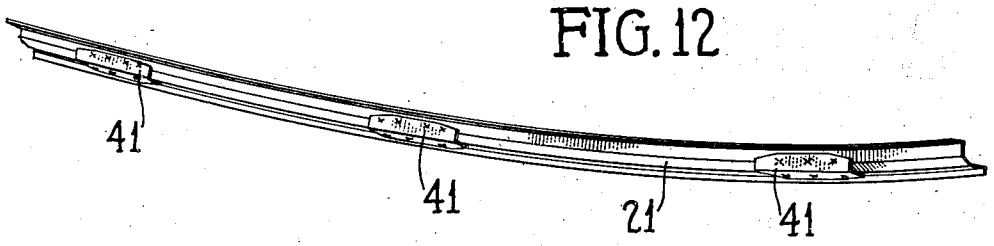
July 19, 1932. E. J. W. RAGSDALE 1,868,073

METHOD OF CONSTRUCTING AIRPLANE FUSELAGES

Filed Dec. 27, 1929 3 Sheets-Sheet 1

FIG. 12



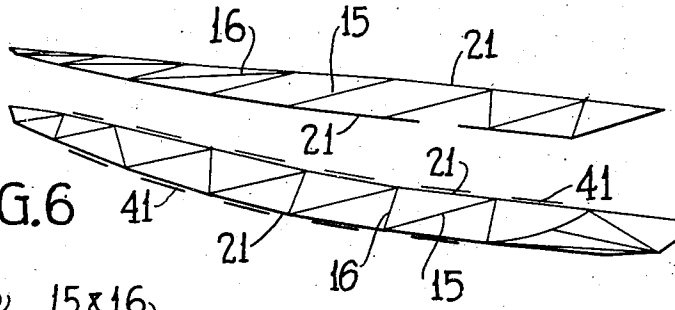


FIG. 5

FIG. 6

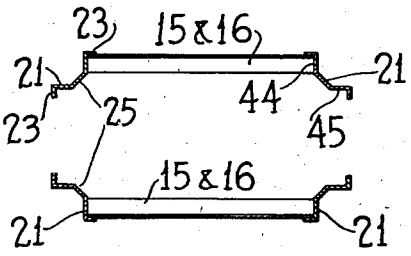


FIG. 7

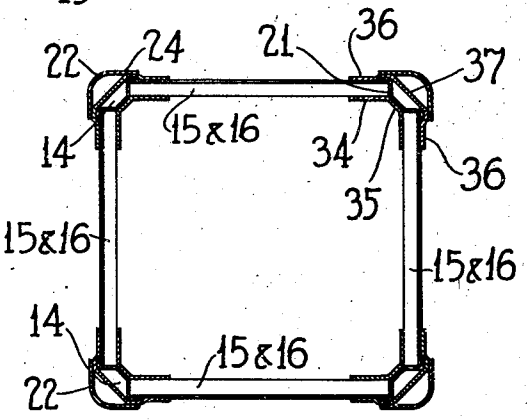


FIG. 8

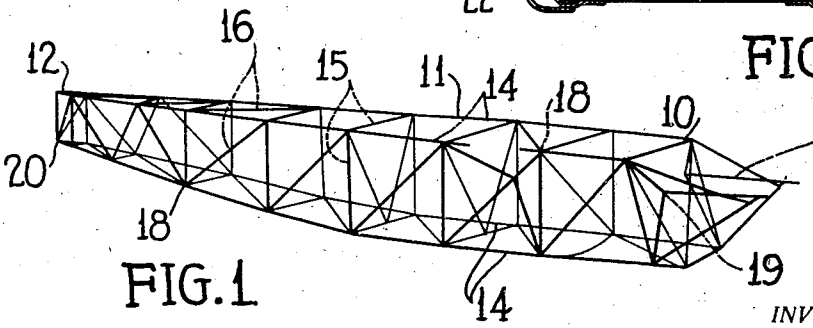


FIG. 1

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July 19, 1932. E. J. W. RAGSDALE 1,868,073

METHOD OF CONSTRUCTING AIRPLANE FUSELAGES

Filed Dec. 27, 1929 3 Sheets-Sheet 2

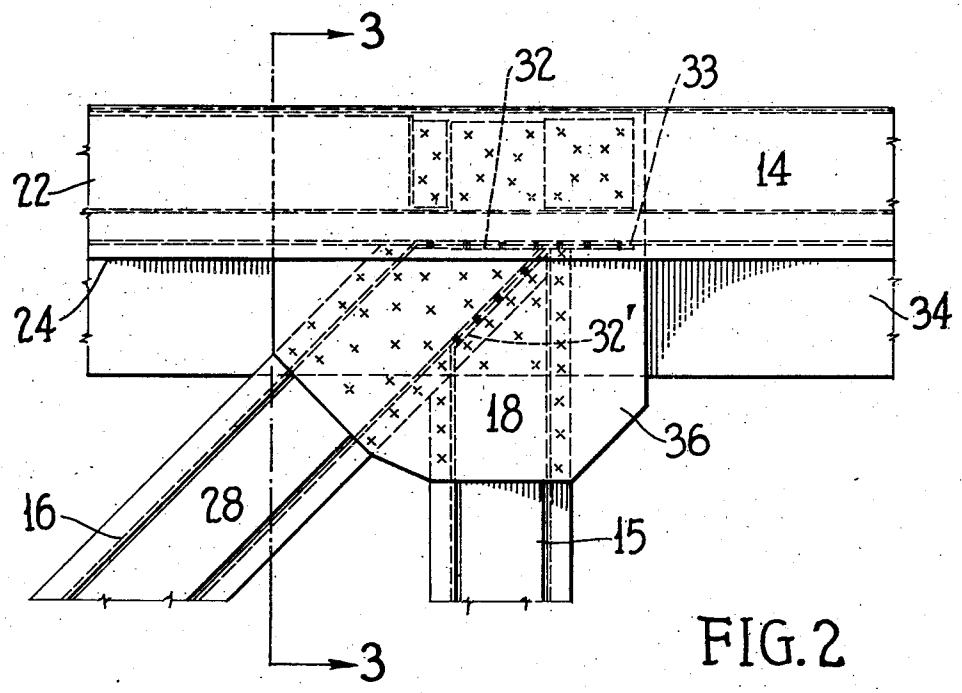


FIG. 2

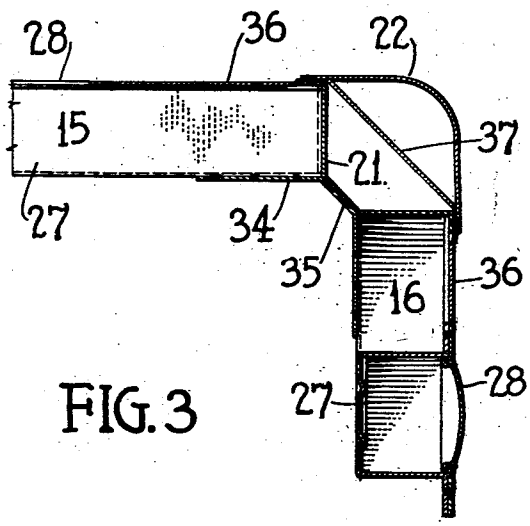


FIG. 3

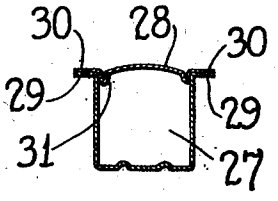


FIG. 4

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METHOD OF CONSTRUCTING AIRPLANE FUSELAGES

Filed Dec. 27, 1929 3 Sheets-Sheet 3

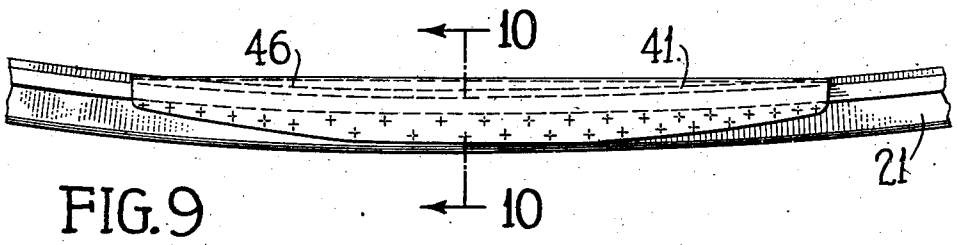


FIG. 9

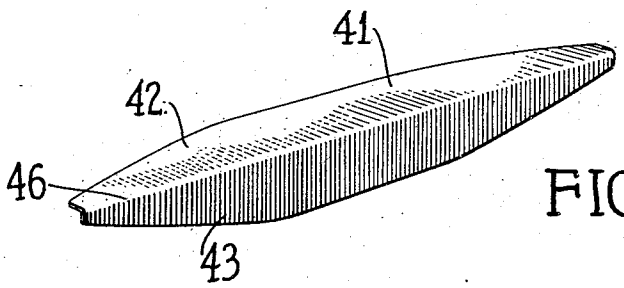


FIG. 11

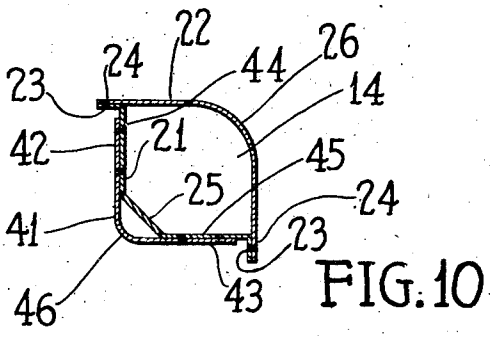


FIG. 10

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METHOD OF CONSTRUCTING AIRPLANE FUSELAGES

Application filed December 27, 1929. Serial No. 416,835.

In my application Serial No. 392,319, filed September 13, 1929, Aircraft construction and method of making same, I have disclosed a structure of strip stock electrically spot welded together and the method of fabricating this structure. This invention has to do with the modified structure and method.

In general, the structure of the application referred to comprises chord members of closed cross section composed of complemental parts of open cross section, the chord members constituting the longerons, and diagonal and transverse members constituting struts secured to one at least of said open cross section portions of each longeron from the inside of its hollow cross section. It comprises further reenforcing gusset members for the joints so made, exteriorly of the struts and longerons and interiorly thereof. The whole is electrically spot welded together.

The improved structure embodies closed cross section reinforcements for the closed cross section chord members, beaded reinforcements for the struts, and a stronger cluster joint between the diagonal and transverse struts and the chord members. The chord reinforcement has especially to do with curvilinearly extending chord members, and comprises an angle cross section outwardly presenting member of rectilinear extent applied interiorly of the body in nested relation to the angle cross section outwardly presenting member of the chord per se. The struts are reenforced by beadings in the bottom of their channel cross sections in addition to the beadings in the top thereof. The joint cluster is formed by directly founding the diagonal struts upon the chord member and in turn directly founding the ends of the transverse struts upon the ends of the diagonal struts. The cluster so formed has a greatly augmented joint strength under certain conditions of service.

The improved method of fabrication consists in first forming the open cross section longitudinally extending parts of the chord members (which present outwardly) to their ultimate curvature, next locating upon them and securing in reinforcing relation the rectilinearly extending reinforcement, then properly locating with respect to each other the diagonally outwardly opening parts of the cross sections of the longerons in planes of corresponding pairs of longerons, that is to say, of longerons corresponding in location with respect to the longitudinally extending plane of symmetry of the fuselage; spot welding to the open sections of the corresponding pairs of longerons the struts of the planes of the respective pairs, these planes in general being transverse to the plane of symmetry of the body, thereby forming trusses of these corresponding pairs of longerons of which the longerons constitute chords, and thereafter joining the trusses so formed together by welding to the yet open sections, the interplane struts, those paralleling the plane of symmetry. Thereafter, the reenforcing gussets are welded in place interiorly and exteriorly of the open sections. Finally, the open sections of the pairs of longerons and the struts are closed by welding to them co-extensive complemental sections. Diagonal struts are welded in place ahead of transverse struts.

Of the drawings—

Figure 1 is a general perspective diagram of the structural members of a fuselage.

Figure 2 is a side elevation showing in detail the joint between the longerons and struts of the structure disclosed in my copending application.

Figure 3 is a transverse section thereof on line 3—3 of Fig. 2 looking in the direction of the arrows.

Figure 4 is a transverse cross section of one of the struts.

Figures 5 and 6 are diagrammatic perspectives of the upper and lower trusses of the structure diagrammed in Fig. 1, constituted by the corresponding pairs of longerons and the struts of the planes in which they lie.

Figure 7 is a transverse cross section in structural detail of the trusses of Figs. 5 and 6 as super-imposed in the second step of fabrication.

Figure 8 is a transverse cross section showing the detail of the completed body and illustrating the third and fourth steps of my method.

Figure 9 is an enlarged detail showing of the curvilinearly extending chord member and its rectilinearly extending reenforcement.

Figure 10 is a cross section of the same on line 10—10 looking in the direction of the arrows.

Figure 11 is a perspective of the reinforcing member itself.

Figure 12 is a perspective illustration of the curvilinearly extending chord member and several located and attached reinforcements.

Referring to the respective diagram of Fig. 1, it will be seen that the body illustrated is of substantially rectangular cross section and of the usual approximate stream line form in which there is a gradual enlargement of cross section from the nose portion 10 to an intermediate region 11 and thereafter a gradual diminishing cross section to the end or tail 12 of the structure. In the nose of the body diagram is diagrammed a portion of the truss structure supporting engine bearers 13. This portion is irregular as respects the main body which is characterized by conventional regularity of truss form. In its conventional form it is comprised of longitudinally extending chord members 14 cross connected to each other in the outer surfaces of the body by transverse and diagonal struts 15 and 16 respectively. The functions of these parts are so well understood as to need no description. Commonly they are made of steel tubing, arc welded or acetylene welded together at the joints 18 to the chord members 14 and similarly at other joints such as 19 in the motor supporting front end and 20 at the tail end.

Fig. 2 shows a joint 18 as fabricated by my structure and according to my method. The complete members of the body are given the numbers of corresponding parts in the diagram of Fig. 1. But instead of being composed of tubes or members of one piece cross section, these members are composed each of the longitudinally extending multipart cross sections.

The chords (or longerons, as they are commonly called), are comprised of the inner outwardly presenting angle cross section part 21 and the complemental outer inwardly presenting angle cross section part 22. The edges of the angle cross section of the part 21 are provided with outwardly extended flanges 23. The edges 24 of the outer part 22 are extended complementally to overlap the flanges 23. Thus is formed a box section chord member 14 of two opposed cross sections longitudinally divided from each other (or when completed, secured to each other) substantially in the diagonal plane of its transverse cross sections. The apex 25 of the angle cross sectioned inner part 21 is flattened diagonally of the interior of the body to facilitate placement of reenforcements. The apex 26 of the outer part 22 is rounded to permit round drawing of fabric or other covering thereover.

The chord members or longerons 14 of the bottom of the body diagram in Fig. 1 are curvilinear in extent as clearly appears also in Fig. 6. This curvature may apply to all such chord members 14. It is shown in exaggerated detail in Fig. 9. Such curved chord members are especially constructed intermediate the strut connections thereto to give them greatest strength against undue deflection under compression. In special aircraft bodies not only the bottom such member but all such members are curvilinear in extent.

This construction appears very clearly in Figs. 9 and 10. An angular reenforcing member 41 of considerable length, but less length than the distance between the strut connections is spot welded by the branches 42 and 43 of its cross section to the branches 44 and 45 of the inner and outwardly presenting angle section chord member 21. This reenforcing and stiffening member 41 is substantially rectilinear in extent, especially in its apex 46 though either or both of its side walls 42 and 43 may by reason of the peculiar curvature of the part 21 of the chord 14 partake of that curvature. Apex 46 is, moreover, relatively sharp as respects the apex 25 of the chord part 21 and the two apices 25 and 46 together constitute a closed box type cross section extending throughout the length of the member 41, of a maximum cross sectional area intermediate the ends and gradually diminishing toward the ends as is apparent from Figs. 9 and 10. The walls 42 and 43 correspondingly are diminished in height from intermediate points to each end, being greatest in height in the mid region.

The construction of the transverse and diagonal struts 15—16 appears in detail in Figs. 3 and 4 inclusive. The channel cross section outwardly presenting part is designated 27. The substantially plane section inwardly presenting part which closes the mouth of the channel to form the substantially rectangular box section of Fig. 4 is designated 28. 29 are the outturned flanges of the side walls of the channels. 30 are the complementally extended edges of the inwardly presenting parts 28. These inwardly presenting parts 28 are provided adjoining edges 30 and contiguous with the side walls or channels 27 with beads 31 for the purpose of initially positioning the edges 30 for complemental securement to the flanges 29, and subsequent addition to the strength and stiffness of the box cross section.

The diagonally extending struts 16 are formed at their ends 32 on biases complemental to the angle of the diagonal whereby they may be seated on such end flatly against

the chord members 14. The side walls of these diagonal struts 16 are respectively provided with extensions 32 and 33 which may lie flatly against the walls of the members 14 and be spot welded thereto as is clearly shown in Fig. 2 in dotted lines. The transverse struts 15 on their part have their ends formed on biases at angles complemental to the angles of the respective diagonal struts with the members 14 also as shown in dotted lines in Fig. 2. They are adapted thereby to abut flatly the planes of the side walls of the respective diagonal struts 16. The side walls of the transverse struts 15 like the side walls of the diagonal struts 16 are provided with end extensions 32′ and 33′ adapted to lie flatly against and be welded to the side walls of the diagonal struts 16 abutted by the ends of the transversely extending struts.

The reinforcing gussets interior to the body are shown in Figs. 2, 3 and 8 and are designated 34. They are angular in transverse cross section and provided with a flattened apex 35 complemental to the flattened apex 25 of the chord members 14. In lateral and longitudinal extent they cover a substantial area co-extensive with the general area of the joint 18 and sufficient to overlap to a considerable extent each of the chord and strut members of the joint.

In Figs. 2, 3 and 8 also appear the reenforcing gussets 36 interior with respect to the joints 18. These too are of angular form and have flattened apex portions 37, in this case of a lateral expanse reaching in plane form diagonally across the closed cross section of the chord members 14 from joint to joint of its parts. Its expanse is co-extensive in general with that of the joint including the gusset 34 and overlapping to a considerable degree of various strut members.

According to my method, the individual parts having been fabricated of sheet stock, the structure is assembled in the following manner. Initially the inner chord parts 21 of corresponding pairs of chords or longerons are held upon a form and given requisite curvature by the form and with reference thereto. They are suitably held in that position by any desired clamping devices. While so curvilinearly extending in precisely the form which they will have in the completed body, the members 41 are applied at proper locations intermediate the points at which the struts are to be located and spot welded in place from the inside of the outwardly projecting part 21. This is indicated especially in Fig. 12. Then, the chord members 21 of corresponding pairs of longerons, upper and lower, in this case, having been relatively located as respects each other as they shall be located in the completed body, either by the initial jigging operation of members 21 or by subsequent such operation, the transverse and diagonal struts of the planes of the respective pairs are joined to the pairs of chord parts 21 as diagrammatically indicated in the super-imposed Figures 5 and 6, thereby constituting complete trusses of these pairs of upper and lower chord parts 21. Such completed trusses are shown cross-sectionally in super-imposed relation in Fig. 7. First the diagonally extending struts 16 are welded in place at proper points by spot welding the wall extensions 32, 33 to the side walls of the member 21, the welding being done from the interiors of the respective cross sections of the members 16 and 21. The one tab 32 of member 16 lies interiorly of the member, the other tab 33 of member 16 lies exteriorly thereof. Second, the transverse struts 15 are welded in place, their ends being seated, the extremity upon the tab 33 and through it upon the side wall of member 21 (see Fig. 2), and the major area of the end upon the side wall of the diagonal struts 16. The tabs 32′ and 33′ of the transverse struts 15 are inturned and commonly spot welded to the side wall of the diagonal strut member 16. Here also the welding is done from the interior of the respective sections of the members 15 and 16. The upper and lower trusses of Figs. 5 and 6 having been thus completed, they are next connected together by spot welding in place the interplane struts. This is done in a manner entirely similar to the welding in place of the struts of the planes of the pairs as just described, the outwardly presenting cross sectioned parts of the chords 14 being still in the open condition of Fig. 7. The diagonal interplane struts 16 are first located and welded in place and then the transverse ones. At this juncture the gussets 34 and 36 are welded in place about the clusters of strut ends at strut locations along the members 21. Finally, chord members 14 are closed by the welding in place of the chord parts 22 co-extensive with the chord parts 21. This closes the heretofore opened outwardly presenting cross section of the parts 21 and constitutes the completed members 14 of box cross section reenforced at the joints by the diagonally extending portions 37 of the gussets 36, and reenforced against undue flexure intermediate the clusters by the members 41 applied in the initial step of assembly. And, of course, the channel cross section struts 16 and 15 are likewise closed in this final operation by the application of other closing elements 28 and the spot welding of them in place.

In view of the fact that my invention is susceptible not only of various modifications, but also of uses in other arts than that in which it has been particularly developed, as for example, the building art, the scope of my invention is to be determined by what has been done in those arts and its relation to the generic spirit of my invention rather than the

circumstantial terminology of the annexed claims.

What I desire to claim as new and useful and protect by Letters Patent is:—

1. The method of fabricating an aircraft fuselage whose longerons are of closed cross section which consists in first laying diagonal outwardly opening parts of the cross sections in planes of corresponding pairs of longerons, spot welding to the open section of the longerons the struts in the planes of the respective pairs, and thereafter joining the trusses so formed together by welding to the yet open sections the interplane struts of the pairs.

2. The method of fabricating aircraft fuselage whose longerons are of closed cross section which consists in first laying diagonal outwardly opening parts of the cross sections of corresponding pairs of longerons, spot welding to the open section of the longerons the struts in the planes of the respective pairs, thereafter joining the trusses so formed together by spot welding interplane struts to the yet open sections of the pairs, then reinforcing the joints of the struts by spot welding gussets thereto, and finally closing the cross sections of the respective longerons.

3. The method of fabricating an aircraft fuselage having diagonal and transverse struts of closed cross section which consists in first anchoring in place to chord members the diagonal struts and then anchoring in place to the diagonal struts the transverse struts.

4. The method of fabricating an aircraft truss whose longerons are of closed cross section and comprising diagonal and transverse struts which consists in first anchoring in place to the chords the diagonal struts and thereafter anchoring in place to the diagonal struts the transverse struts.

5. The method of fabricating an aircraft truss having curved chord members of closed cross section which consists in first forming the curvature in an open cross section longitudinally extending part of such chord members, then applying reinforcements to said part and thereafter applying an additional longitudinally extending part or parts to form the chord member of closed cross section.

6. A chord member for aircraft trussing comprising a longitudinally extending angle cross section part curvilinear in its longitudinal extent and a reinforcing member therefor extending longitudinally thereof and likewise of angle cross section but rectilinear in its extent, the side walls of which parts are secured together to form a longitudinally tapering box section between the curved part and the rectilinear part.

7. An elongated hollow sheet metal structural member extending longitudinally thereof and curvilinear in extent, a reinforcing member therefor rectilinear in extent and having walls of cross section corresponding generally to the cross section of the structural member in nested engagement with the walls of the curvilinearly extending member and secured thereto to form a longitudinally tapering box section between the curved part and the rectilinear part.

8. An aircraft truss comprising a chord member, a diagonal strut having its end founded directly upon the chord member, and a transverse strut having its end founded upon the end of the diagonal strut.

9. In an aircraft truss comprising hollow chord members and struts, diagonal struts having their hollow ends founded directly upon the hollow section chord members and transverse struts having their ends founded upon the ends of the diagonal struts.

10. An aircraft truss comprising chords having parts of open cross section presenting outwardly of the truss, a diagonal strut having an end wall projected interiorly of the section and anchored to the open cross section chord part, and hollow cross section transverse struts likewise having end walls deflected inwardly of its cross section, and in turn founded upon the end portion of the wall of the diagonal strut.

11. A sheet metal structural member of closed cross section built up of several members, one at least of said members being of angle section, and curved longitudinally and a straight relatively short longitudinal reinforcing member of general corresponding section nested with said angle section member and rigidly secured thereto in the nested areas.

12. The method of fabricating a frame member of closed cross section which consists in first spot welding a complete reinforcement having a section corresponding generally to the cross section of an open cross section part entering into the construction of said frame member, to the outer back side of such part and thereafter applying a part or parts to close the cross section of said member.

13. The method of fabricating curved structural members of closed cross-section which consists in first forming an open cross-section, longitudinally-extending part of such structural member to its ultimate curvature, then attaching reinforcements across such open cross-section part and finally applying an additional, longitudinally-extending part or parts to form a member of closed cross-section.

In testimony whereof he hereunto affixes his signature.

EARL J. W. RAGSDALE.