May 16, 1967 K. F. BRAEUNINGER ET AL 3,319,543

STRUCTURAL UNIT

Filed May 5, 1965 2 Sheets-Sheet 1

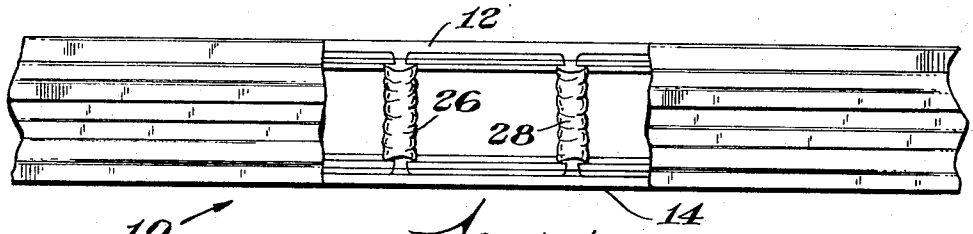


Fig. 1

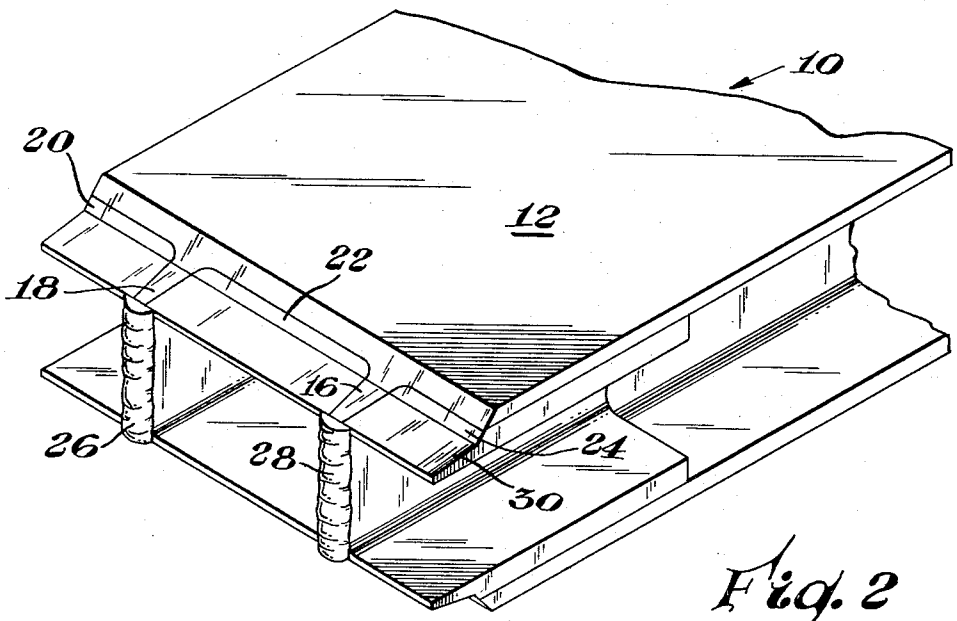


Fig. 2

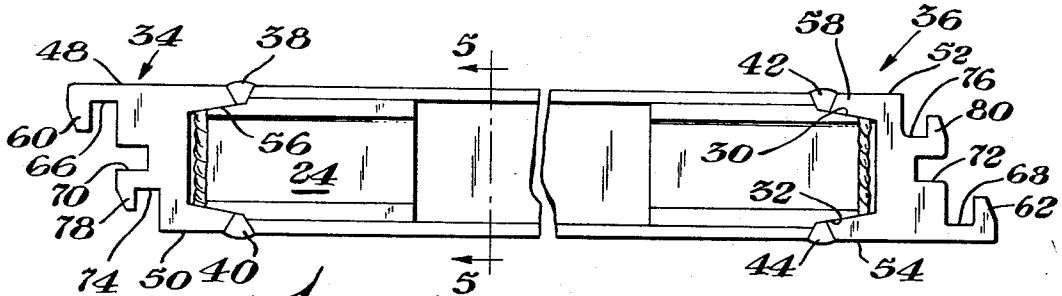


Fig. 3

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STRUCTURAL UNIT

Filed May 5, 1965 2 Sheets-Sheet 2

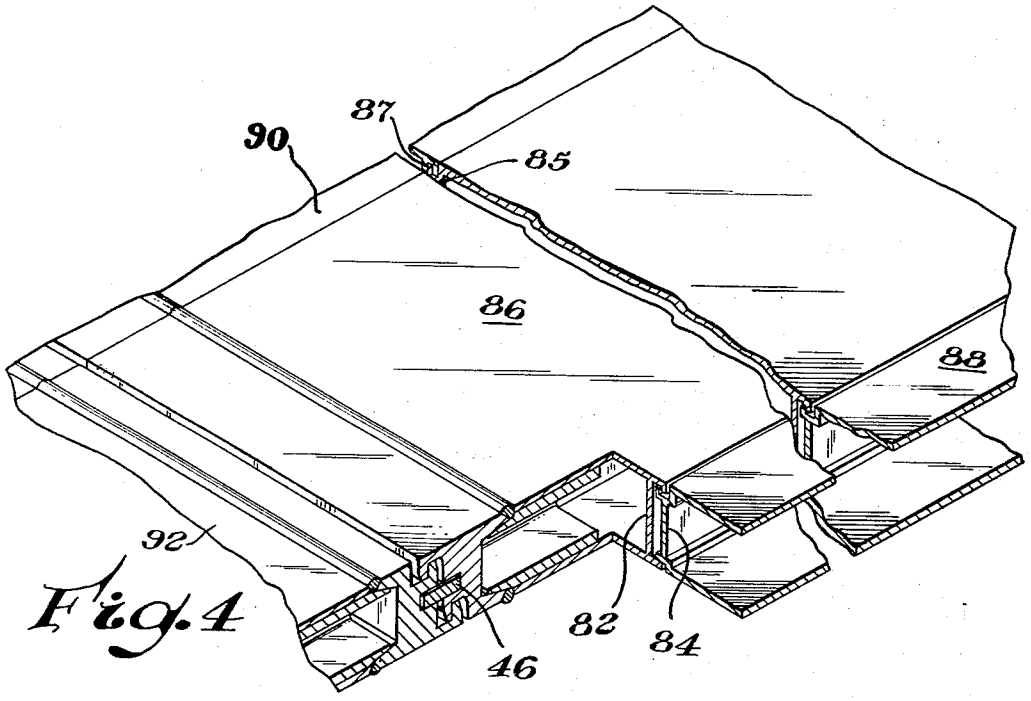


Fig. 4

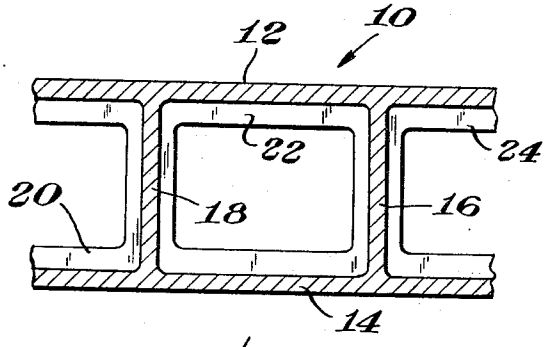


Fig. 5

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3,319,543

# STRUCTURAL UNIT

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9 Claims. (Cl. 94—13)

This invention relates to structural units which are adapted to be interlocked with each other to provide a deck or surface which may be used as a temporary roadway, aircraft runway, or the like.

Such structural units are usually made in the form of elongated planks which have interlocking sides and end parts. Usually the units have a more or less flat top and bottom parts which are spaced apart and joined by a plurality of web elements which extend longitudinally of the units.

Because such units are desirable for use in making temporary military aircraft landing fields, or for any purpose where the units must be transported a considerable distance to their point of usage, the units should be as light as possible consistent with the strength necessary to sustain the heavy loads encountered. Further, the weight per structural unit should be light enough to permit manual handling during assembly of the runway or road.

In the past, if the top, bottom and webbing parts were made light enough to be acceptable from the standpoint of the gross weight of the structural unit, such units had a tendency to break near the end parts, e.g., at or near where the extruded mat section joins the coupling connector, where the units were joined together in an interlocking manner.

Accordingly, a principal object of this invention is to provide an improved structural unit which is light in weight yet capable of sustaining repeated shock and sustained loads without mechanical failure.

Another object of this invention is to provide a structural unit having improved end coupling means.

A further object of this invention is to provide an improved, simple to assemble, structural unit.

In accordance with this invention a structural unit having top and bottom parts and a plurality of spaced apart joining web parts has tubular elements whose cross-sectional configuration are such that they fit closely but easily slidably within the space between the top, bottom and adjacent web parts of each structural unit. The length of the tubular elements is in excess of the distance by which the top and bottom parts are separated, and preferably is a few inches.

The tubular elements and the web elements are welded together at their adjacent parts, then the end of the units are machined (tapered) to permit the end part to be welded to the basic unit. An end part may, for example, be of the type claimed in U.S. Patent No. 3,172,508, issued March 9, 1965, to Doering et al.

The invention, as well as additional objects and advantages thereof, will best be understood when the following detailed description is read in connection with the accompanying drawings, in which:

FIG. 1 is a fragmentary end elevational view, partly broken away, of a structural unit in accordance with this invention;

FIG. 2 is an isometric view showing the manner of preparing the end section of the basic structural unit for attachment of the interlocking end part;

FIG. 3 is a side elevational view, with the side attaching means removed, of a structural unit made in accordance with this invention;

FIG. 4 is an isometric view showing the manner in which adjacent structural units in accordance with this invention are joined together, and



FIG. 5 is a fragmentary sectional view taken along the line 5—5 of FIG. 3.

Referring to the drawings, and particularly to FIGS. 1, 2, 3 and 5, there is shown a structural unit, indicated generally by the numeral **10**, which has a top part **12**, bottom part **14**, and a plurality of web parts (**16**, **18** in FIG. 5, for example) joining the top and bottom parts. The outer surface of the top and bottom parts is generally flat.

Inserted within the space between the top, bottom, and adjacent web parts are tubular elements **20**, **22**, **24**, for example. The tubular elements have a cross sectional configuration which fits slidably with the hollow space defined by the top, bottom and adjacent web parts. The length of the tubular elements **20**, **22**, and **24** is greater than the thickness of the structural units by a substantial amount, and is usually of the order of a few inches.

As may be seen in FIGS. 1, 2 and 3, the tubular elements **20**, **22**, and **24** are each welded, as by welds **26**, **28**, to an adjecent web element but are not welded or otherwise mechanically secured (except that they fit slidably adjacent to the top and bottom) to the top and bottom parts.

After the tubular elements (**20**, **22**, **24**) are inserted and welded to the web parts, the end of the basic structural unit is machined to provide a tapered top and bottom surface (**30**, **32**, for example) which is adapted to be received by the end coupling parts, indicated generally by the numerals **34**, **36**, respectively.

The end coupling parts **34**, **36** extend across the width of each structural unit **10** and are welded to the top and bottom parts of the unit **10** and to the top and bottom of the tubular elements (**20**, **22**, **24**, for example) by the welds **38**, **40** and **42**, **44**, respectively.

As may be seen from FIG. 3, the cross-sectional configuration of the end connectors **34**, **36** is complementary, the two types of connectors being adapted to mate with each other (and, on the insertion of a bar **46**, as shown in FIG. 4, to form an interlocking end coupling between structural units.

Each of the end connectors **34**, **36** has a flat top and bottom surface **48**, **50** and **52**, **54**, respectively. Each connector **34**, **36** has a tapered grooved edge part **56**, **58**, respectively, adapted to mate with the tapered end surfaces (**30**, **32**, for example) of the basic structural unit and be welded to the basic structural unit.

The connector **34** has a downwardly extending flange **60** and the connector **36** has an upwardly extending flange **62** (which is similar to the flange **60** in configuration) at their ends which are most remote from the basic structural unit. Each of the connectors **34**, **36** has a recess **66**, **68**, respectively behind the flanges **60**, **62**, respectively.

Each of the connectors **34**, **36** has a horizontally disposed slot **70**, **72** extending towards the basic structural unit from the outer face of the connector, the slots being located midway between the top and bottom of the connectors whereby when the connectors are coupled together the slots are aligned one with another.

Each of the connectors **34**, **36** has a vertically extending slot **74**, **76**, respectively, adjacent to the end of the basic structural unit, the outer wall of the slot being a flanged element **78**, **80**, respectively.

Referring now to FIG. 4, particularly, it may be seen that the side edges **82**, **84**, **85**, **87** of the structural units **86**, **88**, **90** are adapted to interlock together.

The structural unit **86** is shown coupled end-to-end to a structural unit **92**. It may be seen that the end connectors mate with each other and are held together by means of the rod **46** which extends through the abutting slots which correspond to the slots **70**, **72** in FIG. 3.

Thus, in operation, the roadway or runway or similar

load bearing assembly is assembled by joining a plurality of structural units **10** together in end-to-end and side-to-side relationship to form a load bearing surface of the required dimensions.

The use of the tubular elements (**20**, **22**, **24**, for example) inserted in the ends of the basic structural units and welded to the web elements of the basic structural units provides the strength needed to prevent structural failure of the elements **10** at their ends while permitting lighter weight in the rest of the structure.

The present invention provides a practical, light weight means for transfer of high shear loads from one structural unit through the end connectors and thence to the end part of the next adjoining structural unit.

This particular structure is well adapted for use in aircraft landing mats where the function is to distribute the wheel load over a much greater area of ground than would be true if the wheel contacted the ground directly. When a wheel is at the very end of a "plank," or structural unit, the adjacent plank can provide support to the loaded plank only to the extent that the joints between the planks can transfer a shearing type of load.

Because the welds **38**, **40** and **42**, **44**, respectively, couple the end connectors **34**, **36** both to the top and bottom parts **12**, **14** of the basic extrusion unit and to the top and bottom parts of the tubular elements (**20**, **22**, **24**, for example) inserted into the ends of the basic structural unit, this invention provides an excellent, simple to assemble and manufacture means for transferring a high shear load from one plank to another.

In one structural unit (a landing mat plank) made in accordance with this invention, the overall thickness of the basic structure unit is 1½ inches, with the top and bottom part each being about 3/32 inch thick. The thickness of individual web elements is about 1/16 inch, the web elements being disposed generally perpendicular to the top and bottom parts, spaced apart about 1¾ inches on centers, and running lengthwise of the plank.

The tubular sleeves inserted in the end of the basic structural units are generally of hollow rectangular cross-sectional configuration, with the side walls being about 1/16 inch thick and the top and bottom walls being about ⅛ inch thick.

The grooves made prior to making the welds **38**, **40**, **42**, **44** extend through the top and bottom part **12**, **14** of the basic structural unit and about half way through the top and bottom of the tubular elements (**20**, **22**, **24**, for example).

The "planks" are, as cut to length, about two feet wide and twelve feet long, although other sizes may be made.

The connector elements on both the ends and sides of the planks fit loosely together both for ease of assembly by relatively unskilled people and for providing flexing during usage and in event the base over which the units are assembled is somewhat uneven.

While the invention has been described in connection with a specific coupling assembly by way of example, other end coupling devices may be used, such as connectors which are adapted to be bolted together, for example.

Also, the web elements in the instant structural unit are perpendicular to the top and bottom, but may be of other configurations. For example, web elements disposed so as to require tubular inserts of triangular or trapezoidal cross-sectional configuration.



The particular dimensions needed for structural units adapted to bear specific loads will vary with the type of alloy used. In the instant example, an aluminum alloy is used, although structural units of other light metal or ferrous alloys may be made in accordance with this invention.

What is claimed is:

**1.** A structural unit comprising elongated plate-like top and bottom members joined by spaced apart longitudinally extending web members which run from end-to-end of said top and bottom members, said top and bottom members and said web members defining a plurality of channels when viewed in transverse cross-section, a plurality of tubular elements, each of said tubular elements being dimensioned to fit closely but slidably into one of said channels, the length of said tubular elements being a minor fraction of the length of said unit, said tubular elements being disposed within said channels with an end of each of said channels being coextensive with the end of one of said web members, said end of said channels and said end of said web members being welded together, the end parts of said top and bottom members and said tubular elements being beveled whereby the top of said tubular elements and the top and bottom parts of said web members are exposed, and an elongated end coupling element being received on said beveled surfaces, said coupling element being welded to said top and bottom members, the top and bottom parts of said tubular elements, and the top and bottom parts of said web members.

**2.** A structural unit in accordance with claim **1**, wherein said tubular elements are equal in number to said channels.

**3.** A structural unit in accordance with claim **1**, wherein said tubular elements have thicker walls adjacent to said top and bottom parts than adjacent to said web parts.

**4.** A structural unit in accordance with claim **1**, wherein said slots are rectangular in transverse cross-sectional configuration.

**5.** A structural unit in accordance with claim **1**, wherein said structural unit is made of light metal alloy.

**6.** A structural unit in accordance with claim **1**, wherein the length of said tubular elements is between 1 and 2 times the thickness of said structural unit.

**7.** A structural unit in accordance with claim **1**, wherein the length of said tubular element is of the order of 2 inches.

**8.** A structural unit in accordance with claim **1**, wherein the configuration of the coupling elements welded to each end is such that their gripping parts are complementary in configuration.

**9.** A structural unit in accordance with claim **1**, wherein said coupling element is welded to said top and bottom plate-like members, said top and bottom of said tubular elements, and said top and bottom of said web members by a line weld across the top and a line weld across the bottom of said structural unit.

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JACOB L. NACKENOFF, *Primary Examiner.*