TOY CONSTRUCTION BLOCKS AND ASSEMBLY

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This invention relates to toy construction devices and, more particularly, to toy blocks and links which are designed to be interconnected to create a multitude of structural shapes.

This application is a continuation-in-part of my co-pending application, Ser. No. 295,974, filed July 18, 1963, now abandoned, and is an improvement of the construction toy disclosed in my earlier Patent No. 2,406,759 issued Sept. 7, 1946.

While the blocks disclosed in my earlier patent have been quite successful, particularly for building structures having circular patterns and rotary joints, they do not provide the versatility of the present devices. Moreover, even where those prior art blocks have been conventionally connected, insecure connections and interference between adjacent parts have been encountered, particularly in attempting to interconnect the blocks to form a large, flat, rectangular surface.

In accordance with the present invention, the older X-shaped blocks are modified to provide a positive lock between cooperating parts of the blocks and to prevent interference between adjacent parts of the blocks when they are interconnected in various new and interesting designs and configurations.

To provide this increased versatility, toy blocks constructed in accordance with this invention, in addition to having parallel front and rear faces and a peripheral surface which comprises a plurality of projections and a plurality of recesses, include flat end surfaces on the projections and mating flat surfaces in the recesses with which the projections cooperate. With the improvements herein noted, the blocks of this invention may be assembled together by inserting a projection of one block into a recess of another block to form a relatively snug fit without rotation therebetween.

This invention further includes various links and other accessories adapted to be used with the X-shaped blocks to form numerous configurations of two and three dimensions.

A significant feature of this invention is the ease with which young children can build the blocks and accessories into an unlimited number of creative shapes and forms without tools. The flattened rectilinear end surfaces of the projections and recesses enable the blocks to be connected together in groups of four, for example, with their centers forming a square but without interference between adjacent arms. By this means, a plurality of such groups may be built up to form a large flat rectangular surface particularly useful in combination with the accessories included in this invention in creating buildings, bridges and toy wheeled vehicles, which will hold firmly together until taken apart for the next project.

To further stabilize the X-shaped blocks when they are interconnected, there are provided in one embodiment of this invention a series of bosses on the arcuate sides of the projections. These bosses cooperate with the side surfaces defining the recesses in others of the blocks to hold the projections firmly in the recesses.

The foregoing and other features of this invention will be apparent from the following detailed description when read with reference to the accompanying drawings in which:

FIG. 1 is a perspective view of a toy construction block designed in accordance with this invention;

FIG. 2 is a plan view of an interconnected group of four of the blocks illustrated in FIG. 1;

FIG. 3 is a perspective view showing portions of two of the blocks and an angular link connecting them;

FIG. 4 is a plan view showing portions of two of the blocks and a male link connecting them;

FIG. 5 is a plan view showing portions of two of the blocks and a female link connecting them;

FIG. 6 is a perspective view showing portions of two of the blocks connected by an elongated tube;

FIG. 7 is a perspective view of a portion of a toy wheeled vehicle constructed with blocks and links designed in accordance with this invention;

FIG. 8 is an exploded perspective view showing portions of two blocks of a second embodiment of this invention in position to be interconnected; and

FIG. 9 is a sectional view through the arcuate sides of the second embodiment illustrated in FIG. 7.

Referring to FIG. 1, an X-shaped block 5 having the axes 4 of the arms 6 perpendicular is a basic unit of the toy construction device of the present invention. The block has a front face 10, a parallel rear face (not shown) and a peripheral or boundary surface 7. The faces of the block are recessed relative to the edges 8, 9 of the peripheral surface 7.

Each of the four arms 6 has a projection 12 at its end. Each projection 12 includes a pair of opposed, arcuate sides 14, 15 forming a circular segment and an outer rectilinear end 16 which forms a chord of the segment substantially perpendicular to the axis 4 of the associated arm 6. A recess 13 is formed in the block midway between each adjacent pair of arms. Each recess 13 is complementary to the projections and includes two opposed, arcuate sides 18, 19 forming a circular segment with an outer opening 20 and an inner rectilinear end 17 which forms a chord of the segment at an angle of about 45° with the axes 4 of the block arms 6. Each projection 12 is joined to the adjacent recesses 13 by webs or shoulders 21.

As shown in FIG. 2, the block 5 is designed to be interconnected with other identical blocks of the series by inserting a projection 12 of one block into a recess 13 of another block (not shown) with their central axes 22, 23 aligned. When so connected, the rectilinear portion 16 of the projection mates with the rectilinear portion 17 of the recess to provide a snug fit, and to prevent rocking of one block relative to the other. Further, the tips 24 of the shoulders 21 fit tightly around the neck 25 of the projection to prevent rocking or rotary movement about the central axis 22 of the connected projection.

The spacing between the tips 24 of the shoulders 21 at the opening 20 of the recess is less than the diameter of the projections 12. Thus, the projection will not pass freely between the shoulder tips 24 and a secure connection is obtained when the projection is engaged in the recess. If the block is composed of relatively flexible material, the projection may be forced into the recess by using the rounded sides 14, 15 of the projection as wedges to spread the shoulder tips 24. On the other hand, if the material employed is rigid, the projection may be inserted and removed along the central axis 23 of the recess.

The block further includes a square central bore 26 having sides 27 equal in length to the diameter of the recesses 13. Thus the bore 26, like the recesses, is adapted to receive the projections 12 of other blocks to interconnect them.

In FIG. 2 four blocks 5a, b, c, d are shown interconnected so that their centers 25 define the four corners of a square 28. In this grouping, two of the blocks 5b, d are rotated at 45° relative to the other two blocks 5a, c in order to interconnect the appropriate projections 12 and recesses 13.
In order that the projections 12b, d of the two arms 6b, d which extend toward the center of the square 28 do not overlap or interfere with each other in arranging the blocks in this rectangular grouping, each block is designed so that the distance between the outer rectilinear end 16 of the projections and the center 25 of the block does not exceed one-half the length of the diagonal of the square 28 defined by the centers 25 of the four blocks 5a–d. If A equals the distance between the center 25 of a block and the inner rectilinear end 17 of any of its recesses 13, and B equals the distance between the center 25 of the block and the outer rectilinear end 16 of any of its projections 12, then each side of the square 28 is approximately equal to $A - B$. From the Pythagorean theorem, the length of the diagonal squared equals twice the length of a side squared, so that:

$$\text{diagonal}^2 = 2(A - B)^2$$

Since it is desired that 2B be no greater than the length of the diagonal, then:

$$(2B)^2 < 2(A - B)^2$$

In the preferred embodiment shown, $(2B)^2$ is slightly less than $2(A - B)^2$ so that a very slight gap 30 exists between the two end surfaces 16b, d and there is no possibility of interference.

The block grouping shown in FIG. 2 particularly enhances the play value of the blocks of this invention since it provides for the construction of a flat structural member in a rectangular pattern. The grouping may be expanded in area by merely adding additional blocks thereto, thus forming large flat surfaces which may be used, for example, as the walls, floors and roofs of toy houses and other buildings. Another application of this grouping is in the packaging in form of a wagon or other wheeled toy vehicle by employing the elements shown in FIG. 7 and described hereinafter.

FIG. 3 illustrates a right-angle link 30 used to connect two of the blocks 5. The angle link 30 includes two elongated male portions 31, 32 which are joined to each other in a perpendicular relationship by a plate 33. The male portions 31, 32 are preferably each X-shaped in section. One arm 34 is shortened to accommodate the flat-tended end 17 of the recesses, so that the male portions will fit snugly in the recesses 13. Thus, two blocks may be connected at a right angle to form wall corners, column sides, roof peaks and other structures.

FIG. 4 illustrates a small male connecting link 40 used to connect two of the blocks 5 side-by-side. This link 40 includes two oppositely oriented projections 41, 42 each similar to the projections 12 of the blocks 5. The two projections 41, 42 of the link 40 are joined by a short body 43 of such a length that adjacent projections 12 of two blocks connected by the link fit closely together without overlapping or interfering. Thus, the male links may be used to build a long string of side-by-side blocks for fences, sidewalks, track sideboards, and many other uses. The male connecting link 40 may indeed be inserted in the recesses 13 so as to extend perpendicular to the face 10 of the block and connect two blocks in face-to-face relationship, which is useful e.g. in building three-dimensional shapes such as animal bodies.

FIG. 5 illustrates a small female connecting link 50 used to connect two of the blocks 5. This link 50 includes two oppositely oriented, juxtaposed recesses 51, 52, joined together at 53. Each is similar to the recesses 13 of the block 5 and adapted to alternatively engage the male portions 31, 32 of the angle link 30, the projections 44, 42 of the male connecting link 40, or the projections 12 of the block 5 to form open gablework, fences, abstract designs, and other creative structures.

FIG. 6 shows an elongated round tube 60 connecting two of the blocks. The outside diameter of the tube 60 is equal to the outside diameter of the projections 12, so that the tube 60, like the projections 12, may be used to connect two blocks 5 by inserting its ends in the bores 26. The tube is made of a flexible material such as polypropylene so that it may also be inserted into the recesses 13 as shown in FIG. 6 by slightly flexing a portion to form a flattened configuration 61 at its circumference to mate with the flattened end 17 of the recess 13. Further, it may be flexed sufficiently to be connected in the recesses 13 with its axis extending parallel to the face 10 of the block and its sides pinched between the shoulder tips 24. The tube is useful in a great many structures including the wheeled vehicle illustrated in FIG. 7.

The toy vehicle illustrated in FIG. 7 includes at least four of the blocks 5 connected in the rectangular pattern shown in FIG. 2 to form a flat bed 71. One wheel 70 is illustrated as connected to the bed; it being understood that additional wheels may be attached as desired. The wheel 70 is constructed of a block 5 snugly received in a boss 72 which forms the wheel rim.

The wheel 70 is rotatably mounted on an axle 73 which includes a small diameter tube 74 loosely received in the bores 26 of the wheel block 5. A larger diameter tube 60 of the type shown in FIG. 6 is snugly telescoped on each end of the small tube 74 to retain the wheel on the axle.

An end of one of the larger tubes 60 is received in one recess 52 of a female connector member 50, and a projection 42 of a male link 40 is received in the other recess 51 of the female link 50. The other projection 41 of the male link is snugly received in the bore 26 of one block of the bed 71 to connect the wheel 70 and axle 73 to the bed.

FIGS. 8 and 9 illustrate a modified embodiment of the blocks 5, wherein each arcuate side 14, 15 of the projections 12 includes two elongated pairs of bosses 81, 82 each pair extending substantially from edge 8 to edge 9 of the flat bed of the two bosses of each pair. One pair of bosses 81 on each side is near the outer rectilinear end 16 and one pair of bosses 82 is near the shoulder 21.

As is most clearly shown in FIG. 9, the two bosses of each pair 81, 82 together have a double-tapered or V-shaped longitudinal section with the vertex of the V pointing toward the central axis 23 of the projection. The inner surface of the arcuate sides 18, 19 of the recesses 13 is also V-shaped, i.e., the broad V on the left-hand surface of side 18 in FIG. 9 having its apex opposite face 10 with the vertex pointing toward the central axis 22 of the recesses.

When the projection 12 is engaged in the recess 13, the V-shape of the pairs of bosses 81, 82 conforms to the broad V of the recess sides and locks the projection against removal in either direction perpendicular to the face 10 of the block. Thus, the projections and recesses have cooperating locking portions which are V-shaped in a plane including the central axis of the projection and intersecting the locking portion, i.e., the plane in which the section of FIG. 9 is taken. This embodiment of the block is particularly useful when the blocks are made of flexible material so that the projections may be forced into and out of the recesses, but will strongly resist accidental disengagement when connected.

The block configuration of FIGS. 8 and 9 is particularly suited for the construction of large toy structures, since the pairs of bosses 81, 82 provide a lock acting perpendicular to the faces of adjacent ones of the blocks and in combination with the large diameter tubes 60, the flattened ends 16, 17 to provide a structure which is rigid in all directions.

As a consequence of the improved design of the blocks embodying this invention, a child is able to build the construction units quite precisely into a relatively solid structure without the blocks tending to distort the structure or prevent the building of a structure which is squared up in accordance with conventional practice. The repetitive shapes and
dimensions used in the design of the blocks and connectors permit construction of a multitude of structures, including those utilizing large, flat, rectangular surfaces. Further, it will be noted that the appearance of the block is not changed by rotating it 90°, 180°, 270° or 360° about its center. This symmetry adds flexibility to the use of the blocks by permitting connection at various rotated positions.

The above described embodiments of this invention are intended to be exemplary and the invention should be limited only in accordance with the following claims:

I claim:

1. A series of identical toy construction blocks, each comprising:
   (a) a first pair of opposite arms lying along a first axis;
   (b) a second pair of opposite arms lying along a second axis which intersects said first axis perpendicularly at the center of said block;
   (c) a projection at the end of each arm comprising a pair of opposed, arcuate sides concentric about a central axis perpendicular to the axis of the arm to form a circular segment; and, an outer rectilinear portion at the distal end of the projection forming a chord of said circular segment perpendicular to the axis of the arm;
   (d) a recess formed between each adjacent pair of arms, said recess being proportioned to receive the projections of other blocks of said series to interconnect said blocks in a plurality of configurations, each said recess comprising a pair of opposed, arcuate sides concentric about a central axis perpendicular to the axes of the arms to form a circular segment; and, an opening through the outer portion of said segment, and a rectilinear inner portion nearest the center of the block forming a chord of said circular segment;
   (e) said projections being dimensioned so that when four of said blocks are interconnected such that their centers define the corners of a square, the projections on the inwardly disposed arms do not overlap or interfere with each other; and,
   (f) each said block being proportioned so that
   \[2(B^2) - 2(A + B)^2\] where

\[A = \text{the distance between the center of the block and the inner rectilinear portion of any recess thereof, and} \]
\[B = \text{the distance between the center of the block and the outer rectilinear portion of any projection thereof.}\]

2. A series of identical toy construction blocks as defined above in claim 1 wherein:
   (a) each arcuate side of said projections includes a locking portion which is V-shaped in a plane including the central axis of the projection and intersecting the locking portion; and,
   (b) each arcuate side of said recesses includes a locking portion which is V-shaped in a plane including the central axis of the recess and intersecting the locking portion of said recess for cooperating with the locking portion of a projection received in the recess to restrain said projection against dislodgement in the direction of the central axis.

3. A series of identical toy construction blocks as defined above in claim 2 wherein the projection locking portions comprise two arcutely spaced elongated bosses means on each arcuate side of the projections.

4. A series of identical toy construction blocks as defined above in claim 1 and further comprising:
   (a) a web joining the base of each projection to the adjacent recess; and,
   (b) a bore through the center of each of said blocks with its axis perpendicular to the axes of said arms, each said bore being adapted to snugly receive the projections of the other blocks to interconnect the blocks.

5. A series of identical toy construction blocks as defined above in claim 4 in combination with a link for connecting said blocks together, said link comprising:
   (a) an elongated body; and,
   (b) a projection substantially identical to said block projections at each end of said body, said body being dimensioned so that adjacent projections of two blocks connected by said link are juxtaposed but do not interferingly contact each other.

6. A series of identical toy construction blocks as defined above in claim 4 in combination with a link for connecting said blocks together, said link comprising:
   (a) a body; and,
   (b) a recess substantially identical to said block recesses at each end of said body, said two recesses being juxtaposed and oppositely oriented.

7. A series of identical toy construction blocks as defined above in claim 4 in combination with a link for connecting said blocks together, said link having two elongate male members with their longitudinal axes at a right angle relative to each other, each of said male members including four arms defining an X-shaped cross-sectional configuration with one arm shorter than the other three, said male member being adapted to be received in the recesses of the blocks to interconnect two blocks at right angles to each other.

8. A series of identical toy construction blocks as defined above in claim 4 in combination with:
   (a) an elongated tube adapted to interconnect said blocks, each end of said tube being adapted to fit snugly interior of said bore and said recesses; and
   (b) a cylindrical hoop circumscribing the projections of one of said blocks to form a wheel.

9. A toy wheeled-vehicle having a flat body surface comprising:
   (a) four identical blocks interconnected to form a substantially flat surface, each said block comprising (b) parallel front and rear faces, a central bore, and a peripheral surface defining (c) four arms of equal length spaced from each other by 90°;
   (d) a projection at the end of each arm, each said projection including an outer rectilinear end surface and opposed arcuate side surfaces;
   (e) a recess midway between each adjacent pair of arms, each said recess including an inner rectilinear end surface and opposed arcuate side surfaces;
   (f) said blocks being interconnected by appropriate ones of said projections being snugly received in appropriate ones of said recesses to form a flat surface with the centers of the blocks defining the corners of a square and with two of said arms extending toward the center of said square;
   (g) the distance from the center of each block to the outer rectilinear end surface of its projections being such that the pair of end surfaces near the center of said square are slightly spaced one from the other;
   (h) at least one connecting member extending downward from said blocks;
   (i) an axle attached to said connecting member below said blocks; and,
   (j) a wheel mounted on said axle for rotation relative to said blocks.

10. A series of identical toy construction blocks, each comprising:
   (a) a first pair of opposite arms lying along a first axis;
   (b) a second pair of opposite arms lying along a second axis which intersects said first axis perpendicularly at the center of said block;
a projection at the end of each arm comprising a pair of opposed sides and an outer rectilinear portion at the distal end of the projection;

(d) a recess formed between each adjacent pair of arms, said recess being proportioned to receive the projections of other blocks of said series to interconnect said blocks in a plurality of configurations, each said recess comprising a pair of opposed sides, an opening through the outer portion of said segment, and a rectilinear inner portion nearest the center of the block;

(e) said projections being dimensioned so that when four of said blocks are interconnected such that their centers define the corners of a square, the projections on the inwardly disposed arms do not overlap or interfere with each other; and,

(f) each said block being proportioned so that $(2B)^2 \leq 2(A + B)^2$ wherein $A =$ the distance between the center of the block and the inner rectilinear portion of any recess thereof, and $B =$ the distance between the center of the block and the outer rectilinear portion of any projection thereof.

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