April 18, 1961 E. ENGLUND 2,980,215

TUBULAR INTERLOCKING JOINT

Filed Nov. 12, 1957 2 Sheets-Sheet 1

Fig. 1

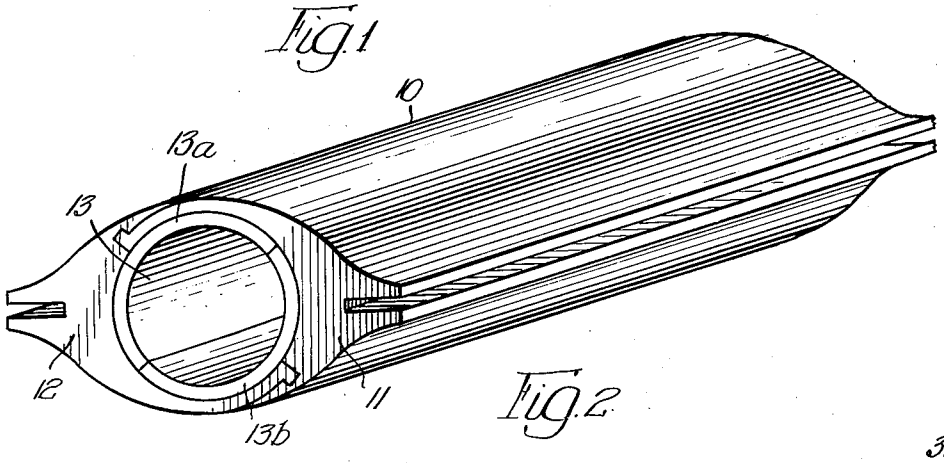


Fig. 2

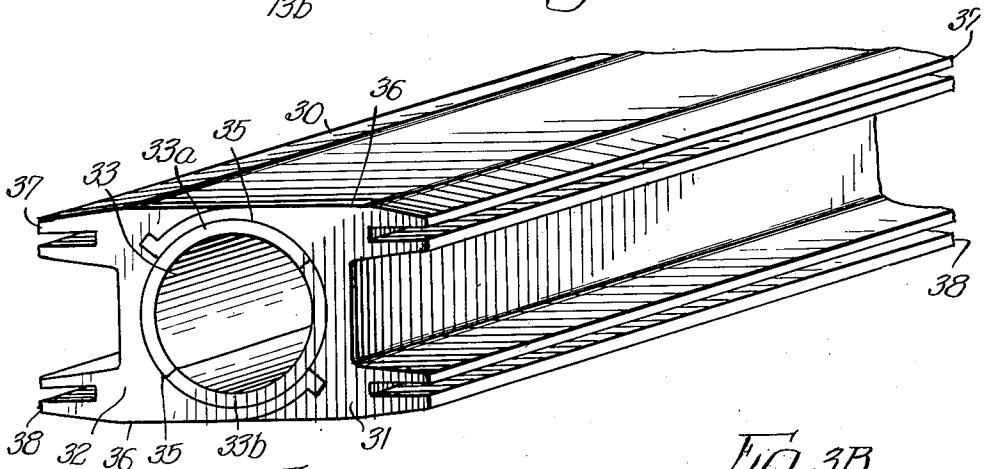


Fig. 3A

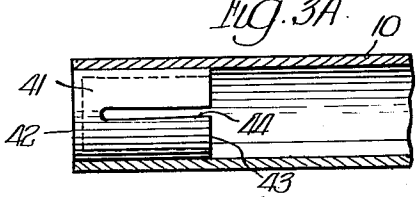


Fig. 3B

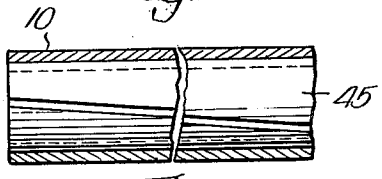


Fig. 3C

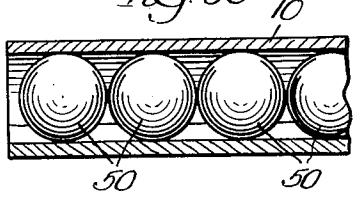
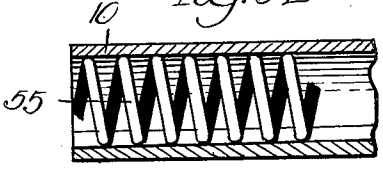


Fig. 3D



INVENTOR.

Ernest Englund,

BY

Byron, Hume, Brown & Clemmick.

Attys.

April 18, 1961 E. ENGLUND 2,980,215

TUBULAR INTERLOCKING JOINT

Filed Nov. 12, 1957 2 Sheets-Sheet 2

Fig. 4

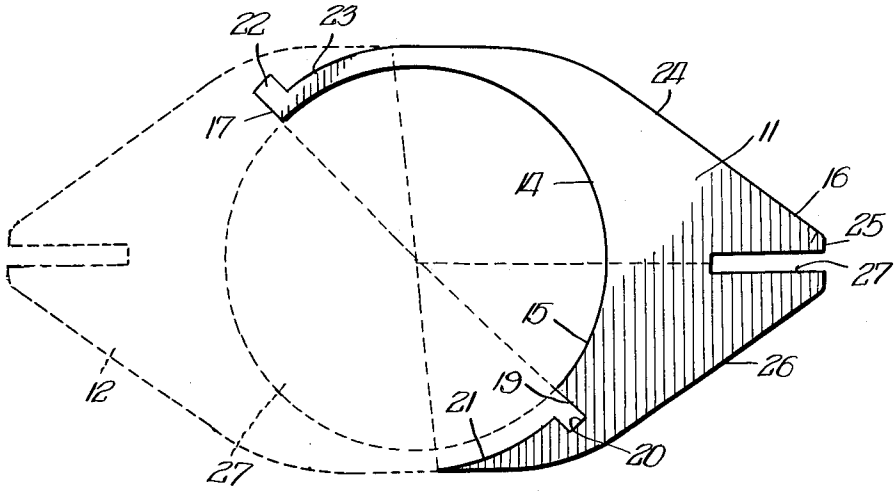
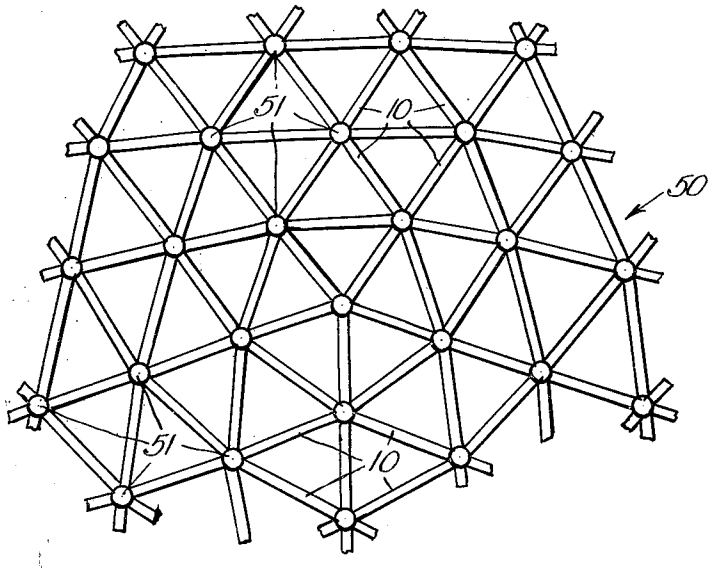


Fig. 5



INVENTOR.
Ernest Englund,
BY
Byron, Hume Hoover & Clement,
Attys.

United States Patent Office 2,980,215 Patented Apr. 18, 1961

2,980,215

TUBULAR INTERLOCKING JOINT

Ernest Englund, 118 W. Florida, Urbana, Ill.

Filed Nov. 12, 1957, Ser. No. 695,834

1 Claim. (Cl. 189—34)

The present invention relates to shelter structures and particularly to support members suitable for use in forming the frames of shelter structures.

In architectural engineering, a type of frame construction known generally as space-grid construction has been widely used for hemispherical dome shelters, of which the geodesic is one form, and for semi-cylindrical arch shelters resembling, in form at least, what is commonly known as the Quonset hut type of structure. Additionally, the principles of space-grid framing have been successfully used for horizontal and vertical planar wall structures, being exemplified in the latter case by what is known as curtain-wall structure.

Generally, a space-grid structural frame is made up of support members interconnected in a geometric pattern so as to form a structure of such a favorable weight-to-strength ratio that it is, in fact, self supporting. To provide shelter against the elements of nature, the space-grid frame may carry thereon a covering skin or a lining skin, or both, of a conformable material which may be of metal, plastic, fabric and the like; or the frame may support in the spacings between the support members panels or structural units which fill the spacings and are rigidly connected to the support members for contributing to the total strength of the structure. Such a structural unit is described in the applicant's copending application Serial No. 681,955, filed September 4, 1957, now abandoned. It is to improvements in support members for such frame constructions that the present invention is directed.

An object of the present invention is to provide an improved support member for frame constructions which is lightweight, simple and inexpensive to manfacture and easy to assemble.

Another object of the invention is to provide an improved support member which is easily adapted to extrusion methods of manufacture.

An additional object of the invention is to provide an improved support member having a favorable weight-to-strength ratio which is particularly well adapted for use in space-grid structures and to receive and support structural units spaced therebetween.

A more specific object of the invention is to provide an improved support member made up of longitudinal sections that are overlapped and interlocked one with another to define a tubular cavity and which carries within the tubular cavity structure for maintaining the sections in interlock, whereby the structure is made lightweight yet rigid and strong. Inasmuch as the longitudinal sections are identical, manufacture of the support member is greatly simplified and easily accomplished by extrusion methods and permits the inclusion of projecting surfaces on which panels may be fixed and supported.

Further objects and features of the invention pertain to the particular construction and arrangement employed in attaining the above identified objects.

The invention, both as to its structure and mode of

use, will be better understood by reference to the following specification and drawings, forming a part thereof, wherein:

Figure 1 is a perspective view of a support member in accordance with the invention;

Figure 2 is a perspective view of an alternate embodiment of a structural member in accordance with the invention;

Figures 3A, 3B, 3C and 3D show in longitudinal cross-section a support member in accordance with the invention and filler arrangements for insertion into the cylindric cavity of the support member;

Figure 4 is an end view of an arcuate section such as used in the support member shown in Fig. 1; and

Figure 5 is a top plan view of the central vertex section of a geodesic type frame structure employing support members in accordance with the invention.

Referring now to the drawings, there is shown in Figure 1 a support member **10** in accordance with the invention made up of interlocked arcuate sections **11** and **12** and a cylindric sleeve **13** split longitudinally into two sections **13***a* and **13***b*. The arcuate sections **11** and **12** are identical and as best shown from the cross-sectional view of Figure 4 the arcuate section **11** is made up of an inner surface **15** and an outer surface **16**. The inner surface **15** is a concave cavity extending from a blunted end **17** to a sharpened end **18** and is defined by a semi-cylindric surface **14** extending from the blunted end **17** and terminated at a diametrically opposed surface **19**, a slot **20** of which the surface **19** forms one side and a curved surface **21** extending between the slot **20** and the pointed end **18**. The center of curvature of the curved surface **21** is concentric with that of the semi-cylindric surface **14** and the radius of curvature is slightly larger than that of the semi-cylindric.

The outer surface **16** of section **11** is shaped to conform generally to that of the inner surface **15** and includes a projection or key **22** at the blunt surface **17** joined to a curved surface **23** having the same length, the same center of curvature and the same radius of curvature as the curved surface **21**, and which continues into a curved surface **24** of gradually diminishing curvature which is terminated in a flat surface **25**. Another curved surface **26** taking a shape inverse to that of the surface **24** extends from the pointed end **18** of the section **11** to the flat surface **25**. At the flat surface **25** a deep slot **27** is formed which extends inwardly towards the center of curvature of the surfaces **14**, **21** and **23**. The key **22** conforms to the shape of the slot **20** so that when the section **11** is mated with a correspondingly identical section, such as section **12** indicated by the dotted lines in Figure 4, the sections interlock at the slot **20** and at the key **22** to define a symmetrical support member having a cylindric cavity **27**.

It is to be understood that the shape of the outer surface **16** is not critical to the practice of the invention, the configuration shown in Fig. 4 being selected as one that provides a structure of thickness resistive to flexing forces and accommodates apertures or slots, such as the slot **27**, into which structural units or panels can be mounted. Accordingly, the outer surface **16** can be formed in accordance with the usage to which the support member is to be put and can be made up of flat or rounded surfaces, and include apertures and projections of either a continuous or an intermittent nature. As pointed out, the structure of Figures 1 and 4 has been selected as being particularly well adapted for use in carrying the structural units of the above-mentioned copending application.

Illustrative of the variations that may be introduced into the outer surface **16** of an arcuate section is the showing in Figure 2 wherein there is shown a support

member 30 made up of arcuate sections 31 and 32 and a cylindric sleeve 33 split longitudinally into two sections 33A and 33B. The arcuate section 31 is identical to the arcuate section 32 and the inner surface 35 thereof is identical to the inner surface 15 shown in Figure 4. The outer surface 36 is more of a box shape including a pair of spaced apart slotted flanges 37 and 38. The outer surface configuration shown in this instance is designed to accommodate and carry a pair of spaced apart panels so as to provide a double wall structure with a dead air space insulating cavity.

The cylindric sleeves 13 and 33 employed, respectively, in support members 10 and 30 are inserted into the cylindric cavity defined by the arcuate sections of the support members for maintaining the sections in interlock. Though the cylindric sleeves are shown to be longitudinally split into two segments, they could be unitary. The split cylindric is illustrated because it is believed by use of such an arrangement the tighter fit can be achieved within the cylindric cavity. In actual practice the split need not be longitudinal with the axis of the sleeve but it could be helical, wedge shaped or of any other convenient configuration.

Alternative structures for maintaining the arcuate sections interlocked are shown in Figures 3A, 3B, 3C and 3D. Figure 3A shows a longitudinal cross-sectional view of the support member 10 and a short cylindrical stub 41 which is closed at its end 42, open at its end 43 and includes therein at least one partial longitudinal slot 44. At its end 43 the cylindric stub is preferably slightly larger than the cylindric cavity of the support member 10 so that when placed within the cylindric cavity the stub flexes at the slot 44 and fits snugly to the cavity. Figure 3B shows in longitudinal cross-section the support member 10 carrying therein a slotted cylindric sleeve 45. The cylindric sleeve 45 is preferably of a greater diameter than the diameter of the cylindric cavity and is longitudinally slotted either parallel to the axis thereof or in a helical pattern and is fitted snugly within the cavity. Figure 3C shows in longitudinal cross-section a support member 10 carrying therein spheres 50 such as tennis balls, ping pong balls, and the like, and of a diameter to fit snugly within the cylindric cavity of the support member. Figure 3D shows in cross-sectional view the support member 10 carrying therein a helical spring 55 which is made of resilient material and preferably of a diameter slightly larger than the diameter of the cylindric cavity.

It is understood that the cylindric sleeves and structures shown in Figures 3A to 3D are inserted into the cylindric cavity defined by the support member in order to force the arcuate sections thereof into interlocking relationship at the surfaces of overlap. The support member so presented is then unitary, light and strong and may be employed in a geodesic type of structure such as is illustrated in part in Fig. 5. Therein the support members 10 are arranged in a frame structure 50 by means of fastening devices 51 of any suitable form such, for example, as those described in the R. B. Fuller Patent No. 2,682,235, issued June 29, 1954. As previously noted, the support members 10 are adapted to support within the open spaces appropriate construction units or panels such as described in the applicant's copending application.

Though the invention has been described in terms of support member made up of arcuate sections, it is understood that the support member may take any cross-sectional configuration, and that the sections thereof may be angular as well as arcuate. The sections which go to make up the support member, are believed to be particularly well adapted to an extrusion method of manufacture. They may be made of metal, aluminum having been found to be an easily extrudable material, or plastic with or without reinforcing fibers and laminates. The advantage of this type of manufacture is that obviously the lengths of the arcuate sections are indeterminate and the shapes which may be given to the outer surfaces is completely flexible being determined entirely by the dies used with the extrusion machinery. Molding or centrifugal casting operations are considerably more expensive and provide members of limited lengths. Additionally, considerable advantage can be achieved from having a support member made up of longitudinal sections in that movement and positioning of the members is greatly simplified by the reduced weight of the fractional parts that go to make up this structural member. Sections of considerable length, for example, 20 feet, can be easily moved by two men and raised into construction position, the sections being joined in the construction position and the internal expansion member being inserted thereafter. This provides a structure that is not only inexpensive and easy to manufacture, but is of considerable advantage in use.

In view of the foregoing disclosure, it is obvious that there has been presented herein an improved support member that is light of weight yet rigid and strong, convenient and easy to handle, and easily adapted to extrusion methods of manufacture. While the arrangement described and presented herein is at present considered to be preferred, it is understood that variations and modification may be made therein and it is intended to cover in the appended claim all such variations and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

A frame member comprising a plurality of longitudinally extending, laterally curved sections arranged in radial overlap to define in composite a cavity, each of said sections overlapping and underlapping respectively adjacent sections and being longitudinally slotted on the surface of overlap and being longitudinally keyed on the surface of overlap for interlocking said section with adjacent sections, and means conformable to the dimension of said tubular cavity including a sectioned column coextensive with the length of said frame member for maintaining said sections in interlock.

References Cited in the file of this patent

UNITED STATES PATENTS

1,596,360	Krey	Aug. 17, 1926

FOREIGN PATENTS

951,882	France	Apr. 25, 1949
275,333	Switzerland	Aug. 1, 1951
145,433	Australia	Feb. 27, 1952