April 14, 1931. F. C. KRUMMEL 1,801,202

AIRSHIP CONSTRUCTION

Filed Nov. 26, 1928 3 Sheets-Sheet 1

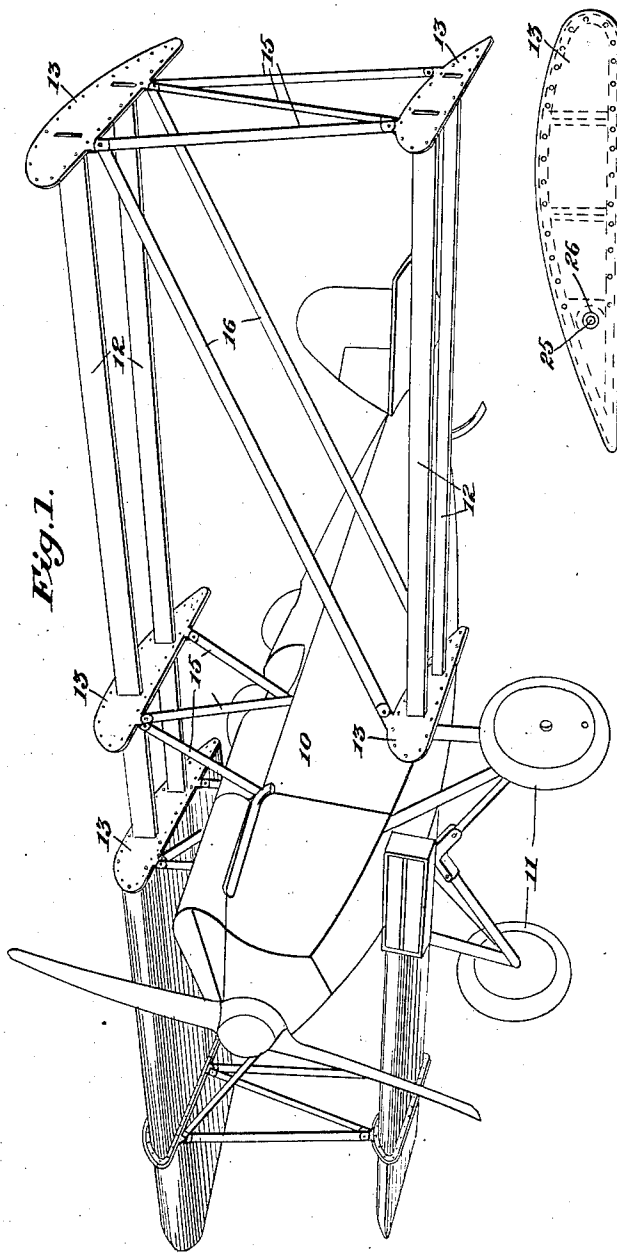


Fig. 1.

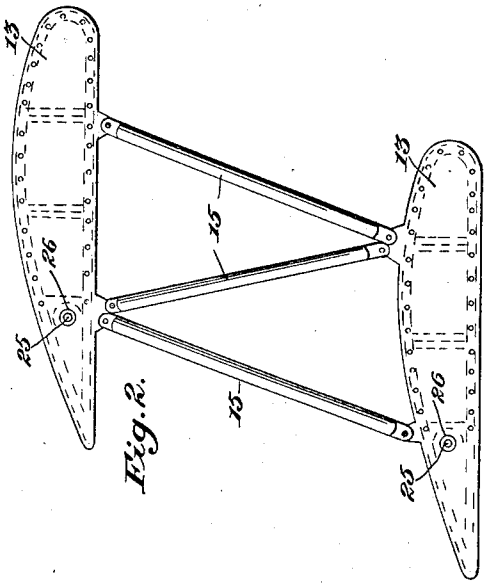


Fig. 2.

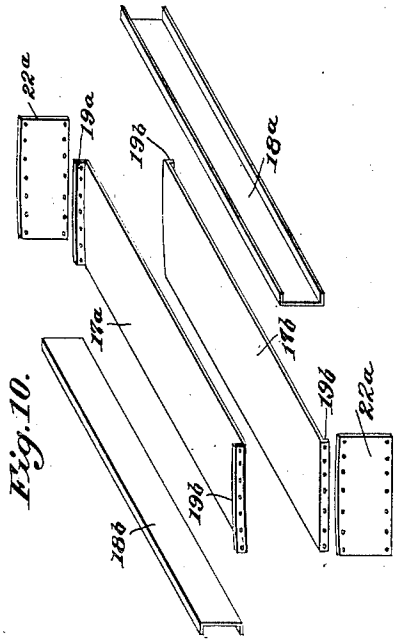


Fig. 10.

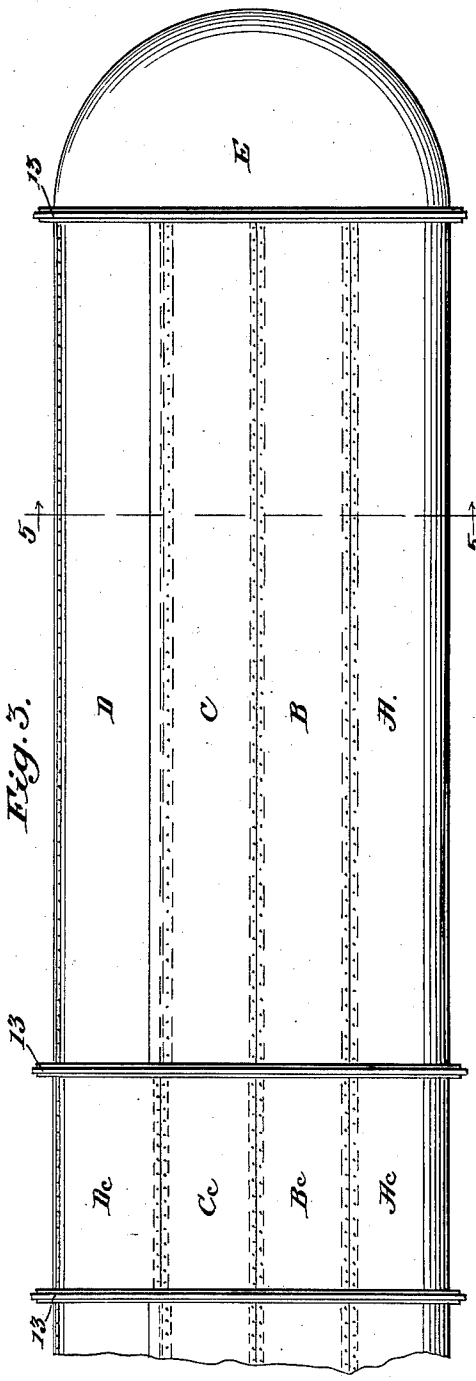
Inventor:
Frederic C. Krummel,

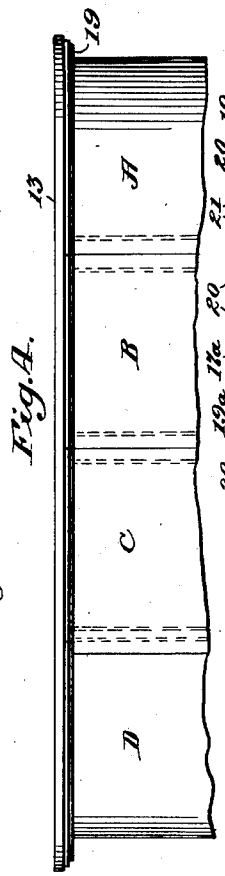
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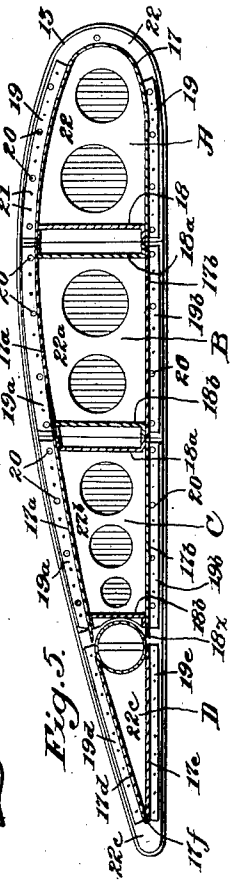
April 14, 1931. F. C. KRUMMEL 1,801,202

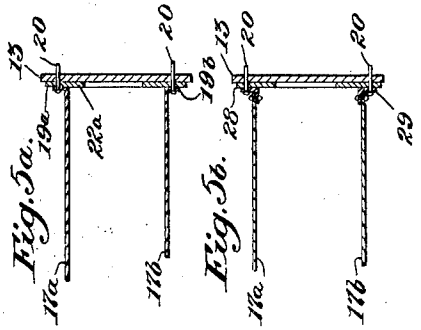
AIRSHIP CONSTRUCTION

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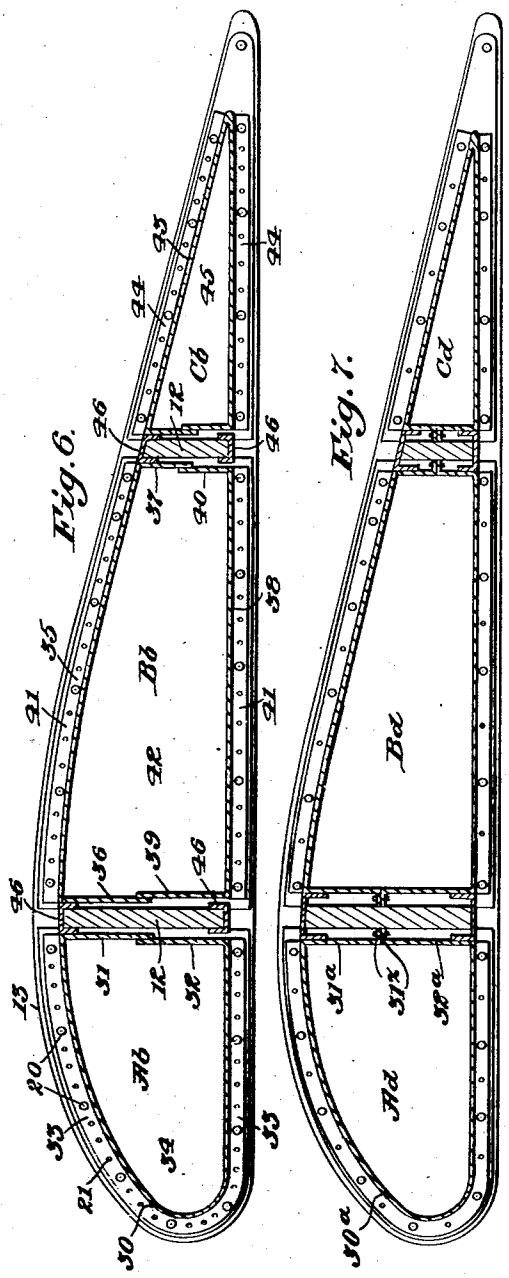
Inventor:
Frederic C. Krummel,

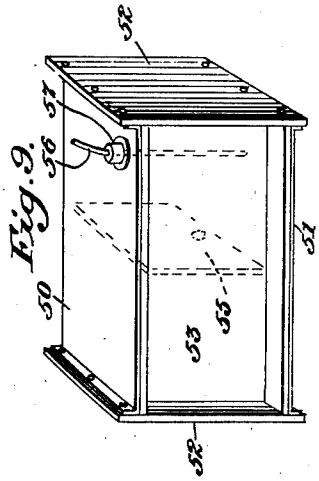
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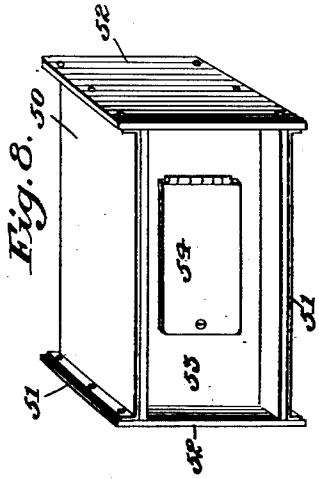
April 14, 1931. F. C. KRUMMEL 1,801,202

AIRSHIP CONSTRUCTION

Filed Nov. 26, 1928 3 Sheets-Sheet 3







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Patented Apr. 14, 1931 1,801,202

UNITED STATES PATENT OFFICE

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AIRSHIP CONSTRUCTION

Application filed November 26, 1928. Serial No. 322,009.

This invention relates to improvements in the construction of airships, and more particularly proposes to provide a construction in which the wing surfaces are assembled of pre-constructed units in such a manner that the surfaces may be readily removed and replaced as desired.

One of the objects of this invention, therefore, is to provide an airplane construction in which the wings are formed of pre-constructed units.

Another object of this invention is to provide a construction of such wings in which a skeleton frame is provided to which such pre-constructed units may be readily attached and from which they may be readily removed.

Still another object of this invention is the provision of such pre-constructed means and means for supporting the same whereby the units are substantially self-sustaining and self-supporting in flight, so that the lifting effect upon these surfaces is carried by the surfaces themselves and is transmitted by them to the fuselage.

Still another object of this invention is the provision of pre-constructed units for the wings which are movable in quantity so that units may be prepared and stored ready for employment as desired.

Still a further object of this invention is the provision of a wing assembly in which pre-constructed units are employed, these units being connected in the assembly along lines in the direction of the air flow so that substantially no opposition is afforded to the free flow of the air under these surfaces.

Still a further object of the invention is the provision of an airship assembly in which a skeleton frame is formed with ribs to which pre-constructed units may be attached.

Still another object of this invention is the provision of pre-constructed units constituting supporting surfaces or parts thereof which may be readily removed or replaced with respect to the body of the airship, and which may be employed for the storage of materials to be carried by the airship.

Several forms of execution according to the present invention are shown by way of illustration in the drawings to demonstrate the application of this invention in general airship construction.

In these drawings:

Figure 1 is a perspective view of a biplane in which a skeleton frame is provided upon which pre-constructed units may be assembled.

Fig. 2 is an end view of such a biplane, showing the arrangement of the ribs when pre-constructed units are employed for the ailerons.

Fig. 3 is a plan view of a portion of an airship wing formed of such units and connecting devices.

Fig. 4 is a view corresponding to Fig. 3, on an enlarged scale.

Fig. 5 is a sectional view through a wing such as that of Fig. 4, but showing the assembly with the aileron unit formed of a pre-constructed unit.

Figures 5^a and 5^b show details of the cell attachment.

Figs. 6 and 7 are views of modified forms of assembly of the pre-constructed unit, and represent sections through wings assembled from such units.

Figs. 8 and 9 are perspective views of units employed for the carrying of material.

Fig. 10 is a disassembled perspective view of the parts of an illustrative unit.

The airship construction according to the present invention proposes the provision of pre-constructed units formed with upper and lower walls which may be the foil surfaces of the wings, together with attaching means at the ends of such surfaces whereby they may be connected to members, herein termed "ribs" by which a plurality of these units may be connected in alinement and fixed relationship with one another whereby they support and sustain the fuselage of the machine by transmitting and lifting effects thereto. In a particular form of execution, these pre-constructed units are assembled upon a skeleton frame comprising spars and these ribs, together with the necessary struts for stiffening and spacing the surfaces with respect to one another and to the fuselage. The pre-constructed units are arranged so

that they are independent one of another along lines at right angles to the direction of flight, i. e., lengthwise of the wing: while they are attached relatively to one another at lines extending in the direction of flight, as for example, to the aforementioned ribs. A particular advantage of this construction is that any pre-constructed unit may be removed and replaced without interference by any other unit. In particular, the units may be made of metal and sealed airtight so that they will support the airship in the event of a descent into water: and the individual units may be employed for the storing and carrying of materials such as fuel or other liquid for the operation of the airship, or freight or general goods to be transported, such as mail or other articles.

On the accompanying drawing, in Fig. 1 a biplane is represented as having the fuselage 10 with the landing gear 11 and a skeleton frame formed of the spars 12 extending lengthwise of the respective wing surfaces and passing through the ribs 13 which are shaped generally to the cross section of the air foil, but preferably are of slightly larger dimensions as will be described hereinafter. In this skeleton frame, the spars 12 and ribs 13 are supported by the vertical struts and braces 15, and by the oblique struts 16. These parts of the skeleton frame are fixed rigidly together so that the skeleton frame is self-sustaining in the initial assembly of the airship. In the plan view of Fig. 3, which may be considered as the top plan of the upper wing of the biplane of Fig. 1, the ribs 13 are shown as extending beyond the air foil surface of the wing proper, the latter being composed of a plurality of units A, B, C, D, which are not fastened directly together but are independent one of another along lines extending lengthwise of the wing. Between the central ribs 13 of the airship, being those located adjacent the fuselage, are likewise provided the central sections A*c*, B*c*, C*c*, D*c*, which usually will be of lesser length than the sections A, B, C, D. At the outer end of the wing is provided a tip surface E.

In Fig. 5, the pre-constructed units A, B, C and D are shown in section as providing the air foil surface proper. The front edge unit A is formed of a single sheet of metal 17 which is curved to the shape of the front edge of the wing, and at its own rear edges is supported and spaced by a channel member 18 extending its full length and secured to the sheet 17 by suitable means such as riveting or welding. At the ends of the unit A, the sheet 17 has integral flanges 19 which are turned respectively outwardly and are provided with apertures to receive bolts 20 which likewise pass through the ribs 13 and thus secure the individual cell at both ends to the ribs 13.

In Fig. 5, likewise, the intermediate sections B and C are each formed of the sheets 17*a*, 17*b*, and are provided at both front and back with channel members 18*a*, 18*b*. They are likewise provided with the flanges 19*a*, 19*b* at top and bottom with holes to receive connecting bolts 20. Each of the members B and C therefore forms an integral unit independent of each other unit.

The rear unit D is formed of the upper surface 17*d* and the lower surface 17*e* which are joined together at the rear or trailing edge 17*f*, and which are supported at the front on the stiffening tube member 18*x*.

In the particular form of execution shown in Figs. 4 and 5, the flanges 19, 19*a*, 19*b* are not joined directly to the ribs 13, but are connected by rivets 21 to an individual end plate 22, 22*a*, 22*b*, which in turn has holes registering with the holes for the reception of the bolts 20. The end walls 22, 22*a*, 22*b* therefore assist in stiffening the individual units and close them at their ends. The walls 22, 22*a*, 22*b* may be cut away as shown in this figure for greater lightness. The rear units D have also been represented as having the outwardly turned flanges 19*d*, 19*e* which may be riveted to their stiffening plates 22*c* of the rear units, these stiffening plates likewise being connected to the cylindrical member 18*x*. It will be understood that the sheets 17*d*, 17*e* may be integral and that they and the end plates 22*c* are independent of the ribs 13 but are connected to the cylindrical member 18*x* which is permitted to rock within the ribs 13. As shown in Fig. 2, the cylindrical members 18*x* terminate in stub shafts 25 which are carried in bearing members 26 of the individual ribs 13.

In Fig. 5*a*, a section such as A, B or C is shown with its upper and lower surfaces 17*a*, 17*b* having the flanges 19*a*, 19*b* and the end plate 22*a* secured together by riveting, in juxtaposition to a rib 13 with the bolts 20 to hold the parts together. In Fig. 5*a* is shown a slightly modified form in which the sheets 17*a*, 17*b* are not provided with end flanges, but angle irons 28, 29 are provided which in turn receive the bolts 20 for connection to the rib 13. It will likewise be noted that in Fig. 5*b* the end plates have been dispensed with although obviously they might also be employed.

In the modified form shown in Figs. 6, the front unit A*b* is formed as before of a single sheet of material 30 which is curved to correspond to the cross section of the air foil, but at its rear edges is turned inward toward the interior of the wing so that the two end sheet portions 31, 32 overlap at the center and are joined together as by welding or riveting.

The flanges 33 are provided as before at the ends to receive rivets 21 whereby they are connected to the end plates 34. The flanges 33 and the end plates 34 also have holes for

the connecting bolts 20 by which the unit is assembled on the rib 13. This is a somewhat simpler construction, as only a single piece of material is employed for the foil surfaces and for the bracing, and only a single line of union is necessitated for the leading section A*b*. In Fig. 6 the central section B*b* is similarly constructed, with a single sheet 35 forming the upper air foil surface, and having both edges turned inwardly at 36, 37, whereby these edges overlap at corresponding edges 39, 40 of the lower air foil surface 38, and are secured thereto by riveting or welding. Flanges 41 are provided as before for securing the end plates 42. The air foil shown in Fig. 6 is riveted, i. e., it has no relatively movable aileron. The rear unit C, B can thus be formed similarly to the leading unit A*b* from the single sheet 43 having the end flanges 44 which are connected to the end plates 45. The spars 12 in Fig. 6 are located between the inwardly turned edge flanges or plates of the respective unit, and it is preferred to provide the spars with the shoes 46 which are properly shaped to substantially fill the gaps between the individual units along lines parallel to the length of the spars, so that the air foil surface is substantially kept at top and bottom.

In Fig. 7, a further modified form is shown in which the front unit A*d* is formed as in Fig. 6 from a single sheet 30*a*, the inturned edges 31*a*, 32*a*, of which have relatively rearwardly bent flanges 31*x* which may be riveted together. The other parts are as shown in Fig. 6: and the cells B*d* and C*d* may be constructed similarly to A*d*.

It will be noted that the individual units may be made airtight when the end plates are not perforated. Even with such perforation, the securing of the individual units to the ribs 13 by bolts 20 will produce a substantially airtight seal so that air will escape very slowly and to a limited extent from these units. The units therefore form floats for sustaining the airship on water.

The units may likewise be employed for the carrying of materials. For example, the smaller units such as B*c* or C*c* may be constructed as shown in Figs. 8 and 9. In these figures the upper and lower air foil surfaces 50, 51 are formed of plates with flanges 51 by which they may be secured to the end plates 52. The channel members 53 are likewise joined to the plates 50 and 51 so that a closed box is formed, which may be provided with an aperture closable by a hinged door 54 having proper securing means. With such a box-form of unit, mail or other material may be placed in the unit, the door 54 closed and sealed and the unit delivered for insertion in the airship, so that the mail will take up no space whatsoever in the fuselage nor will it encumber the stream lines of the airship. Upon arrival at the destination the unit may be removed and delivered to the consignee who can assure simself of the integrity of the shipment by inspecting the seal.

In Fig. 9, the unit is shown as likewise having the top and bottom air surfaces 50, 51, the end plates 52 and the walls 53. A baffle 55 is located within the receptacle, which forms a closed container for liquid fuel, for example, which may be removed by inserting a supply tube 56 through the closure 57.

A manner of constructing one of these preassembled units is indicated in Fig. 10, in which the six sides are shown in perspective and in position relative to one another. The upper and lower surfaces 17*a* and 17*b* are shown as provided with end flanges 19*a*, 19*b* for engagement with the end plates 22*a*. The open front and back portions of the unit are to be closed by the channel members 18*a*, 18*b*. The parts may be connected by either riveting or welding, as indicated above. The final product is a strong, rigid, self-contained unit which may be stocked in its several shapes and faces for immediate replacement of any damaged member in an airship. The units may be so designed that the front, intermediate and rear units may be employed in either monoplanes or biplanes: and the supporting surfaces of such units may be formed of plane or corrugated material in manners already well known in the art. Further, supporting surfaces may be employed as supports for a fabric or other covering extending entirely around the wing and joined preferably at the rear or trailing edge, this covering forming the air-foil proper which engages the air.

In construction, a skeleton frame may be assembled as shown at the right in Fig. 1, and upon this the individual units may be mounted by passing bolts through the end portions of the units and the ribs 13. Each unit will be independent of all other units, but will be substantially self-supporting, so that only a fraction of the load is transmitted to the spars 12 and thence to the fuselage, while the major portion of the load is carried from the upper wing, for example, by the struts 15 and 16 from the ribs 13. In the event of damage to any unit, it may be individually removed by withdrawing the screws 20, so that it may be withdrawn from between the ribs 13, and replaced by another unit.

The form of construction of the units lends itself for rapid machine construction so that the units are of predetermined size and strength: and by the simplicity of material and manufacture permits the preparation of units for stock so that they may be kept on hand for repairs.

The invention is not limited to the employment of central and lateral units and wing tips, but any number of lateral sec-

tions may be employed of any desired size, and with any subdivision between front and rear edges. The invention further is not limited to the provision of spars 12 in the skeleton frame, since the self-supporting and lift transmitting nature of the unit makes it possible to assemble the two ribs 13 at their ends so that one or more units will form a skeleton for the assemblage of other units.

Other general applications of the invention may be made without departing from the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. An airship construction comprising a plurality of independent wing forming units separated from one another along lines extending from the body toward the wing tip, each of said members including a channel-shaped closing wall at the side adjacent another such unit, the groove of said channel being directed toward the other unit, a plurality of ribs, and means connecting each of said units to the ribs at the ends of the units, said units being independent one of another so that any unit may be assembled in or removed from the wing by securing and loosening said connecting means, and so that said channels of adjacent units are adapted in themselves to constitute a reinforcing structure for the wing between said ribs.

2. A wing for an airship comprising a plurality of independent units separated from one another along lines extending from the body toward the wing tip, and each having upper and lower air-sustaining surfaces and end plates connecting said surfaces and secured rigidly thereto, channel members having their grooves directed outwardly from the interior of the unit and positioned between said sustaining surfaces and secured rigidly thereto, a plurality of ribs, and means connecting the said plates of each unit to a pair of said ribs, said units being free of connection with one another whereby any unit may be assembled in and removed from the same by securing and loosening said connecting means.

3. A unit as in claim 2, in which the end plates are extended beyond the sustaining surfaces and the connecting means pass through said end plates and said ribs.

4. In an airship having a fuselage and a plurality of ribs spaced apart laterally from the fuselage, a plurality of wing forming units each providing a part of the sustaining surfaces for the airship, means to connect certain of said units rigidly to said ribs, bearings near the rear end of two adjacent ribs, the rear unit located between said ribs being provided with pivot means cooperating with said bearings, said rear unit constituting an aileron for the airship.

5. A sustaining unit as set forth in claim 2, in which the unit is made air and water tight and a door and securing means therefor are provided through a wall other than the walls providing the sustaining surfaces.

6. A wing for an airship comprising a plurality of ribs spaced apart laterally from the fuselage, a plurality of wing forming units separated from one another along lines extending from the body toward the wing tip, one of said units comprising a single sheet of material folded upon itself to provide an edge for the wing surface and having outwardly extending flanges at its ends parallel to two of said ribs, said first unit being provided adjacent another of said units with a vertical wall, said other unit having upper and lower air-sustaining surfaces and outwardly extending flanges at its ends to bear against said ribs and a vertical wall connecting said surfaces, a wing spar joining said ribs and located between said vertical walls, and connecting means passing through said flanges and said ribs whereby to hold the unit in position in the airship, said units being independent one of another whereby any unit may be assembled on and removed from the airship by securing and loosening said connecting means.

In testimony whereof, I affix my signature.

FREDERIC C. KRUMMEL.