Jan. 5, 1926.

O. H. STRUB

1,568,252

BUILDING BLOCKS FOR TOY STRUCTURES

Filed August 10, 1923

3 Sheets-Sheet 1

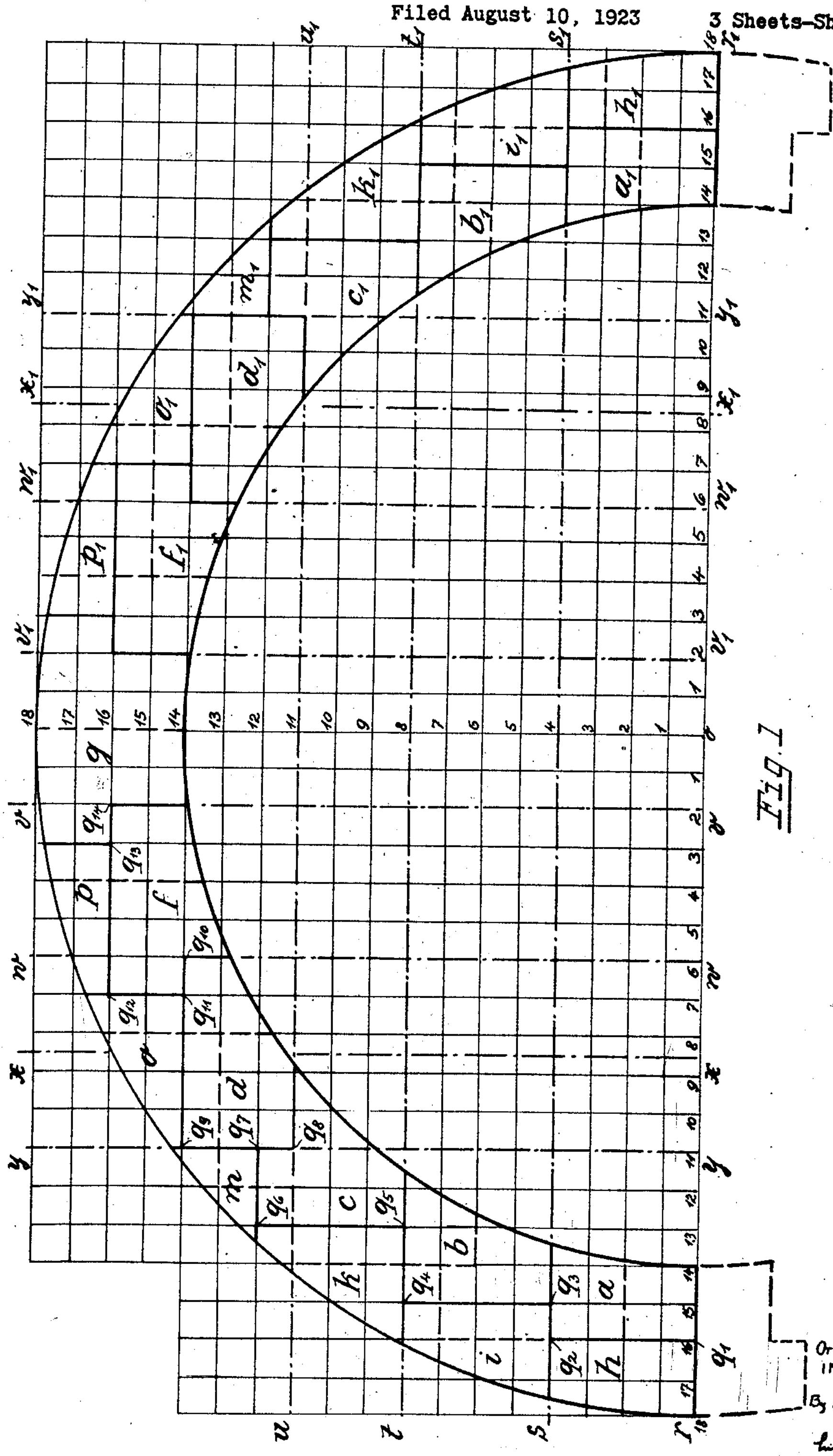

Fig. 1

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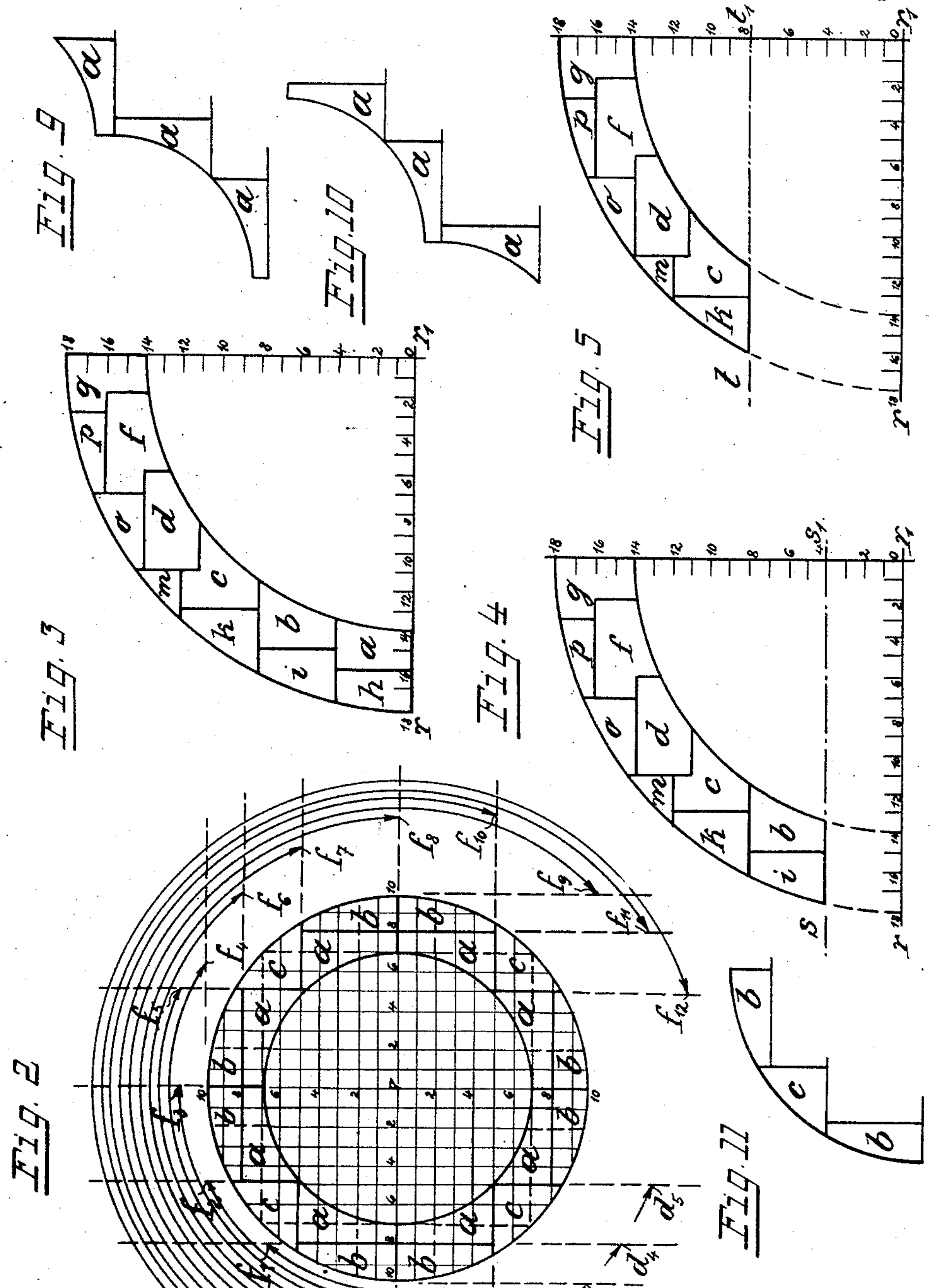

OTTO H. STRUB

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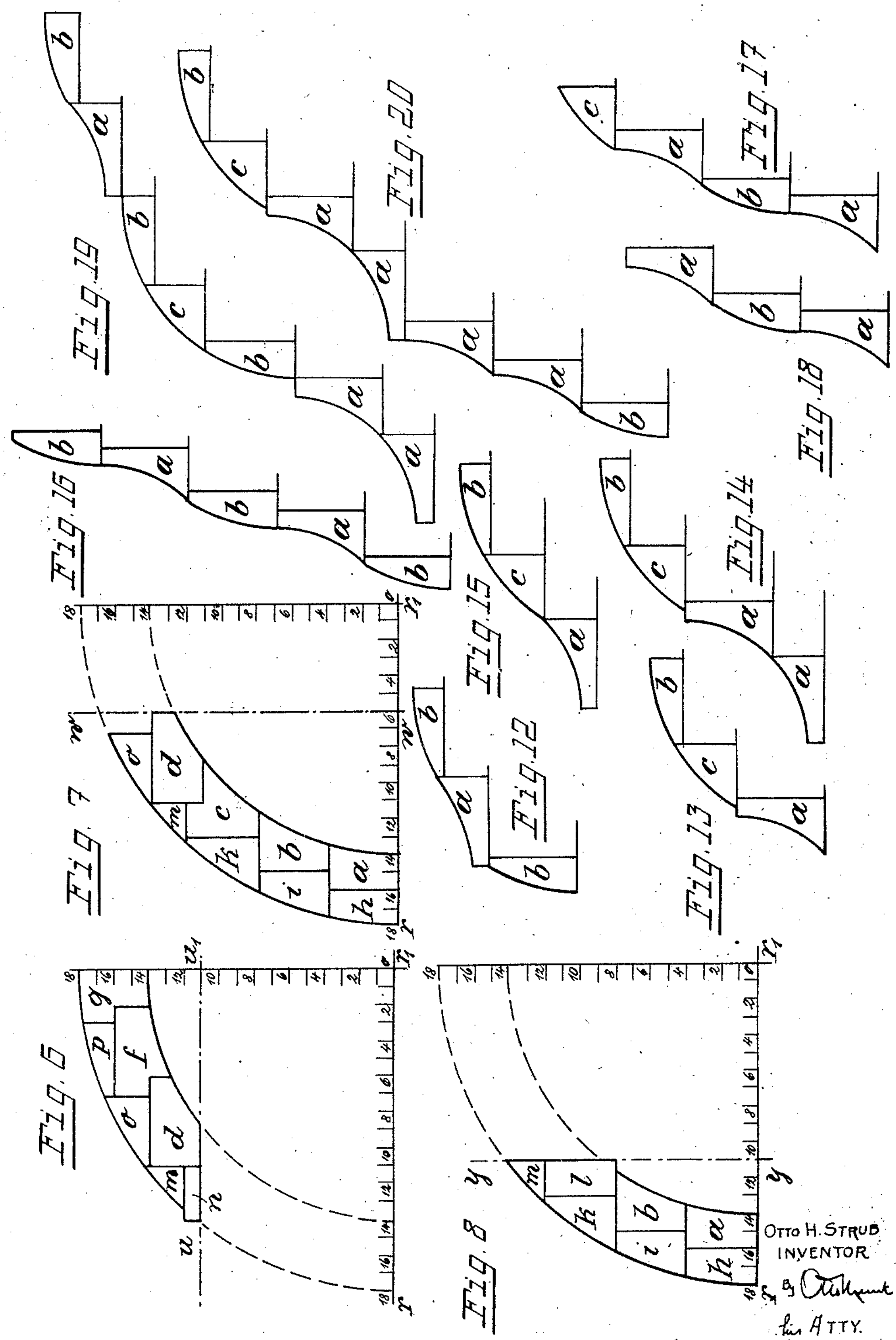
Jan. 5, 1926. 1,568,252

O. H. STRUB

BUILDING BLOCKS FOR TOY STRUCTURES

Filed August 10, 1923 3 Sheets-Sheet 3



OTTO H. STRUB
INVENTOR
By [signature]
his ATTY.

Patented Jan. 5, 1926. **1,568,252**

UNITED STATES PATENT OFFICE.

OTTO H. STRUB, OF RUDOLSTADT, GERMANY, ASSIGNOR TO THE FIRM F. AD. RICHTER & CIE. A. G., BAUKASTENFABRIK, OF RUDOLSTADT, THURINGIA, GERMANY.

BUILDING BLOCKS FOR TOY STRUCTURES.

Application filed August 10, 1923. Serial No. 656,719.

To all whom it may concern:

Be it known that I, OTTO H. STRUB, citizen of Switzerland, residing at Rudolstadt, Thuringia, Germany, have invented certain new and useful Improvements in Building Blocks for Toy Structures; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention refers to segmental stones for model building which can be equally well applied to several entirely different spheres of usefulness and which permit of the execution of a large number of form variations in each of these spheres.

The segmental stones are in the first place adapted for building circular walls in such a manner, that any desired number of parts of a circle can be chosen, each such part affording a right-angled connection with the normal wall. The circular wall can hereby be executed in either concave or convex form.

The same segmental stones can also be used for erecting concave or convex roofs or gable profiles, in which case the form stones always engage at right angles with the roof frame or construction or in the case of gables with the wall. A large number of simple and combined forms can be evolved.

A fourth sphere of usefulness is found, when the concave segmental stones within a semicircle or a part of a semicircle project one below the other, the stones being in this case erected in a vertical plane; in this manner a selfbearing cupola or dome is formed, the internal, concave layer of stones supporting the outer, convex layer without any further frame-work or constructive means.

In the case of circular walls, the new element of the present invention is the arrangement that all side joints of the freestones are parallel to the sides of a square tangent to the circumference of the wall circle and not, as is usually the case, radial or in thick walls, parallel to the circumference. Instead of a square tangent to the circumference any square may be chosen, of which the centre corresponds with the centre of the circle.

The result of this arrangement is that all side joints within the section of the wall meet at right-angles, from which results a further new element of the present invention, namely, that the segmental stones in consequence of their right-angled delimitation can be used for erecting roofs, gables and domes.

If the segmental stones lying in a horizontal plane are used for an erection in a vertical plane, side joints will in part be converted into bearing joints and former bearing joints into side joints. The new element in the invention consists however in the peculiar formation of those joints, which are parallel to the sides of a square, that is, which form parts of the chords of a circle. Since these joints may, according to the sphere of usefulness, be either side joints or bearing joints, they will in the following be generally referred to as internal joints.

A further new element is contained in the fact that all internal joints are distant from each other in the ratio of 1:2:3:4, i. e.; in multiples of a certain unit; this unit corresponds with the fundamental unit of the normal stones in cooperation with which they are used. The radii are also multiples of the same unit.

Reference being had to the accompanying drawings, Figs. 1 and 2 illustrate the characteristics of the invention, and Figs. 3 to 20 show examples of its application.

Fig. 1 shows a section through a semicircular arch or a semicircular wall if the stones are laid horizontally. The concave stones *a*, *b*, *c*, *d*, *f*, *g* and the convex stones *h*, *i*, *k*, *m*, *o*, *p* are designed on the basis of a network of squares in such a manner, that the radius of the concave stones measures 14 side lengths of such a square unit, the radius of the convex stones 18 such lengths, and therefore the thickness of the wall 4 such lengths. The side length of a square corresponds with the fundamental unit of a normal stone.

Each internal joint q_1 to q_{14} coincides in its position with the side of a square, and the distances q_1 to q_2, q_2 to q_3, q_3 to q_4, etc., therefore correspond with multiples of the side length of a square. The internal joints lie along lines parallel to the sides of a square.

Since therefore the internal joints always meet together at a right-angle and since the distance from one internal joint to the other is always a multiple of the unit of the normal stone, it is possible to build on to any desired internal joint with the normal freestones, without the help of any kind of connecting or transition stones, which are always necessary in the case of ordinary quoins for circular walls. This has a further result:

If a piece of any desired size is chosen out of the semicircle of Fig. 1, the distance to the normal wall, which is built on to the ends of the chosen circular pieces, will be a multiple of the normal unit, i. e. the side of a square in the drawing. It therefore follows that any desired formation made with the segmental stones will connect with and join on to the normal wall without any remainder over. An example will make this clear. If in Fig. 1 all the stones of the right half of the semicircle and the stones f and p of the left half are taken away, then a piece similar to Fig. 7 will remain. The point q_{11}, to which the normal wall connects at one end, forms together with the point q_1 at the other end the diagonal of a rectangle, the sides of which are in the ratio of 9:14 unit lengths. Both figures or lengths are a multiple of the normal unit and are therefore divisible without remainder into the normal wall.

In order to illustrate the large number of pieces out of a circle, which may be used as a ground plan for alcoves, bay windows, verandas, corner towers and the like a simple example is shown in Fig. 2. The layer of stones consists of only three different segmental stones, namely the concave stone (a) and the convex stones b and c. If now a piece of normal wall is connected to the appertaining internal joint of the stones (a) and (b) in the direction of the dotted lines d_1, then 12 different ground planes of circular erections will be attainable from f_1 to f_{12}, the dotted lines showing the position of the connecting normal wall on the other side. Or if the first connecting normal wall is removed from d_1 to d_2, d_3, d_4 or d_5, then further new forms for the ground plan will result.

Concave ground plan forms may be constructed in the same way, or concave forms combined with convex, as is often met with the rococo-style of architecture.

The above also applies to the segmental stones of Fig. 1, only in this case the number of possible ground plan forms will be a multiple of the forms possible with Fig. 2. Figs. 4 to 8 illustrate examples of such forms. The new feature in the use of these segmental stones is also to be found in the possibility of connecting or walling back with normal freestones at right-angles from any desired point of the concave or convex profile.

For building circular walls only quoin stones with wedge-shaped side joint surfaces have hitherto been known, of which the wedge surfaces were the continuation of radii of the wall circle. The erection of different forms of circular walls with such quoins is a matter of difficulty requiring for each individual case several forms of special stones, which can be used only for that particular case, and which are required for connecting with the normal wall. In the case of the segmental stones according to the present invention, each single stone can be used as a connecting stone, and each stone has further dimensions proportionate to a normal unit, no matter in what position said stone is used.

The hitherto known quoin stones are altogether unsuited for building concave or convex roofs or gables, whereas the segmental stones according to the present invention are especially well adapted for this purpose, all the above-described advantages of the segmental stones for erecting circular walls being here also retained.

The internal points of Fig. 1 q_1 to q_2, q_2 to q_3, q_3 to q_4 and so forth up to q_{14} divide the segmental stones into two halves, a convex half and a concave half, and also bring about that each segmental stone has only one curved surface and that all other surfaces of these stones are at right angles to each other. The two last characteristics are an indispensable condition for the erection of different forms of curved roofs and gables.

Figs. 9 to 20 show a number of examples of such concave and convex roofs and gables put together with the segmental stones of Fig. 2. In Fig. 2 also an internal joint running the length of the wall divides the concave from the convex half. The profiles shown in the Figs. 9 to 20, which consist only of the stones a, b, and c, illustrate only one side or half of the erection, in order to economize space.

The profiles of the Figs. 9 and 10 have been put together with the concave stone (a) and the profile according to Fig. 11 with the two convex stones b and c, whereas the profiles according to Figs. 13, 14, 15, 19 and 20 utilize all three segmental stones. The number of possible profiles which can be used for model building is exceedingly great. Each profile can here represent either the section through a roof, a dome, the crown of a tower or the view of a gable.

In each individual case the segmental stones fit onto the normal wall perfectly and without any gap, in consequence of the multiple proportions which are peculiar to them, and which has its origin in the fundamental unit of the normal freestone. This point has already been demonstrated and proved in the case of segmental stones used for building circular walls, and all that has been said above under this heading also applies to the segmental stones when used for building roofs, gables, domes and the like.

The peculiar arrangement of the internal joints leads to a third sphere of usefulness of the segmental stones, which will be made clear by referring again to Fig. 1. The side joints of the concave stones a, b, c, d, f, g and a_1, b_1, c_1, d_1, f_1, which are parallel to the diameter $r\ r_1$, are so arranged, that up to the central stone g one of these joints always projects wholly or partly below the next stone. If now this layer is erected vertically, no stone will be able to fall inwards or downwards. One stone carries the next, in bracket fashion, so that a vault-like, self-bearing structure results.

It is therefore obvious, that, in order to build any desired form of cupola or dome with the convex stones h, i, k, m, o, p, g and h_1, i_1, k_1, m_1, o_1, p_1, no kind of auxiliary frame or construction will be required, since the cupola or dome is self-bearing, this being effected by the inside, concave stones. Other forms of a cupola or dome can be attained by shifting the base of the dome from $r\ r_1$ in Fig. 1 to $s\ s_1$, the segmental stones h, a and a_1, h_1 being here taken away; this form is shown more clearly in Fig. 4. Or if the stones i, b and b_1, i_1 are also omitted, the basis of the dome shifts to t, t_1, as is shown more particularly in Fig. 5. By further removing the segmental stones c, k and c_1, k_1 in Fig. 1 and filling up the gap under the stone m with a normal freestone n a cupola or flat dome, as illustrated in Fig. 6, will remain on the base line u, u_1.

According to Fig. 1 other forms can be attained by shifting the centre of the dome and leaving away the segmental stones at the crown of the dome. By removing the stones f, p and f_1, p_1 and also the centre stone g, and by moving the remaining stones together until the stones d and d_1 come into contact at the new middle axis $w—w_1$, the steep dome according to Fig. 7 will be formed. In this case a gap remains at the crown above the bearing joints q_{10} to q_{11}, which can be filled up with a normal freestone. This latter may be used as a base for any kind of ornamental piece, for a peak or the like, such as are usual to crown a dome or cupola.

In this way, by removing more stones, the central axis of the dome can be shifted to $x—x_1$ or $y—y_1$ (Fig. 1). The latter case is illustrated in Fig. 8, where the gap under the stone m caused by the removal of the stone c has again been filled up by a normal stone. This does not, however, exhaust the possibilities of erecting different and self-bearing domes and cupolas. In Fig. 1, for instance, the base of the cupola may be moved from $r—r_1$ to $s—s_1$ and at the same time the central axis to $w—w_1$. By thus contracting the original form at the base and crown simultaneously, a new series of cupola forms can be arrived at, which have, however not been individually illustrated on the accompanying drawings.

To recapitulate: The present invention makes it possible with the same small number of differently formed building elements to erect both concave and convex walls, concave and convex roofs and similarly profiled gables, and finally to build self-bearing cupolas and domes, in all of which four spheres of usefulness the number of possible architectural forms of different shape and character is exceedingly great, it being further possible in each and every case to build or connect with normal freestones at any desired point of the profiles.

What I claim as my invention and desire to secure by Letters Patent, is:

1. In a set of complementary toy building blocks adapted to interengage to form a ring, a plurality of units having only one curved surface, each of the other surfaces being parallel to one of three mutually perpendicular planes.

2. In a set of complementary toy building blocks adapted to interengage to form a ring, a plurality of units having only one curved surface, certain of which surfaces are concave and certain of which are convex.

3. In a set of complementary toy building blocks adapted to interengage to form a ring of rectangular cross section, a plurality of units having only one curved surface, and contacting surfaces parallel to either side of a right angle.

4. In a set of complementary toy building blocks, a unit having only one curved surface, each of the rest being parallel to one of three mutually perpendicular planes, said curve being a circular arc of less than 90°.

5. A set of complementary toy building blocks adapted to interengage to form a semi-circular arc, comprising a keystone, and a plurality of mutually contacting units on either side of the keystone, all said units including the keystone having contacting surfaces which are parallel to either side of a common right angle.

6. In a set of complementary toy building blocks adapted to interengage to form a portion of a ring, a plurality of units having only one curved surface and contacting surfaces parallel to either side of a right angle, the distances between parallel contacting surfaces being multiples of a unit length.

7. In a set of complementary toy building blocks, a plurality of units as claimed in claim 6, in which the radii of the curved surfaces of said ring portion are also multiples of said unit length.

8. A set of toy building blocks compris-

ing a plurality of complementary units having surfaces whereby the units are adapted to interengage to form a portion of a circular ring of rectangular cross section, each unit having only one curved surface which constitutes part of the curved surfaces of the ring, all the other surfaces being parallel to any of three mutually perpendicular planes.

9. A set of complementary toy building blocks adapted to interengage to form an arc, said blocks each having a cross-section forming a rectangle, part of which rectangle is cut away, at least a part of said cut away portion forming a curve, each of said blocks having only one curved surface, some of said curved surfaces being convex and some concave.

10. A set of complementary toy building blocks adapted to fit together to form various lengths of an arc of an annulus, the cross-section of each block having a right angle bounded by two straight sides, said cross-sections each having one curved side, some of said curved sides being convex and some being concave, the blocks when fitted together being adapted to form a part of an annulus, the outer curved surface of which is an arc of a circle and the inner curved surface of which is an arc of a smaller circle concentric therewith.

11. A set of complementary toy building blocks adapted to fit together to form various lengths of an arc of an annulus, the cross-section of each block having a right angle bounded by two straight sides, said cross-sections each having one curved side diametrically opposite said right angle, some of said curved sides being convex and some being concave, the blocks when fitted together being adapted to form a part of an annulus, the outer curved surface of which is an arc of a circle and the inner curved surface of which is an arc of a smaller circle concentric therewith.

12. A set of cooperating toy building blocks, each block having one curved surface and a plurality of plane faces adapted to engage with cooperating plane faces of adjacent blocks, at least one of said plane faces being drawn along a minor chord of the circular surface of which the curved face is a part.

13. A set of cooperating toy building blocks, some of said blocks having one convex surface and a plurality of plane faces adapted to engage with the cooperating plane faces of the adjacent blocks, said plane faces being drawn along minor chords of the circular surface of which the curved face is a part.

14. A set of cooperating toy building blocks, some of said blocks having one concave surface, said concave surface constituting a part of a circular surface, and a plurality of plane faces adapted to engage with cooperating plane faces of adjacent blocks, at least one of said plane faces being drawn along a minor chord of a circle concentric with the circular surface of which the curved face is a part.

In testimony whereof I hereunto affix my signature.

OTTO H. STRUB.