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[54] **METHOD FOR PRODUCING ARCHED STRUCTURES**

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[52] **U.S. Cl.** **52/745**, 52/80, 52/86

[51] **Int. Cl.** **E04b 1/32**

[58] **Field of Search** 52/84, 86, 80, 98, 52/100, 741, 745, 747; 425/289; 264/32

[56] **References Cited**

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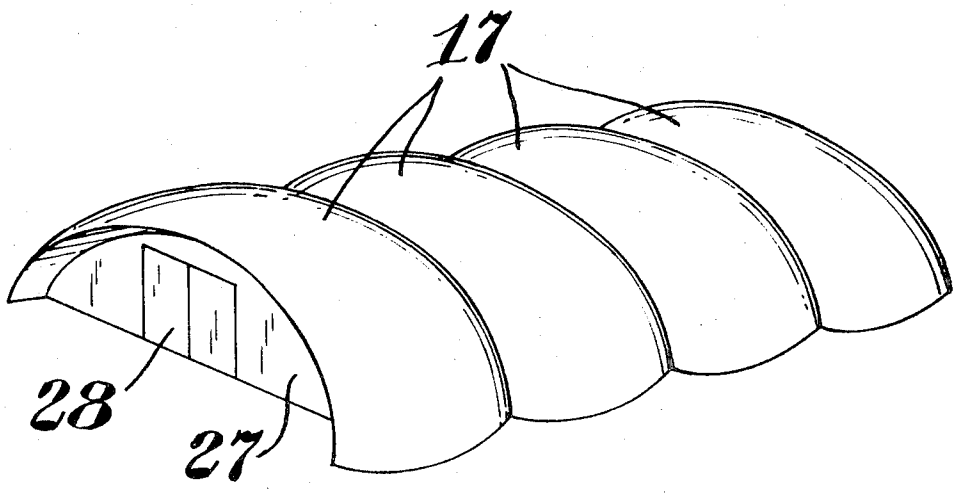
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[57] **ABSTRACT**

Arched structures are prepared by spirally generating a spherical segment of two bases, dividing the structure along generally axial planes to form a plurality of doubly curved segments. The segments are then assembled into a barrel vault-like structure.

5 Claims, 3 Drawing Figures



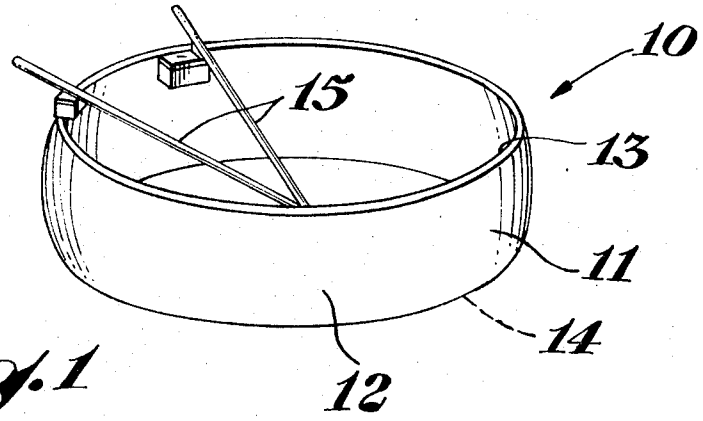


Fig. 1

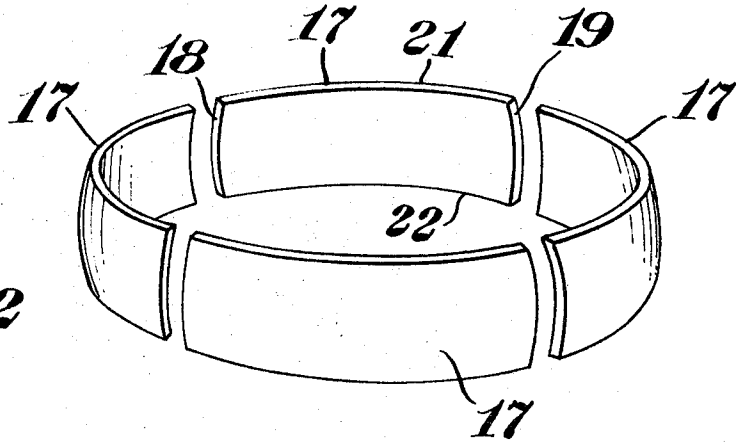


Fig. 2

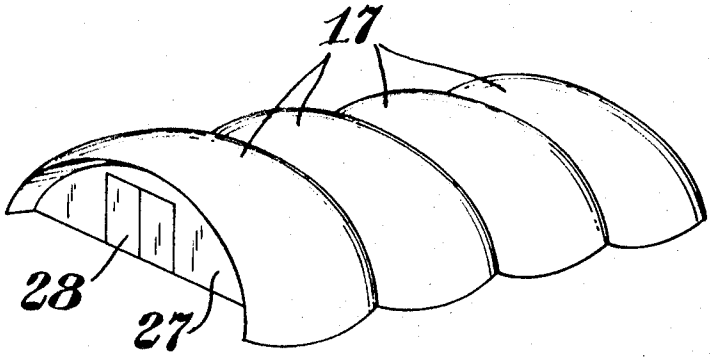


Fig. 3

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METHOD FOR PRODUCING ARCHED STRUCTURES

The invention herein described was made in the course of or under a contract with the Department of the Army.

A variety of walled structures are prepared employing hardenable material and more or less cast or deposited in a predetermined configuration. One of such techniques is that of spirally generating structures. The spiral generation process is well known in the art and is set forth in U.S. Pat. Nos. 3,206,899; 3,336,631; 3,336,636; 3,337,384; 3,417,429; 3,423,791; 3,443,276 and 3,507,735, the teachings of which are herewith incorporated by reference. One particularly desirable form of structure is the so-called barrel vault construction wherein the roof structure is a portion of a cylinder cut generally parallel to a plane which passes through the axis of generation. Such barrel vault structures have been prepared by a variety of techniques.

It would be desirable if there were available an improved method for the preparation of structures generally resembling barrel vault construction.

It would also be desirable if there were available an improved method for the construction of vault-like structures having a high strength relative to the weight of materials employed.

It would further be desirable if there were available a method for the production of doubly curved segments for use in barrel vault construction.

These benefits and other advantages in accordance with the present invention are achieved in a method for the construction of structural elements, the steps of the method comprising forming a compound or doubly curved generally convex segment of two bases of the structural material, dividing the segment of two bases into a plurality of doubly curved sections by dividing the segment along planes passing generally through the axis of generation of the segment, each of the segments having convex and concave sides, terminal end portions and edge portions, the terminal end portions corresponding generally to locations of division of the segment, and beneficially joining the sections in edge to edge relationship to form a segmented barrel vault-like structure.

Further features and advantages of the present invention will become more apparent from the following specification taken in connection with the drawing wherein:

FIG. 1 schematically depicts the preparation of the hollow spherical segment of two bases.

FIG. 2 depicts the divided segment of FIG. 1.

FIG. 3 schematically depicts a structure prepared in accordance with the invention.

In FIG. 1 there is schematically depicted a structure generally designated by the reference numeral **10**. The structure **10** comprises a wall portion **11** having a generally spherical surface **12** and a first base or edge **13** and a second base or edge **14**. The wall **11** is being prepared by spiral generation means generally designated by the reference numeral **15**. As depicted in FIG. **1**, the structure **10** is a symmetrical spherical segment of two bases having a plane of symmetry which passes normally through the axis of generation and divides the wall **11** into two mirror image portions.

In FIG. **2** the spherical segment **10** has been divided into four identical sections **17** by sawing or other convenient cutting means appropriate to the material of construction, the cuts being made along planes intersecting the axis of generation of the segment **10** and the planes being normal to each other. Sections **17** have first ends **18** and second ends **19** and sides **21** and **22**, respectively. If desired, the ends of the segments are readily shaped to engage any suitable base or foundation.

In FIG. **3** there is shown a structure **25** which comprises four segments **17** joined in edge to edge relationship to form a generally barrel vault-like structure. A planar end **27** having a door or passage **28** is disposed within an end wall **27**.

As depicted in FIGS. **1**, **2** and **3**, a symmetrical spherical segment of two bases has been employed. However, when a plurality of structures are to be prepared, conveniently the spherical segments need not be symmetrical. For example: if two spherical segments are prepared and cut as illustrated in FIG. **2**, one of the spherical segments having a diameter larger than the other and the diameter of the smallest base of the largest segment being equal to the largest base of the smallest segment, the eight sections may be combined in various manners to provide structures of differing configurations. For example: if the longest edge of the largest segments are fixed together and the largest edge of the smallest sections affixed to the smallest edge of the largest sections, a structure with small ends and large center section is obtained. Alternately, the smallest edges of the smallest segments may be joined and the largest edge of the smallest section joined to the smallest edge of the largest section to provide a structure having a small center section and large ends; that is, tapering toward the center.

Employing structures prepared from unsymmetrical spherical segments of two bases, a wide variety of structures may be prepared which are readily apparent to those skilled in the art. The number of sections into which a segment is cut conveniently has been depicted as four. However, one segment may provide two sections and be employed to form a generally hemicylindrical structure. Alternately, the segments may be cut into two unequal sections and the sections employed in different structures or large and small sections alternated to provide side wall openings.

Structures prepared in accordance with the present invention show exceptional resistance to buckling under load. In general in comparing the strength of the structure prepared in accordance with the present invention with a long cylindrical single curved shell, the buckling force increases rapidly and generally has the relationship of P_1/P_2 as equal to R/T wherein P_1 is the buckling pressure of structures prepared in accordance with the present invention and P_2 is the buckling pressure of a long cylindrical singly curved shell; R is the radius of the spherical segment such as the segment **10** and T is the shell thickness.

The manner of joining the sections to form structures in accordance with the invention is well known in the art and need not be further illustrated. Structures prepared in accordance with the present invention employing plastic foams, concrete and the like exhibit exceptional resistance to buckling.

The Figures have been described with particular reference to a spherical form; however, other compound curved forms are employed with benefit. Segments of ellipsoids, toroids and other geometric forms prepared by spiral generation which are divisible into mating

doubly curved sections are utilized to provide a wide variety of structures.

As is apparent from the foregoing specification, the present invention is susceptible of being embodied with various alterations and modifications which may differ particularly from those that have been described in the preceding specification and description. For this reason, it is to be fully understood that all of the foregoing is intended to be merely illustrative and is not to be construed or interpreted as being restrictive or otherwise limiting of the present invention.

What is claimed is:

1. A method for the construction of a barrel vault-like structure, the steps of the method comprising

spirally generating a generally convex doubly curved segment of two bases of the structural material,

dividing the segment of two bases into a plurality of doubly curved sections by dividing the segment along planes generally passing through the axis of generation of the segment, each of the segments having terminal end portions and edge portions, the terminal end portions corresponding generally to locations of division of the segment, and

joining the sections in edge to edge relationship, thereby providing a segmented barrel vault-like structure.

2. The method of claim 1 including the step of shaping the ends of the segments to conform to a base or support means.

3. The method of claim 1 wherein the structural material is a synthetic resinous foam.

4. The method of claim 1 wherein the segments are segments of spheres of generally like diameter.

5. The method of claim 1 wherein at least one segment is a segment of a sphere of unlike diameter from the remaining segments.

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