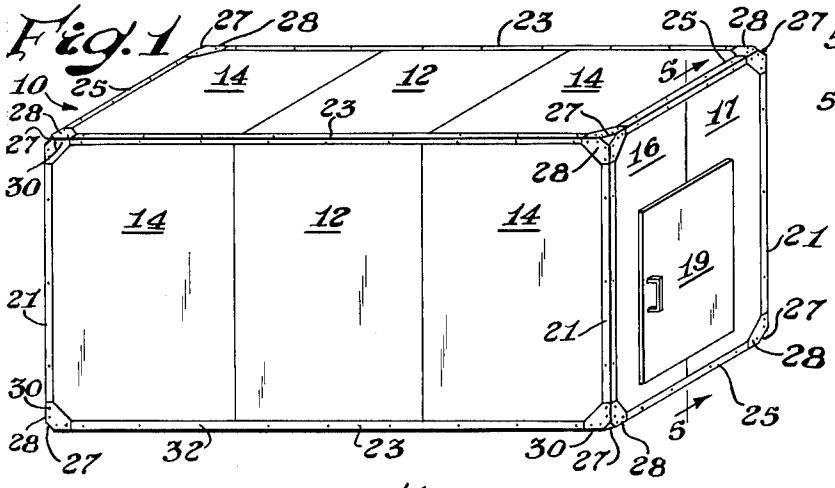
July 5, 1966 J. S. BEST ETAL 3,259,264

SELF-SUSTAINING STRUCTURE

Filed March 19, 1965

Fig. 1



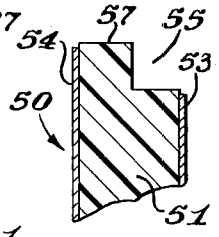


Fig. 6

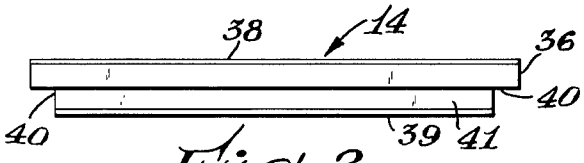


Fig. 2

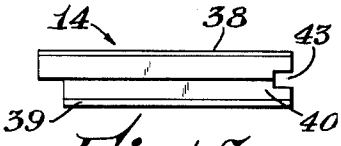


Fig. 3

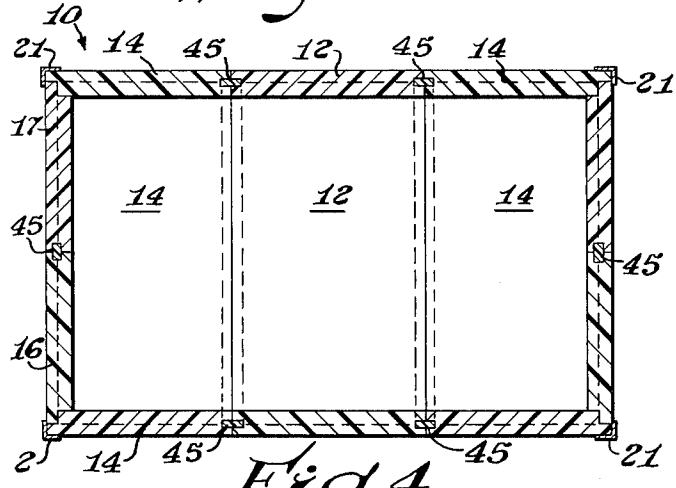


Fig. 4

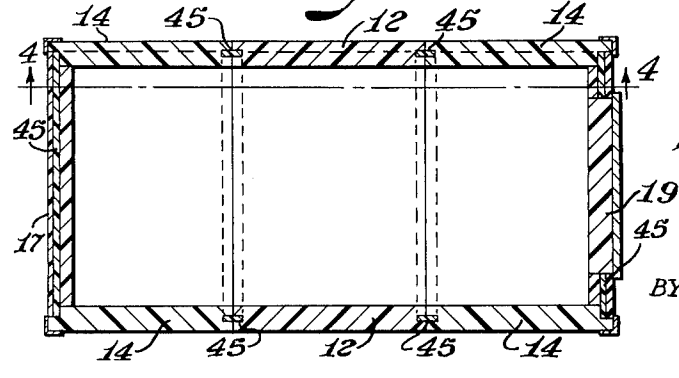


Fig. 5

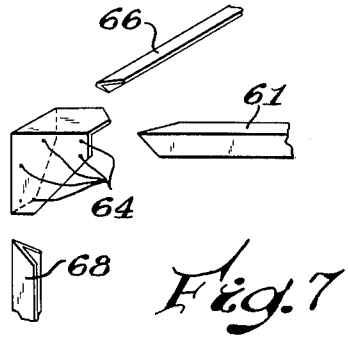


Fig. 7

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SELF-SUSTAINING STRUCTURE

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3 Claims. (Cl. 220—4)

This application is a continuation-in-part of our copending application Serial No. 123,508, filed July 12, 1961 and now abandoned.

This invention relates to a self-sustaining structure. It more particularly relates to self-sustaining structures comprised of a plurality of panels for environmental control.

In the fabrication of structures for environmental control, such as cold rooms, walk-in refrigerators, and similar structures wherein a considerable degree of isolation of the space enclosed within the structure from the space surrounding the structure is required, it is conventional practice to construct a frame and fill spacing between frame members with an insulating material. Much difficulty has been encountered in obtaining adequate service from such enclosures because of thermal and moisture leaks. In cases in conventional frame construction, the studs, joists, and rafters present a path for heat to travel in or out of the enclosure. Other thermal paths are provided by nails, screws, bolts, and similar means having relatively high thermal conductivity. Frequently the walls, ceiling, and floor of such an enclosure are not as vapor-tight as would be desired, resulting in undesirable and disadvantageous frost build up when low temperature facilities are involved or undesirable leaks and temperature irregularities and nonuniformities in such an enclosure is intended to operate above the ambient temperatures. Generally, in order to form an enclosure of sufficient resistance to moisture penetration and mechanical disruption caused by temperature differences, a considerable amount of gasketing and caulking is required. Such joints frequently fail after extended exposure to temperature cycles and often become unsatisfactory when employed at low temperatures.

It is an object of this invention to fabricate an enclosure having good thermal insulation between its interior and its exterior.

It is another object of this invention to fabricate an enclosure from a plurality of panel-like members which requires no fastening means within the walls thereof.

It is still another object of this invention to fabricate a self-sustaining insulated space which is held together by external tension members.

These benefits and other advantages are achieved in accordance with the invention by providing a self-sustaining enclosure comprising a plurality of interfitting panels so constructed and arranged so as to provide an enclosure and said panels maintained in engagement with each other by elongated external tension members disposed about the periphery of the structure and applying a compressive force thereto.

Further benefits and advantages of the invention will become more apparent when the following specification is taken in conjunction with the drawing wherein:

FIGURE 1 depicts an isometric view of an enclosure fabricated in accordance with the invention;

FIGURES 2 and 3 are a side and end view of panels employed in the fabrication of the enclosure;

FIGURE 4 is a sectional view of the enclosure of FIGURE 1;

In FIGURE 5 there is illustrated a sectional view of FIGURE 1;

FIGURE 6 depicts an alternate configuration of a portion of a panel employed in the practice of the invention; and

FIGURE 7 shows an alternate configuration of a tension member attachment means for use in the present invention.

In FIGURE 1 there is illustrated an isometric view of an enclosure for environmental control generally illustrated by the reference numeral **10**. The enclosure **10** comprises a plurality of panels. Visible in the drawing are two center panels **12**, four end panels **14**, and two door receiving panels **16** and **17**. The panels **16** and **17** carry a door member **19**. About the edges of the enclosure **10** are positioned vertical tension members **21**, longitudinal tension members **23**, and horizontal tension members **25**. At the corners **27** of the enclosure **10** are a plurality of corner caps **28**. The corner members **28** are secured by means of screws **30** to one each of the tension members **21**, **23** and **25**. The tension members are held to panels **12**, **14**, **16** and **17** by means of screws **32**.

In FIGURE 2 there is illustrated a side view of a panel **14** having a core **36**, an outer face sheet **38**, and inner face sheet **39**. The panel **14** defines a pair of rabbets designated by the reference numeral **40** and the rabbet **41**.

In FIGURE 3 there is illustrated an end view of the panel **14** showing a relative position of the rabbet **40**, rabbet **41**, and a groove **43**.

FIGURE 4 is a cross-sectional view of the enclosure **10** showing the relationship between the various panels and their manner of interfitting. The floor of the enclosure comprises two panels **14**, and a panel **12**. The longer side walls are similarly formed. The ends of the structure are each comprised of 2 panels **16** and **17**. The panels **16** and **17** and **12** and **14** are joined at their grooved edges by a plurality of splines **45**. The vertical tension members **21** overlay the adjacent corners of panels **14** and **16** and **14** and **17** are formed by the overlapping of the rabbets **41**.

In FIGURE 5 there is illustrated a section of the enclosure **10**, illustrating the relationship of the panels **12**, **14** and **17** and splines **45** (not shown).

In FIGURE 6 there is depicted a sectional view of an alternative embodiment of a panel generally designated by the reference numeral **50**; the panel **50** has a core **51**, an inner face member **53**, and an outer face member **54**. The core **51** defines a rabbet **55**. The core **51** extends slightly beyond the face sheets **53** and **54** to provide a core protrusion **57**.

In FIGURE 7 there is illustrated an exploded view of an alternate embodiment for the connection of tension members generally indicated by the reference numeral **60**. The connector **60** generally comprises a generally tetrahedral cap **62** having defined therein a plurality of openings **64** adapted to receive fastening members (not shown). Tension members **66**, **67** and **68** are adapted to fit within the generally tetrahedral cap **62** and be secured thereto by fastening members through the openings **64**.

In the fabrication of enclosures in accordance with the invention, a wide variety of panel members are employed. Typically and advantageously, various commercial insulating panels are adaptable to the presently contemplated structures, such as those which are formed from a pair of face sheets overlying and adhered to a cellular expanded plastic core; typical cores which are employed in such panels are those of foamed polystyrene, polyvinyl chloride foams, phenol formaldehyde foams as well as foamed glass, rigid organic and inorganic fiber mats, and the like.

Face sheets for such cores are readily fashioned from plywood, wood veneer, fiber glass, epoxy resin compositions, metal, and the like. The particular core materials and face sheet employed will depend on the application for which the enclosure is to be utilized. If the enclosure

is to be subjected to moisture and periodic cleaning such as might be encountered in meat storage, advantageously, polyester facing sheets and foamed polystyrene cores could be employed, as both materials are substantially water resistant. In less critical applications, more porous and water absorbent face sheets may be utilized or such absorbent face sheets may be given a suitable protective coating. The tension members generally may be steel, brass, aluminum or similar metals when the configuration in accordance with the drawing is employed. However, other forms of tension members may be utilized wherein threaded rods, or rods with turnbuckles or similar tensioning devices therein may be positioned along the outer edges of the enclosure to provide the necessary compressive force to maintain the structure in accordance with the invention in its intended position. Cable, rope, tape, and like members capable of providing a compressive force upon the enclosure are also utilized.

A preferred embodiment of the present invention is illustrated in FIGURE 1 wherein two general types of panels are employed; these are typified by the panels **12** and **14**. The panel **12** is provided with a rabbet on either end and spline receiving groove **43** on either side. Thus, the panels **12** may be joined together in side by side relationship by introducing a spline **45** into the grooves **43** and a relatively rigid relationship is maintained between the two sheets. The panels **14** similarly may be joined to the panels **12** or to like panels **14** to give what effectively is a larger sheet. Generally, junctions between the sheets such as **12** when disposed at right angles to each other is accomplished by lap fitting to the terminal portions of the sheets having defined therein the rabbet **40** at right angles. Thus, the enclosure **10** is formed by the interfitting of two basic types of panels **12** which could be designated as an end corner panel, that is, it is designed to form a corner at the ends of the panel by lapping the end portions thereof, and the other type of panel **14** is a side and corner panel wherein three sides of the panel are adapted to meet with rabbets to form walls generally normally to the plane of the panel on two ends and the side thereof. The panels designated as **16** and **17** are basically and fundamentally identical with the panel **14** with the exception that part of the panels have been removed to form an opening to carry the door **19**.

By the provision of rigid fitted joints where two panels come together to form an angle and spline joints wherein panels butt together in edge to edge relationship a structure is formed which is rigid when under compression. External pressure by the corner members **27** or the alternate embodiment **60** serve to firmly force together 3 panels disposed substantially at right angles to each other. The tension members such as **23** further provide the adequate pressure to maintain the edge to edge relationship between the panels **12** and **14**. It is impossible without distortion or destruction of the panel for the panels to be displaced inwardly into the space enclosed by the structure. For most applications, the tension members **23** provide sufficient and adequate pressure to maintain adequate fitting for the rabbeted ends of the panels **12**. However, if relatively large structures are prepared in accordance with the invention wherein the length to thickness ratio of a given panel becomes very large or the overall length of the structure is great, for example, about five panel widths, advantageously one or more tension bands may be placed about the structure to assure tight fitting of the ends of the panels **12**.

Although the invention has been described in terms of spline and lapped rabbet joints, advantageously in cases where particularly rigid and well sealed corner joints are required the lap joints may be replaced with a splined mitre joint. In a similar manner, other conventional joints such as dado and rabbet and the like may be employed. Generally, for ease of construction and low cost with satisfactory performance, the lapped rabbet and spline joints are found satisfactory for most installations.

Advantageously, particularly tight seals between the members forming lap joints and butt joints are provided by an extension of the core beyond the facing sheet as illustrated in FIGURE 6. The core material is usually deformable to some extent and any minor irregularities in the face sheets will be filled by the core material when pressure is applied. In the case of butt joints, sufficient deformation will take place under the pressure excited by the tension members to give core to core contact. Beneficially, a thin resilient gasket may be employed between the joints. Such gasketing generally comprises thin slices of core material, foam rubber, polyethylene, and the like.

By way of further illustration, a number of panels were prepared having one eighth of an inch thick hardboard faces (tempered Masonite made by the Masonite Corporation), and 4 inch thick cores of cellular polystyrene. The face sheets of hardboard were adhered to the foam polystyrene core by means of a phenol formaldehyde resin. The resultant panel had a total weight of 70 pounds. The panels were then grooved and rabbeted as illustrated in the accompanying drawing and assembled into an enclosure substantially as shown in FIGURES 1, 4 and 5. The enclosure had an overall dimension of about 8 feet wide by 12 feet long and 8 feet 4¼ inches in height. The splines employed to join the panels in edge to edge relationship were about 1½ inch by 3 inch by 8 foot strips of expanded cellular polystyrene which were press fit in the panel core grooves **43**. The tension members **21**, **23** and **25** were 3 by 3 by 0.04 inch galvanized sheet steel. Corner members **62** of FIGURE 7 were prepared from similar galvanized sheet metal. The corners **62** and tension members **21**, **23** and **25** were secured by means of sheet metal screws. Sheet metal screws were also used to secure tension members to the panels **12** and **14** at 12 inch intervals. A door opening was cut in one end of the enclosure and an insulated refrigerator door installed. Refrigeration coils and circulating fan were placed within the enclosure and connecting lines were passed through tight fitting openings in the panel. The entire assembly was painted inside and out. Temperatures in the range of about −40° Fahrenheit were maintained within the enclosure for an extended period of time. No damage or undesirable effects were observed after a period of about 2 months.

Although the invention is described with particular reference to generally rectangular structures, which find most frequent application, other configurations are employed with equal facility such as tetrahedral, pyramidal, and prisms such as pentagonal, hexagonal, octagonal, and the like.

What is claimed is:

1. A self-sustaining refrigerated structure which is readily assembled and disassembled comprising in cooperative combination at least 12 generally rectangular panels, said panels comprising a pair of opposed face members having disposed therebetween foamed plastic insulating means, each of said panels having at least three edges provided with a rabbet designed to interfit with a like rabbet, the remaining edge defining a groove within the core of said panel, said groove being disposed therein a spline in a plane generally parallel to a face of said panel, four of said panels being arranged in the form of a hollow rectangular prism having a first end and a second end with the splined sides at the first end of said hollow rectangular prism, a pair of panels positioned within the opening at the second end of said prism having grooved edges abutting and a spline in said grooves, the rabbeted edges of said panels engaging the rabbeted edges of said rectangular prism to form a five sided generally rectangular configuration, a second similar five sided generally rectangular configuration disposed with the grooved edges of its first end in engagement with the grooved edges of the first end of said first five sided configuration and receiving first end of said first five sided configuration, one of said

panels defining a passageway from the enclosed space within the panel structure to the space without, an insulated door closing said passageway and elongated external tension members disposed about the periphery of the structure, the elongated tension members providing a compressive force on the structure and providing the sole means to maintain the panels in engagement with each other in the longitudinal direction of the tension members, the tension members being metal angles longitudinally disposed along each of the peripheral edges of the structure and overlying corners formed by adjacent panels, the tension members conforming generally to the external configuration of the refrigerated structure.

2. The enclosure of claim **1**, wherein said plastic is a polystyrene.

3. The enclosure of claim **1**, wherein said splines are foam plastic splines.

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