United States Patent [19]

Hogan

[11] **3,844,664**

[45] **Oct. 29, 1974**

[54] **ICOSAHEDRON DISC**

[76] Inventor: **John P. Hogan,** 704 Elm, Williamsburg, Iowa 52361

[22] Filed: **Aug. 10, 1973**

[21] Appl. No.: **387,449**

[52] **U.S. Cl.** **403/171,** 52/81, 52/DIG. 10

[51] **Int. Cl.** **E04b 7/08**

[58] **Field of Search** ..... 403/64, 169, 170, 171, 403/172, 176; 52/80, 81, 82, DIG. 10; 46/29; 135/3 B

[56] **References Cited**

UNITED STATES PATENTS

2,197,791	4/1940	Eddy	135/3 C
3,152,819	10/1964	Fentiman	403/172
3,486,278	12/1969	Woods	403/172 X
3,563,374	2/1971	Lund	52/DIG. 10

OTHER PUBLICATIONS

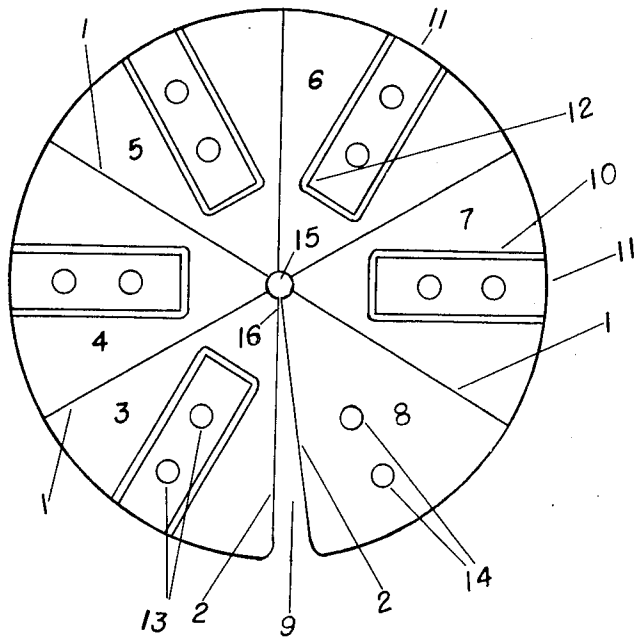
"Domebook 2," publ. by Pacific Domes, 1971, pg. 25.

Primary Examiner—Werner H. Schroeder

[57] **ABSTRACT**

This invention relates to a structural joint for the construction of "icosahedron structures".

10 Claims, 7 Drawing Figures



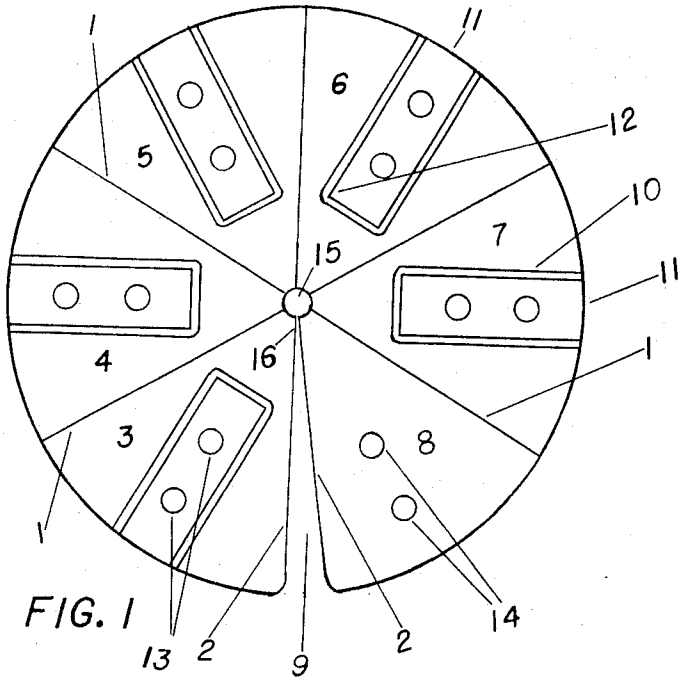


FIG. 1

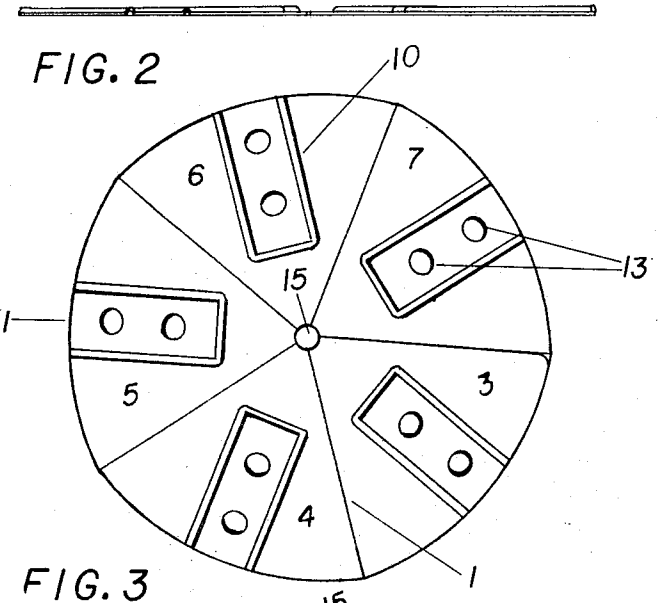


FIG. 3

FIG. 2

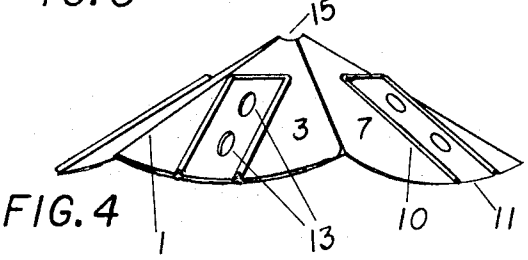


FIG. 4

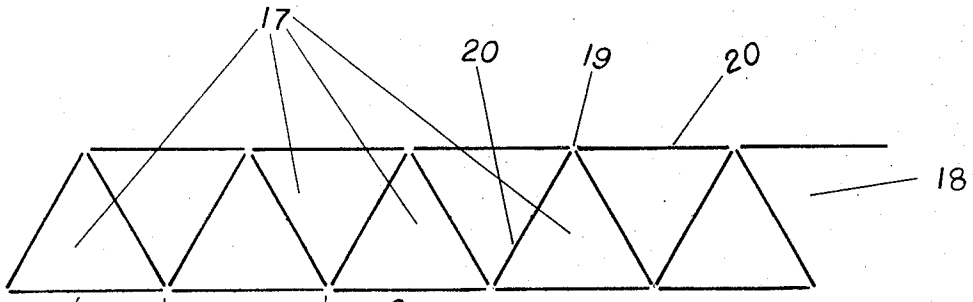


FIG. 5

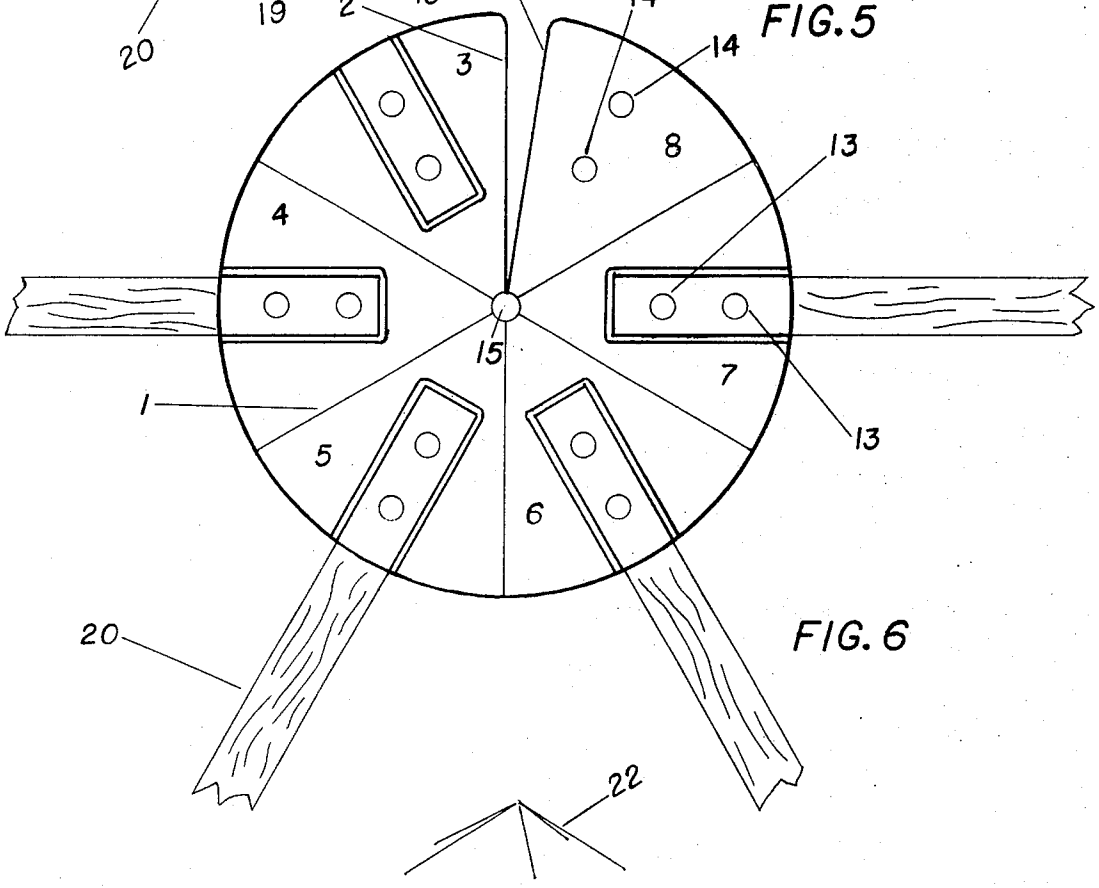


FIG. 6

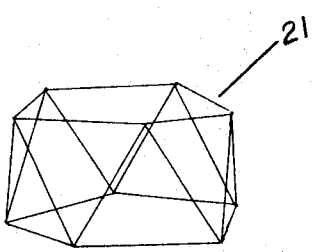


FIG. 7

ICOSAHEDRON DISC

An "icosahedron structure" is a construction framework based on the regular icosahedron from which one vertex and five clustered equilateral facets have been removed. The icosahedron disc is simply a vertex-forming joint from which an "icosahedron structure" can be generated. It is unique in that it allows the structure to be built in two different ways.

The disc can generate a convex "icosahedron structure" directly from itself, but it also can be used to connect up to twenty struts on a single, two-dimensional plane and then be shaped to the icosahedron structural form. This extra dimension allows for more freedom and, in some instances, simplicity in the construction of an "icosahedron structure".

The disc in its primary position is uniplanar. It takes the general shape of a flat circular plate. The center of this plate is the point from which five identical sectors radiate. These five sectors will be called the surface sectors. The angle formed by the converging radii of any of these surface sectors is essentially 60 degrees.

There is a final sector which shares one of its radii with a surface sector, but has its other radius separated from the adjoining surface sectorial edge by a wedge-shaped gap. This sixth sector's converging radii form an angle slightly less than 60 degrees, but when added to the angle generated by the wedge-shaped void, is essentially 60 degrees also. This sector will be called the overlapping plate.

The radii of the five surface sectors are marked by scorings on the surface of the plate (or disc). These scorings allow the material to be bent at these points into six different planes. When the disc is bent to form these six different planes and when the two sectors bordering on the wedge-shaped gap are overlapped, so that the disc presents five identical planar faces, the disc is then said to be in its secondary, or working position.

The struts of the structure are attached to the faces of the surface sectors so that they bisect the faces of the aforementioned sectors. The individual strut is properly positioned on the individual sectorial face by a three-sided ridge whose inner dimensions conform to the outer dimensions of the end of said strut. Within the perimeter of said three-sided ridge are two holes through which nails, screws, or bolts can be used to attach said surface sector to said strut. The sixth, or overlapping, sector has no three-sided ridge, but does have two holes, which align perfectly with the holes of the surface sector tangent with the gap when the two sectors are overlapped to form the secondary position of the disc.

Only eleven discs and twenty-five pieces of strut material of equal length are needed to build an "icosahedron structure".

Any light, but sufficiently rigid material which when scored attains a semi-flexible quality may be used for making the disc. For example, sheet metal of the proper gauge thickness could be machine-stamped to make the disc; or the proper plastic material of the right consistency could be molded to make the disc unit.

For a clearer understanding of the present invention, along with a preferred embodiment of it, reference can be made to the following description as it is related to the various drawings.

FIG. 1 shows the disc in its primary position as seen from above.

FIG. 2 shows the disc in its primary position as seen from the side.

FIG. 3 shows the disc in its secondary position as seen from above.

FIG. 4 shows the disc in its secondary position as seen from the side.

FIG. 5 shows twenty struts positioned to form nine equilateral triangles on a single plane.

FIG. 6 shows a close-up of a disc properly placed on a group of converging struts.

FIG. 7 shows the wall and roof sections of the "icosahedron structure".

Now referring to FIGS. 1 and 2; the basic composition of the disc is the six sectors 3–8 into which the disc is divided. Five of the sectors are identical, generating essentially 60 degrees between their respective radii edges 1–2. These five sectors are called the surface sectors 3–7, because upon the surface of their respective planes the strut material will be attached.

The sixth sector 8 generates slightly less than 60 degrees between its respective radii edges. This sector is called the overlapping plate 8 due to its use in transforming the uniplanar disc into a rigid five-sided regular convex figure.

Between the radius edges 2 of surface sector 3 and overlapping sector 8 is a wedge-shaped gap 9 which generates an angle considerably less than 60 degrees between its bordering radii 2, but when added to the radial angle of the overlapping sector 8 adds up to essentially 60 degrees.

On the face of each of the surface sectors 3–7 is a three-sided ridge 10 which will position a strut so that it bisects the surface sector. Therefore the two sides of the ridge 10 which touch the arc 11 of the surface sector are parallel to each other. The length of ridge which connects these two parallel sides is perpendicular to each of the parallel sides. Therefore the two angles formed within the ridge are essentially 90 degrees each 12. Also the dimensions of any one ridge unit are identical to the other four: i.e., they all have the same inside length and width.

Upon the imaginary line which bisects the area enclosed by the two parallel ridge legs lie two holes 13. These two holes serve as apertures through which nails, screws or bolts can be passed and used to connect a strut to the sector.

The overlapping plate also has two holes 14. Its two holes do not bisect anything on the overlapping sector's surface, but rather are aligned so that when surface sector 3 is made to overlap sector 8, so that surface sector 3's open radius edge 2 is tangent with the radius edge between sectors 7 and 8, the two holes of the overlapping sector 14 are in alignment with the holes of surface sector 13.

Nails, screws or bolts can be passed through these holes to attach a strut to the surface sector 3–7, but also hold the overlapping sector 8 in a rigid position directly underneath the surface sector 3 and thus form a rigid convex figure with five identical sectors that generate essentially 60 degrees each.

Located at the center of the disc is a hole 15 approximately the same diameter as the holes 13–14 enclosed within the sectorial ridges 10 and which is kept from complete enclosure by an opening occurring at the wedge-shaped gap 16. The purpose of this hole is to keep the disc from buckling at its centerpoint when the

disc is shaped into its secondary position and the centerpoint becomes the vertex of the disc.

Also the radius edges that occur between sectors of the disc **1** are scored in such a way so that the substantially rigid disc will bend on their edges. This insures a uniform transformation from the disc's primary position to its secondary position.

FIGS. **3** and **4** show the disc in its secondary position. In this position, the disc can generate an "icosahedron structure" by virtue of its vertex-forming properties. In this position it appears that there are five 60 degree sectors **3–7** clustered around a common hole **15.** Each of these sectors has on its surface a three-sided ridge **10** which will position a strut end in such a way that it bisects the sector. Within each ridge are two holes **13** for attaching the strut material to the disc.

The disc used initially in its secondary position will generate the "icosahedron structure" as individual struts are attached to the discs.

The disc can be used in another way (FIGS. **5** and **6**). If **20** of the struts are arranged on a flat surface in such a way that they form **9** continuous alternated equilateral triangles **17** plus one incomplete triangle **18,** it will be seen that ten vertices **19** will be formed by the various converging struts **20** — five on each side of the triangular line. The disc, in its primary position, can be attached to the struts at each of their convergence points (FIG. **6**). The struts would be attached to four surface sectors of the disc **4,5,6** and **7,** leaving surface sectors **3** and overlapping sector **8** free to be overlapped. Once all ten of the discs are attached to their respective convergence points, the entire length of struts and discs can be lifted to a vertical position (FIG. **7**) and turned in upon itself to form the wall portion of an "icosahedron structure" **21.** The struts at the ends will have to be connected to their respective discs, but once that has been done the wall portion of the structure will be complete, leaving only the five strut "roof" to be attached **22.**

Using this method of construction could nearly halve the time of the building process on small and medium-sized projects. Furthermore, directions for building the "icosahedron structure" would be much simpler and easy to follow if it were all described on a uniplanar level. If there were more than one person working on building the structure, using the disc in its primary position would be the preferred method of construction.

Although the disc, as described, is used for the purpose of generating "icosahedron structures", no limitations are intended to be placed upon it insofar as other structural frameworks could be generated with or from it.

I claim the following:

1. A structural joint consisting of a plane disc composed of five identical rigid sectors that generate 60 degrees each, wherein each sector has a means for the attachment of strut material; one additional rigid sector that generates slightly less than 60 degrees, leaving a wedge-shaped gap of considerably less than 60 degrees, which when combined with the adjoining rigid sector that generates slightly less than 60 degrees, generates 60 degrees; furthermore the rigid sector that generates slightly less than 60 degrees is used as an overlapping plate with the adjacent 60 degree sector it is separated from by the wedge-shaped gap.

2. A structural joint as claimed in claim **1** in which said attachment means are enclosed by an identical three-sided ridge on each of the five identical sectors, the ridge so placed on each of said five sectors that it will position a straight piece of strut material so as to bisect the sector.

3. A structural joint as claimed in claim **2** in which said attachment means within the perimeter of said ridge are two apertures for fastening each piece of strut material to each of the five identical sectors.

4. A structural joint as claimed in claim **3** having two apertures on the sector which generates slightly less than 60 degrees, the apertures so placed as to align with the apertures of the said adjacent 60 degree sector when said sectors are overlapped.

5. A structural joint as claimed in claim **1** in which an aperture of slight diameter is positioned at the center of the plane disc.

6. A structural joint as claimed in claim **1** in which the boundaries between the sectors are flexible.

7. A structural joint as claimed in claim **1** which can be loaded with struts in either a two-dimensional plane or in a convex three-dimensional space.

8. A structural joint as claimed in claim **1** in which said attachment means comprise two apertures on each of the five identical sectors, the apertures so placed on the individual sector that they will serve as apertures with which a straight piece of strut material can be attached so as to bisect the sector.

9. A structural joint as claimed in claim **8** having two apertures on the sector which generates slightly less than 60 degrees, the apertures so placed as to align with the apertures of the said adjacent 60 degree sector when said sectors are overlapped.

10. A structural joint as claimed in claim **1** in which said attachment means is a bolt and nut means.

* * * * *