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(54) APPARATUS AND METHOD FOR BONDING THREE DIMENSIONAL CONSTRUCTION TOYS WHEN ASSEMBLED

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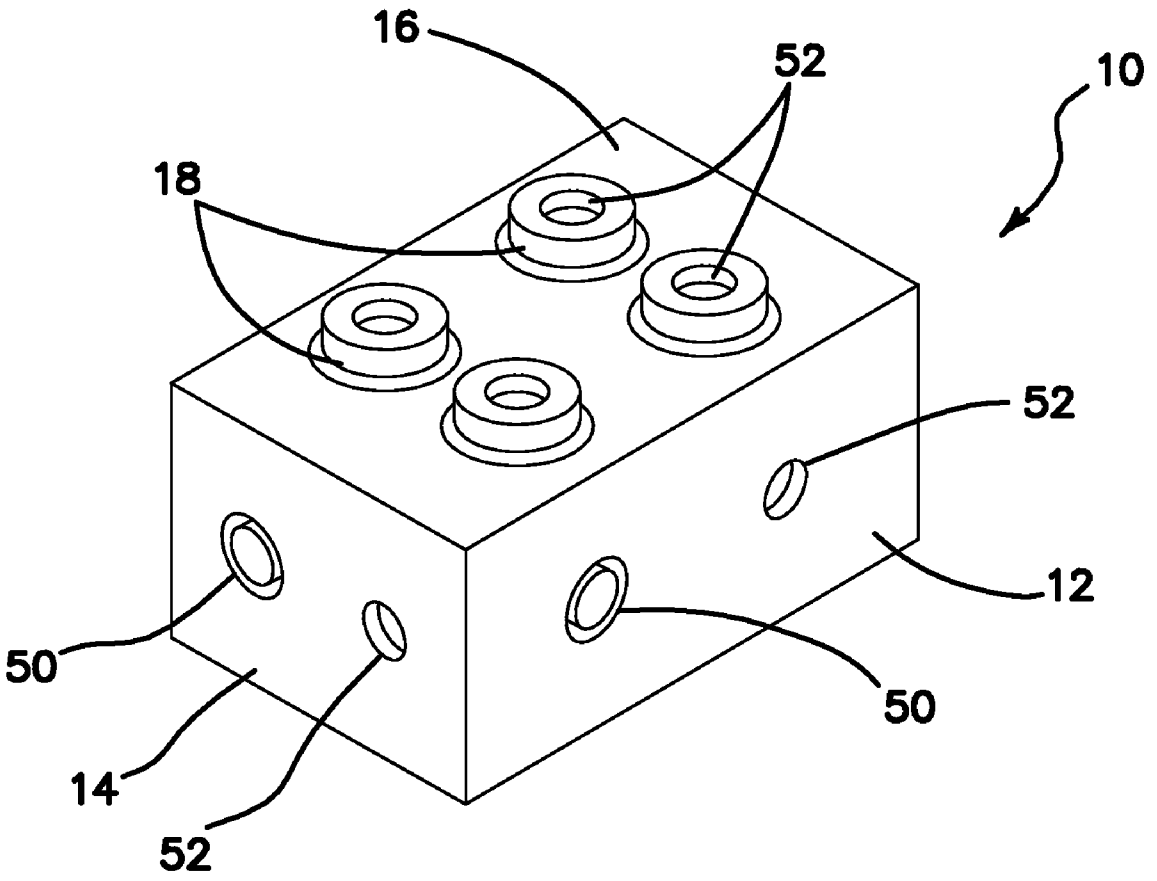
(57) **ABSTRACT**

The invention provides means and a method for temporarily or permanently coupling three dimensional blocks together commonly used in toys or puzzles. After the blocks have been assembled, a low current is sent through the blocks in order to notify a user that the blocks have been properly configured. The current through the blocks is then increased which activates a means for coupling the blocks together including a plurality of electrodes, a series of magnetic apertures, a plurality of resin pouches, or a combination thereof. After the blocks are coupled together, the current flow is stopped, leaving the blocks temporarily or permanently in the last position in which they were placed before the increased current was applied. In some embodiments, the blocks may be disassembled, placed into a new configuration, and then recoupled as many times as desired.



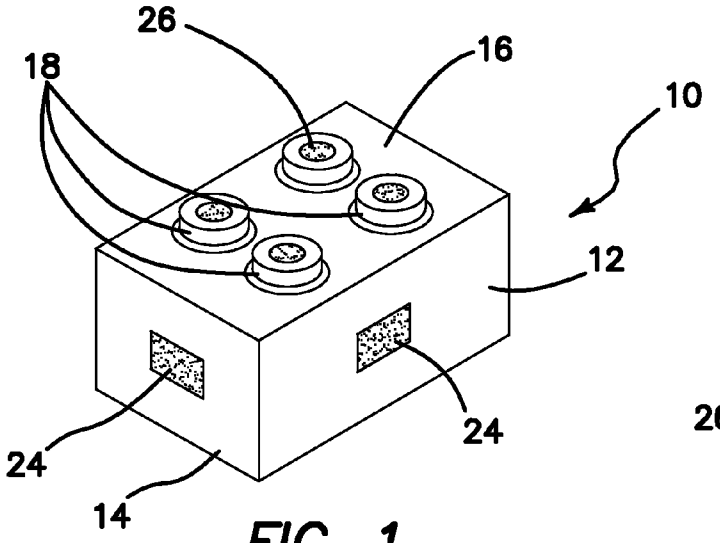


FIG. 1

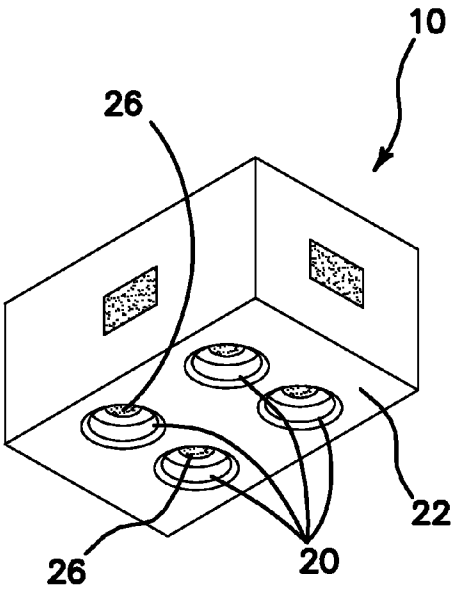
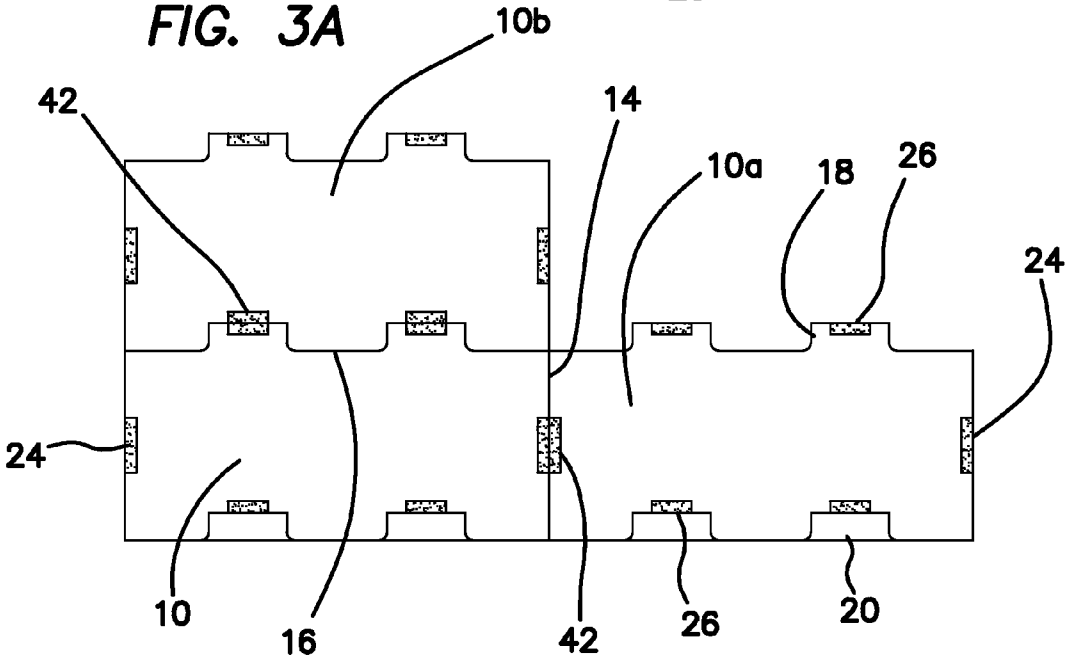


FIG. 2

FIG. 3A



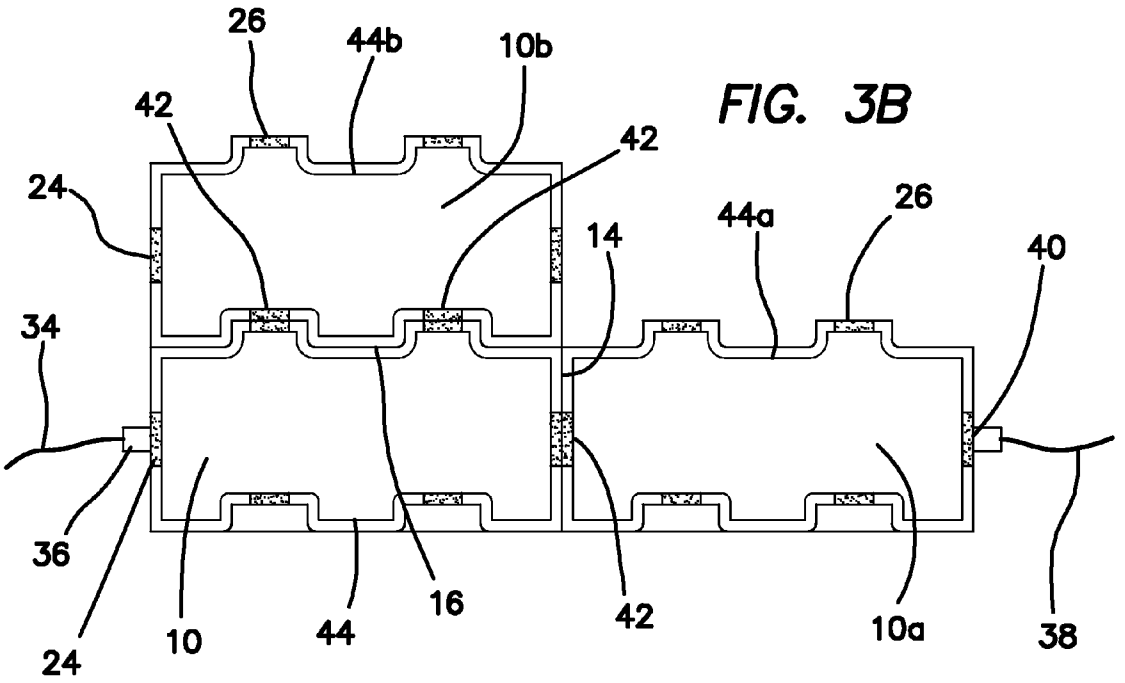

26
44b
10b
42
42
24
44a
26
14
40
34
36
24
10
44
16
42
10a
38

FIG. 3B

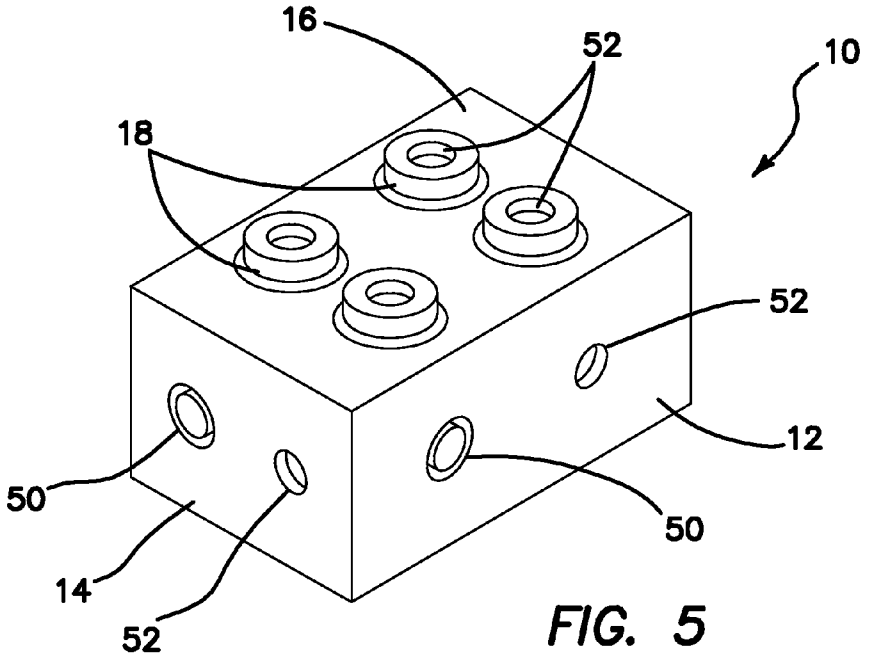

16
52
10
18
52
12
50
50
14
52

FIG. 5

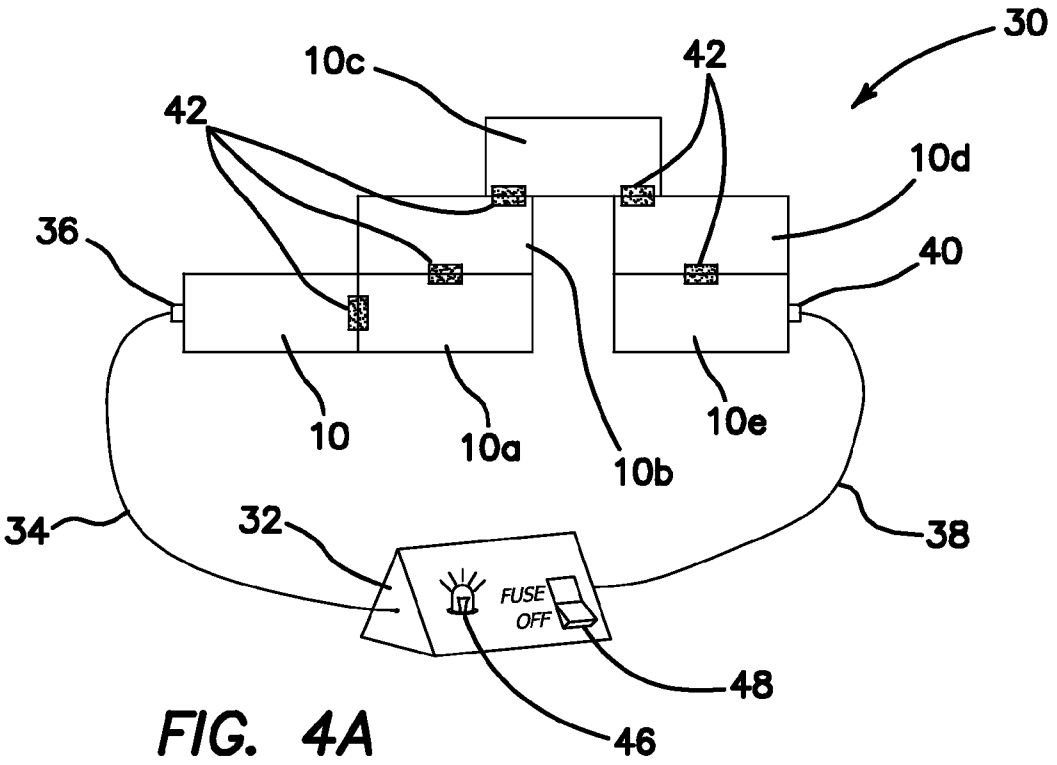

30
10c
42
42
10d
36
40
10
10a
10b
10e
34
32
38
FUSE
OFF
48
46

FIG. 4A

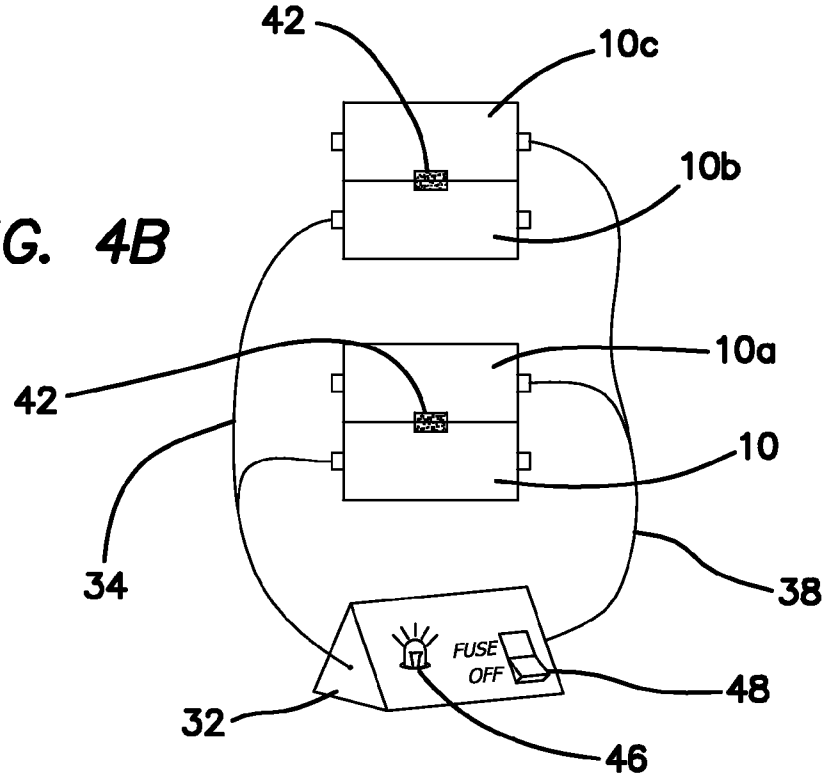

42
10c
10b
42
10a
10
34
38
FUSE
OFF
48
32
46

FIG. 4B

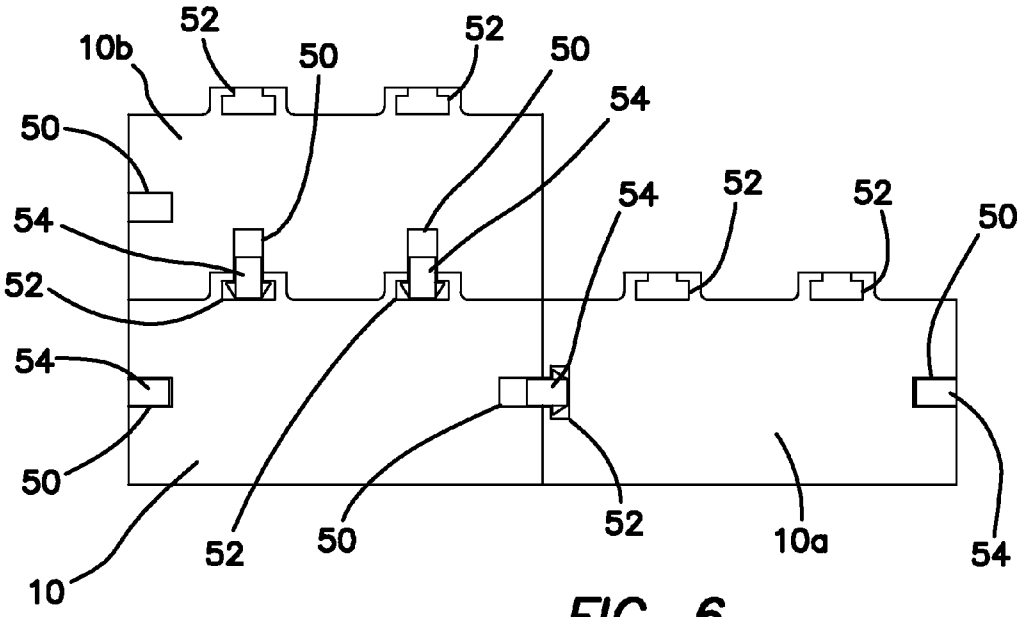


FIG. 6

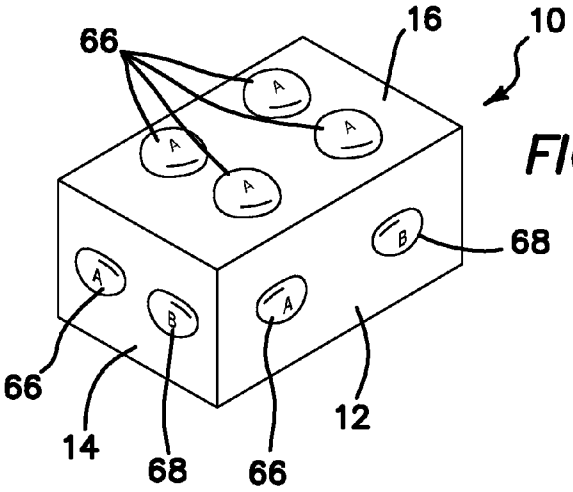


FIG. 8

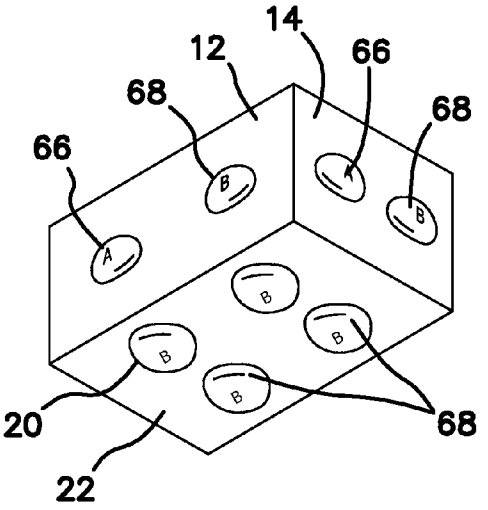


FIG. 9

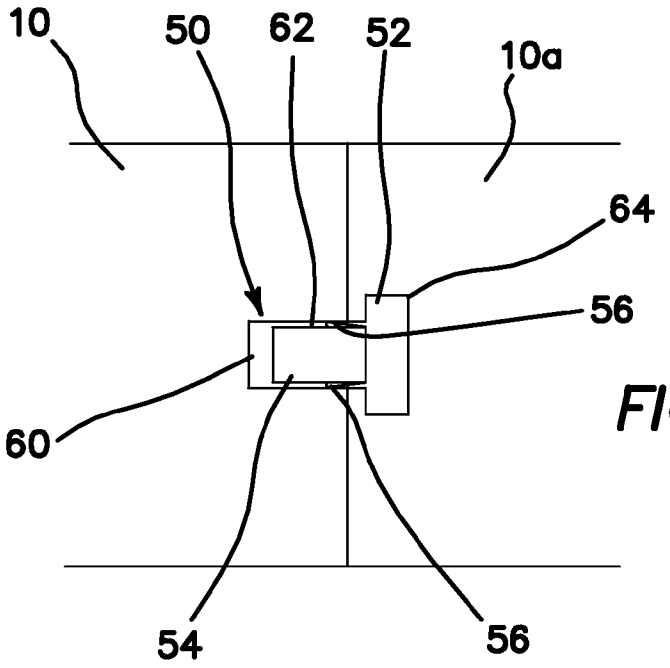


FIG. 7A

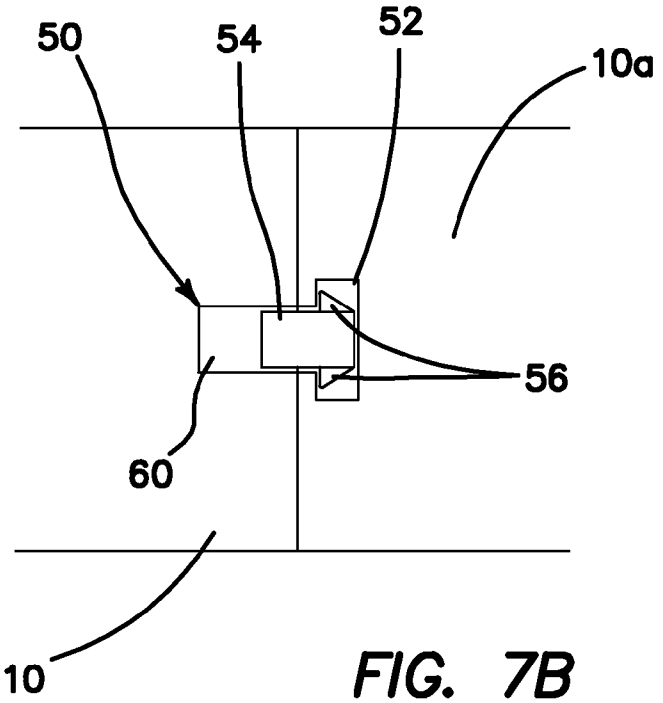


FIG. 7B

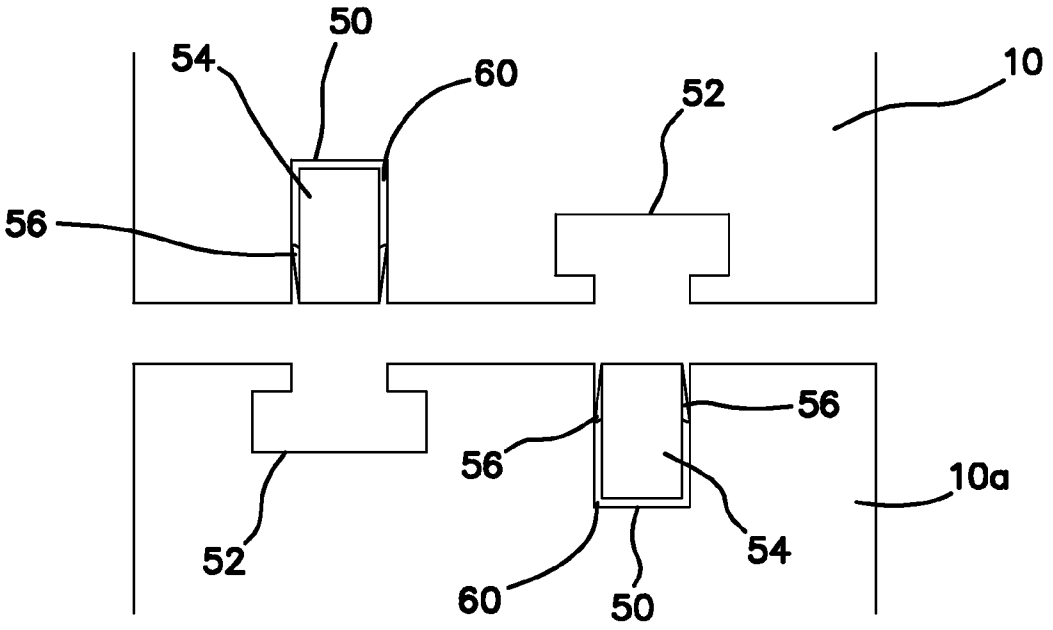


FIG. 10A

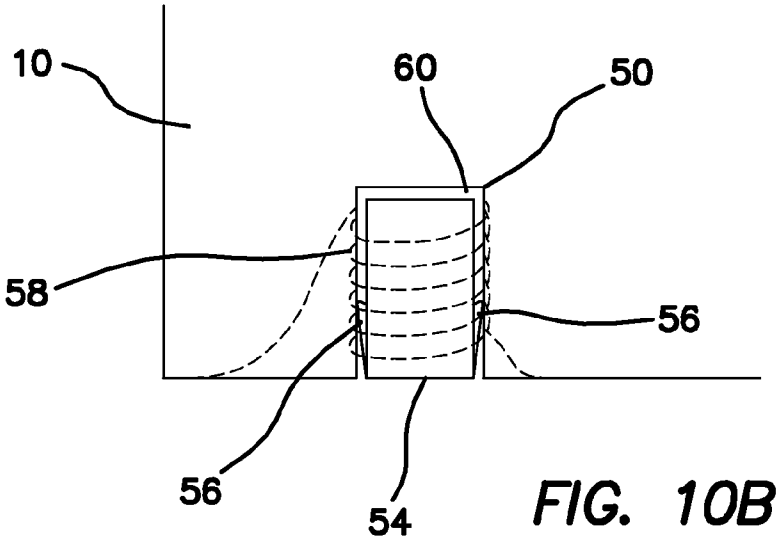


FIG. 10B

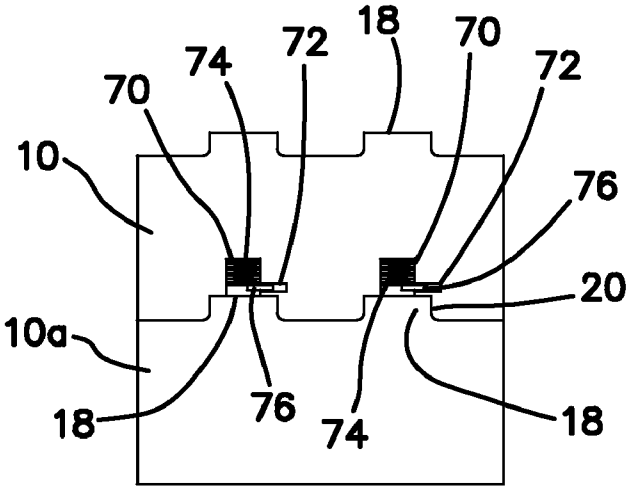


FIG. 11

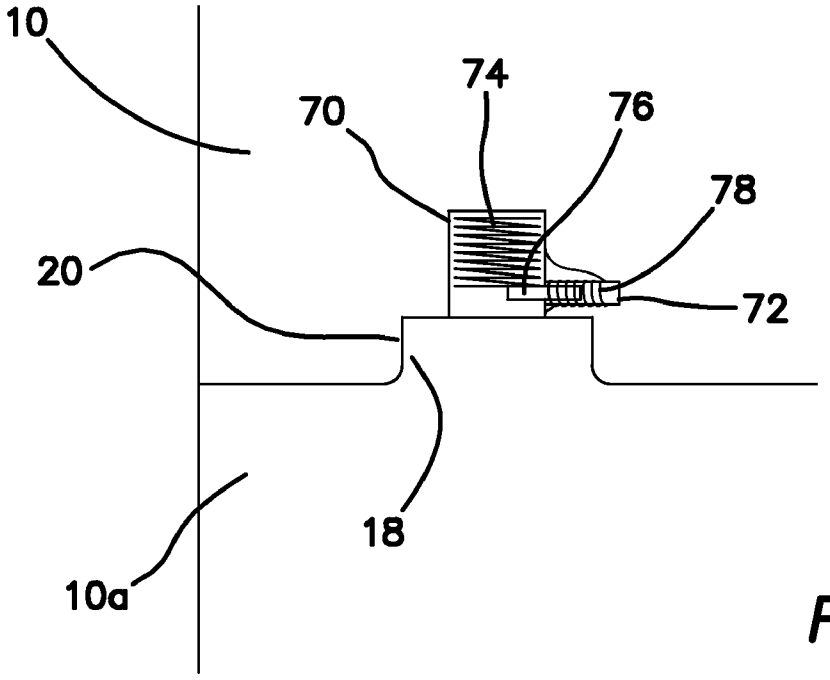


FIG. 12A

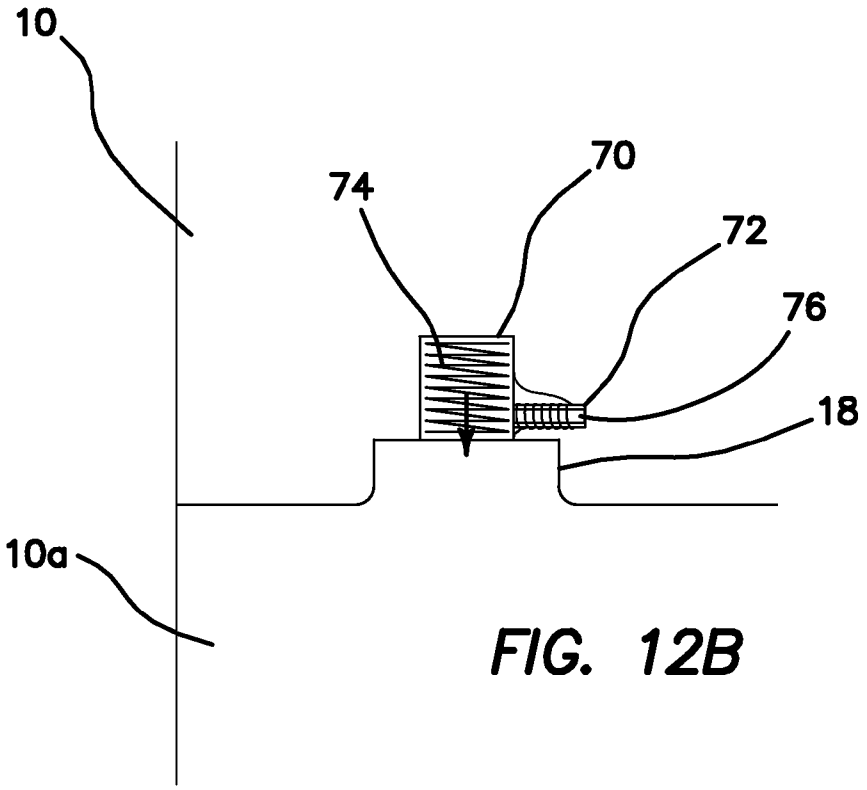


FIG. 12B

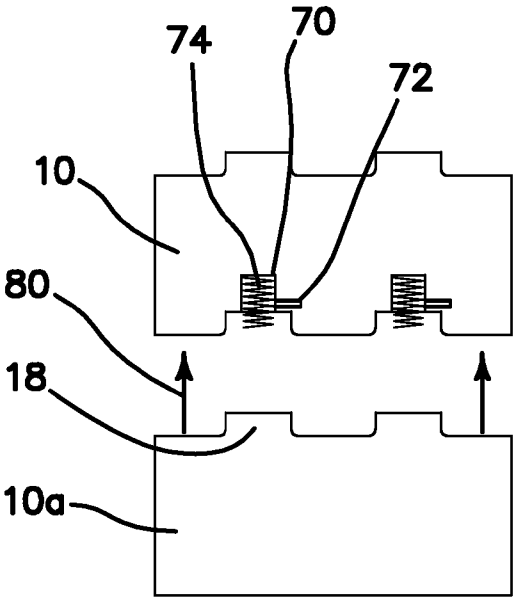


FIG. 13

APPARATUS AND METHOD FOR BONDING THREE DIMENSIONAL CONSTRUCTION TOYS WHEN ASSEMBLED

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The invention relates to the field of three dimensional construction toys, namely for a means for permanently or temporarily coupling the individual pieces of the three dimensional construction toys together once properly assembled.

[0003] 2. Description of the Prior Art

[0004] Children have long built toys or assembled various forms of puzzles from Legos® and other types of three dimensional construction toys that fall apart when pulled or dropped onto a hard surface. Sometimes a child or other individual wishes to maintain that toy or puzzle in its completed form either on a temporary or even a permanent basis. Unfortunately, most if not all three dimensional construction toy puzzles inherently lack the durability and structural integrity required in order to be displayed or transported for even a short amount of time, let alone permanently.

[0005] Several attempts have been made to correct this problem, all to various degrees of success. For example, some puzzles found in the prior art may be locked together by a pressure sensitive adhesive or even a heat activated adhesive that binds the various pieces of the puzzle together. Other solutions have included pouring a resin or epoxy over the completed puzzle and then letting the resin or epoxy dry thus maintaining the puzzle in its completed shape. Still other attempts have included the use of magnets, releasable adhesives, tape, electrostatic cling, snaps, or even hook-and-loop type fasteners.

[0006] While these prior art solutions to maintaining a completed puzzle toy in a fixed position are not without their merits, they are not without their respective faults either. Adhesives can prove to be messy and unreliable, especially when there is excessive moisture present. Furthermore, if one of the pieces of the puzzle is found to be missing after the resin has been applied, there is no way to add the missing piece to the rest of the puzzle without possibly destroying the now bonded together puzzle. Other means such as magnets, hook-and-loop fasteners, and electrostatic cling do not provide reliable long term display of the completed construction puzzle toy.

[0007] What is needed is a means for a three dimensional construction puzzle toy to be temporarily or permanently bonded together reliably if, and only if, that puzzle toy has been properly and completely constructed.

BRIEF SUMMARY OF THE INVENTION

[0008] The illustrated embodiment of the current invention is directed to the temporary or permanent bonding of a plurality of three dimensional construction pieces or toy blocks. Each construction piece includes a means for permanently or temporarily bonding on or in each of its surfaces. When the construction pieces are assembled, an electrical circuit is formed. A control box, which is electrically coupled to the assembled construction pieces, determines and alerts a user when a completed circuit has been formed by the assembled construction pieces. The user may then selectively activate the permanent or temporary bonding means in order to bind the construction pieces together.

[0009] In one embodiment, the means for permanently or temporarily bonding the plurality of construction pieces together includes a fusible electrode disposed on each of the construction pieces. Each fusible electrode is capable of aligning with another fusible electrode located on an adjacent construction piece and forming an electrical connection between there between.

[0010] The toy forms a complete electrical circuit with a wire network that is on or in each of the construction pieces. When assembled, the wire network within each construction piece link up and electrically couple at the position where two electrodes are aligned together.

[0011] Each of the construction pieces of the toy may also be composed of conductive material and be arranged and configured so that each construction piece is capable of being electrically coupled to an adjacent construction piece only through a selected fusible electrode, the remainder of the construction piece being electrically insulated.

[0012] The control box coupled to the toy includes a way for providing a low intensity electrical current into the assembled construction pieces. The control box attempts to send the low intensity electrical current in a loop through a circuit defined by the plurality of construction pieces to determine whether or not a completed circuit has been formed in the assembled construction pieces. If a complete circuit has been formed by the plurality of construction pieces, an indicator located on the control box indicates as such to the user.

[0013] In another embodiment, after the indicator has acknowledges a complete circuit has been made, the control box provides a second high intensity electrical current to the completed circuit in the assembled construction pieces. The high intensity current activates a magnetic actuator and a corresponding receiving cavity disposed on opposing adjacent surfaces of two adjacent construction pieces. The magnetic actuator and receiving cavity of the opposing construction pieces were aligned with each other to couple to each other. The magnetic actuator includes an armature and a way of producing a magnetic field so that the armature is magnetically pushed out of the actuator and into the corresponding receiving cavity disposed on the adjacent construction piece to form a mechanical coupling between the adjacent construction pieces. The actuator produces a magnetic field with a wire capable of carrying electrical current wrapped around the outside surface of the magnetic actuator, much like a solenoid as is well known in the art. The armature includes a plurality of retractable barbs disposed along its longitudinal axis. The barbs of the armature remain retracted while in the magnetic actuator and then deploy once within the larger receiving cavity of the adjacent construction piece.

[0014] In a separate embodiment, the plurality of construction pieces of the toy include a plurality of resin pouches disposed on each surface of the plurality of construction pieces. Each of the resin pouches are composed of material that upon application of an aqueous solution, are dissolved. Dissolving of the resin pouches releases the resin contained within the resin pouches which then comes into contact with the contents of a resin pouch of an adjacent construction piece. The resins mix, are allowed to dry, and then form a strong bond between the construction pieces. The contents of the resin pouches are resins or epoxies that are well known in the art which include means for reacting with each other but do not react with the surrounding aqueous solution.

[0015] The current invention also provides for a method for temporarily or permanently coupling a plurality of three

dimensional construction pieces together including first assembling the plurality of construction pieces into a desired configuration. After the pieces are assembled, a first electrical current to the assembled is applied to the construction pieces and is conducted through the assembled construction pieces through a completed circuit. When a completed circuit has been achieved, an indicator is activated. At this point, the means for temporarily or permanently joining the plurality of construction pieces together may be implemented.

[0016] In one embodiment, the means for temporarily or permanently joining the plurality of construction pieces together includes applying a second electrical current that is stronger than the first electrical current to a plurality of electrodes disposed on the surfaces of each of the plurality of construction pieces. The second electrical current fuses together each of the electrodes which are in contact with each other between adjacent construction pieces. Once fused, the second electrical current is discontinued and the fused electrodes are cooled to form a spot weld with the adjacent construction piece.

[0017] In a separate embodiment, means for temporarily or permanently coupling the plurality of construction pieces includes applying a second electrical current that is stronger than the first electrical current to a magnetic actuator. The actuator then creates a magnetic field around it which forces out an armature from the within the magnetic actuator. The armature is then disposed into a receiving cavity of an adjacent construction piece. Once inserted, a plurality of retractable barbs disposed along the longitudinal axis of the armature are expanded within the receiving cavity of the adjacent construction piece. The application of the second electrical current is then discontinued and the armature is maintained within the receiving cavity to form a mechanical bond between one construction piece and an adjacent construction piece.

[0018] In a separate embodiment, the means for temporarily or permanently coupling the plurality of construction pieces includes submerging the toy in an aqueous solution bath. The aqueous solution then breaches or dissolves two aligned resin pouches disposed on opposing surfaces of two adjacent construction pieces. Resins contained within the two aligned resin pouches are released and make contact with each and mix between the adjacent construction pieces. The resins are allowed to cure and harden and thus from a bond between the adjacent construction pieces.

[0019] While the apparatus and method has or will be described for the sake of grammatical fluidity with functional explanations, it is to be expressly understood that the claims, unless expressly formulated under 35 USC 112, are not to be construed as necessarily limited in any way by the construction of "means" or "steps" limitations, but are to be accorded the full scope of the meaning and equivalents of the definition provided by the claims under the judicial doctrine of equivalents, and in the case where the claims are expressly formulated under 35 USC 112 are to be accorded full statutory equivalents under 35 USC 112. The invention can be better visualized by turning now to the following drawings wherein like elements are referenced by like numerals.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] FIG. **1** is a top perspective view of a three dimensional construction toy block with a plurality of electrodes coupled to its surfaces.

[0021] FIG. **2** is a bottom perspective view of the three dimensional construction toy block seen in FIG. **1**.

[0022] FIG. **3**A is a cross sectional view of a plurality of three dimensional construction toy blocks seen in FIG. **1** coupled together via the plurality of electrodes.

[0023] FIG. **3**B is a cross sectional view of the plurality of three dimensional construction toy blocks seen in FIG. **3**A with the internal wire networks of each toy block also coupled together via the plurality of electrodes.

[0024] FIG. **4**A is schematic diagram of a plurality of three dimensional construction toy blocks coupled together and to a control box in series.

[0025] FIG. **4**B is schematic diagram of a plurality of three dimensional construction toy blocks coupled together and to a control box in parallel.

[0026] FIG. **5** is a top perspective view of an alternative embodiment of the three dimensional construction toy block comprising a plurality of magnetic actuators and receiving cavities.

[0027] FIG. **6** is a cross sectional view of a plurality of three dimensional construction toy blocks seen in FIG. **5** coupled together via the plurality of magnetic actuators and receiving cavities.

[0028] FIG. **7**A is magnified view of the coupling between the magnetic actuator and receiving cavity of the three dimensional construction toy blocks seen in FIG. **6** before the magnetic actuator is fully enveloped within the receiving cavity.

[0029] FIG. **7**B is magnified view of the coupling between the magnetic actuator and receiving cavity of the three dimensional construction toy blocks seen in FIG. **6** after the magnetic actuator is fully enveloped within the receiving cavity.

[0030] FIG. **8** is a top perspective view of an alternative embodiment of the three dimensional construction toy block comprising a plurality of resin pouches.

[0031] FIG. **9** is a bottom perspective view of the alternative embodiment of the three dimensional construction toy block seen in FIG. **8**.

[0032] FIG. **10**A is top down plan view of the alignment of the magnetic actuators and receiving cavities between two adjacent three construction toy blocks seen in FIG. **5**.

[0033] FIG. **10**B is a magnified view of the magnetic actuator of the three dimensional construction toy block seen in FIG. **5** before the armature has been deployed from the bore of the magnetic actuator.

[0034] FIG. **11** is a cross sectional view of an alternative embodiment of the three dimensional construction toy blocks comprising a plurality of magnetically actuated springs internally disposed within the toy blocks.

[0035] FIG. **12**A is a magnified view of a magnetically actuated spring of the three dimensional construction toy blocks seen in FIG. **11** before the spring is released by an armature.

[0036] FIG. **12**B is a magnified view of a magnetically actuated spring of the three dimensional construction toy blocks seen in FIG. **11** after the spring is released by an armature.

[0037] FIG. **13** is a cross sectional view of the three dimensional construction blocks seen in FIG. **11** after the plurality of magnetically actuated springs internally disposed within the toy blocks have been released, launching the top toy block off of the bottom toy block disposed beneath it.

[0038] The invention and its various embodiments can now be better understood by turning to the following detailed description of the preferred embodiments which are pre-

sented as illustrated examples of the invention defined in the claims. It is expressly understood that the invention as defined by the claims may be broader than the illustrated embodiments described below.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0039] The illustrated embodiment of the current device is directed for use with three dimensional constructional toys or building blocks, such as Legos®, constructed of plastic, plastic composite, or any other suitable material now known or later devised. While it is preferred that a pre-existing construction toy be used such as those made by Legos®, any type of toy that is constructed from a plurality of separate pieces now known or later devised may be used without departing from the original spirit and scope of the invention. In the illustrated embodiment, the description will be made in terms of building blocks made of plastic, but it must be understood that any material may compose the building blocks with appropriate modifications made to the embodiment to accommodate that material according to overall object of the embodiment.

[0040] Greater understanding of the current device can be had by turning to FIGS. **1**-**3**B which shows the most basic embodiment of the device in the form of a block **10**. The block **10** is substantially rectangular shaped as seen in FIG. **1** and takes the form most commonly used in three dimensional construction toys or puzzles, namely it comprises at least two lateral surfaces **12**, at least two traverse surfaces **14**, and a top surface **16**. It should be expressly understood however that the shape shown in FIGS. **1**-**3**B is for illustrative purposes only. Other three dimensional shapes such as cubes, spheres, or polyhedrons may also be used. Simple three dimensional shapes are illustrated here for ease of depiction. Alternatively, other embodiments may comprise where the individual pieces of the puzzle toy are structurally shaped such as the pieces that comprise a model airplane or ship for example.

[0041] Turning to FIG. **1**, the top surface **16** of the block **10** comprises a plurality of nodes **18** which are used to couple the block **10** into a corresponding plurality of female apertures **20** located within a bottom cavity **22** of another block **10** disposed or placed above it as seen in FIGS. **2** and **3**A. Internal printed circuit wiring deposited onto or into the block **10**, not shown, interconnects the nodes **18** such that when a plurality of blocks **10** are correctly assembled into the completed puzzle a complete circuit through all the nodes is provided. By providing an appropriate topology of internal circuit connection between selected nodes only a single or selected correct construction or group of constructions will provide a complete circuit and allow for the possibility of the nodes **18** later being fused together so that the puzzle remains intact.

[0042] In one embodiment, the blocks **10** are either manufactured with or coated with at time of manufacture with a thermosetting material coating to be determined according to the material which composes the piece. The material coating may be similar to the composition the piece or may be made with different chemical or physical properties. When the puzzle toy is assembled or constructed by the user, the user places the completed puzzle toy under a heat lamp, the heat flow from a light, a heated air flow from a hand dryer, or in an oven to activate the material coating causing the blocks **10** it is disposed over to bond together. Alternatively, the plastic or material that comprises the blocks **10** itself may be fusible so that merely heating the assembled blocks **10** when in the assembled state will allow them to bond together. The bond may be permanent or reversible, so that if it were reheated, the blocks **10** could then be repeatedly decoupled and reassembled and then bonded together again. The use of bonding sprays for permanently fixing together assembled two dimensional jig saw puzzles are well known.

[0043] In another embodiment, the material coating is delivered as a very light spray with high surface tension so that it is "sucked" into the joints or small gaps between the blocks **10**. The coated blocks **10** are then set with heat, a laser, or a UV light or any other kind of an activating energy or material.

[0044] The specific choice of the material coating used is not critical to the invention as long as it is capable as acting as a bonding agent. In each of the foregoing embodiments, the material coating having the properties attributed to it may be selected from any one of a plurality of conventional bonding agents currently known in the art to exist or as may be later developed without departing from the original spirit and scope of the invention.

[0045] However in the illustrated embodiment of the current invention, the puzzle toy comprises a means for bonding the blocks **10** together which may be activated, if elected, by a wired or printed circuit disposed within the blocks **10** which create a closed circuit when the puzzle toy is complete.

[0046] For example, in one embodiment shown in FIGS. **1** and **2**, the block **10** comprises a plurality of square electrodes **24**, one square electrode **24** being disposed on each of the traverse surfaces **14** and on each of the lateral surfaces **12**. Additionally, a plurality of circular electrodes **26** are disposed on top of the coupling nodes **18** and within the corresponding female apertures **20** as best seen in FIG. **2**. Both the square electrodes **24** and circular electrodes **26** are comprised of fusible materials well known in the art that when a predetermined amount of current passes through it, melt and thus destroy the electrode **24**, **26** itself.

[0047] As the puzzle toy is being assembled by a user, the block **10** may be placed next to an adjacent block **10**A. Alternatively, block **10** may serve as the base for a stacked block **10**B on top of it with the nodes **18** of the block **10** firmly inserted into the female apertures **20** of the top block **10**B as seen in the cross-sectional view of FIG. **3**A. The coupling between the nodes **18** and the female apertures **20** is initially accomplished by applying pressure to the nodes **18** until they are well within the female apertures **20** as is well known in the art. As seen in FIG. **3**A, when the blocks **10**, **10**A, **10**B are properly placed, the square electrodes **24** and circular electrodes **26** disposed at their respective locations line up and are in close contact with each other. For example with block **10** and adjacent block **10**A, both square electrodes **24** disposed on their respective traverse surfaces **14** meet and are in contact with each other and form a contact **42**. Additionally with block **10** and stacked block **10**B, the circular electrodes **26** disposed on top of the nodes **18** of the block **10** are pressed and held against the circular electrodes **26** disposed within the female apertures **20** of the stacked block **10**B and form another contact **42**. The square electrodes **24** and circular electrodes **26** of the blocks **10**, **10**A, **10**B that are not touching another block are left exposed to the ambient air. Other configurations than what is shown in FIG. **3**A may be used without leaving the scope of the invention. For example, fewer or additional blocks in an infinite number of stacked

configurations, adjacent configurations, or combinations thereof are expressly considered to be contained within this embodiment.

[0048] When the puzzle toy has been completed or in a final configuration desired by the user as seen in FIG. **4**A and denoted with general reference numeral **30**, an electrical current is passed through the completed puzzle toy **30** by a control box **32**. The control box **32** comprises an incoming lead **34** that is electrically coupled to the completed puzzle toy **30** by an electrical aperture input **36**. Conversely, the control box **32** also comprises an outgoing lead **38** electrically coupled to the completed puzzle toy **30** by an electrical aperture output **40**. The control box **32** receives power from a power supply which may be a plurality of internal batteries or an AC or DC power source as is known in the art.

[0049] In one embodiment, when the control box **32** has had its incoming lead **34** and outgoing lead **38** coupled to the completed puzzle toy **30**, a low intensity electrical current is sent from the control box **32** through the incoming lead **34** and into the completed puzzle toy **30**, preferably through one of the plurality of square electrodes **24** disposed on its surface. The current is sufficiently low so that it may pass through the electrodes **24**, **26** without causing them to melt and thus break the circuit. The low current then travels through the blocks comprising the completed puzzle toy **30** through a series of formed contacts **42**, namely either a pair of adjacent square electrodes **24** or a pair of stacked circular electrodes **26**. For example, in the puzzle toy **30** shown in FIG. **4**A, the current would enter the puzzle toy **30** at block **10**, then travel to block **10**A, block **10**B, block **10**C, block **10**D, and block **10**E in succession by means of the plurality of contacts **42** and then exit the puzzle toy **30** through the electrical aperture output **40**. The current then returns to the control box **32** through the outgoing lead **38** and thus completes a circuit with the plurality of blocks **10**-**10**E coupled together in electrical series.

[0050] It should be understood that the exact configuration of the blocks **10**-**10**E being coupled in series is for illustrative purposes only. For example, the blocks **10**-**10**E may also coupled in parallel to the control box **32** as seen in FIG. **4**B. In this embodiment, the incoming lead **34** is coupled to two blocks, specifically blocks **10** and **10**B here. Similarly, the outgoing lead **38** is coupled to two blocks, specifically blocks **10**A and **10**C here. Current received from the control box **32** enters blocks **10** and **10**B simultaneously and crosses the respective contact **42** to blocks **10**A and **10**C contemporaneously. The current then exits block **10**A and block **10**C simultaneously and is returned to the control box **32** by the outgoing lead **38** and completing the circuit. It should also be expressly understood that any number of series circuits, parallel circuits, or combinations thereof may comprise the completed puzzle toy **30**.

[0051] In the preferred embodiment where the plurality of blocks that comprise the completed puzzle toy **30** are made from plastic or plastic composites, the electric current sent from the control box **32** travels from block to block and contact to contact via a plurality of internal wire networks **44**-**44**B. When current enters the first block **10** seen in FIG. **3**B from the incoming lead **34**, it first makes contact with the square electrode **24** disposed on that particular surface of the block **10**. The current is then split into several different directions by a first internal wire network **44**. The first internal wire network **44** is a plurality of conventionally used wires suitable for transferring current loads that link all of the square electrodes **24** and circular electrodes **26** together within the first block **10** in series. In other words, the first internal wire network **44** is the means by which an incoming current is instantly distributed to all of the electrodes **24**, **26** within the block **10** from a single entry point, namely from the electrode in which the incoming lead **34** is coupled to by the incoming electrical aperture **36**. In the instances where the electrodes **24**, **26** form part of a contact **42** with either block **10**A or **10**B as seen in FIG. **3**B, the current crosses the contact **42** by means commonly known in the art and enters that respective block **10**A, **10**B. Both block **10**A and block **10**B each comprise their own internal wire network **44**A, **44**B respectively which then repeats the process of sending the current throughout every electrode **24**, **26** disposed within each block **10**A, **10**B. It is in this fashion that electric current may be spread block to block throughout the entirety of the completed puzzle toy **30**. Eventually, the current will reach the electrode **24**, **26** which is coupled to the outgoing lead line **38** via the electrical aperture output **40**, thus completing the circuit with the control box **32**.

[0052] Alternatively, the blocks **10** comprising the puzzle toy **30** may be manufactured from an electrically conductive material themselves, thus eliminating the need for internal wire networks **44** completely. In this embodiment, electric current would pass from block **10** to block **10** via the surface contacts made at the lateral surfaces **12**, traverse surfaces **14**, or at the contact point of the nodes **18** to the female apertures **20**. The surface of the blocks **10** are then coated with an insulator so that electrical connection is made only through selected nodes **18** that are selectively rendered conductive and allowed to make electrical connection with a mating selectively conductive node **18** in another block **10**, if correctly assembled. Incorrect assemblies will not result in interconnection between all the blocks **10** through active or conductive nodes **18** and hence a complete circuit will not be made.

[0053] In one preferred embodiment, when a low level current has been established through the completed puzzle toy **30**, a small light and/or buzzer **46** disposed on the control box **32** is illuminated as seen in FIGS. **4**A and **4**B, notifying the user that the blocks **10** which comprise the completed puzzle toy **30** have been properly constructed. The light **46** may illuminate as soon as the last block **10** has been properly placed, or alternatively, after both the incoming lead line **34** and outgoing lead line **38** have been properly placed as disclosed above.

[0054] In another embodiment, when a low level current has been established through the completed puzzle toy **30**, the puzzle toy **30** itself activates to notify the user that the blocks **10** which comprise the completed puzzle toy **30** have been properly constructed. As the puzzle toy **30** is being assembled, means for notification within the puzzle toy **30** are also being assembled. For example, the means for notification are located in or on the blocks **10** and are either coupled to the plurality of internal wire networks **44**, or are coupled to a non-electrically insulated portion of the blocks **10** directly so that when a complete circuit has been made through the puzzle toy **30**, the circuit necessarily includes the means for notification. The means for notification may be any means of producing light, sound, or motion in a small toy as is known in the art that are specific to that particular puzzle toy **30**. For example, if the puzzle toy **30** is in the shape of a house once completed, lights within or on the house may become illuminated, garage doors may open or close, or sounds from within the house such as a doorbell may be heard. Alternatively, if the puzzle toy **30** forms an automobile once completed, the head-

lights may illuminate, the horn may sound, or the wiper blades may activate and so on. The means of notification within the puzzle toy **30** are powered by the incoming electrical current provided by the control box **32**. If the control box **32** is decoupled from the puzzle toy **30**, or the circuit otherwise breaks, the means for notification automatically and immediately cease.

[0055] At this point, if the user is satisfied with the construction of the completed puzzle toy **30**, the user may manipulate a switch **48** or other similar means to increase the amount of current delivered from the control box **32** and its power source. The increased current travels throughout the puzzle toy **30** as described above and simultaneously comes into contact with every or at least selected ones of the square and circular electrodes **24**, **26** within the puzzle toy **30**. The increased current is substantial enough to be above the threshold value of current that is capable of being conducted through the electrodes **24**, **26** which causes them to begin to break down and melt. The specific threshold value of current that causes the electrodes **24**, **26** to melt depends upon the material comprising the electrodes **24**, **26** themselves as is well documented in the art. For the square and circular electrodes **24**, **26** that form the contacts **42**, as the electrodes **24**, **26** melt, they begin to blend and mix together and form one single electrode. Similarly, for the electrodes **24**, **26** left open to the ambient air, they too begin to soften and melt. At a certain point, the electrodes **24**, **26** become so liquid that they cease being viable electrical conductors and thus the current stops flowing and the circuit is destroyed within the puzzle toy **30**. With the current stopped, the partially melted electrodes **24**, **26** are allowed to cool. For the electrodes **24**, **26** that form the contacts **42**, the cooling allows the metal to harden into a fixed position and therefore form a "spot weld" between two adjacent or stacked blocks **10**. The incoming lead line **34** and outgoing lead line **38** are then decoupled from the puzzle toy **30**, leaving the plurality of blocks **10** comprising the puzzle toy **30** spot welded together at every point there was a contact **42**. The puzzle toy **30** is now permanently fixed in the last position it was placed before the increased current was applied.

[0056] In one particular embodiment, the blocks **10** that comprise the electrodes **24**, **26** and the internal wire networks **44** form a subset of the plurality of construction pieces and are only disposed around the periphery or border of the puzzle toy **30**, leaving a second subset of the plurality of construction pieces with no electrical contacts forming the majority of the puzzle toy **30**. In other words, only the blocks **10** which, when properly connected, form a completed circuit are disposed around the border of the puzzle toy **30** such that a frame is created which encapsulates the non-electrode carrying blocks within the electrode carrying blocks **10**. When a second, higher electrical current is applied to the puzzle toy **30** by the control box **32** as disclosed above, only the electrode carrying blocks **10** fuse together leaving the blocks without electrodes still firmly locked into the last position they were placed. If the user wishes to rebuild the puzzle toy **30**, the fused blocks **10** that form the frame for the puzzle toy **30** are broken up and disposed of and then the remaining non-electrode carrying blocks are simply pulled apart and then reassembled into a new configuration. New and un-fused electrode carrying blocks **10** may then be coupled to the reassembled non-electrode carrying blocks, once again encapsulating and framing the puzzle toy **30** into a semi-permanent configuration once the proper electrical current has been sent through the electrode carrying blocks **10**.

[0057] In another embodiment shown in FIGS. **5**-**7**B and **10**A-**10**B, the blocks **10** that comprise the puzzle toy **30** are coupled permanently or temporarily together by means of a plurality of magnetic actuators **50** and a corresponding plurality of receiving cavities **52**. Turning to FIG. **5**, it can be seen that each traverse surface **14** and each lateral surface **12** of the block **10** comprises at least one magnetic actuator **50** and one receiving cavity **52**, the magnetic actuator **50** always being disposed on the block **10** to the left-hand side of the cavity **52**. Additionally, a cavity **50** is disposed on top of each of the nodes **18** on the top surface **16** of the block **10**. Conversely, a magnetic actuator **52** is disposed within each of the female apertures **20** located in the bottom cavity **22** of the block **10**.

[0058] When a plurality of blocks **10** have been constructed in a similar manner as to that seen in FIG. **3**B and a complete circuit has been obtained, a control box **32** capable of producing electric current is coupled to the blocks **10** as disclosed above. The user selects to send the current through the first block **10** seen in FIG. **6**. The current enters the first block **10** through a suitable access point (not shown) or directly into the material of the block **10** itself. The current then travels throughout the block **10** by conducting through the material comprising the block **10** or through the internal wire network **44** as disclosed above to each of the plurality of magnetic actuators **50** disposed around the block **10**.

[0059] In one embodiment, each magnetic actuator **50** comprises a substantially cylindrical bore **60** defined into the surface of the block **10** as best seen in FIG. **10**B. Within the bore **60** is a cylindrical armature **54**, preferably comprised of a permanent magnet. Wrapped around the outside of the magnetic actuator **50** is a wire **58** that receives current from or is a part of the internal wire network **44** disclosed above. The bore **60**, armature **54**, and wire **58** work together so as to form a solenoid as is known in the art. Specifically, the wire **58** provides enough turns about the bore **60** so that when electrical current is flowing through the wire **58**, a sufficient magnetic field is created that pushes the armature **54** distally out of the bore **60** and past the outside surface of the block **10**.

[0060] Greater detail of the magnetic actuator **50** and receiving cavity **52** coupling process is found by turning to FIGS. **7**A, **7**B, and **10**A where the magnetic aperture **50** and receiving cavity **52** of a first block **10** are aligned with the opposing magnetic aperture **50** and receiving cavity **52** of a second block **10**A. As can be seen in the top down view of FIG. **10**A, the magnetic aperture **50** of block **10** opposes the receiving cavity **52** of block **10**A, and the magnetic aperture **50** of block **10**A opposes the receiving cavity **52** of block **10** respectively.

[0061] As can be seen in the cross-section of FIG. **7**A, as current travels through the block **10** and around the turns of the wire **58** of the magnetic aperture **50**, the armature **54** slides out of the bore **60** and enters the receiving cavity **52** of the adjacent block **10**A. The receiving cavity **52** is substantially cylindrical in shape and comprises a first diameter **62** that begins at the surface of the block **10**A and extends until contacting a second diameter **64** that is larger than the first diameter **62**. The armature **54** itself comprises a plurality of substantially wedged shaped barbs **56** disposed along the longitudinal axis of the armature **54**. The barbs **56** comprise means for retracting into the armature **54** by compressing an internal spring (not shown) as the armature **54** moves out of

the bore **60** and into the narrower first diameter **62** of the receiving cavity **52**, much like how a latch retracts into a common door knob as the door is being shut. The barbs **56** remain retracted into the armature **54** as it slides through the first diameter **62** of the receiving cavity **52**, the walls of the first diameter **62** effectively pushing and keeping the barbs **56** in their retracted position as seen in FIG. **7**A. The armature **54** continues moving into the second diameter **64** of the receiving cavity **52** until the proximal edge of the barbs **56** clear the point at which the second diameter **52** begins. With the walls of the first diameter **62** no longer restraining the barbs **56**, the barbs **56** freely expand into the receiving cavity **52** as seen in FIG. **7**B by means of the internal spring. With the barbs **56** in their fully expanded position, any movement back in proximal direction in which the armature **54** came is prevented.

[0062] After each armature **54** has been extended into its respective receiving cavity **52**, each block **10** and adjacent block **10**A is firmly coupled together at two points along each lateral and traverse surface **12**, **14**. Similarly, for a block **10** and a stacked block **10**B as seen in FIG. **6**, each block **10**, **10**B is coupled together at every node **18** and female aperture **20** combination by the same magnetic actuators **50** and receiving cavities **52** disclosed above. Therefore it is conceivable that one block **10**, for example the block **10** as seen in FIG. **5**, can be coupled up to a maximum of sixteen times contemporaneously to a plurality of adjacent blocks **10**A and stacked blocks **10**B.

[0063] After the blocks **10** have been locked together by the magnetic actuators **50** and receiving cavities **52**, the user may discontinue the flow of electric current by manipulating the switch **48** on the control box **32** or otherwise decoupling the control box **32** from the puzzle toy **30**. With the flow of electric current stopped, the plurality of magnetic actuators **50** cease producing magnetic fields and leave the plurality of armatures **54** in their positions within the second diameter **64** of the plurality of receiving cavities **52**.

[0064] In another embodiment shown in FIGS. **11-13**, the magnetic aperture may be used to separate or "explode" the blocks **10** from each other after being assembled.

[0065] After being assembled, for example in the stacked configuration as seen in FIG. **11**, blocks **10** and **10**A are coupled to the control box **32** as disclosed above. The first block **10** comprises at least one spring cavity **70** defined in at least one of its outward facing surfaces. However as is seen in FIG. **11**, the spring cavities **70** are preferably located within the female apertures **20**. Each spring cavity **70** is cylindrical in shape and further comprises a secondary aperture **72** defined into its surface. Each spring cavity **70** also comprises a spring **74** coupled to its inner most internal surface. Within each secondary aperture **72** is an armature **76** which is preferably comprised of a permanent magnet. As can be seen in the magnified view of FIG. **12**A, the armature **76** extends distally out of the secondary aperture **72** into the spring cavity **70**. The spring **74**, when in its compressed position, is held in place and in its compressed position within the spring cavity **70** by the extended armature **76**.

[0066] After block **10** has been stacked on top of adjacent block **10**A, preferably with the nodes **18** of the adjacent block **10**A inserted into the female apertures **20** of block **10**, the opening of the spring cavity **70** is placed directly over the adjacent block **10**A. An electrical current is sent through the puzzle toy **30**, including blocks **10** and **10**A, by means of the control box **32** as disclosed above. As the current makes contact with the spring cavity **70**, it sent through a wire **78** that is wrapped around the secondary aperture **72**. The secondary aperture **72**, armature **76**, and wire **78** work together so as to form a solenoid as is known in the art. Specifically, the wire **78** provides enough turns about the secondary aperture **72** so that when electrical current is flowing through the wire **78**, a sufficient magnetic field is created that "pulls" or retracts the armature **76** back into the secondary aperture **72** and out of the spring cavity **70** as seen in FIG. **12**B.

[0067] As the armature **76** is drawn into the secondary aperture **72**, the distal end of the armature **76** is cleared of the spring **74**, allowing the spring **74** to immediately uncoil and extend down through the spring cavity **70** towards the surface of the adjacent block **10**A. The proximal end of the spring **74** remains coupled to the inner most internal surface of the spring cavity **70** while the distal end of the spring **74** strikes the surface of the adjacent block **10**A. The distal end of the spring **74** strikes the adjacent block **10**A with force significant enough to decouple the nodes **18** of the adjacent block **10**A from the female apertures **20** of block **10** and project block **10** up into the air in direction shown by arrows **80**, away from the adjacent block **10**A as seen in FIG. **13**. It is easy to understand that the more spring cavities **70** that the block **10** comprises, the easier the decoupling process will be between it and the adjacent block **10**A and the further that the blocks **10**, **10**A will separate, thus creating an "exploding" or "explosion" like effect on the puzzle toy **30**. It should also to be expressly understood therefore that the number and position of the spring cavities **70** shown in FIGS. **11-13** is meant for illustrative purposes only. Fewer or additional numbers of spring cavities **70** in alternate configurations other than what is shown, for example a spring cavity **70** defined within a lateral surface of the block **10**, may be used without departing from the original spirit and scope of the invention. It should also be understood that the entirety of the blocks **10** comprising the puzzle toy **30**, or a predetermined subset thereof, may comprise the means for "exploding" as described above.

[0068] In an alternative embodiment shown in FIGS. **8** and **9**, the blocks **10** that comprise the puzzle toy **30** are coupled permanently or temporarily together by means of a plurality resin pouches, namely a plurality of resin "A" pouches **66** and a plurality of resin "B" pouches **68**. Turning to FIG. **8**, it can be seen that each traverse surface **14** and each lateral surface **12** of the block **10** comprises at least one resin "A" pouch **66** and one resin "B" pouch **68**, the resin "A" pouch **66** always being disposed on the block **10** to the left-hand side of the resin "B" pouch **68**. Additionally, a resin "A" pouch **66** is disposed on top of each of the nodes **18** on the top surface **16** of the block **10**. Conversely, a resin "B" pouch **68** is disposed within each of the female apertures **20** located in the bottom cavity **22** of the block **10** as seen in FIG. **9**.

[0069] When a plurality of blocks **10** have been constructed in a similar manner as to that seen in FIG. **3**B and a complete circuit has been obtained, each resin "A" pouch **66** is matched up to a corresponding resin "B" pouch **68** of either an adjacent block **10**A or a stacked block **10**B as is appropriate. A control box **32** capable of producing electric current is coupled to the blocks **10** as disclosed above and the user selects to send an electrical current through the first block **10**. The current enters the first block **10** through a suitable access point (not shown) or directly into the material of the block **10** itself. The current then travels throughout the block **10** by conducting through the material comprising the block **10** or through the internal wire network **44** as disclosed and then continues on throughout the remaining blocks **10** comprising the puzzle toy **30**.

The electrical current then travels back to the control box **32** and a small light and/or buzzer **46** disposed on the control box **32** is illuminated as seen in FIGS. **4**A and **4**B, notifying the user that the blocks **10** which comprise the completed puzzle toy **30** have been properly constructed.

[0070] At this point, the user may take the completed puzzle toy **30** and submerge it in a bath of aqueous solution such as water. As the aqueous solution makes contact with each pouch **66**, **68**, the material comprising the pouches **66**, **68** dissolves and releases its contents, namely resin "A" from the resin "A" pouches **66** and resin "B" from the resin "B" pouches **68**. Resin "A" and resin "B" then mix together and react to form a strong chemical bond as is known in the art at the surface between block **10** and adjacent block **10**A or stacked block **10**B. Resin "A" and resin "B" may be any two chemical components or compositions known in the art that are capable of forming a strong bond upon being mixed together, but do not react with the aqueous solution. Conversely, the resin "A" pouches **66** and resin "B" pouches **68** may contain the same resin or epoxy, such as superglue, which is released after the aqueous solution has dissolved the material comprising the pouches **66**, **68**. After the pouches **66**, **68** have been dissolved, the user removes the puzzle toy **30** from the aqueous solution bath. As the mixture of resins "A" and "B" dries and hardens, the puzzle toy **30** is effectively left in the last position or configuration it was in before it was submerged in the aqueous solution bath.

[0071] In one embodiment, once it has been determined that the puzzle toy **30** has been properly completed by completion of an internal circuit as disclosed above, instead of submerging the puzzle toy **30** into a bath of aqueous solution, the aqueous solution may be applied to the puzzle toy **30** by an external means such as a spray bottle or by simply pouring the solution over the puzzle toy **30**.

[0072] In one embodiment, the blocks **10** of the puzzle toy **30** may be decoupled or otherwise taken apart by applying heat to the puzzle toy **30**, the heat effectively melting or breaking down the bond of the resin "A" and resin "B" mixture between the blocks **10**. Alternatively, a solution or other fluid that breaks down the bond of the resin "A" and resin "B" mixture as is known in the art may be applied to the puzzle toy **30** until the blocks **10** separate thus allowing the user to reconfigure the blocks **10** in the conventional manner.

[0073] Many alterations and modifications may be made by those having ordinary skill in the art without departing from the spirit and scope of the invention. Therefore, it must be understood that the illustrated embodiment has been set forth only for the purposes of example and that it should not be taken as limiting the invention as defined by the following invention and its various embodiments.

[0074] Therefore, it must be understood that the illustrated embodiment has been set forth only for the purposes of example and that it should not be taken as limiting the invention as defined by the following claims. For example, notwithstanding the fact that the elements of a claim are set forth below in a certain combination, it must be expressly understood that the invention includes other combinations of fewer, more or different elements, which are disclosed in above even when not initially claimed in such combinations. A teaching that two elements are combined in a claimed combination is further to be understood as also allowing for a claimed combination in which the two elements are not combined with each other, but may be used alone or combined in other combinations. The excision of any disclosed element of the invention is explicitly contemplated as within the scope of the invention.

[0075] The words used in this specification to describe the invention and its various embodiments are to be understood not only in the sense of their commonly defined meanings, but to include by special definition in this specification structure, material or acts beyond the scope of the commonly defined meanings. Thus if an element can be understood in the context of this specification as including more than one meaning, then its use in a claim must be understood as being generic to all possible meanings supported by the specification and by the word itself.

[0076] The definitions of the words or elements of the following claims are, therefore, defined in this specification to include not only the combination of elements which are literally set forth, but all equivalent structure, material or acts for performing substantially the same function in substantially the same way to obtain substantially the same result. In this sense it is therefore contemplated that an equivalent substitution of two or more elements may be made for any one of the elements in the claims below or that a single element may be substituted for two or more elements in a claim. Although elements may be described above as acting in certain combinations and even initially claimed as such, it is to be expressly understood that one or more elements from a claimed combination can in some cases be excised from the combination and that the claimed combination may be directed to a subcombination or variation of a subcombination.

[0077] Insubstantial changes from the claimed subject matter as viewed by a person with ordinary skill in the art, now known or later devised, are expressly contemplated as being equivalently within the scope of the claims. Therefore, obvious substitutions now or later known to one with ordinary skill in the art are defined to be within the scope of the defined elements.

[0078] The claims are thus to be understood to include what is specifically illustrated and described above, what is conceptionally equivalent, what can be obviously substituted and also what essentially incorporates the essential idea of the invention.

I claim:

1. A toy including a plurality of three dimensional construction pieces comprising:

means for permanently or temporarily coupling the plurality of construction pieces to each other in at least one combination, the means for permanently or temporarily coupling being disposed on or in each surface of the plurality of construction pieces;

means for forming a completed electrical circuit after the plurality of construction pieces have been assembled; and

a control box electrically coupled to the assembled construction pieces for determining if the completed circuit has been formed by the assembled construction pieces, and for selectively activating the means for permanently or temporarily coupling the plurality of construction pieces together.

2. The toy of claim **1** where the means for permanently or temporarily coupling the plurality of construction pieces comprises at least one fusible electrode disposed on each the plurality of construction pieces, each fusible electrode capable of aligning with a fusible electrode of an adjacent

construction piece and forming an electrical connection between the aligned fusible electrodes on adjacent construction pieces.

3. The toy of claim **2** where each construction piece includes at least two electrodes and where the means for forming a complete electrical circuit comprises a wire network disposed on or in each of the plurality of construction pieces, the wire network electrically coupling the at least two electrodes together.

4. The toy of claim **2** where each of the construction pieces are composed of conductive material and are arranged and configured so that each is capable of being electrically coupled to an adjacent construction piece only through a selected fusible electrode.

5. The toy of claim **2** where the control box comprises means for providing a low intensity electrical current into the assembled construction pieces through the completed circuit in the plurality of construction pieces and back to the control box to determine whether the completed circuit has been formed in the assembled construction pieces.

6. The toy of claim **5** where the control box further comprises an indicator for indicating when the low intensity electrical current flows through the completed circuit.

7. The toy of claim **3** where the control box comprises means for providing a high intensity electrical current to the completed circuit in the assembled construction pieces to join adjacent construction pieces together.

8. The toy of claim **6** where the control box comprises means for providing a high intensity electrical current capable of activating the means for permanently or temporarily coupling the plurality of construction pieces after the indicator indicates that a completed circuit is achieved.

9. The toy of claim **1** where the means for permanently or temporarily coupling the plurality of construction pieces comprises at least one magnetic actuator and at least one corresponding receiving cavity disposed on adjacent surfaces of at least two adjacent construction pieces, which are aligned with each other to couple to each other.

10. The toy of claim **9** where the control box comprises:

means for providing a low intensity electrical current to the completed circuit; and

an indicator for indicating when the low intensity electrical current flows through the completed circuit.

11. The toy of claim **9** where the control box comprises means for providing a high intensity electrical current to the completed circuit, where the at least one magnetic actuator comprises an armature and means for producing a magnetic field so that the armature is magnetically pushed out of the actuator and into the corresponding receiving cavity disposed on an adjacent construction piece to form a mechanical coupling between the adjacent construction pieces.

12. The toy of claim **11** where the armature comprises a plurality of retractable barbs disposed along the longitudinal axis.

13. The toy of claim **1** where the means for permanently or temporarily coupling the plurality of construction pieces comprises a plurality of resin pouches disposed on each surface of the plurality of construction pieces, the resin pouches being breached upon application of an aqueous solution, so that the contents of the resin pouches come into contact with one another and form a bond.

14. The toy of claim **13** where the control box comprises means for providing a low intensity electrical current to the completed circuit, and an indicator for indicating when the low intensity electrical current flows through the completed circuit.

15. The toy of claim **13** where the contents of the resin pouches comprise means for reacting with the contents of the resin pouches of an adjoining construction piece but do not react with the surrounding aqueous solution.

16. The toy of claim **11** where the means for producing a magnetic field comprises a wire capable of carrying electrical current wrapped around the outside surface of the magnetic actuator.

17. A method for temporarily or permanently coupling a plurality of three dimensional construction pieces together comprising:

assembling the plurality of construction pieces into a desired configuration;

applying a first electrical current to the assembled construction pieces;

conducting the first electrical current through the assembled construction pieces through a completed circuit;

activating an indicator when a completed circuit has been achieved; and

temporarily or permanently joining the plurality of construction pieces together.

18. The method of claim **17** where temporarily or permanently coupling the plurality of construction pieces comprises:

applying a second electrical current that is stronger than the first electrical current to at least two electrodes disposed on the surfaces of each of the plurality of construction pieces, one of the at least two electrodes forming an electrical contact with one of the at least two electrodes of an adjacent construction piece;

fusing together each of the electrodes which are in contact with each other;

discontinuing the second electrical current; and

cooling the fused electrodes in each contact to form a spot weld with at least one adjacent construction piece.

19. The method of claim **17** where temporarily or permanently coupling the plurality of construction pieces comprises:

applying a second electrical current that is stronger than the first electrical current to a magnetic actuator;

creating a magnetic field around the magnetic actuator;

creating a" magnetic force in the magnetic actuator to push out an armature from the magnetic actuator;

disposing the armature into a receiving cavity of an adjacent construction piece by means of the magnetic force;

extending a plurality of retractable barbs disposed along the longitudinal axis of the armature within the receiving cavity of the adjacent construction piece;

discontinuing the application of the second electrical current and magnetic force;

maintaining the armature within the receiving cavity to form a mechanical bond between at least one construction piece and an adjacent construction piece.

20. The method of claim **17** where temporarily or permanently coupling the plurality of construction pieces comprises:

submerging the toy in an aqueous solution bath;

breaching at least two aligned resin pouches disposed on opposing surfaces of at least two adjacent construction pieces by means of the aqueous solution;

releasing resins contained within the at least two aligned resin pouches;

contacting the resins released from the at least two aligned resin pouches of the adjacent construction pieces; and

curing the contacted resins to from a bond between adjacent construction pieces.

21. The toy of claim **1** where the means for forming a complete electrical circuit after the plurality of construction pieces have been assembled further comprises an indicator on or in the assembled construction pieces for indicating when a low intensity electrical current flows through the completed circuit.

22. The toy of claim **2** where the means for permanently or temporarily coupling the plurality of construction pieces to each other in at least one combination comprises permanently or temporarily coupling a first subset of the plurality of construction pieces around a border of the toy such that a frame is created which encapsulates a second subset of the plurality of construction pieces within the first subset, and wherein only the first subset of the plurality of construction pieces comprise at least one fusible electrode.

23. The toy of claim **1** further comprising means for explosively decoupling the plurality of construction pieces from each other after the plurality of construction pieces have been joined together.

24. The method of claim **17** further comprising explosively decoupling the plurality of construction pieces from each other after the plurality of construction pieces have been joined together.

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