

Nov. 8, 1960

J. C. A. MacMILLAN

2,958,918

MOLD AND METHOD FOR MAKING A DOME STRUCTURE

Filed Aug. 1, 1956

2 Sheets-Sheet 1

FIG. 1.

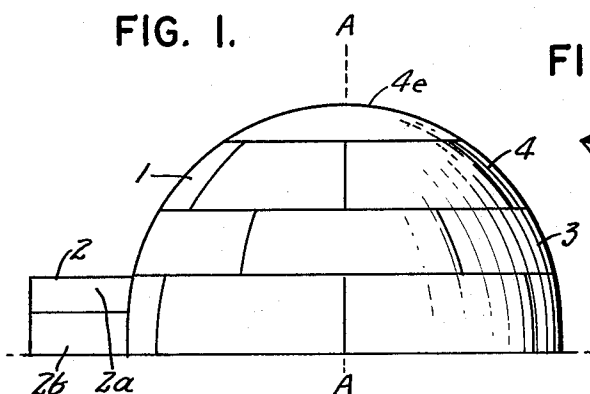


FIG. 3.

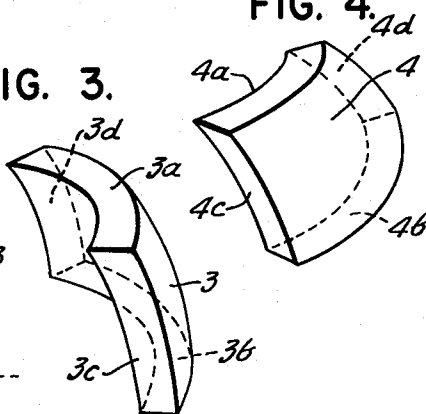


FIG. 4.

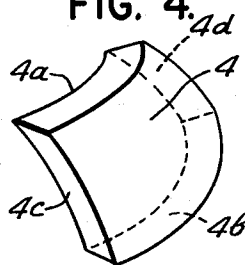


FIG. 2.

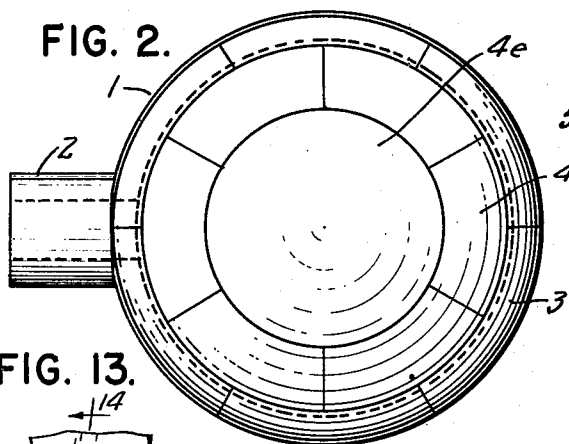


FIG. 5.

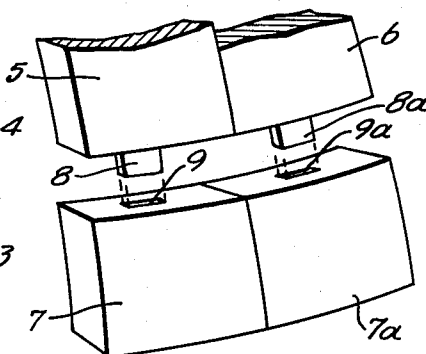


FIG. 13.

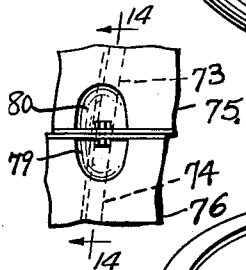


FIG. 7.

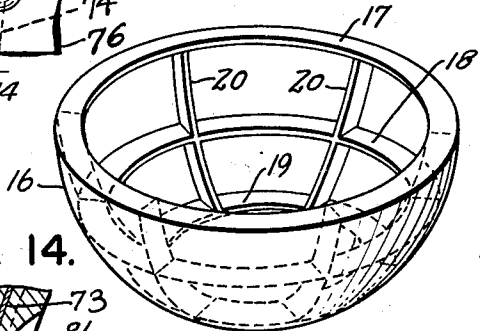


FIG. 14.

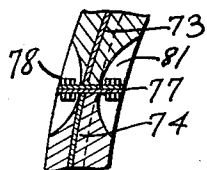
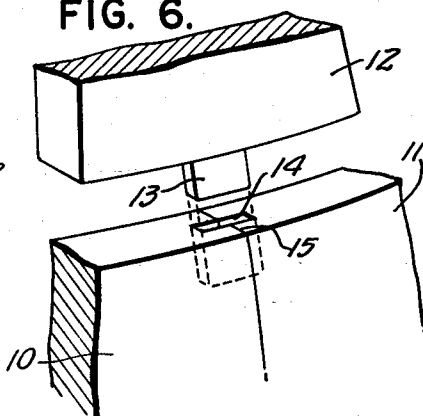


FIG. 6.



INVENTOR.

JAMES C. A. MACMILLAN

BY

Kohsch and Kohsch

ATTORNEYS

Nov. 8, 1960

J. C. A. MacMILLAN

2,958,918

MOLD AND METHOD FOR MAKING A DOME STRUCTURE

Filed Aug. 1, 1956

2 Sheets-Sheet 2

FIG. 9.

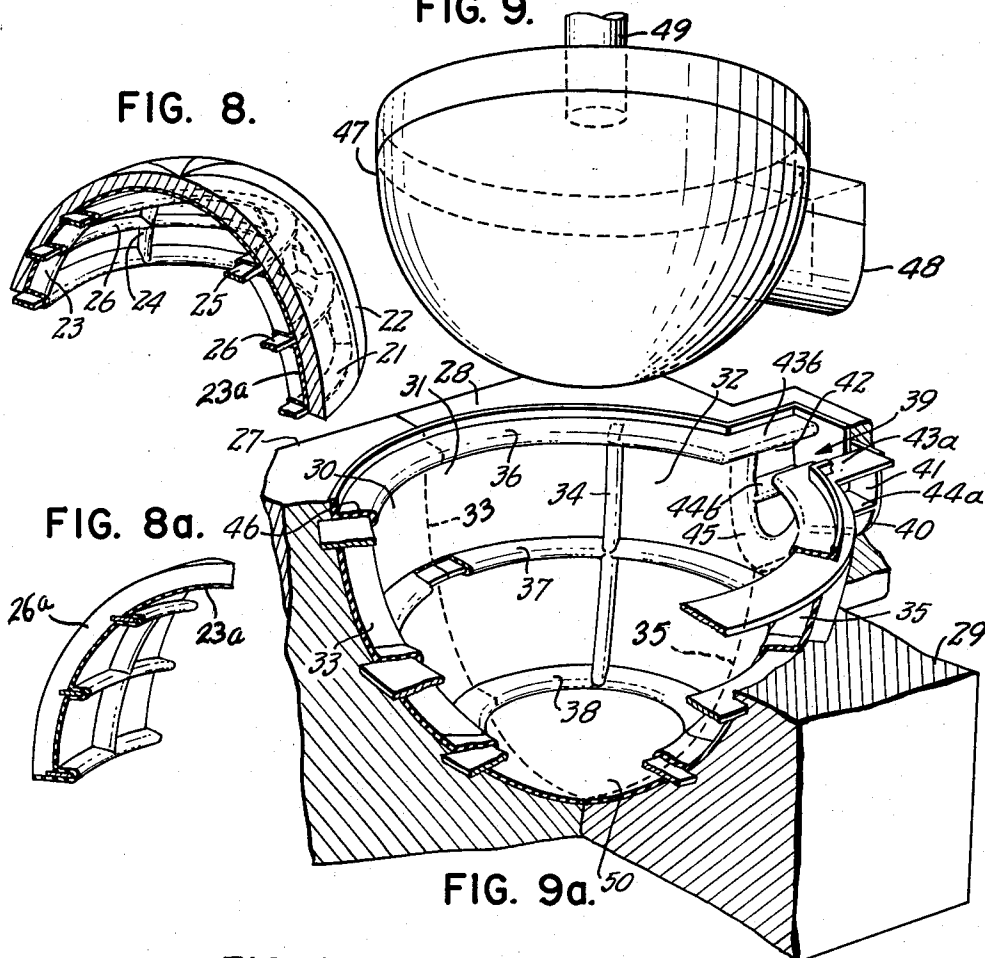


FIG. 10.

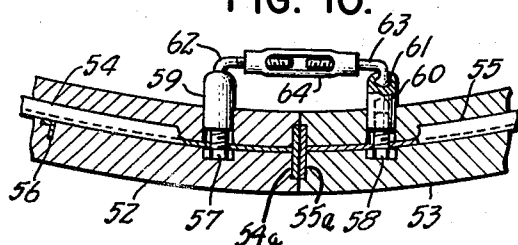


FIG. 11.

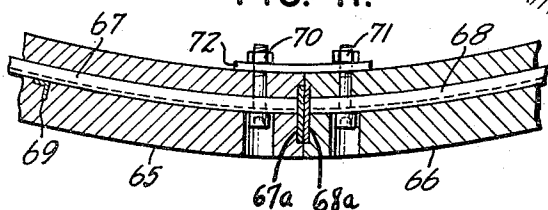
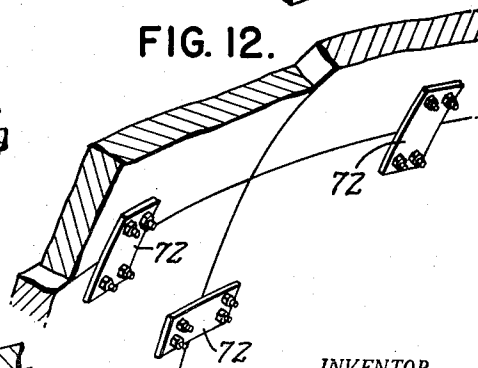


FIG. 12.



INVENTOR.

JAMES C. A. MACMILLAN

BY

Kohsich & Kohsich
ATTORNEYS

1

2,958,918

MOLD AND METHOD FOR MAKING A DOME STRUCTURE

James C. A. MacMillan, 4730 Centre Ave., Pittsburgh, Pa.

Filed Aug. 1, 1956, Ser. No. 601,389

6 Claims. (Cl. 25—121)

The present invention relates to structures of dome-like configuration and particularly to a method and novel mold assembly for producing a plurality of curved segments capable of being fitted together to form an inhabitable dome-like structure or construction toys such as toy igloos and the like.

Recent trends in the do-it-yourself field have opened up new avenues of approach in the field of building construction enabling home owners to put together prefabricated segments or units to form desirable structures, such as breezeways, sheds, small country cottages, etc. The present invention which relates to dome-like structures is particularly applicable to the new do-it-yourself trend. The invention is also applicable to the field of educational toys of the three-dimensional puzzle variety.

Construction toys generally comprise rectangularly configured blocks from which rectangular structures are then constructed. However, in the general toy field not much has been done with the construction of dome-like structures from curved building block segments. Apparently the reason for this is because it is difficult to produce such segments or elements economically which can then be fitted together to produce a dome-like structure. Such segments would have to be curved in three dimensions and would have to be made sufficiently accurate so that the parts can be fitted together easily by children. This also holds true for the construction of inhabitable structures.

It is the object of the present invention to provide a novel mold assembly which enables the production of curved building block segments required to form a single dome-like structure.

Another object of the present invention makes possible the provision of three-dimensionally curved segments which are fittable together to form a curved dome.

A further object of the present invention is to provide curved segments with connecting means whereby when the curved segments are fitted together, the resulting structure will be rigid.

Still another object of the invention is to provide a toy igloo comprising a plurality of fittable, three-dimensionally curved building block segments.

A further object of the invention is to provide a method whereby all of the curved segments can be produced from a single mold in one operation.

These and other objects will more clearly appear when taken in conjunction with the following description and the accompanying drawings wherein:

Figs. 1 and 2 show the elevation and top views respectively of an igloo shaped structure produced from three-dimensionally curved segments;

Figs. 3 and 4 are examples of the type of segments which are employed in producing the dome-like structure;

Fig. 5 is illustrative of connecting means which may be employed to fit various curved segments together in producing a rigidly constructed dome;

Fig. 6 shows another embodiment similar to Fig. 5;

Fig. 7 is a phantom view of a flexible rubber-like mold

2

comprising a plurality of manipulative mold compartments from which a plurality of three-dimensionally curved segments can be produced and thereafter fitted together to form a dome-like structure;

5 Figs. 8 and 8a show a partial and phantom view of another type of mold comprising a rigid, segmented outer shell and a flexible, manipulative inner membrane that can be employed in carrying out the invention;

10 Figs. 9 and 9a illustrate male and female die molds, respectively, which may be employed in producing igloo type structures; and

15 Figs. 10 to 14 show embodiments of connecting means which may be employed in connecting curved segments in the production of rigid, inhabitable structures, Fig. 14 being a section through Fig. 13.

Referring to the drawing, Figs. 1 and 2 show a toy igloo produced in accordance with the invention comprising a dome-like portion 1 and an entrance portion 2. The dome-like portion 1 is made up of a plurality of three-dimensionally curved segments such as segments 3 and 4 which are shown separately in Figs. 3 and 4 respectively. The segments are characterized by transverse top and bottom portions 3a and 3b as shown in Fig. 3, or 4a and 4b as shown in Fig. 4. The top and bottom portions are referred to broadly as flat support- 25 able base portions of curvilinear contour, the flat surface lying in a plane which passes transversely through the polar axis of the dome-like structure produced when the curved segments are assembled together. The curved segments are also characterized by flat side portions 3c and 3d as shown in Fig. 3, or side portions 4c and 4d as shown in Fig. 4, the flat side edges also being of curvilinear contour and the flat side surface lying in planes which contain the polar axis of said dome-like structure. 30 The polar axis referred to would be the axis A—A as shown in Fig. 1 of the dome-like igloo. When the curved segments are configured as described above by molding, they are easily assembled together side by side and one on top of another to form an accurately assembled dome-like structure. The top of the dome may comprise a cap 4e as shown in Fig. 1, or triangular curved segments fitted together to form a cap.

If a rigid structure is desired capable of withstanding vibrational disturbance within its immediate environment, connecting means may be utilized between adjacent co- 35 inciding flat base portions of the segments. This is illustrated with particularity in Figs. 5 and 6 of the drawing. Fig. 5 shows a bottom curved segment 7 and 7a having two recesses 9 and 9a which are directly below two connecting means or projections 8 and 8a projecting downwardly from two curved segments 5 and 6, respectively. In Fig. 6 a similar structure is formed with the exception that the recess 14 is made up of two recessed portions, one in segment 10 and the other in segment 11, the recess 40 spanning the juncture between the coinciding face 15 of segments 10 and 11. Recess 14 is adapted to receive connecting means 13 projecting downwardly from curved segment 12. Of course, it will be appreciated that various types of connecting means can be employed to insure rigid dome-like structures as will be described later.

Fig. 7 illustrates one type of mold assembly comprising a flexible shell 16 having arranged internally thereof horizontal flexible partition rings 17, 18 and 19 intersecting with vertical rib portions 20 arranged pretty much as great circles are arranged within the interior of a hollow sphere. The intersections of the horizontal rings and vertical partitions form a plurality of manipulative mold compartments or sections corresponding to the shape of segments 3, 4, etc., of Figs. 1 to 4. The mold compartments in the flexible mold are filled with a settable material such as plaster 45 of Paris and the exposed face of the material smoothed out with a spatula flush with the top of the partitions and

then allowed to set. After the material has hardened the mold need only be flexed by manipulation with the hands to dislodge the various curved segments which are then ready for assembly into a dome-like structure conforming to the internal configuration of the rubber-like mold.

If desired, the mold can be produced with a hard or rigid outer shell comprising manipulative lunar-type sections 21, 22, etc., as shown in the sectional view of Fig. 8. Integral with the side faces of the mold segments are formed vertical ribs or partitions such as 23 and 24, which abut against horizontal partition ribs, such as 25 and 26, to form the desired mold compartments in which the curved segments are produced. This is illustrated more clearly in Fig. 8a which shows the edge of the horizontal partitions flush with the side edge 26a of the mold section. In other words, the horizontal partitions are segmented so that the mold sections are manipulatable via the rubber-like coating bridging the edges of the partitions. The partitions may be made of flexible material. However, in this case the inner portion of the rigid mold assembly is preferably completely sprayed with an elastic rubber-like material 23a, for example Latex, which forms a thin stretchable membrane against which the settable material is cast and smoothed within each of the mold compartments. When the settable material has hardened, the rigid mold sections 21, 22, etc., are caused to move slightly outward by hand manipulation thereby causing the thin rubber-like membrane to stretch and dislodge from the mold compartments the hardened pieces of settable material. The mold assembly of Fig. 8 has the advantage over the mold assembly of Fig. 7 in that during its use the surface of the elastic membrane can be maintained somewhat rigid by virtue of the backup support of the rigid mold sections thus assuring more accurately-shaped segments.

The expression "rubber-like" as employed herein is meant to include materials with at least some elasticity when subjected to distorting or warping stresses. Such material may have a rubber base or a plastic base, particularly those plastic materials frequently referred to as artificial rubber. Latex is particularly useful when employed as a distortable membrane in combination with a back-up support. Examples of flexible plastic materials are elastomeric plastics such as polyethylene, styrene and butadiene co-polymers, styrene polymers, etc.

The thin flexible ribs which define the mold compartments may likewise be made of rubber-like material, although flexible plastic materials such as nylon may be used. In some instances fairly rigid portions may be employed, such as curved aluminum strips, etc. The thickness of the partition ribs may range from about 0.005 to one-thirty second of an inch. When producing large curved segments, thicker partitions may be employed.

As illustrative of the mold combination which may be employed to produce igloo-type structures, reference is made to Figs. 9 and 9a which show a male and female mold die respectively. Fig. 9a shows a partial view of the female mold comprising outer supporting segments 27, 28, 29, etc. backing up three-dimensionally curved mold segments 30, 31, 32, etc. showing partition lines 33, 35, etc. bounded interiorly by vertically disposed partitions 34 and horizontal segmented partitions rings 36, 37 and 38 which meet at said partition lines. As will be noted, the intersection of the horizontal and vertical rings result in a plurality of mold compartments, each capable of forming a three-dimensionally curved segment. The portion defining the entrance of the igloo is shown generally at 39 as comprising an arch portion 40 and side wall portions 41 and 42. Horizontal ring 36 connects with the entrance portion via partitions 43a and 43b. Two other partitions 44a and 44b running transverse to U-shaped partition 45 are also shown. Thus, this portion of the die is adapted to produce three entrance segments comprising an archway such as 2a of Fig. 1, and two side supports such as 2b also of Fig. 1. In producing a toy igloo by a segmented mold of this type, it is desirable, though not essential, to coat the

whole inner molding face of the mold including the partitions with a rubber-like membrane 46 similar to membrane 23a of Fig. 8, of sufficient elasticity so that when a plurality of curved building segments are formed in the molding compartments, they can be easily removed by manipulating the molding surface segments (30, 31, 32), in this case by drawing the outer integral supporting segments 27, 28, 29 outward sufficiently to subject the inner rubber-like membrane covering the mold segments to distortion, thereby loosening the formed material and enabling it to be removed.

In producing an igloo, the molding material, such as a soft putty-like mixture of plaster of Paris is poured into the compartments of the mold, including the igloo entrance portion, smoothed in place to the top level of the partitions, allowed to set, and then removed by merely manipulating the mold segments to stretch or distort slightly the rubber-like membrane, thereby loosening the cast segments. The curved pieces are easily fittable together to form an igloo-like structure.

Another method for producing the igloo-like structure is by using a combined male and female die mold, the male die mold being shown in Fig. 9 as comprising a dome-like surface 47 with a projection 48 conforming exteriorly to the entrance portion of the igloo and rod portion 49 for handling or controlling the movement of the male die. In using the combination, a measured amount of moldable material, such as plaster of Paris, is placed in the bottom 50 of the mold defining the cap portion of the igloo and the male die brought down into the mold to apply pressure to the moldable material causing it to flow into the compartments of the female mold. After it has been made certain that all of the material has flowed uniformly to all parts of the mold, the male die is removed and the material in the mold compartments further smoothed, if necessary, or excess material removed before it has completely set. Upon completion of setting the thus-produced curved pieces are removed by manipulating the mold segments, such as 30, 31 and 32, in order to dislodge the pieces via the distortion of the rubber-like membrane.

While the foregoing mold combination has been described in conjunction with the production of a toy igloo, it is to be understood that a similar mold combination of larger dimension could be used in the production of inhabitable structures. In such instances, the rubber-like membrane need not be used. The male and female die mold could be made from metal, such as cast iron or steel. The mold segments, e.g. 30, 31 and 32, etc., and the partitions integral therewith might be made separately from cast iron and fitted together and held in place by back-up segments, such as 27, 28 and 29 shown in Fig. 9a. A mold of this type construction could be used in the production of curved segments from heat curable materials, such as mixtures of wood fibers and resin-type binders, e.g. phenolformaldehyde resin and the like.

In utilizing the mold combination for the production of heat cured wood products, the male die is adapted to be heated by a liquid or steam carrying coil buried beneath the die surface periphery. The male die (be it dome-shaped) may comprise an outer shell of metal with a coil of tubing on its under surface, the tubing being backed up by an insulating or other suitable material. Thus, in producing curved wood panels for dome-like structures, a mixture of wood fibers (e.g. sawdust) and a heat curable resin (for example from about 3% to 12% resin) is distributed throughout the inner periphery of the female mold, the heated male die inserted and the material simultaneously pressed and cured. The male die is withdrawn and the pressed wood composition cooled and then removed from the mold by manipulating the mold segments. Because of the compressibility of the wood fibers, the mold compartments would be deeper, i.e. the partitions would rise to a higher height from the surface of each compartment. To accommodate the male mold snugly, 75

(horizontally and vertically) into which the partitions would fit when the dies are brought together.

In making curved segments by the foregoing method, it is preferred that the segments be reinforced to improve their strength. This can be done by imbedding curved angle iron in the segments. The angle iron can be indexed in position within the mold compartments and the composition mixture pressed around it. The angle iron can then be used to effect connection between curved segments in providing permanent structures.

Curved building segments with imbedded angle iron are shown in Figs. 10 and 11. Fig. 10 illustrates two connected curved segments 52 and 53 with angle irons 54 and 55 via abutting flanges 54a and 55a, respectively, running therethrough. An angle iron 56 (for further reinforcement) is shown running transverse to 54, there being a corresponding one (not shown) transverse to angle iron 55. In producing this type of curved construction element, bolts 57 and 58 running through angle irons 54 and 55 are positioned through said reinforcing angle irons prior to molding, the exposed threads of the bolts being protected by a wooden plug. After the segments have been molded, the wooden plugs are removed and a pair of internally threaded sleeves 59 and 60 connected to each bolt, the sleeves being connected by a universal joint (e.g. 61) to threaded L-shaped bolts 62, 63, adapted to receive turn buckle 64. This type of connecting means enables the curved building segments to be fitted together and secured permanently.

Fig. 11 shows another embodiment for connecting together curved segments 65 and 66, also reinforced interiorly by angle irons 67 and 68 with other angle irons running transverse thereto, such as 69. Holes for receiving bolts are provided for in the curved segments during pressing by means of stepped cylindrical wooden plugs which pass through the angle irons and about which the material is molded. The plugs are removed after curing leaving a hole adapted to receive bolts 70 and 71 for holding the curved securing plate 72 shown more clearly in Fig. 12. Instead of using removable wooden plugs to form bolt holes in the building segments, metal sleeves adapted to receive bolts can be imbedded during pressing and allowed to remain permanently in the fabricated segments. This would enable a connection involving a securing plate on both sides of the two segment surfaces with bolts passing through the imbedded sleeves and the metal plates, thus making for rigid structures via abutting flanges 67a and 68a of the angle irons.

Figs. 13 and 14 illustrate another type of connecting means for holding curved segments 75 and 76 together via imbedded angle irons 73 and 74 characterized by boltable flanges 77. The curved segments 75 and 76 have at their abutting edges recesses 79 and 80 which in cross section appear as large recess 81 (Fig. 13) in which flanges 77 are exposed enabling them to be connected by bolts 78. This type of connecting means is preferred over those of Figs. 10 and 11 for appearances sake.

As has been mentioned hereinbefore, the present invention is also adaptable to three-dimensional puzzles. In this connection, the invention can be adapted to the making of a world relief map in the form of a spherical globe. Two molds would be used divided into a plurality of compartments for each half of the globe, the molding surface being relieved with a negative reproduction of the world. Thus, by using two molds, and operating each separately, a plurality of curved segments can be produced, e.g. from plaster of Paris or other molding material, capable of being fitted together by holding means to form a hollow spherical object containing a relief of the world even down to the mountains. Or if a dome-like building is desired showing reliefs of windows, doors and the like, the interior mold surface can be relieved with such surface configurations. Even three dimensional picture puzzles can be made in the same way, that is with the pictures imprinted by molding on the curved surface

of the dome. Such puzzles would have considerable educational value for children.

Summarizing an educational aspect of the invention, a method is provided for producing a plurality of three-dimensionally curved building block segments capable of being fitted together to form a toy dome-like structure of hollow configuration comprising casting a settable material, such as plaster of Paris, against a flexible inner mold surface of hollow dome-like configuration divided into molding compartments by a series of vertical and horizontal partition ribs. The material in the compartments is smoothed flush with the top of the partitions and then allowed to set to form curved building block segments which are thereafter removed by simply flexing or distorting the rubber-like casting surface. The shape of the segments is characterized in that they can be assembled into a dome-like structure, e.g. into an igloo.

While the present invention has been described in conjunction with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention, as those skilled in the art will readily understand. Such modifications and variations are considered to be within the purview and scope of the invention and the appended claims.

I claim:

1. A molding assembly for the production of a dome structure, said assembly characterized by a molding surface of dome-like configuration wherein said molding surface is manipulatively movable to dislodge components molded thereagainst, a plurality of annular ring partitions horizontally spaced and integral with said molding surface, and a plurality of arcuately curved partitions longitudinally disposed along and integral with the molding surface and which lie in planes containing the polar axis of said dome-like molding surface, the intersections formed by the horizontally and longitudinally disposed partitions defining a plurality of molding compartments adapted to receive a settable material for molding into a plurality of segments from which a dome can be fitted together.

2. A molding assembly for the production of a dome structure, said assembly characterized by a molding surface of dome-like configuration wherein at least said molding surface is comprised of elastic rubber-like material distortable to dislodge components molded thereagainst, a plurality of annular ring partitions horizontally spaced and integral with said molding surface, and a plurality of arcuately curved partitions longitudinally disposed along and integral with the molding surface and lying in planes containing the polar axis of said dome-like molding surface, the intersections formed by the horizontally and longitudinally disposed partitions defining a plurality of molding compartments adapted to receive a settable material for molding into a plurality of segments from which a dome can be fitted together.

3. A flexible unitary mold for the production of a dome structure comprising a shell of elastic rubber-like material of dome-like configuration at the molding surface thereof, a plurality of flexible annular ring partitions horizontally spaced and integral with said molding surface, and a plurality of arcuately curved partitions longitudinally disposed along and integral with the molding surface and which lie in planes containing the polar axis of said dome-like molding surface, the intersections formed by the horizontally and longitudinally disposed partitions defining a plurality of molding compartments adapted to receive a settable material for molding into a plurality of segments which can be dislodged by distorting said mold after the material has set.

4. A method of producing a dome structure which comprises forming a molding surface of dome-like configuration wherein said molding surface is manipulatively movable to dislodge components molded thereagainst, dividing said molding surface into a plurality of molding compartments by horizontally spacing a plurality of an-

nular ring partitions latitudinally about said molding surface and longitudinally disposing a plurality of arcuately curved partitions whereby said longitudinally disposed partitions lie in planes containing the polar axis of said molding surface, casting a settable material within each of said molding compartments against said mold surface, smoothing said settable material flush with the top of said partitions defining said molding components, setting said molding material, and removing the set molding material as segments characterized by three-dimensionally curved surfaces from the compartments by manipulating said molding surface.

5. A method of producing a dome structure which comprises forming a back-up molding surface of dome-like configuration from a plurality of molding elements, said back-up molding surface being covered with a layer of elastic rubber-like material manipulatively distortable to dislodge components molded thereagainst, dividing said molding surface into a plurality of molding compartments by horizontally spacing a plurality of annular ring partitions latitudinally about said molding surface and longitudinally disposing a plurality of arcuately curved partitions, whereby said longitudinally disposed partitions lie in planes containing the polar axis of said molding surfaces, casting a settable material within each of said molding compartments against said mold surface, smoothing said settable material flush with the top of said partition defining said molding components, setting said molding material, and removing the set molding material as segments characterized by three-dimensionally curved surfaces from the compartments by distorting said molding surface.

6. A method of producing a dome structure which comprises forming a flexible mold of elastic rubber-like material characterized by a molding surface of dome-like configuration wherein said molding surface is manipulatively movable to dislodge components molded thereagainst, dividing said molding surface into a plurality of molding compartments by horizontally spacing a plurality of annular ring partitions latitudinally about said molding surface and longitudinally disposing a plurality of arcuately curved partitions, whereby said longitudinally disposed partitions lie in planes containing the polar axis of said molding surfaces, casting a settable material within each of said molding compartments against said mold surface, smoothing said settable material flush with the top of said partition defining said molding components, setting said molding material, and removing the set molding material as segments characterized by three-dimensionally curved surfaces from the compartments by distorting said mold.

References Cited in the file of this patent

UNITED STATES PATENTS

796,641	Hall	Aug. 8, 1905
1,013,536	De Forrest	Jan. 2, 1912
1,140,840	Moore	May 25, 1915
1,287,599	Leland et al.	Dec. 10, 1918
1,976,627	O'Rourke	Oct. 9, 1934
2,309,149	Wood et al.	Jan. 26, 1943
2,433,210	Gits	Dec. 23, 1947
2,469,603	Le Tourneau	May 10, 1949
2,559,846	Boucher	July 10, 1951