Nov. 6, 1962 C. J. SCHMIDT 3,061,977

SPHERICALLY DOMED STRUCTURES

Filed May 27, 1959 4 Sheets-Sheet 1

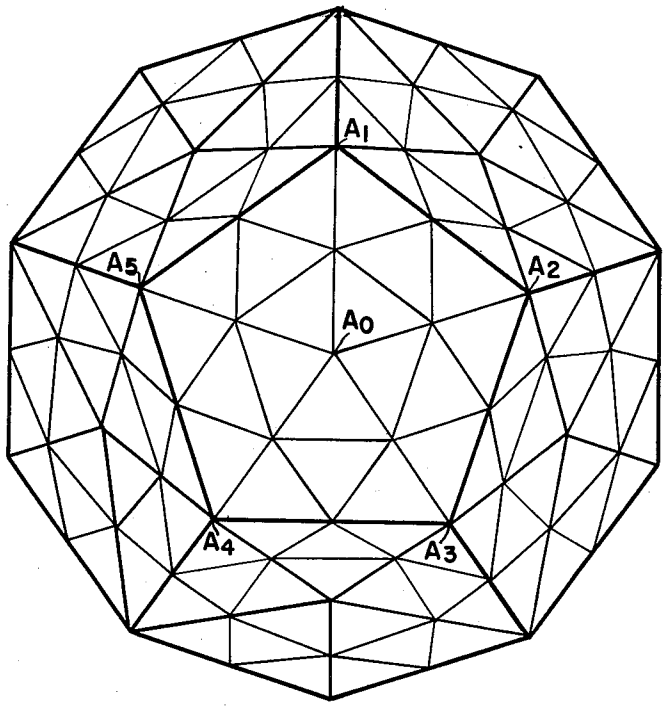


FIG.-1

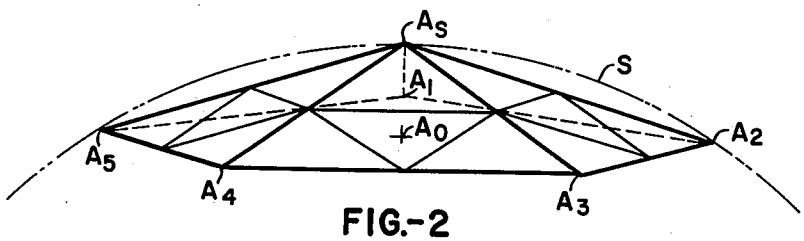


FIG.-2

INVENTOR.
CLARENCE J. SCHMIDT
BY
ATTORNEY

Nov. 6, 1962 C. J. SCHMIDT 3,061,977

SPHERICALLY DOMED STRUCTURES

Filed May 27, 1959 4 Sheets-Sheet 2

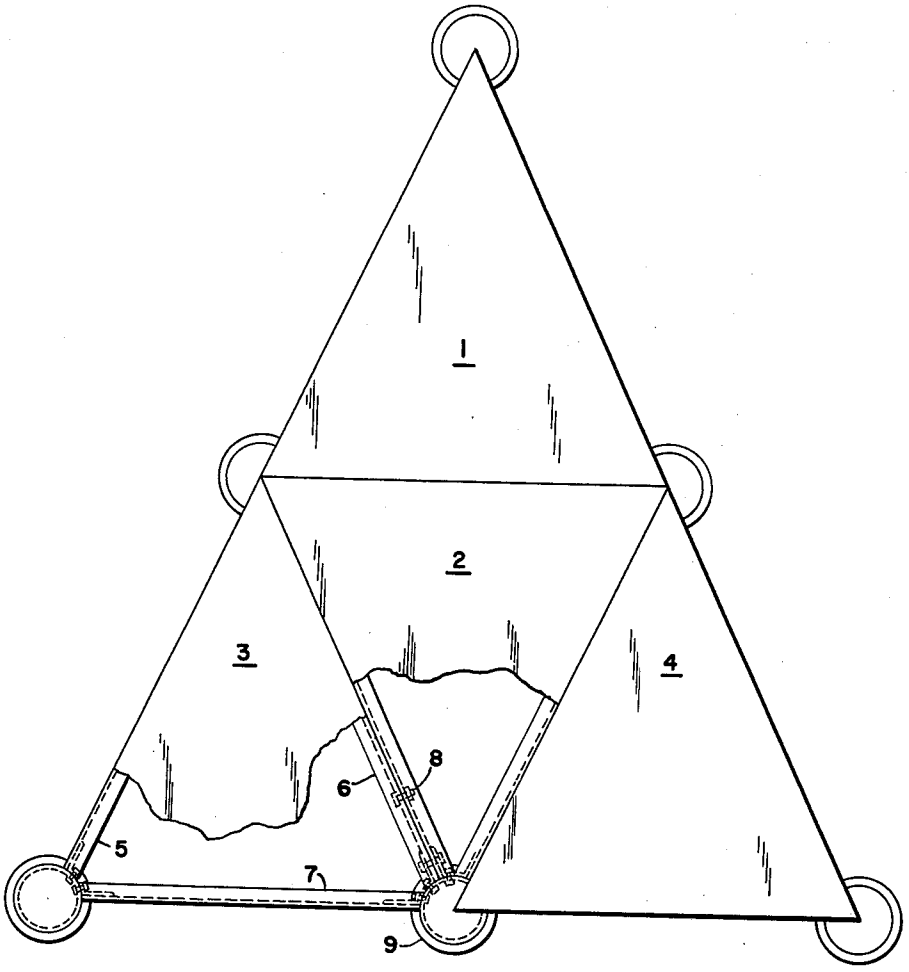


FIG.-3

INVENTOR.
CLARENCE J. SCHMIDT

BY

ATTORNEY

Nov. 6, 1962 C. J. SCHMIDT 3,061,977

SPHERICALLY DOMED STRUCTURES

Filed May 27, 1959 4 Sheets-Sheet 3

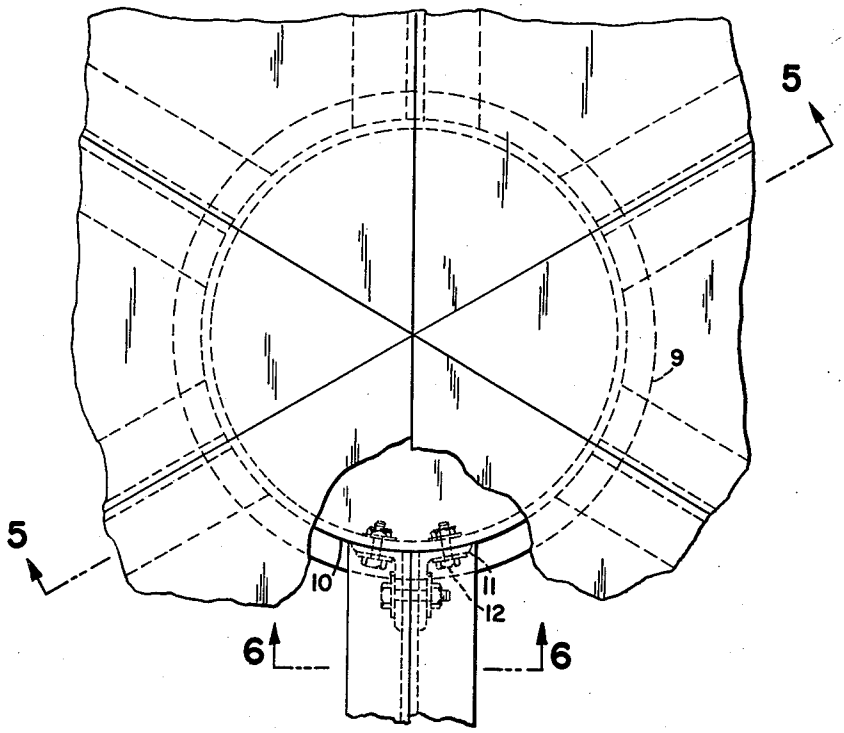


FIG.-4

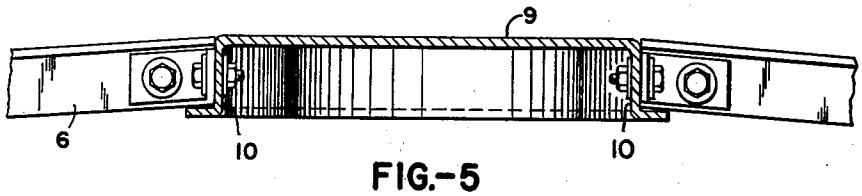


FIG.-5

INVENTOR.
CLARENCE J. SCHMIDT
BY
ATTORNEY

Nov. 6, 1962 C. J. SCHMIDT 3,061,977

SPHERICALLY DOMED STRUCTURES

Filed May 27, 1959 4 Sheets-Sheet 4

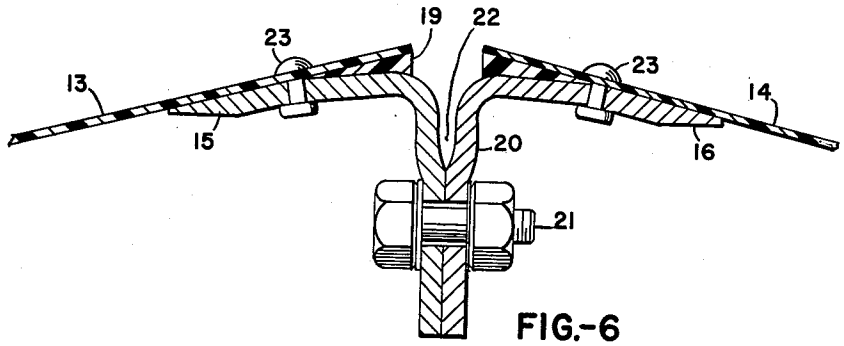


FIG.-6

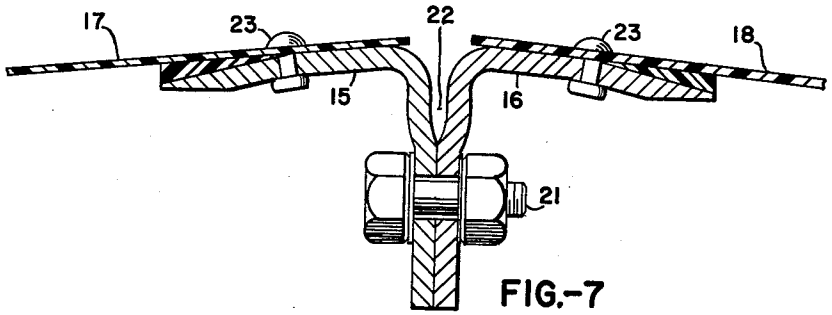


FIG.-7

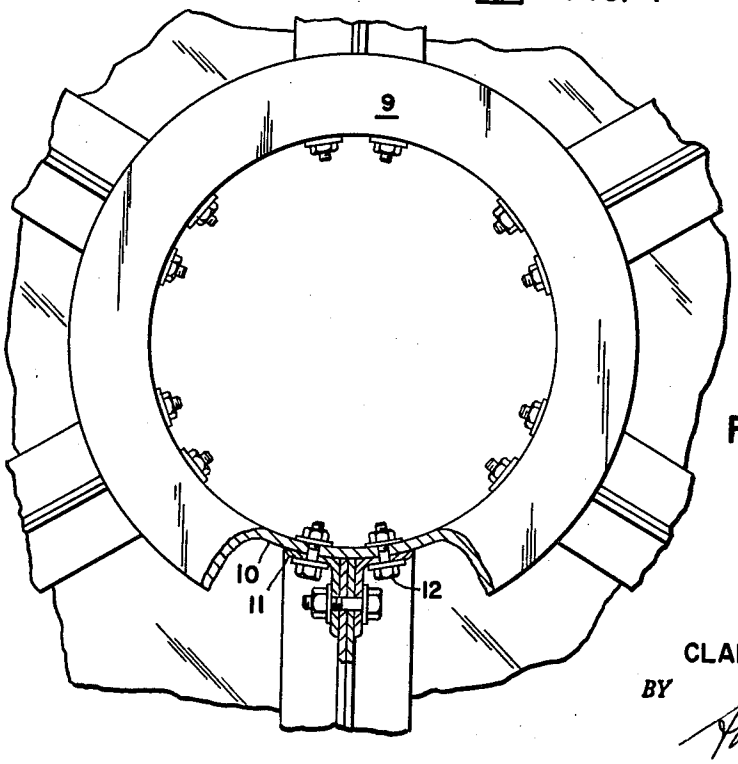


FIG.-8

INVENTOR.
CLARENCE J. SCHMIDT
BY
ATTORNEY

United States Patent Office

3,061,977

Patented Nov. 6, 1962

3,061,977

SPHERICALLY DOMED STRUCTURES

Clarence J. Schmidt, Cuyahoga Falls, Ohio, assignor to Goodyear Aircraft Corporation, Akron, Ohio, a corporation of Delaware

Filed May 27, 1959, Ser. No. 816,152

3 Claims. (Cl. 50—52)

This invention relates to spherically domed structures and is especially useful in the construction of radomes and other substantially spherical enclosures.

In the construction of radomes and similar substantially spherical structures it has been found desirable to provide building units of as few sizes and shapes as possible so as to simplify the erection operation. It has also been found desirable to provide a construction which could be constructed almost entirely of resin bonded glass fiber material or other non-metallic material.

It is an object of the present invention to provide a frame and panel construction which could be constructed of sheet material and frame pieces of a minimum number of kinds, sizes, and shapes.

Another object is to provide such a construction adaptable to Fiberglas or similar material.

Still another object is to provide frame members of one angle cross section which could be used throughout the structure.

A further object is to provide a joint for connecting the frame members.

These and other objects will appear from the following description and the accompanying drawings forming a part hereof.

Of the drawings:

FIG. 1 is a diagrammatic plan view of a pentagonal dodecahedron with each of the pentagonal faces divided into five equal isosceles triangles and each of the five triangles subdivided into four isosceles triangles, showing the preferred arrangement of panels and frame members.

FIG. 2 is a diagram showing in perspective a pentagonal pyramid having a base corresponding to a pentagonal face of the dodecahedron and of such altitude as to have its apex tangent to a spherical surface tangent to the five corners of its base, each face of the pyramid being subdivided into triangles.

FIG. 3 is an outer face view of an isosceles triangle unit assembly for use in constructing a dome-shaped structure in accordance with the invention.

FIG. 4 is a detail view of the face of a spherical structure at the conjunction of six panels, showing a bath tub connector therefor.

FIG. 5 is a sectional view taken on line 5—5 of FIG. 4.

FIG. 6 is a cross sectional view taken on line 6—6 of FIG. 4 showing the adjacent panels at their greatest angular departure from a single plane.

FIG. 7 is a similar sectional view showing adjacent panels at their least angular departure from a single plane.

FIG. 8 is a view similar to FIG. 4 but as seen from the inner face showing a modification of the connector.

Referring to the drawings and first to FIG. 1 thereof, this shows pentagonal dodecahedron having twelve equal pentagonal faces six of which appear as outlined by the most heavy lines, the center of the one pentagon being central of the figure and having its corners designated A_1, A_2, A_3, A_4 and A_5 and having its center at A_0. Each pentagonal face has been divided by lighter lines such as A_0—A_1, A_0—A_2, A_0—A_3, A_0—A_4 and A_0—A_5 dividing it into five equal congruous isosceles triangles. Each isosceles triangle such as A_0—A_1—A_2 has been further subdivided by bisecting the perpendicular distance from the apex A_0 to a midpoint of its base A_1—A_2 and drawing a line parallel to the base through the point of bisection, then drawing lines from the midpoint of the

base line through intersection of the drawn line with the sides A_0—A_1, and A_0—A_2 of the triangle. The result will be a division of each isosceles triangle into two congruous base to base triangles and two remaining triangles which will be mirror images of one another. Such subdivision will provide an arrangement of triangular panels requiring only three different types to complete the enclosure of dodecahedron form. By employing supporting frame elements and the three types of panels, assembly units having the shape of a triangle A_0—A_1—A_2 may be constructed and assembled to provide a dodecahedron or any portion thereof.

Where more nearly spherical enclosures are required, this may be accomplished as follows: Referring to FIG. 2 a pyramid has been constructed having a pentagonal base A_1—A_2—A_3—A_4—A_5 equal to the face of the dodecahedron. A sphere S is circumscribed about the dodecahedron with its surface intersecting the corners of the pentagon. Now a radius of the sphere passing through the center A_0 of the pentagon will intersect the spherical surface at A_S. Then lines drawn from A_S to the five corners of the pentagon will define a pyramid having five isosceles triangles for its sides. Should such a pyramid be superimposed on each pentagonal face of the dodecahedron we would have a polyhedron of sixty congruous isosceles triangular faces closely approximating a sphere.

In similar manner should the completely subdivided dodecahedron of FIG. 1 be circumscribed by a sphere and then projected radially outward onto the spherical surface or exploded thereonto a sphere would result divided into panels of only three types.

According to this invention panels of suitable sheet material are constructed and arranged to correspond with the arrangements shown in FIGS. 1 and 2 and are reinforced by straight or curved frame elements to provide either a sixty-faced polyhedron or a spherical surface, the frame elements being straight or curved correspondingly. Referring to FIG. 3 this shows four panels **1**, **2**, **3** and **4** of resin bonded glass fiber material arranged to occupy a surface such as A_0—A_1—A_2 of FIG. 1. Each panel is laid over marginal frame elements **5**, **6** and **7** of angle cross section and preferably of resin bonded glass fiber. The frame elements have one flange extending radially inward of the panel, such radial flanges of adjacent panels meeting back to back and being secured by bolts **8** passing therethrough. At the conjunction of frame elements tub-shaped connectors **9** are provided, each tub-shaped connector having a substantially flat or spherical closed top located substantially at the surface of the domed structure and an inwardly directed peripheral flange thereabout integral with the top, and the frame elements abut the inwardly extending peripheral side walls **10** of the connector as shown in FIGS. 4, 5 and 8 and are secured thereto by connecting angles **11** and bolts **12**, while the panels extend over the head of the connector. The bolts are accessible from the inner side of the enclosure. The connectors may be formed of resin bonded glass fiber material.

The marginal frame elements of the panel assemblies such as that of FIG. 3 are secured by bolts in the same manner to marginal flanges of adjacent assemblies. These frame elements are shown in cross section in FIGS. 6 and 7. As there shown, adjacent panels **13** and **14** as also shown in FIG. 6 depart from one another at the greatest angle of departure of a panel from a radius of the structure found in a structure such as that of FIGS. 1 and 2 and the horizontal flanges from the rivets outwardly are made to a corresponding angle of 85° 18′ with their radial flanges. In other words, each panel-engaging flange of a frame member is divided longitudinally into two longitudinal facets which are respectively at the greatest and least angles of departure of a panel from a radius of the struc-

ture. In FIG. 7 the adjacent panels **17**, **18** depart at the least angle found in such a structure, namely 87° 28′ to a radius of the structure and the facets of the flanges **15**, **16** inwardly of the rivets are made to conform to such angle. In other words, each flange has two adjacent facets which are slightly inclined to one another to accommodate panels at a range of departures. In the case shown in FIG. 6 a resin cement filling **19** is provided at the margin of the panel outside the rivet line and in FIG. 7 a similar filling is provided between the panel and the flange inwardly of the rivet line.

After assembly of the structure, a caulking composition is used to fill joints between adjacent frame elements and panels. It is advisable to provide a caulking space of sufficient width to receive this caulking material. For this purpose the angle frame elements have their radial flanges offset outwardly of their meeting plane as at **20** radially outward of the bolts **21** to provide an outwardly open channel **22** to receive and anchor the caulking material and the panels are so cut as to be spaced apart for the same purpose.

While the panels have been shown as secured in place by rivets **23** in FIGS. 6 and 7, these may be replaced by cement or by other fastening means if desired. After assembly of the panels on the framework, caulking material is placed in the space **22** flush with the outer surface of the panels. The points of the triangular panels may extend over the tub-like connectors or the corners of the panels may be cut away to clear the connectors which may be made deep enough to have their channel tops flush with the panels.

Where less than a complete spherical or near spherical structure is required the same construction may be employed but the panels and frame members may be trimmed away where the spherical or near spherical surface is to be terminated.

While certain representative embodiments and details have been shown for the purpose of illustrating the invention, it will be apparent to those skilled in this art that various changes and modifications may be made therein without departing from the spirit or scope of the invention.

What is claimed is:

1. A spherically domed structure comprising a plurality of construction units of the same size and of isosceles triangular shape, each unit comprising four panels of sheet material each of isosceles triangular shape arranged in edge to edge relation, each panel having frame members of L-shaped cross section secured to margins of its inner surface, said frame members being of uniform cross section and being shorter than the sides of the panels; six tub-like connectors securing the ends of the frame members of each construction unit together, each connector extending beyond the confines of the unit with the ends of frame members of adjoining units connected thereto, said frame members radiating from said connectors, each connector having a closed top located substantially flush with the top of the frame members and an inwardly directed flange thereabout integral with the top, bolts connecting the flange of each connector to ends of said frame members radiating therefrom, the corners of the panels overlying and closing the closed top of each connector, and bolts connecting said construction units to one another with marginal frame members thereof in back to back relation.

2. A spherically domed structure comprising a plurality of construction units of the same size and of isosceles triangular shape, each unit comprising four panels of sheet material each of isosceles triangular shape arranged in edge to edge relation, each panel having frame members of L-shaped cross section secured to margins of its inner surface, said frame members being of uniform cross section and being shorter than the sides of the panels; six tub-like connectors securing the ends of the frame members of each construction unit together, said connectors extending in part beyond the confines of the unit and being secured to the frame members of adjacent units, said frame members radiating from said connectors, each connector having a closed top located substantially flush with the top of the frame members and an inwardly directed flange thereabout integral with the top, bolts connecting the flange of each connector to ends of said frame members radiating therefrom, and bolts connecting said construction units to one another with marginal frame members thereof in back to back relation, said frame members each having one flange arranged radial of the structure and the other flange defining a panel-engaging flange with a longitudinally divided face of two facets inclined respectively to the least and the most angular departure of the panels from a tangent of the domed structure.

3. A spherically domed structure comprising a plurality of construction units of the same size and of isosceles triangular shape, each unit comprising four panels of sheet material each of isosceles triangular shape arranged in edge to edge relation, each panel having frame members of L-shaped cross section secured to margins of its inner surface, said frame members being of uniform cross section and being shorter than the sides of the panels, tub-like connectors securing the ends of the frame members of a construction unit and of adjoining units thereto with the frame members radiating from said connectors, each connector having a closed top located substantially flush with the top of the frame members and an inwardly directed flange thereabout integral with the top, bolts connecting the flange of each connector to ends of said frame members radiating therefrom, and bolts connecting said construction units to one another with marginal frame members thereof in back to back relation, said frame members each having one flange arranged radial of the structure and the other flange defining a panel-engaging flange with a longitudinally divided face of two facets inclined respectively to the least and most angular departure of the panels from a tangent to the domed structure, and the radial flange being offset away from the meeting plane of the members near the outer face of the structure to provide a caulking space.

References Cited in the file of this patent

UNITED STATES PATENTS

446,028	Smith	Feb. 10, 1891
2,682,235	Fuller	June 29, 1954
2,736,072	Woods	Feb. 28, 1956
2,792,164	Cauffiel	May 14, 1957
2,918,992	Gelsavage	Dec. 29, 1959

FOREIGN PATENTS

520,322	Italy	Mar. 21, 1955

OTHER REFERENCES

Architectural Record, November 1955, p. 235.

Architectural Record, pp. 251, 252, 253, and 254, March 1957.

Popular Mechanics, April 1957, pp. 126 and 127.