Sept. 6, 1938. B. S. FERGUSON 2,129,466

STRUCTURAL MEMBER

Filed July 13, 1936 2 Sheets-Sheet 1

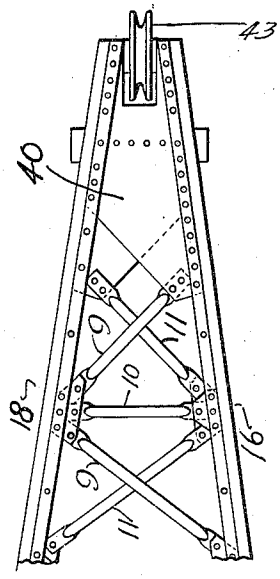


Fig. 1

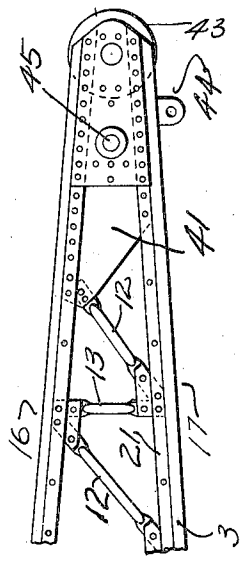
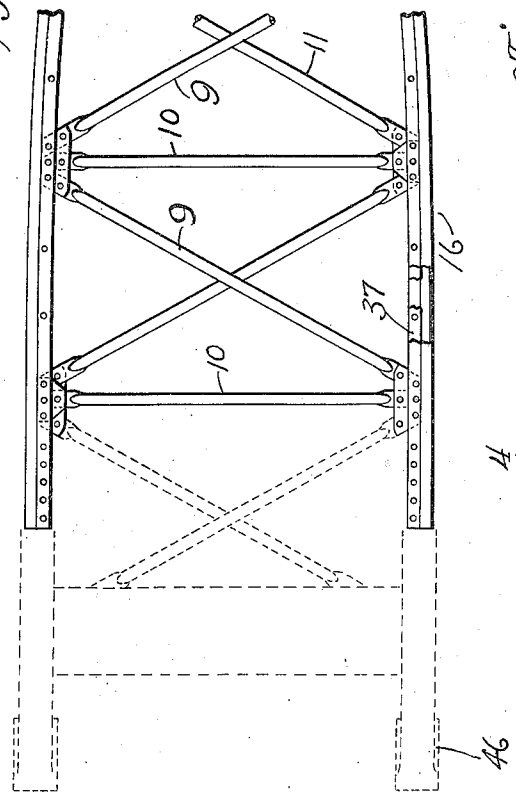
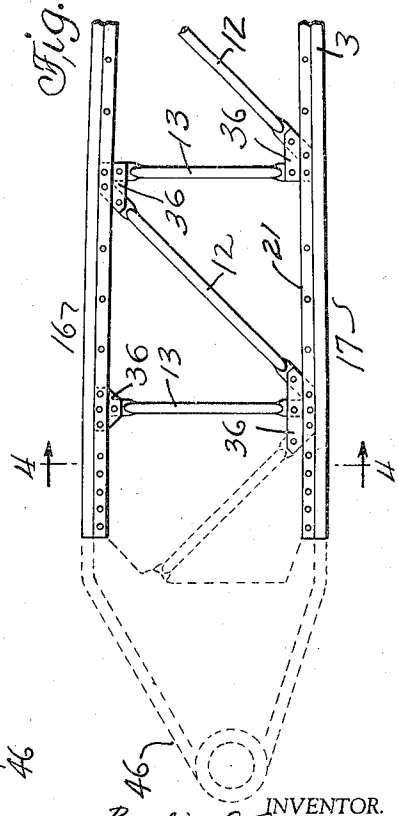


Fig. 2





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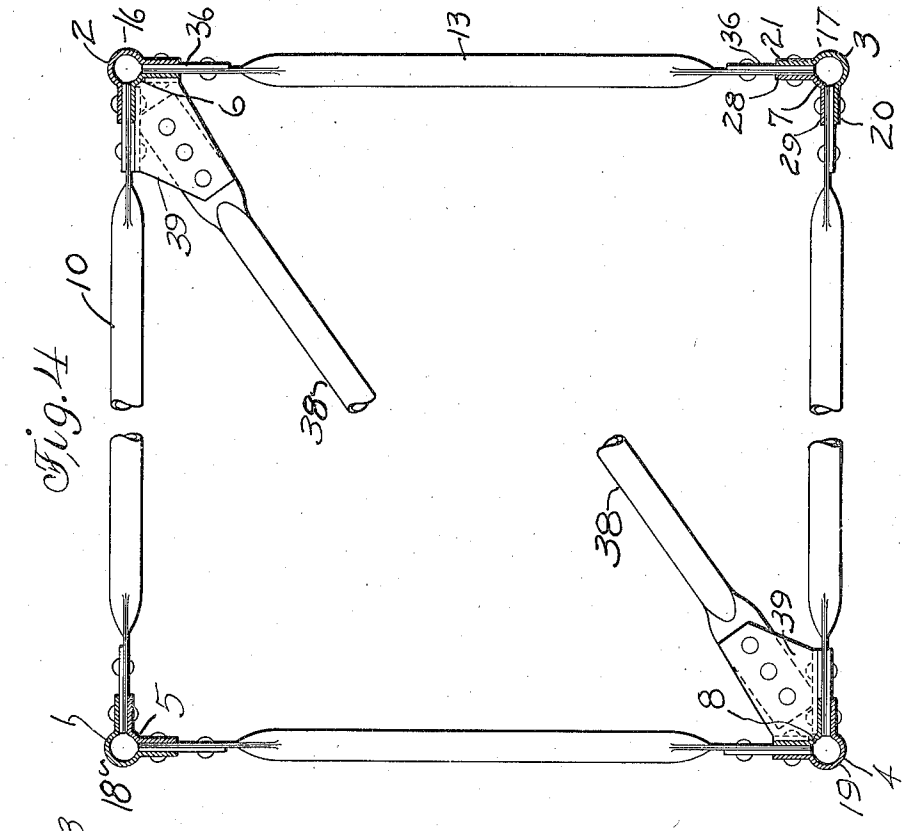


Fig. 4

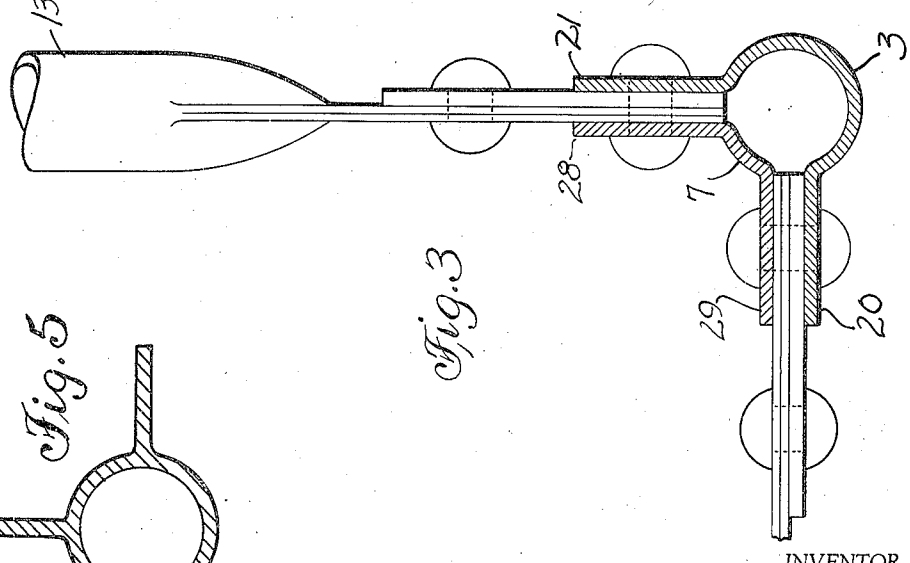


Fig. 3

Fig. 5

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UNITED STATES PATENT OFFICE

2,129,466

STRUCTURAL MEMBER

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4 Claims. (Cl. 189—19)

This invention relates to the art of fabricating built-up structural members and resides in a new form of polygonal latticed box member composed of tubular elements. The longitudinals defining the corners of the polygonal box are tubular in cross section and are composed of tubular elements having angularly spaced radial fins running longitudinally thereof. The angle subtended between the radial fins of the longitudinals is determined by the number of sides in the polygonal box structure. In order to complete the latticed box structure, diagonal and transverse struts extend between adjacent longitudinals. These struts, formed of tubes with flattened ends, are held in place by adjoining the flattened ends to the radial fins.

The structural member of this invention is well adapted to being fabricated by conventional methods of fastening, as by riveting, and may be quickly and easily assembled. This ease and simplicity of fabrication is unusual in view of the fact that tubular sections are employed, the use of which normally entails special difficulties in fabrication. The structural member of this invention is particularly adapted for use where the material employed is unusually expensive, as in the case of aluminum and other light alloys. In such cases the weight of the structure is a matter of paramount importance and in addition to being easily fabricated, the superior strength of the member of this invention permits of further economies in material and, consequently, in weight. When the member of this invention is embodied in aluminum and employed as a boom on a crane or other lifting apparatus, the saving in weight, not only due to the employment of light material but also to economy of material, because of the strength of the design brings about a substantial increase in the useful load which the crane can lift.

The structural member of this invention is best described by reference to the accompanying drawings, wherein

Fig. 1 shows a top view of a boom fabricated in accordance with this invention,

Fig. 2 is a side view of the boom shown in Fig. 1,

Fig. 3 is a cross section of a longitudinal,

Fig. 4 is a cross sectional view taken at the plane 4—4 of Fig. 2, and

Fig. 5 is a cross sectional view of another form of longitudinal.

As shown in the drawings, the member of this invention is fabricated in the form of a latticed box composed of four longitudinals bearing the numerals 16, 17, 18, and 19. As shown more clearly in Figs. 3 and 4, the longitudinals above referred to are composed of exterior segments 1, 2, 3, and 4, and inner segments 5, 6, 7, and 8, respectively. One of said longitudinals is shown in greater detail in the lower right hand corner of Fig. 3. It is composed of the exterior segment 3 and the interior segment 7. The exterior segment 3 has webs 20 and 21, which extend away from the margin of the tubular portion of the segment 3 at an angle of ninety degrees. The webs 20 and 21 are formed integrally with the tubular segment 3 and extend along the margin of the segment throughout its entire length, as shown clearly in Fig. 2, where the segment web 21 may be clearly seen. The interior segment 7, as shown in Fig. 3, is likewise provided with webs 28 and 29, formed integrally with the segment 7 and extending radially from the margins thereof and arranged along the entire length of the segment. It will be noted that the webs 28 and 29 subtend an angle of approximately 270 degrees, which is the conjugate of the 90 degree angle subtended by the webs 21 and 20 of the exterior segment.

The segments with their webs upon being secured together form tubular longitudinals with radial fins and are the principal elements forming the foundation for the remaining structure. If the box section of the member is to be triangular instead of rectangular as shown in the drawings, the angle subtended by the webs will be, accordingly, adjusted to approximately 60 degrees and 300 degrees so that the fins will subtend an angle of approximately 60 degrees. If, however, the box section of the member is to be other than triangular or rectangular, the angle subtended by the fins may be formed appropriately. The tubular segments with their attending webs are, in the case of aluminum, preferably fabricated by extrusion methods and may, if desired, be extruded in one unitary tube with fins attached, as shown in Fig. 5. The particular method of fabrication employed to shape the segment element to the desired form is, of course, immaterial and any appropriate method may be employed therefor.

In order to provide the necessary lattice braces or tubular cross elements joining the various longitudinals, tubular cross struts, such as 9, 10, and 11, shown in Fig. 1, and 12 and 13, shown in Fig. 2, are provided. These struts are similar in form and are composed of tubes, the ends of which are slit and flattened. As shown clearly in Fig. 4, the flattened ends of cross struts 10, 11, 12, and 13 are inserted between the conjugate faces of the adjoining longitudinal webs. The webs are

spaced apart a sufficient distance to admit the flattened ends of the cross struts as well as gusset plates **36**, as shown in Fig. 2. The gusset plates and flattened ends of the cross struts having been inserted in place between conjugate faces of the webs of the longitudinal segments, the assembly, including the two webs, the gusset plate, and the ends of the cross members, are secured in place by rivets passing through the entire assembly. In the chords between stations where cross struts join the longitudinals the conjugate faces of the webs of the tube segments of the longitudinal are spaced apart, the thickness of the space amounting to the combined thickness of the flattened end of the tubular cross members and the thickness of the diaphragm plate. If desired, this space may be filled with a filler **37**, as indicated in Fig. 1. The filler strip **37** and the adjoining faces of the web are securely fastened together by stitch rivets passing through both webs and the filler strip. If desired, the webs may be offset, thus dispensing with the use of a filler strip, or, if the fins are formed integrally with the tubular longitudinal, fastening means in the chords are unnecessary. In this way the latticed box member of this invention is assembled and upon completion the entire structure is composed of tubular elements of characteristically superior strength.

If it is desired to provide diagonal stiffening for the box member, diagonal struts **38**, such as are shown in Fig. 4, may be placed by riveting bracket plates **39** into the corners of appropriate positions, as shown in the drawings.

As shown in Figs. 1 and 2, the webbed longitudinal segmental elements **16**, **17**, **18**, and **19** are well adapted for holding in place boom tip reenforcement plates **40** and **41**, as well as the corresponding plates hidden from view in the figures. Secured to the reenforcing plates at the tip of the boom are a head sheave **43**, a hoisting line anchorage **44**, and a luffing line anchorage **45**. As shown in Figs. 1 and 2, a boom foot **46** can be easily attached at the lower end of the boom.

The structure of this invention, although easily fabricated by conventional methods, employing the usual conventional tools, and without any special or unusual skill, results in a member composed of tubular elements. The customary design employing angle sections for longitudinals although comparable in ease of assembly to the structure of this invention requires much additional material in order to achieve the same strength. The minimum moment of gyration of angle members is distinctly less than the minimum moment of gyration of the longitudinal member employed in this invention. For this reason, when employing angle members as longitudinals the lateral stiffening struts must either be placed much closer together, entailing the use of more material, or the actual metal contained in the cross section of the longitudinal must be substantially increased. In either event the weight of the member is materially increased. Booms, such as are required for drag-line excavators or lifting cranes, often can be advantageously fabricated from light materials, such as aluminum. This is true in spite of the cost since the increased useful load which a given machine can lift will at times more than offset the additional cost of the light material employed in fabricating the boom. By means of this invention, not only is the advantage of light material availed of, but a further saving in weight and increase in useful load handled by a given machine is gained because of additional economies in weight reflected in the design of the boom. This is accomplished through this invention without entailing any unusual or expensive fabrication difficulties.

The structural member of this invention has been described above in detail in connection with one specific embodiment thereof. It is apparent that as to many of the features variations in design may be employed without departing from the spirit of the invention and it is intended that the protection of Letters Patent to be granted hereon be not unnecessarily limited by the specific embodiment described in the disclosure, but extend to the full scope of the invention.

What I claim as my invention is:

1. In a built-up structural member, the combination comprising tubular longitudinals defining the corners of a polygonal prismatic latticed box, said longitudinals being formed of exterior webbed tube segments having webs extending radially from the segment margins at an angle defined by adjacent longitudinals and interior webbed tube segments having webs extending radially from the segment margins at an angle conjugate with the angle subtended by the webs of the exterior segments, tubular lattice struts extending between longitudinals and having flattened ends, said flattened ends being embraced between the conjugate faces of the webs of said exterior and interior longitudinal segments, gusset plates also embraced between said segment webs and overlapped by the flattened ends of said lattice struts, fillers between the conjugate faces of said longitudinal segments and occupying the space not occupied by the gusset plates and flattened ends of said lattice struts, fastening means for securing together the webs of said exterior and interior longitudinal segments, and fastening means for securing the gusset plates and flattened ends of said lattice struts in place between the webs of said longitudinal segments.

2. In a built-up structural member, the combination comprising tubular longitudinals defining the corners of a polygonal prismatic latticed box, said longitudinals being formed of exterior webbed tube segments having webs extending radially from the segment margins at an angle defined by adjacent longitudinals and interior webbed tube segments having webs extending radially from the segment margins at an angle conjugate with the angle subtended by the webs of the exterior segments, tubular lattice struts having flattened ends extending between longitudinals and terminating between the webs thereof, gusset plates between said webs and overlapped by the flattened ends of said struts, fastening means for securing together the webs of said exterior and interior longitudinal segments, and fastening means for securing the flattened ends of said tubular struts and said gusset plates in place between the webs of said longitudinal segments.

3. In a built-up structural member, the combination comprising tubular longitudinals defining the four corners of a rectangular latticed box, said longitudinals being formed of exterior webbed tube segments having webs extending radially from the segment margins and subtending a right angle and interior webbed tube segment having webs extending radially from the segment margins and subtending three right angles, tubular lattice struts extending between longitudinals and having flattened ends terminating between the faces of said longitudinal

segment webs, gusset plates overlapped by the flattened ends of said struts also positioned between said segment webs, and fastening means for securing the faces of said longitudinal segment webs together and for securing the gusset plates and flattened ends of the lattice struts in place between the faces of said longitudinal segment webs.

4. In a built-up structural member, the combination comprising tubular longitudinals defining the corners of a polygonal latticed box, said longitudinals being formed of exterior webbed tube segments having webs extending from the segment margins and interior webbed tube segments having webs extending from the segment margin, lattice struts extending between longitudinals and having flattened ends terminating between the faces of said longitudinal segment webs, gusset plates overlapped by the flattened ends of said struts also positioned between said segment webs, and fastening means for securing the faces of said longitudinal segment webs together and for securing the gusset plates and flattened ends of the lattice struts in place between the faces of said longitudinal segment webs.

BERLIN S. FERGUSON.