

Nov. 2, 1937.

J. PAVLECKA

2,097,598

CELLULAR STRUCTURE

Original Filed Jan. 13, 1933

3 Sheets-Sheet 1

Fig. 1.

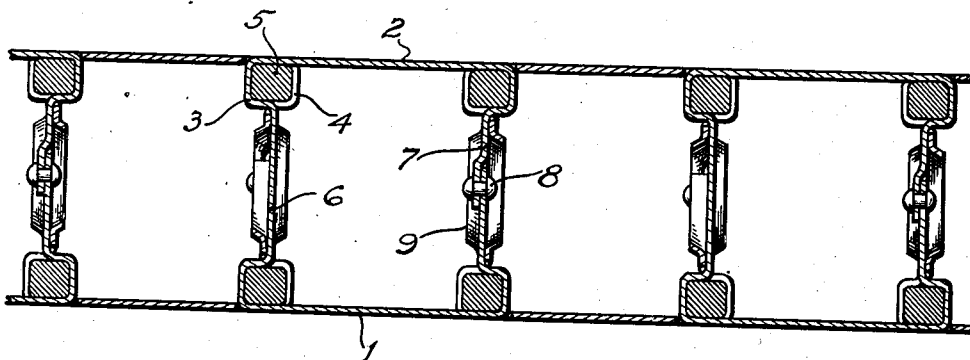
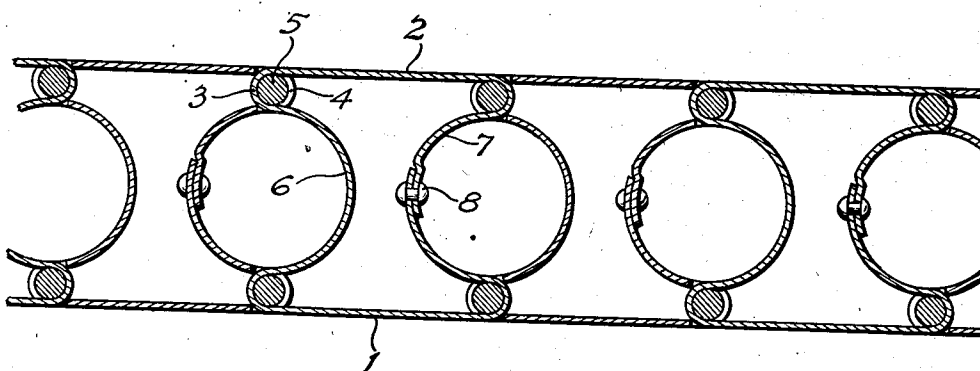


Fig. 2.



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Fig. 3.

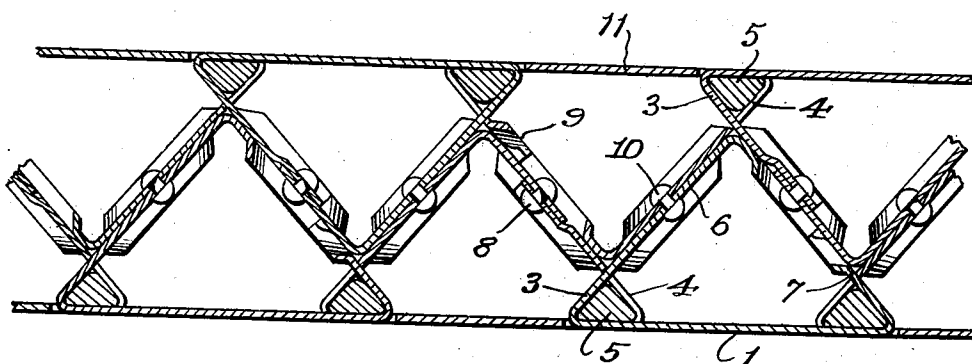
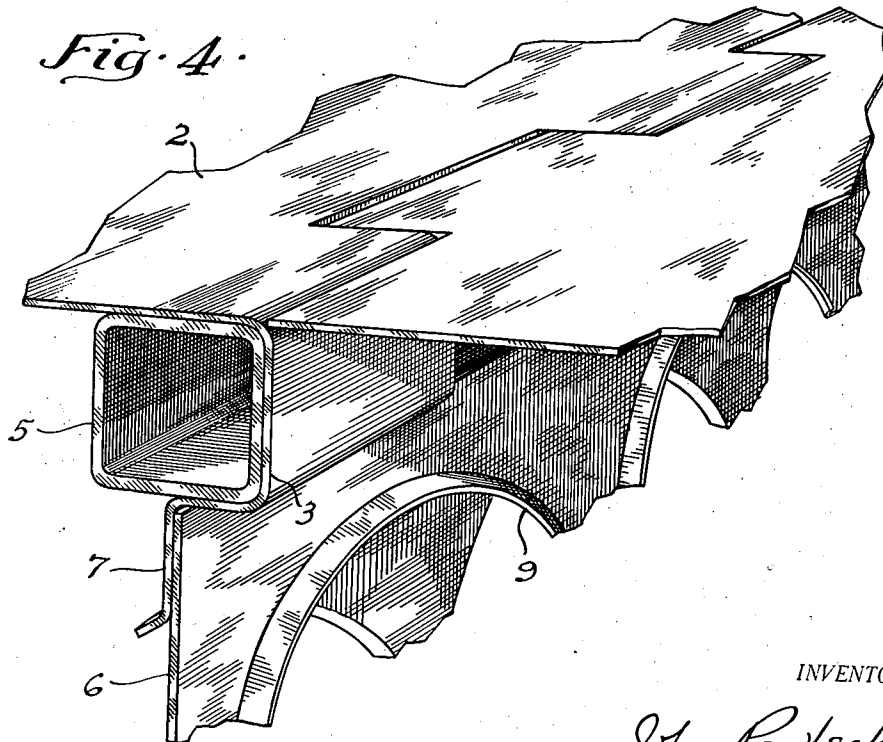


Fig. 4.



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Fig. 5.

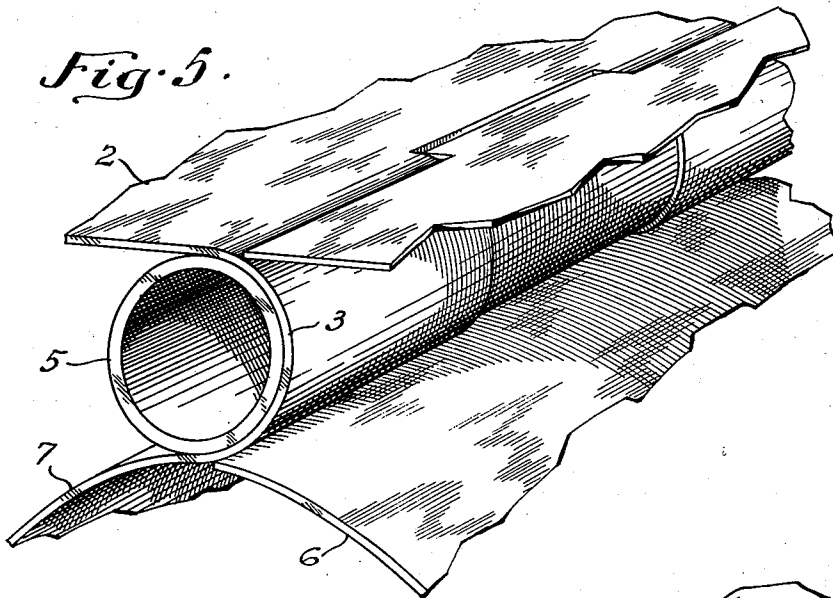
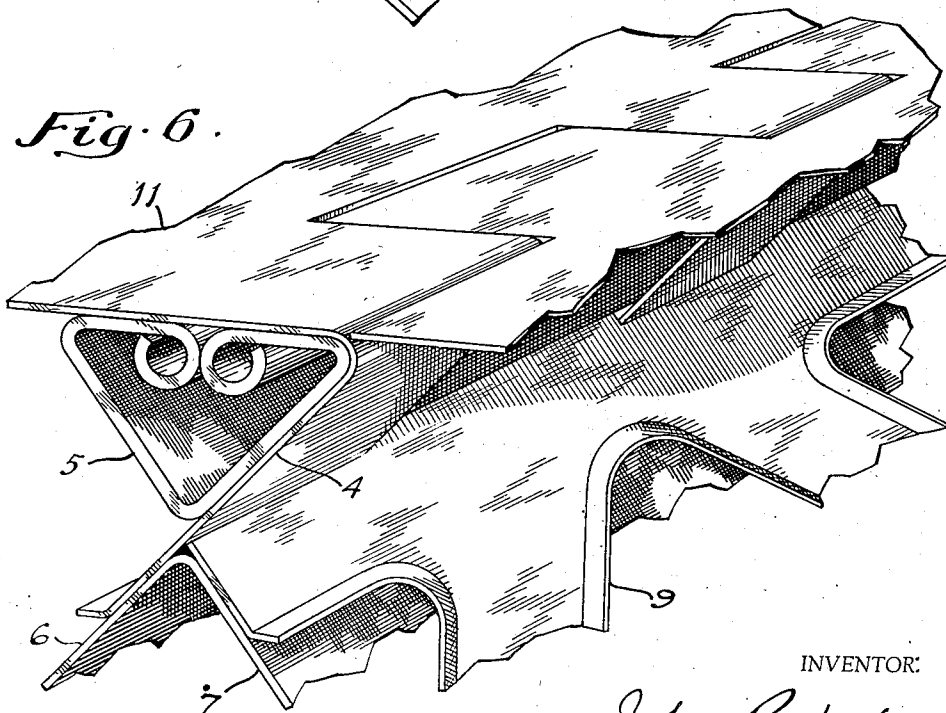


Fig. 6.



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CELLULAR STRUCTURE

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Renewed March 2, 1936

7 Claims. (Cl. 189—34)

My present invention relates to a variety of generic structures having a large load supporting surface, such as floors, walls and wings of aircraft.

5 The purpose of my invention is to devise a structure of the character above mentioned that will sustain most load and weigh least.

Another object is to provide a structure for supporting loads distributed over a large area, hereinafter referred to as the "plane" type, that will utilize mainly sheet material and will be easy to fabricate.

10 A still further object is to devise a structure of the above character that will be easily dismantled and re-assembled at any time for purposes of inspection or replacement of any one of its component members.

15 A structure of the plane type must sustain not only direct weight distributed or concentrated on its surface, but must also resist compressive and tension stresses induced in its body by bending, and must, furthermore, withstand bending and shear forces in its border extremity at its points of attachment to other bodies. These requisites are met in the structure of my invention by supporting the direct weight by sheet material which forms the exterior surfaces of the structure, by resisting the terminal forces by relatively rigid and compact members, such as rods or tubes embodied in the structure, and by opposing the induced stresses within the structure by the combined action of the sheet material which constitutes the body of the structure, as well as the individual rigid members incorporated in the sheet material.

20 The novel features through which the above principle is materialized will now be disclosed in detail as applied to the several embodiments illustrated in the drawings pertaining to this specification and forming an integral part thereof.

In the drawings,

Fig. 1 represents a transverse cross-section through a typical structure of the plane type.

Fig. 2 is a similar cross-section showing certain internal stiffening elements for greater strength.

Fig. 3 is a transverse cross-section through another example of the structure of my invention, this one showing triangular configuration which will be referred to as diagonal truss.

50 Figs. 4, 5, and 6 are perspective views relating to the preceding embodiments and depicting mainly the manner in which the rigid members are incorporated in the body of the structure, and the manner of holding the sheet material in the

body together by means of the same rigid members.

Referring to Fig. 1, the plane type of structure represented in this view is characterized externally by extended proportions in its length and width but by a relatively small thickness. As a whole, the structure may be either a continuous span or a cantilever carrier, and moreover, it may be of uniform proportions throughout its extent or it may taper in width or in thickness, or in both toward one extremity. The body of the structure is an assemblage of a series of individual tubular elements, hereinafter called "cells", extending lengthwise of the structure side by side. The cells are generally polygonal or multi-lateral, by which terms I designate any geometrical or irregular shape having at least two sides meeting in as many well defined apices.

The cells in the structure in Fig. 1 are all alike, being rectangular in shape and comprising each two chord webs 1 and 2, and two side webs 6 and 7, the former providing the bottom and the top exterior surfaces of the structure, respectively, and the latter abutting on the sides of the adjacent cells. The chord webs 1 and 2 meet the side webs 6 and 7 in four apices, which apices are profile grooved laterally and outwardly for the whole extent of the cells, the profile of the grooves in this particular case being rectangular, as shown on a larger scale in Fig. 4. The grooved apices of the cells are transversely serrated throughout their length, the serrations being equidistant portions of the apex grooves cut out to a certain depth; in each two associated cells the serrations are relatively staggered lengthwise so that when, on assembly, the cells are abutted one onto each other, the serrated portions 4 of each cell will intermesh with the full apex portions 3 of the adjacent cell or cells in a hinge-like manner, thereby forming longitudinally a rectangular sheath; into each of these sheaths is thrust one rigid strut 5 which interlocks the cells into unity after the fashion of a hinge pin.

The cells are fabricated of sheet material of suitable gauge to withstand not only local strain but also be able to partake in compressive loads in cooperation with the struts 5. The material in the cells may be steel, duralumin, fibre, or any other. The cells are fabricated as complete units ready for assembly into the structure; this is done by bending or rolling sheets into closed tubular shapes with the apex grooves rolled or embossed in and the serrations punched out preferably in flat stock. The closing seam is located prefer-

ably in one side of the cells, as shown, and is either welded or riveted, as by rivets 8.

As a means of gaining additional stiffness for the side webs 6 and 7, flanged holes 9 are punched in them, these holes being spaced so as to clear the heads of the rivets 9, as shown. Corrugations or embossed beading may be substituted for the holes 9.

The struts 5 are linear members, by which term I designate either a tubular or a prismatic beam of any geometrical or irregular shape to suit any particular embodiment. Functionally, the struts 5, in addition to tying up the cells into a unit, are intended to sustain primarily the bending and the shear forces at and between the terminal points of the structure, provide these terminal points of attachment or suspension of the structure to other bodies, and reinforce the sheet material against local buckling. The struts 5 are, in turn, reinforced by the sheet material of the cells due to the restraining hold that the grooved apex portions of the cells have on them. The cross-section of the struts 5 may, in certain embodiments, be made to correspond to the intensity of stress in them, i. e., the thickness of their walls may be increased toward the point of attachment by splicing a piece of a smaller section into them, or, in case of a cantilever structure, the whole cross-section of the struts may taper longitudinally.

Fig. 2 represents substantially the same type of structure as Fig. 1 with an improvement residing in that the side webs 6 and 7 of the cells between the grooved apex portions 3 and 4 are indented inwardly; in this case they are shown as true circular arches so that the adjoining webs of each pair of associated cells give rise to a round tubular spar within the structure. These spars will materially increase the carrying capacity of the structure by virtue of their inherent stiffness as hollow beams. The struts 5 in this case are shown as being round in cross-section, as also shown in Fig. 5.

A type of structure which embodies all the new features of the preceding types and discloses a further novelty in the manner of assembling the cells is shown in Fig. 3, and on a larger scale in Fig. 6.

In this embodiment the cells are distinguished by their triangular shape and by the fact that only two of their apices are serrated, these being the two apices at the chord webs 1 and 11 at the bottom and top, respectively; the third apex is continuous. The cells are assembled in such a manner that the top and bottom surfaces of the structure are provided by two rows of cells, the cells forming one surface alternate with those forming the opposite surface and each row of cells is interlocked at the chord apices of its cells. The side webs 6 and 7 of each pair of one intermediate and one alternate cell abut onto each other, thereby forming a double diagonal truss web. In order to retain the two rows of upright and inverted cells together, the side webs 6 and 7 of each pair of one upright and one inverted cell are joined together, as by rivets 10. This joining operation is performed before assembling the cells into the structure, the access to the rivets 10 being through the opposite side webs in which flanged holes 9 have been punched out for stiffening purposes; similar holes are punched in the webs joined by the rivets 10, the holes alternating with the rivets. The cells are constructed similarly as in the case of the rectangular cells in Fig. 1, the closing seams being riveted by rivets 8.

The struts 5 are preferably triangular in cross-section whereby they will conform to the natural profile of the cell apices and will dispense with special profiling of these apices.

I claim:

1. A structure comprising, a series of tubular multi-lateral cells having side webs and chord webs meeting in a number of apices, said cells providing the exterior surfaces of said structure with said chord webs and abutting one on each other along said side webs thereby forming walls of double thickness in the interior of said structure, each cell having its apices profile grooved and transversely serrated, the serrated apex portions of each cell being intermeshed with the full apex portions of the associated cell, and linear members interlocking said intermeshed apex portions of said cells.

2. A structure comprising, a series of tubular cells extending lengthwise of the structure and having side webs and chord webs meeting in a number of apices, said cells providing the exterior surfaces of said structure with said chord webs and abutting one on each other along said side webs thereby forming walls of double thickness in the interior of said structure, each cell having its apices profile grooved and transversely serrated, said serrated apices of each two associated cells being intermeshed, linear members interlocking said intermeshed apices, and means for stiffening said side webs of said cells between said apices thereof.

3. A structure comprising, a series of tubular cells extending lengthwise of the structure and having side webs and chord webs meeting in a number of apices, said cells paralleling one another and providing the exterior surfaces of said structure with said chord webs thereof, each cell having its apices profile grooved and transversely serrated, said serrated apices of each two associated cells being intermeshed, and linear members interlocking said intermeshed apices; said side webs of said cells being arched between said intermeshed apices thereof whereby each group of associated cells will give rise to a tubular spar within said structure.

4. A structure comprising, a series of substantially rectangular tubular cells extending lengthwise of the structure and having each two side webs and two chord webs meeting in four apices, said cells providing the exterior surfaces of said structure with said chord webs and abutting one on each other along said side webs thereby forming walls of double thickness in the interior of said structure, each cell having the apices thereof profile grooved and transversely serrated, said serrated apices of each two associated cells being intermeshed, and substantially rigid linear members interlocking said intermeshed apices.

5. A structure comprising, a series of substantially rectangular tubular cells extending lengthwise of the structure and having each two side webs and two chord webs meeting in four apices, said side webs being arched inwardly between said apices, said cells paralleling one another with said chord webs thereof providing the exterior surfaces of said structure and said side webs of each two adjoining cells forming a tubular spar within said structure, each cell having the apices thereof profile grooved and transversely serrated, said serrated apices of each two associated cells being intermeshed, and substantially rigid linear members interlocking said intermeshed apices.

6. A structure comprising, a series of substan-

5 tially triangular tubular cells extending length-
wise of the structure and having each two side
webs and one chord web meeting in three apices,
said cells abutting one on each other inversely
10 whereby all alternate cells will provide with said
chord webs thereof one exterior surface of said
structure and all intermediate cells the other
surface, said side webs of each two abutting cells
forming a double diagonal truss between said ex-
15 terior surfaces, each cell having the two apices
thereof at said chord web transversely serrated
and intermeshed with the apices of the associ-
ated cells, each pair of one alternate and one
intermediate cell being conjoined in said side
webs thereof, and substantially rigid linear mem-
bers interlocking said intermeshed apices.

7. A structure comprising, a series of substan-
tially triangular tubular cells extending length-
wise of the structure and having each two side

webs and one chord web meeting in three apices,
said side webs having flanged holes punched
therein with the flanges turned inwardly, said
cells abutting one on each other inversely where-
5 by all alternate cells will provide with said chord
webs thereof one exterior surface of said struc-
ture and all intermediate cells the other surface,
said side webs of each two abutting cells form-
ing a double diagonal truss between said exterior
10 surfaces, each cell having the two apices thereof
at said chord web transversely serrated and in-
termeshed with the apices of the associated cells,
each pair of one alternate and one intermediate
cell being conjoined in said side webs thereof be-
15 tween said flanged holes therein, and substan-
tially rigid linear members interlocking said in-
termeshed apices.

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