July 2, 1940. I. BALINKIN 2,206,149

CRYSTAL FORM DEMONSTRATOR

Filed Dec. 20, 1937

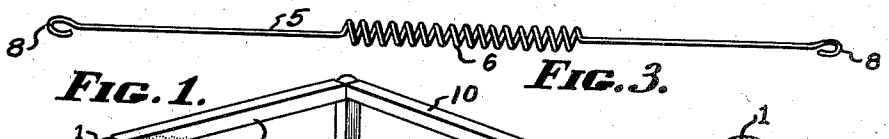
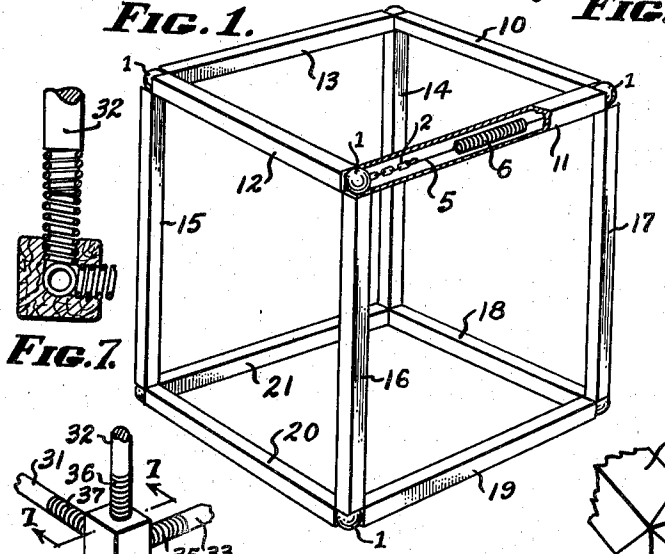


FIG. 1.

FIG. 3.



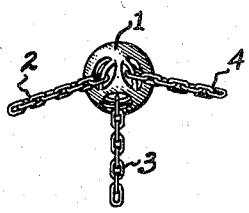


FIG. 2.

FIG. 7.

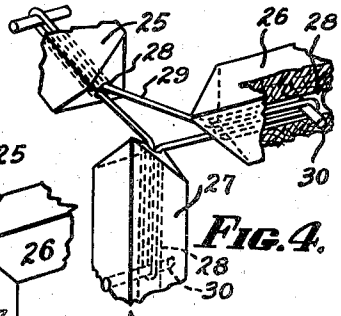


FIG. 4.

FIG. 6.

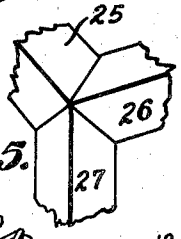
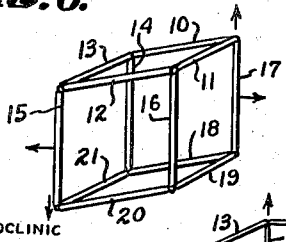
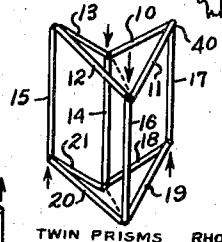


FIG. 5.



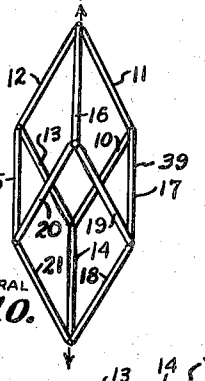
MONOCLINIC

FIG. 8.



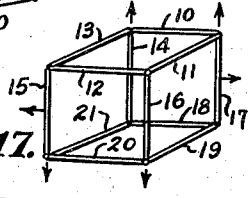
TWIN PRISMS

FIG. 9.



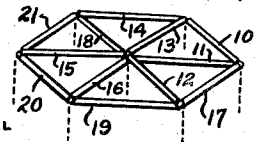
RHOMBOHEDRAL

FIG. 10.



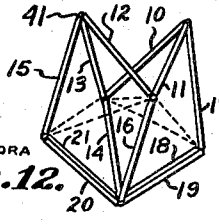
TRICLINIC

FIG. 17.



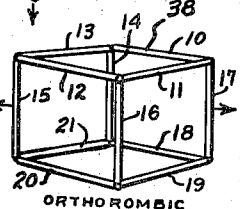
HEXAGONAL

FIG. 11.



TWIN HEXAHEDRA

FIG. 12.



ORTHORHOMBIC

FIG. 13.



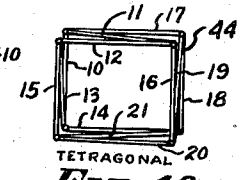
OCTAHEDRON

FIG. 14.



HEXAHEDRON

FIG. 15.



TETRAGONAL

FIG. 16.

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Patented July 2, 1940 2,206,149

UNITED STATES PATENT OFFICE

2,206,149

CRYSTAL FORM DEMONSTRATOR

Isay Balinkin, Cincinnati, Ohio

Application December 20, 1937, Serial No. 180,838

12 Claims. (Cl. 35—10)

My invention relates to a demonstration apparatus for educational and scientific use, and in particular to a model device with which substantially all of the forms in which matter crystallizes, together with certain of the derivative forms, may be demonstrated clearly. Whereas in the past where illustration of crystalline forms has been attempted by means of models, it has been necessary to provide a separate model for each of the many crystalline forms, it is an object of my invention to provide a single unitary device which by manipulation may be caused to assume the forms of or forms suggestive of a wide variety of crystalline structures.

The ancillary objects of my invention which are derived from the main object, as hereinabove set forth, will be apparent to one skilled in the art upon reading these specifications, or will be pointed out hereinafter. These objects I accomplish by that certain construction and arrangement of parts of which I shall now set forth certain exemplary embodiments. Reference is made to the drawing wherein:

Figure 1 is a perspective view with parts in section of one form of my device.

Fig. 2 is a perspective view of a corner member with connecting parts.

Fig. 3 is a view of a resilient member, the devices of Figs. 2 and 3 being used in connection with the embodiment of the device shown in Fig. 1.

Fig. 4 is an expanded view of another type of construction.

Fig. 5 is a view of a corner of a model device embodying the structure illustrated in Fig. 4.

Fig. 6 is a corner view of a third embodiment of the structure.

Fig. 7 is a sectional view taken along the lines 7—7 of Fig. 6.

Figs. 8 to 17, inclusive, are figures illustrative of methods of use of my device and show exemplary crystalline forms which may be illustrated with it.

Briefly, in the practice of my invention, I provide a cage-like structure of rod-like parts, which structure may be distorted into various geometrical shapes by reason of bendable or pivotal or resilient joints at the ends of the said parts. The cage-like structure may be made to have initially a wide variety of complex or simple geometric forms; and I have constructed devices, for example, having as many as thirty-six of the rod-like parts. For the usual uses to which my device is put, however, I prefer to make it in the form of a cube, or in the form of a more elaborate geometrical figure which can readily be distorted to form a cube. Without implying a limitation upon my invention, I shall describe it in cubical form. This is to say, I provide a series of twelve members so connected together at their ends that the members represent the edges of a cube. The members themselves are stiff, but are connected together at their ends by movable, malleable and bendable, or, preferably resilient joints, so that the structure may be distorted from the cubical form for purposes and in ways hereinafter to be set forth.

In Fig. 1 I have shown one form of the structure just referred to in which the side members have been numbered from 10 to 21 respectively. These members are all of equal length and in the structure illustrated in this figure are formed of hollow and preferably rectangular tubing, which may be of metal or of any other suitable substance. At each corner of the cube three members come together, and a joint in the nature of a ball joint is preferably formed. The joint member consists of a hollow ball 1, to which three attachment means 2, 3, and 4 are fastened. These may conveniently be in the form of short lengths of chain. The ball may be hollow and may be cut away as clearly shown in Fig. 2, to form attachment ribs for the chains; but the chains can be otherwise attached to the ball as desired. A spring link member is indicated generally at 5 in Fig. 3. This member comprises a tension spring portion 6 of a size suitable for insertion in the tube members 10 to 21, and end pieces on the spring portion terminating in hook members 8. In assembling my device, one of the hook portions 8 of the tension link 5 is engaged with one of the chains on a ball and the chain and link are inserted in a tube so that the ball rests at the end of the tube. Next the other hook member of the tension link is pulled beyond the opposite end of the tube, and is engaged with a chain member on another ball. When the tension link is released this second ball will be pulled against the other end of the tube. Next, additional tubes are assembled to the first tube and afterward to each other to build up the structure shown in Fig. 1. The tubes can move relative to each other about the balls at their ends; but the action of the tension link 5 is such as to keep the tubes pulled tightly together at their ends and such as to cause the structure of Fig. 1 to maintain its shape, as when placed on a table or the like. However, as indicated, the cage-like structure of Fig. 1 is such that it may be distorted into various other shapes.

Another form of the device is illustrated in Figs. 4 and 5 where the corner members of the cage are formed of wooden or other bars 25, 26 and 27. The ends of these bars are doubly beveled, as clearly shown in Fig. 4, so that they will fit together as illustrated in Fig. 5. To hold them together in a resilient fashion, I form bores 28 inwardly from the ends of the rods and insert in these bores the loops of a continuous rubber band or a spring member 29. Each loop is held in its particular bore by means of a pin 30. The beveling of the ends of the rods not only produces a neat fit, as shown, but assists the cage to hold its shape when not subjected to deflecting strains.

Still another form of the invention is shown in Figs. 6 and 7 where the edge members of the cube are formed by rods 31, 32 and 33. These terminate short of corner blocks 34 but are connected to the corner blocks by coil springs 35, 36 and 37. These spring members permit displacement of the edge members 31, 32, and 33 with respect to each other, but are resilient enough to cause the cage to assume the cubical configuration in the absence of deflecting strains.

With the device in the position shown in Fig. 1, it is clearly representative of a cubical crystal or crystal latticework. In Figs. 8 to 16 inclusive, I have illustrated, but without limitation, certain forms of crystal latticework which may be illustrated by my device. These forms are illustrated by pulling or pushing on the various parts of the cage illustrated in Fig. 1, to cause it to assume other forms; and by small arrows where possible in these figures, I have illustrated the place and direction of the forces applied. For example, at 38 in Fig. 13 I have illustrated an orthorhombic form of crystal latticework produced by pulling outwardly upon the vertical members 15 and 17, so as to cause the top and bottom squares of the cube to become diamond shaped. If, as in Fig. 8, one not only pulls outwardly upon the members 15 and 17, but displaces these members by depressing 15 and raising 17 a representation of the monoclinic form of crystal structure is secured. The monoclinic representation may be changed to a representation of the triclinic form of crystal, as in Fig. 17, by doing what has been described in connection with Fig. 8, and also raising the member 14 and depressing the member 16.

A rhombohedral form of crystalline structure may be illustrated as at 39 in Fig. 10, by grasping diametrically opposite corners of the cube shown in Fig. 1, and pulling these corners away from each other. The device may be collapsed into a plane, as shown in Fig. 11, to illustrate a portion of the structure of a hexagonal crystalline form. By manipulation, as illustrated in Fig. 9 at 40, my device may be caused to assume the form of twin prisms. By further manipulation, as shown at 41 in Fig. 12, twin hexahedra may be formed. A single hexahedron is formed as at 42 in Fig. 15. An octahedron crystalline form is illustrated at 43 in Fig. 14. A tetragonal crystalline form is produced as at 44 in Fig. 16, by rotating the top square 10, 11, 12, 13 of the cube of Fig. 1, through an arc of 90 degrees with respect to the bottom square 18, 19, 20, 21, so as to collapse the vertical members 14, 15, 16, 17, against adjacent top and bottom members.

The illustrated uses in Figs. 8 to 16 inclusive, are by no means all of the crystalline forms which may be illustrated by my device, but they are sufficient to illustrate the versatility of my device in demonstrating or modeling a wide variety of crystalline forms.

It will be clear that modifications may be made in my invention without departing from the spirit of it. The size of the edge members may be varied to suit requirements, also, or in accordance with the particular use to which the model is to be put. For personal use or for use before small groups, the device may be relatively small in size. For the instruction of large groups in a large hall, a larger model may be found desirable. In the commercial manufacture of my device I have been making them as illustrated in Fig. 1, of square aluminum tubing, approximately ⅜ inch in width, the edge members being approximately 12 inches long.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A device for illustrating crystalline forms or the like, comprising a series of rod-like members arranged to form a geometric figure and resilient means joining said members at their ends, the resiliency of said means being such as to maintain the members normally in said geometrical form, while permitting displacement of said members under stress, to cause the device to assume other geometrical forms.

2. A device for demonstrating crystalline formations and the like, comprising twelve rod-like members arranged with respect to each other to form edges of a geometrical figure, and flexible means connecting said rod-like members together at their ends to maintain them in the form of the geometrical figure aforesaid, while permitting deflection of said members into other geometrical forms.

3. A device for the purposes described, consisting of a cage formed of rod-like members connected at their ends by flexible means.

4. A device for the purpose described, consisting of a cage formed of rod-like members connected at their ends by resilient means, said members consisting of pieces of tubing, and said resilient means comprising members extending through said tubing and connected at the ends of said tubing with balls.

5. A device for the purpose described, consisting of a cage formed of a series of rod-like members and means for connecting said members together at their ends, said last mentioned means comprising balls contacted by said members to form a ball joint, and means for holding said members to said balls.

6. A device for the purpose described, consisting of a cage formed of a series of rod-like members and means for connecting said members together at their ends, said last mentioned means comprising balls contacted by said members to form a ball joint, and means for holding said members to said balls, said holding means comprising resilient means whereby the said cage is caused to assume a predetermined geometrical configuration in the absence of deflecting strains.

7. In a device for the purpose described, a series of bars arranged in the form of a geometrical figure and contacting each other at their ends, and flexible means for holding said bars together comprising common flexible means entering perforations in adjacent bars and fastened thereto.

8. A device for the purpose described, comprising a series of rods beveled at their ends, and arranged in the form of a geometrical figure, and at the meeting ends of said bars an endless resilient band having loops entering perforations in the ends of contacting bars and fastened thereto.

9. In a series for the purpose described, a series

of rods arranged in the form of a geometrical figure and approaching each other at the corners of said figure, corner pieces for said device and flexible connections between the ends of said rods and said corner pieces.

10. In a device for the purpose described, a series of rods arranged in the form of a geometrical figure and approaching each other at the corners of said figure, corner pieces for said device and resilient connections between the ends of said rods and said corner pieces, said last mentioned means consisting of coil springs, one end of which is attached to an end of a rod and the other end of which is embedded in a corner piece.

11. In a device for the purpose described, a series of rod-like members of equal length arranged to form the edges of a cube and flexible means for holding the said rod-like members in the form of a cube.

12. In a device for the purpose described, a series of rod-like members of equal length arranged to form the edges of a cube and resilient means for holding the said rod-like members in the form of a cube, said last mentioned means comprising a series of balls, one located at each corner of said cube, said rod-like members being hollow, and resilient connections between said balls located in and effective through the perforations in said rod-like members.

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