the magnet **92** within the pocket **86**, an outer edge **98** having a substantially cylindrical configuration consistent with the local shape of the adjacent edge surface **18**, and a beveled surface **100** disposed between the inner rim **96** and the outer edge **98**.

[0029] Referring again to **FIG. 2**, the substantially rectangular general shape of the first structural component **10** is established by respective first, second, third, and fourth corners **102**, **104**, **106**, **108** of such rectangle. The first, third, fourth, and sixth interconnection elements **28**, **32**, **34**, **38** of the first structural component are disposed immediately adjacent the first, second, third, and fourth corners **102**, **104**, **106**, **108** respectively. The significance of this arrangement will be explained more fully hereinafter.

[0030] Various additional structural components constructed in accordance with the first embodiment of the

present invention are shown in **FIGS. 7-18**, including a second structural component **110** shown in **FIGS. 7-8**, a third structural component **112** shown in **FIGS. 9-10**, a fourth structural component **114** shown in **FIGS. 11-12**, a fifth structural component **116** shown in **FIGS. 13-14**, a sixth structural component **118** shown in **FIGS. 15-16**, and a seventh structural component **120** shown in **FIGS. 17-18**.

[0031] As shown in **FIGS. 7-8**, the second structural component **110** is in the general shape of a trapezoid. More particularly, the second structural component **110** is substantially identical to the first structural component **10**, except insofar as the second structural component **110** lacks the equivalent of the seventh and eighth interconnection elements **40**, **42** featured on the first structural component **10**, and is truncated where the first and second corners **102**, **104** of the first structural component **10** appear. Accordingly, the second structural component **110** includes a first major surface **122**, a second major surface **124**, and a peripheral edge surface **126** disposed between the first and second major surfaces **122**, **124** and including a top edge **128**, a bottom edge **130**, first and second side edges **132**, **134**, a first corner edge **136**, and a second corner edge **138**. As shown in **FIGS. 7-8**, the second structural component **110** includes first, second, third, and fourth interconnection elements **140**, **142**, **144**, **146** along the top and bottom edges **128**, **130**, which interconnection elements correspond with, and are substantially similar in all relevant respects to the second, fourth, fifth, and sixth interconnection elements **30**, **34**, **38**, **40** of the first structural element **10**, respectively.

[0032] As shown in **FIGS. 9-10**, the third structural component **112** is also in the general shape of a trapezoid. More particularly, the third structural component **112** is substantially similar to the second structural component **110**, except insofar as in the structural component **112**, the positions of the first and third interconnection elements **140**, **144** of the second structural component **110** have been interchanged. Accordingly, the third structural component **112** includes a peripheral edge surface **148** and first, second, third, and fourth interconnection elements **150**, **152**, **154**, **156** disposed along the peripheral edge surface **148** at positions corresponding to those of the respective first, second, third, and fourth interconnection elements **140**, **142**, **144**, **146** on the second structural component **112**. The first and third interconnection elements **150**, **154** of the third structural component **112** are configured substantially similarly, in at least a mechanical sense (if not in all respects, including that of magnetic polarity), to the respective third and first interconnection elements **144**, **140** of the second structural component **110**. The second and fourth interconnection elements **152**, **156** of the third structural component **112** are configured substantially similarly in all respects to the respective second and fourth interconnection elements **142**, **146** of the second structural component **110**.

[0033] Referring to **FIGS. 11-12**, the fourth structural component **114** is in the general shape of a right triangle. The fourth structural component **114** includes a peripheral edge surface **158** including a top edge **160**, a bottom edge **162**, a first side edge **164**, a second side edge **166**, and a corner edge **168**. The fourth structural component **114** further includes first and second interconnection elements **170**, **172** disposed along the first side edge **162**, a third interconnection element **174** disposed along the bottom edge **162**, and a fourth interconnection element **176** disposed along the second side edge **166**. The first, second, and fourth interconnection elements **172**, **174**, **178** of the fourth structural component **114** are configured similarly, in at least a mechanical sense (if not in all respects, including that of magnetic polarity), to the first interconnection element **28** of the first structural component **10**. The third interconnection element **174** of the fourth structural component **114** consists of a slot **178** formed in the bottom edge **166** and oriented substantially perpendicular thereto. The slot **178** includes substantially straight, planar side walls **180** which are substantially parallel to each other, but substantially perpendicular to the bottom edge **162**. A substantially planar bottom wall **182** is oriented perpendicular to the side walls **180**.

[0034] As shown in **FIGS. 13-14**, the fifth structural component **116** is also in the general shape of a right triangle. More particularly, the fifth structural component **116** is substantially similar to the fourth structural component **114**, except insofar as in the fifth structural component **116**, the position of the third interconnection element **174** of the fourth structural component **114** has been changed. Accordingly, the fifth structural component **116** includes a peripheral edge surface **184** and first, second, third, and fourth interconnection elements **186**, **188**, **190**, **192** disposed along the peripheral edge surface **184**. The first interconnection element **186** of the fifth structural component **116** is configured substantially similarly to the third interconnection element **174** of the fourth structural component **114**, except that a slot **194** of the third interconnection element **186** extends downward from a corner edge **196** thereof, rather than upward from a bottom edge **198** thereof. The second, third, and fourth interconnection elements **188**, **190**, **192** of the fifth structural component **116** are configured substantially similarly in all respects to the respective first, second, and fourth interconnection elements **170**, **172**, **176** of the fourth structural component **114**.

[0035] Referring to **FIGS. 15-16**, the sixth structural component **118** is generally rectangular in shape. The sixth structural component **118** includes a peripheral edge surface **200** including a top edge **202**, a bottom edge **204**, a first side edge **206**, and a second side edge **208**. The sixth structural component **118** further includes first and second interconnection elements **210**, **212** disposed along the first side edge **206**, and third and fourth interconnection elements **214**, **216** disposed along the second side edge **208**. The substantially rectangular shape of the sixth structural component **118** includes respective first, second, third, and fourth corners **218**, **220**, **222**, **224**, and is substantially similar in size and shape to the generally rectangular shape defined by corresponding respective corners **102**, **104**, **106**, **108** of the first structural component **10**. The significance of this arrangement will be explained more fully hereinafter. The first, second, third and fourth interconnection elements **210**, **212**, **214**, **216** of the sixth structural component **118** are configured substantially similarly in all respects to the respective first, third, fourth, and sixth interconnection elements **28**, **32**, **34**, **38** of the first structural component **10**. The first, second, third and fourth interconnection elements **212**, **214**, **216**, **218** of the sixth structural component **118** are also positioned immediately adjacent to the respective corners **218**, **220**, **222**, **224** thereof, providing an additional point of similarity with the first structural component **10**.

[0036] Referring to **FIGS. 17-18**, the seventh structural component **120** is also generally rectangular in shape. The

seventh structural component **120** includes a peripheral edge surface **226** including a top edge **228**, a bottom edge **230**, a first side edge **232**, and a second side edge **234**. The seventh structural component **120** further includes first and second interconnection elements **236**, **238** disposed along the first side edge **232**, and third and fourth interconnection elements **240**, **242** disposed along the second side edge **234**. The substantially rectangular shape of the seventh structural component **120** includes respective first, second, third, and fourth corners **244**, **246**, **248**, **250**, adjacent to which are positioned the respective first, second, third, and fourth interconnection elements **236**, **238**, **240**, **242**. The first, second, third and fourth interconnection elements **236**, **238**, **240**, **242** of the seventh structural component **120** are configured substantially similarly in all respects to the respective first, second, third, and fourth interconnection elements **210**, **212**, **214**, **216** of the sixth structural component **118**.

[**0037**] In operation, the above-described structural components can be assembled together with ferromagnetic balls to form stable constructions, which can include combinations of one or more cruciform subassemblies formed when some of these structural components are assembled together in an interlocking fashion. For example, and as will be explained in more detail hereinafter, two instances of the first structural component **10** (**FIG. 2**) can be oriented such that their respective slots **60** face each other, after which the two first structural components **10** can be merged to the limit allowed by their respective slot bottom surfaces **64**. Each of the slots **60** terminates (i.e., each of the slot bottom surfaces **64** fall) at approximately the midpoint of the height of the respective first structural component **10**, such that when the two first structural components **10** are merged as just described, the top edge **20** of one of the first structural components **10** become substantially coplanar with the bottom edge **20** of the other of the first structural components **10**, and vice versa. The width dimensions of each slot **60** closely tracks the thickness of the respective first structural component **10** (i.e., the distance between the first and second major surfaces **14**, **16** of the respective first structural component **10**) so as to produce an appropriately frictional fit between the two first structural components **10** when the same are merged as described above. Further, the polarities of the outward-facing magnetic surfaces **74** of the magnets **72** associated with the slots **60** of the respective first structural components **10** can be coordinated (e.g., to ensure the north pole of one such magnet **72** faces the south pole of the other such magnet **72**) so as to produce magnetic attraction between the two first structural components **10**. As shown in **FIGS. 19-20**, and as will be explained in more detail hereinafter, the above-described merging of a pair of first structural components **10** forms a first precisely-configured three-dimensional cruciform subassembly **252**, multiple instances of which can be incorporated within a larger construction for any number of purposes, including contributing structural stability to the assembly. As will also be explained, slightly different cruciform subassemblies can be formed by merging, in a similar fashion, and for example, a second structural component **10** with a third structural component **112** (e.g., producing a second cruciform subassembly **254** as shown in **FIGS. 19-20**), or a fourth structural component **114** with a fifth structural component **116** (e.g., producing a third cruciform subassembly **256** as shown in **FIGS. 19-20**), in a similar fashion.

[**0038**] Referring to **FIGS. 19-20**, construction **258** is shown including one or more instances each of the above-described first, second, third, fourth, fifth and sixth structural components **10**, **110**, **112**, **114**, **116**, **118** (some of which are arranged in the form of respective first, second and third cruciform subassemblies **252**, **254**, **256**, as described above), as well as numerous ferromagnetic balls **260** magnetically connected to, and disposed between, the magnets **50**, **92** (see **FIGS. 4 and 6**) of many of the interconnection elements of such structural components. According to this embodiment of the present invention, the diameters D of the ferromagnetic balls **260** are substantially equivalent, each such diameter preferably being held to within a tight mechanical tolerance of a common value. As may be seen with reference to **FIGS. 2**, **8**, **10**, **12**, **14**, **16**, **18**, **19** and **20**, the various structural components described above share many dimensions, such dimensions also preferably held to within a tight mechanical tolerance of common respective values, and such values being represented by the designations "A", "B", and "½A". The designations "A" and "½ A" represent constant distances between the magnetic axes of the magnets **50** (**FIG. 4**), such axes being substantially parallel. The value "B" represents constant distances between the magnetic surfaces **52** of the magnets **50** (**FIG. 4**). It will therefore be apparent that close coordination is achieved between and among the shapes of the various structural components described above, and between and among the positions, configurations, and orientations of the interconnecting elements associated with such structural components. One salutary effect of this close coordination is that the many ferromagnetic balls **260** contained in the construction **258** are caused to be arranged in a regular array **262** having consistent regular horizontal and vertical spacing, which is not only aesthetically pleasing to the eye, but is also conducive to producing constructions of various scales with consistent precision and stability. This also serves to spark the imagination and creativity of one who uses such structural components to build constructions, since there are very few limits on the shape or configuration of constructions that may be built in accordance with the present invention.

[**0039**] **FIGS. 21-22** illustrate two exemplary manners by which the ferromagnetic balls **260** connect with and/or interconnect the various structural components of the construction **258**. For example, and as shown in **FIG. 21**, a ferromagnetic ball **260** can be placed in magnetic contact with the magnetic surface **52** of the magnet **50** of the first interconnection element **140** of a second structural component **110**, which forms part of a second cruciform assembly **254** along with a third structural component **112**. The size and shape of the opening **48** of the first interconnection element **140** are such that the outer edge **56** is placed in edge-to-surface annular contact with the ferromagnetic ball **260** while the ball **260** is simultaneously in contact with the magnetic surface **52**. Thus the ferromagnetic ball **260** is not only allowed to remain in secure magnetic contact with the second structural component **110**, it is also kept in a constant position and orientation with respect to the first interconnection element **140** by the "seat" provided by the outer edge **56**.

[**0040**] For another example, and as shown in **FIG. 22**, a ferromagnetic ball **260** can be placed in magnetic contact with the magnetic surface **94** of the magnet **92** of the seventh interconnection element **40** of a first structural component **10**. The size and shape of the recess **82**, and specifically of

the cylindrical side wall **84**, is such that the cylindrical side wall **84** is placed in semicircular linear contact with the ferromagnetic ball **260** while the ball **260** is simultaneously in contact with the magnetic surface **94**. Thus the ferromagnetic ball **260** is not only allowed to remain in secure magnetic contact with the first structural component **10**, it is also kept in a constant position and orientation with respect to the seventh interconnection element **40** by the "seat" provided by the cylindrical side wall **84**.

[**0041**] It should be appreciated that numerous advantages are provided by the above-described structural components **10**, **110**, **112**, **114**, **116**, **118**, **120** and/or by constructions (such as construction **258**) containing such structural components in assembly with ferromagnetic balls **260** in accordance with the foregoing description. The consistent spacing between opposite magnetic surfaces of a given structural component, designated by "B", ensures consistent center-to-center distances, designated by "A" (and/or by "½ A"), between adjacent ferromagnetic balls **260** in the array (e.g., the array **262** of **FIGS. 19-20**). In addition, where a magnet, such as the magnet **50** of **FIG. 2**, is positioned immediately adjacent to a corner, such as the corner **104** of **FIG. 2**, of a corresponding structural component, such as the structural component **10** of **FIG. 2**, the magnet is operatively associated with one of the adjacent side edge surfaces, such as the top edge **20** of **FIG. 2**. This provides a simple construction for such a structural component, and as shown in **FIGS. 19-20**, provides one with the choice of gap sizes (e.g., wide or narrow) between adjacent structural components. Furthermore, disassembly and reassembly can be accomplished with great speed.

[**0042**] It should also be noted that the above-described structural components **10**, **110**, **112**, **114**, **116**, **118**, **120** can have numerous modifications and/or variations consistent with the first embodiment of the present invention. For example, one or more of such structural components can be modified to define a general planar shape other than that of a polygon, and/or a generally polygonal shape can be altered with one or more curved edge surfaces as desired. For another example, one or more of the interconnecting elements of such a structural component can be positioned on an edge surface so as not to coincide with the standard spacing of the array formed by the ferromagnetic balls. The same result can be achieved by providing an edge surface that diverges in shape or angle of extension from a more regular (e.g., straight and perpendicular) arrangement. For still another example, one or more of the above-described structural components **10**, **110**, **112**, **114**, **116**, **118**, **120** can have a body formed from two or more molded plastic parts (e.g., translucent and/or colored plastic) which are assembled together, e.g., via ultrasonic welding to form the body. In such circumstances, the pockets containing the magnets of the interconnecting elements can be formed from separate molded wall sections associated with different molded parts, and the magnets can be captured therein during body assembly. For a further example, magnets of different types, sizes and shapes can be used, it being recognized that rare-earth magnets in particular can provide exceptional strength per unit volume, and that a cylindrically-shaped magnet can provide excellent dimensional and orientational uniformity in the assembled structural component. For a still further example, one or more of the above-described structural components can be assembled together without the use of ferromagnetic balls. In such circumstances, the north-south polarity of the magnets used in the interconnection elements can be prearranged to facilitate such an assembly (e.g., axially-aligned magnets separated by a "B" direction and facing in opposite directions, or axially-spaced magnets separated by an "A" dimension and facing in the same direction, can be provided with opposite polarity). In still another example of a modification, the magnets associated with the above-described interconnection interfaces can be embedded without retaining flanges in the bodies of the structural components, and/or in a manner which does not provide annular edge-to-surface seating (e.g., flush with the edge surface)

[**0043**] An additional exemplary embodiment of the present invention is illustrated in **FIGS. 23-26**. Elements illustrated in **FIGS. 23-26** which correspond substantially to the elements described above with reference to **FIGS. 1-22** have been designated by corresponding reference numerals increased by an increment of one thousand. The embodiment of the present invention shown in **FIGS. 23-26** operates and is constructed in manners consistent with the foregoing description of the first embodiment of the invention, unless it is stated otherwise.

[**0044**] Referring to **FIGS. 23-24**, there is shown an eighth structural component **1264** constructed in accordance with a second embodiment of the present invention. As with the structural components associated with the above-described first embodiment, the eighth structural component **1264** is equipped with interconnection elements immediately adjacent to its corners that are still operatively associated with side, and net corner, edges. More particularly, the eighth structural component **1264** includes a body **1266** that is substantially planar in configuration and substantially square in general peripheral shape. The body **1266** includes a peripheral edge surface **1268**, four side edges **1270**, and four corner edges **1272** disposed between the respective side edges **1270**. The eighth structural component **1264** further includes eight interconnection elements **1028** similar to the first interconnection element **28** associated with the above-described first structural component **10**. The interconnection elements **1028** are distributed in a regular arrangement, each such interconnection element **1028** being disposed immediately adjacent one of the two sides of a corner edge **1272**. As shown in **FIG. 25-26**, in use, multiple instances of the eighth structural component **1264** can be assembled together (e.g., to form the two-dimensional assembly **1274** of **FIG. 25**, or the three-dimensional assembly **1276** of **FIG. 26**) with the use of one or more ferromagnetic balls **1260**. As described above, such balls can optionally be eliminated, and multiple instances of the eighth structural component **1264** can be assembled together directly, provided the respective polarities of the associated magnets **1050** are arranged to permit same.

[**0045**] It will be understood that the embodiments of the present invention described herein are merely exemplary and that a person skilled in the art may make many variations and modifications without departing from the spirit and scope of the invention. For example, the magnets **72** of the interconnecting elements **36**, **144** may be removed and the frictional fit between the pairs of structural components **10** and **110**, **112** relied upon to keep such structural components together as part of the respective cruciform subassemblies **252**, **256**. Additionally, other magnetic domains (i.e., north/south polarity arrangements) than those shown in **FIGS. 2,**

8, **10**, **12**, **14**, **16** and **18** may be provided with respect to the magnets **34**, **50**, **72**, **92** of the structural components **10**, **110**, **112**, **114**, **116**, **118**, **120**. All such variations and modifications, including those discussed above, are therefore intended to be included within the scope of the present invention. Further, this application is related to co-pending U.S. Patent Application No. _____, entitled Magnetic Toy Construction Modules with Side-Mounted Magnets by Daftari et al., filed _____, which is herein incorporated by reference in its entirety.

What is claimed is:

1. A planar body having a generally polygonal shape, comprising:

a first major surface;

a second major surface opposite and substantially parallel to the first major surface;

a peripheral edge surface disposed between and substantially perpendicular to the first and second major surfaces, the peripheral edge surface including a first side edge and a second side edge;

a slot formed in the first side edge; and

a first pocket formed adjacent the slot, the first pocket having a first magnet with an outward-facing magnetic surface.

2. The planar body of claim 1, wherein the outward-facing magnetic surface is recessed within the first pocket.

3. The planar body of claim 1, further comprising:

a recess formed in the second side edge, the recess including a substantially cylindrical side wall which is substantially perpendicular to the first and second major surfaces; and

a second magnet formed adjacent the recess.

4. The planar body of claim 1, further comprising a corner pocket disposed adjacent each corner of the generally polygonal shape, each corner pocket having a magnet with an outward-facing magnetic surface disposed therein, the outward-facing magnetic surface being recessed from an outer surface of the peripheral edge.

5. The planar body of claim 1, wherein the planar body is substantially rectangular in shape and wherein a pocket having a magnet fitted therein is disposed at each corner of the planar body.

6. The planar body of claim 1, wherein the planar body is in the general shape of at least one of a trapezoid and a triangle.

7. The planar body of claim 1, wherein the planar body is in the general shape of a rectangle.

8. A planar body having a generally polygonal shape, comprising:

a first major surface;

a second major surface opposite and substantially parallel to the first major surface; and

a peripheral edge surface disposed between and substantially perpendicular to the first and second major surfaces,

the peripheral edge defining a recess, the recess including a substantially cylindrical side wall which is substantially perpendicular to the first and second major surfaces, and

the peripheral edge defining a pocket disposed adjacent the recess, the pocket having a magnet with an outward-facing magnetic surface.

9. The planar body of claim 8, wherein the planar body is substantially rectangular in shape.

10. The planar body of claim 8, wherein the planar body is in at least one of the general shape of a trapezoid and a triangle.

11. The planar body of claim 8, further comprising a corner pocket disposed adjacent each corner of the generally polygonal shape, each corner pocket having a magnet with an outward-facing magnetic surface disposed therein.

12. The planar body of claim 11, wherein the outward-facing magnetic surface of each corner pocket magnet is recessed from an outer surface of the peripheral edge.

13. The planar body of claim 8, wherein the magnet is recessed the peripheral edge.

14. A three-dimensional assembly, comprising:

a plurality of substantially planar bodies, each substantially planar body having a generally polygonal shape including

a first major surface,

a second major surface opposite and substantially parallel to the first major surface,

a peripheral edge surface disposed between and substantially perpendicular to the first and second major surfaces,

the peripheral edge defining a slot, and

the peripheral edge defining a first pocket formed adjacent the slot, the first pocket having a first magnet with an outward-facing magnetic surface; and

a first planar body and a second planar body of the plurality of substantially planar bodies interlocked such that the slot of first planar body engages the slot of the second planar body and the first magnet of the first planar body magnetically bonds to the first magnet of the second planar body.

15. The three-dimensional assembly of claim 14, further comprising:

a third planar body and a fourth planar body of the plurality of substantially planar bodies interlocked such that the slot of the third planar body engages the slot of the fourth planar body and the magnet of the third planar body magnetically bonds to the magnet of the fourth planar body; and

a ferromagnetic ball,

wherein a second magnet formed in a second pocket within the peripheral edge of the second planar body magnetically bonds to the ferromagnetic ball and a second magnet formed in a second pocket within the peripheral edge of the third planar body magnetically bonds to the ferromagnetic ball.

16. The three-dimensional assembly of claim 15, wherein the second magnet of the second and third planar bodies is

recessed from an outer surface of the peripheral edge to form a seat for the ferromagnetic ball.

17. The three-dimensional assembly of claim 14, wherein each of the plurality of planar bodies further comprise:

a recess formed in the peripheral edge including a substantially cylindrical side wall; and

a third magnet formed in a third pocket adjacent the recess.

18. The three-dimensional assembly of claim 17, further comprising:

a third planar body and a fourth planar body of the plurality of substantially planar bodies interlocked such that the slot of the third planar body engages the slot of the fourth planar body and the magnet of the third planar body magnetically bonds to the magnet of the fourth planar body; and

a ferromagnetic ball,

wherein the third planar body and the second planar body are coupled such that the recess of the third planar body and the recess of the second planar body align to form a seat for the ferromagnetic ball, and the ferromagnetic ball magnetically bonds to the third magnet of the third planar body and to the third magnet of the second planar body.

19. The three-dimensional assembly of claim 18, wherein an outward-facing magnetic surface of the third magnet is recessed from an outer surface of the peripheral edge.

20. The three-dimensional assembly of claim 14, wherein the plurality of substantially planar bodies includes at least one planar body having a substantially rectangular shape.

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