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
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 toys 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 heated 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 line 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, when combined with the construction pieces, provides a design that allows for low intensity electrical current to be conducted between each of the construction pieces. The control box utilizes an electrical circuit defined by the plurality of construction pieces to determine whether or not a complete circuit has been formed in the assembled construction pieces. If no 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 acknowledged 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 are 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 bars disposed along its longitudinal axis. The bars 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.

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.

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 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.

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 pucks disposed on opposing surfaces of two adjacent construction pieces. Resins contained within the two aligned resin pucks are released and make contact with each and mix between the adjacent construction pieces. The resins then cure and harden and thus from a bond between the adjacent construction pieces.

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

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

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

FIG. 3A 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.

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

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

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

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.

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.

FIG. 7A 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.

FIG. 7B 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.

FIG. 8 is a top perspective view of an alternative embodiment of the three dimensional construction toy block comprising a plurality of resin pucks.

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

FIG. 10A 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.

FIG. 10B 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.

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.

FIG. 12A 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.

FIG. 12B 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.

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 toy block off of the bottom toy block disposed beneath it.

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-
presented 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. 1-3B 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. 1-3B 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 3A. 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 comprises 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 jigsaw 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 10A. Alternatively, block 10 may serve as the base for a stacked block 10B on top of it with the nodes 18 of the block 10 firmly inserted into the female apertures 20 of the top block 10B as seen in the cross-sectional view of FIG. 3A. 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. 3A, when the blocks 10, 10A, 10B 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 10A, 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 10B, 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 10B and form another contact 42. The square electrodes 24 and circular electrodes 26 of the blocks 10, 10A, 10B that are not touching another block are left exposed to the ambient air. Other configurations than what is shown in FIG. 3A 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. 4A 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 output 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 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. 4A, the current would enter the puzzle toy 30 at block 10, then travel to block 10A, block 10B, block 10C, block 10D, and block 10E 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 10-10E coupled together in electrical series.

[0050] It should be understood that the exact configuration of the blocks 10-10E being coupled in series is for illustrative purposes only. For example, the blocks 10-10E may also be coupled in parallel to the control box 32 as seen in FIG. 4B. In this embodiment, the incoming lead 34 is coupled to two blocks, specifically blocks 10 and 103 here. Similarly, the outgoing lead 38 is coupled to two blocks, specifically blocks 10A and 10C here. Current received from the control box 32 enters blocks 10 and 103 simultaneously and crosses the respective contact 42 to blocks 10A and 10C contemporaneously. The current then exits block 10A and block 10C 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 44-44B. When current enters the first block 10 seen in FIG. 3B 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 10A or 10B as seen in FIG. 3B, the current crosses the contact 42 by means commonly known in the art and enters that respective block 10A or 10B. Both block 10A and block 10B each comprise their own internal wire network 44A, 44B respectively which then repeats the process of sending the current throughout every electrode 24, 26 disposed within each block 10A, 10B. 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, inverse 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. 4A and 4B, 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 doorknob 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. 5-7B and 10A-10B, 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. 3B 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. 10B. 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. 7A, 7B, and 10A 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 10A. As can be seen in the top down view of FIG. 10A, the magnetic aperture 50 of block 10 opposes the receiving cavity 52 of block 10A, and the magnetic aperture 50 of block 10A opposes the receiving cavity 52 of block 10 respectively.

[0061] As can be seen in the cross-section of FIG. 7A, 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 10A. The receiving cavity 52 is substantially cylindrical in shape and comprises a first diameter 62 that begins at the surface of the block 10A 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 bars 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 pushing the bars 56 in their retracted position as seen in FIG. 7A. The armature 54 continues moving into the second diameter 64 of the receiving cavity 52 until the proximal edge of the bars 56 clear the point at which the second diameter 52 begins. With the walls of the first diameter 62 no longer restraining the bars 56, the bars 56 freely expand into the receiving cavity 52 as seen in FIG. 7B by means of the internal spring. With the bars 56 in their fully expanded position, any movement back in proximal direction in which the armature 54 came is prevented.

After each armature 54 has been extended into its respective receiving cavity 52, each block 10 and adjacent block 10A is firmly coupled together at two points along each lateral and traverse surface 12, 14. Similarly, for a block 10 and a stacked block 10B as seen in FIG. 6, each block 10, 10B 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 of FIG. 6, can be coupled up to a maximum of sixteen times contemporaneously to a plurality of adjacent blocks 10A and stacked blocks 10B.

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 40 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.

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.

After being assembled, for example in the stacked configuration as seen in FIG. 11, blocks 10 and 10A 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. 12A, 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.

After block 10 has been stacked on top of adjacent block 10A, preferably with the nodes 18 of the adjacent block 10A inserted into the female apertures 20 of block 10, the opening of the spring cavity 70 is placed directly over the adjacent block 10A. An electrical current is sent through the puzzle toy 30, including blocks 10 and 10A, 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. 12B.

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 10A. The proximal end of the spring 74 remains coupled to the internal most internal surface of the spring cavity 70 while the distal end of the spring 74 strikes the surface of the adjacent block 10A. The distal end of the spring 74 strikes the adjacent block 10A with force sufficient enough to decouple the nodes 18 of the adjacent block 10A 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 10A 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 10A and that this the blocks 10, 10A will separate, thus creating an “exploding” or “explosion” like effect on the puzzle toy 30. It should also 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.

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 of 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-hands 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.

When a plurality of blocks 10 have been constructed in a similar manner as to that seen in FIG. 3B 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 10A or a stacked block 10B 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. 4A and 4B, notifying the user that the blocks 10 which comprise the completed puzzle toy 30 have been properly constructed.

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 10A or stacked block 10B. 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.

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.

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.

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 described by the following invention and its various embodiments.

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 described 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.

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.

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.

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.

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

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 to 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 10 where the control box comprises means for providing a high intensity electrical current to the completed circuit, wherein 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 14 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;
- disconnecting 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 18 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 form 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.