Nov. 18, 1924.

1,516,480

H. L. WHITTEMORE

BEAM

Filed April 10, 1918

3 Sheets-Sheet 1

Fig: 1

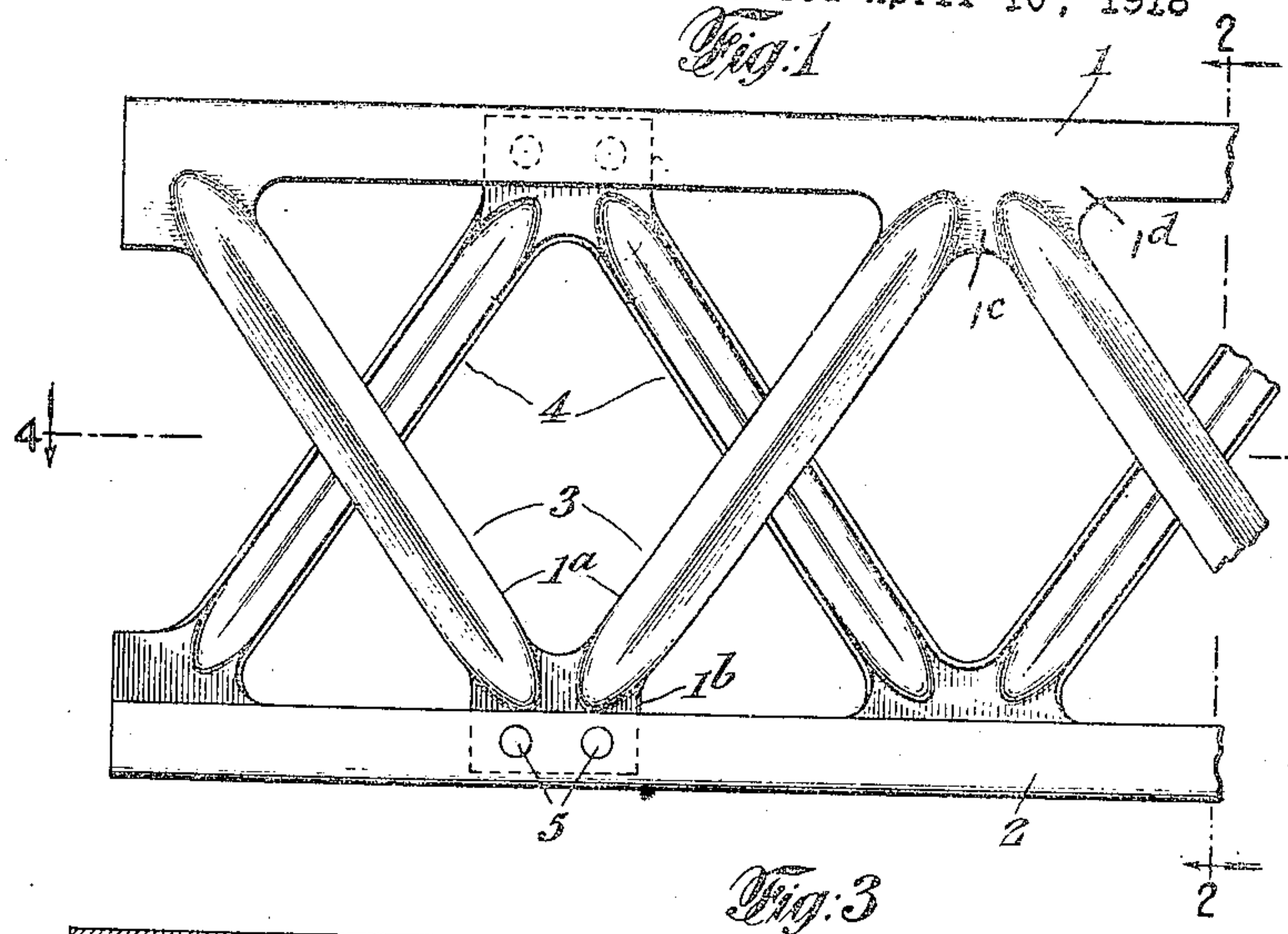


Fig: 2

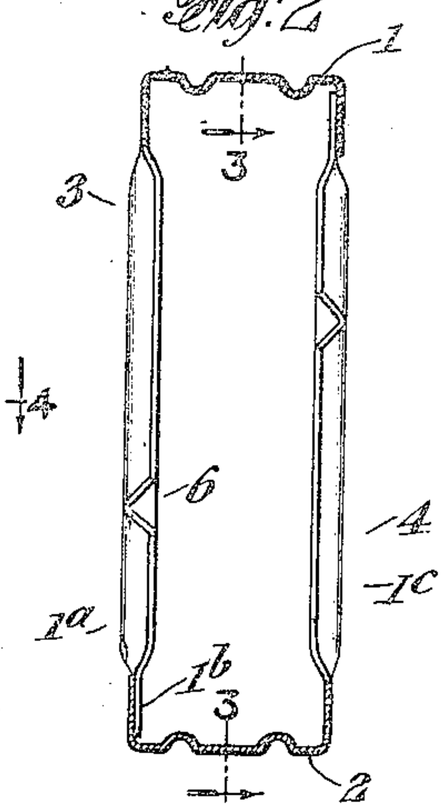


Fig: 3

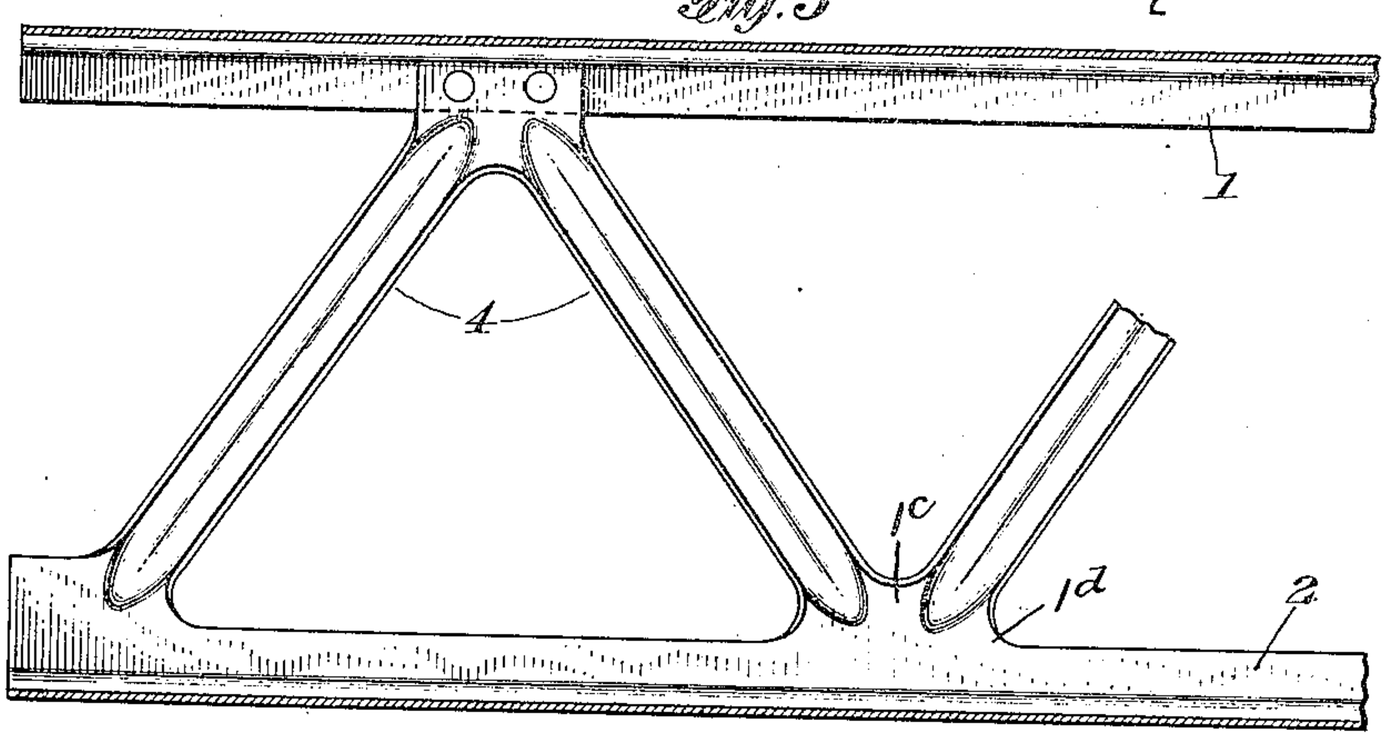


Fig: 4

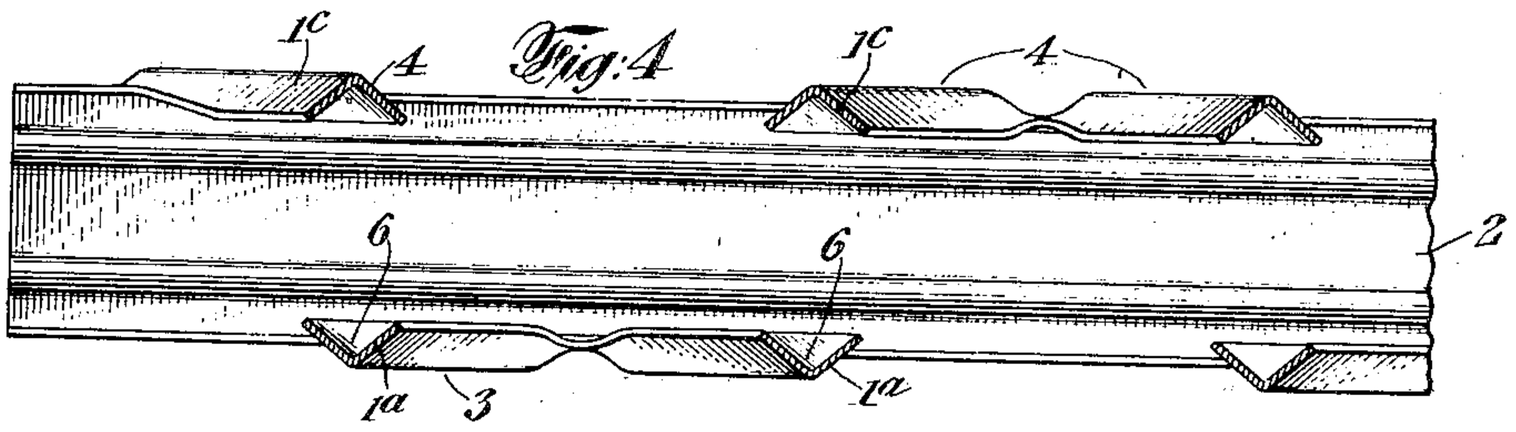
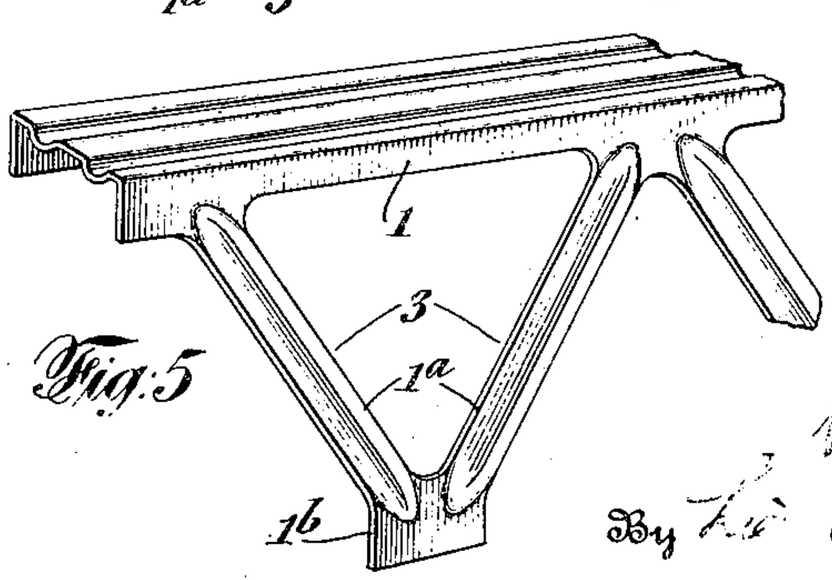


Fig: 5



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Nov. 18, 1924. 1,516,480

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Filed April 10, 1918 3 Sheets-Sheet 2

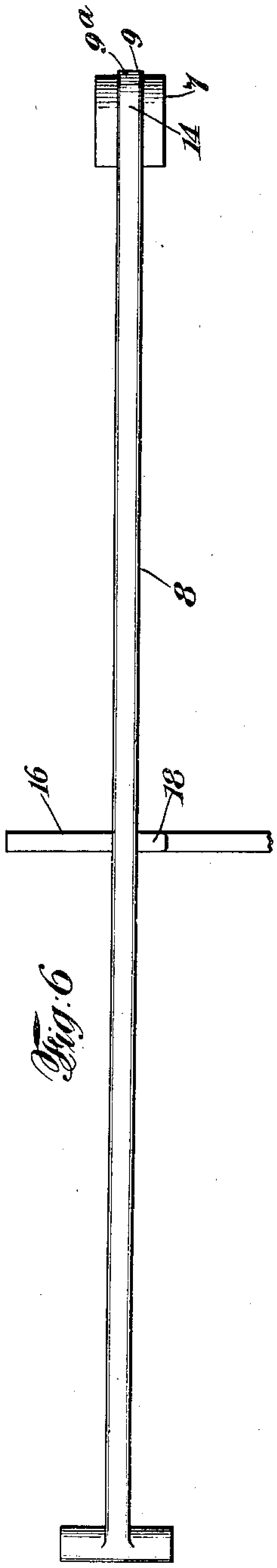

Fig. 6

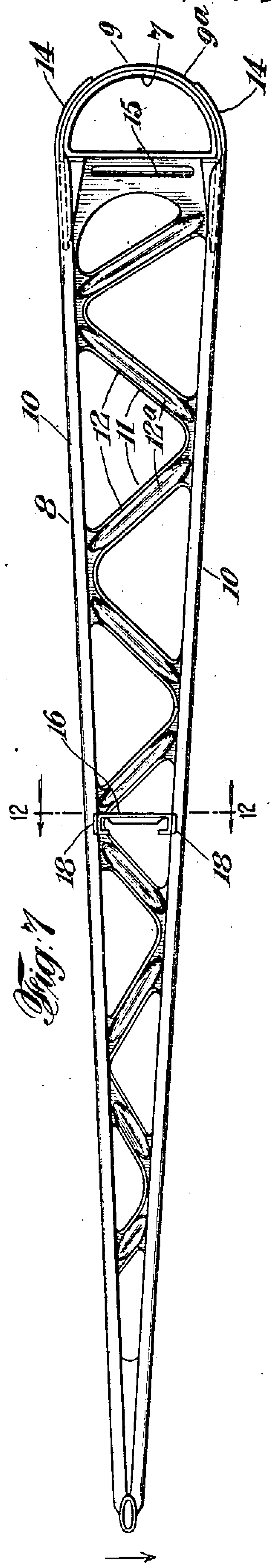

Fig. 7

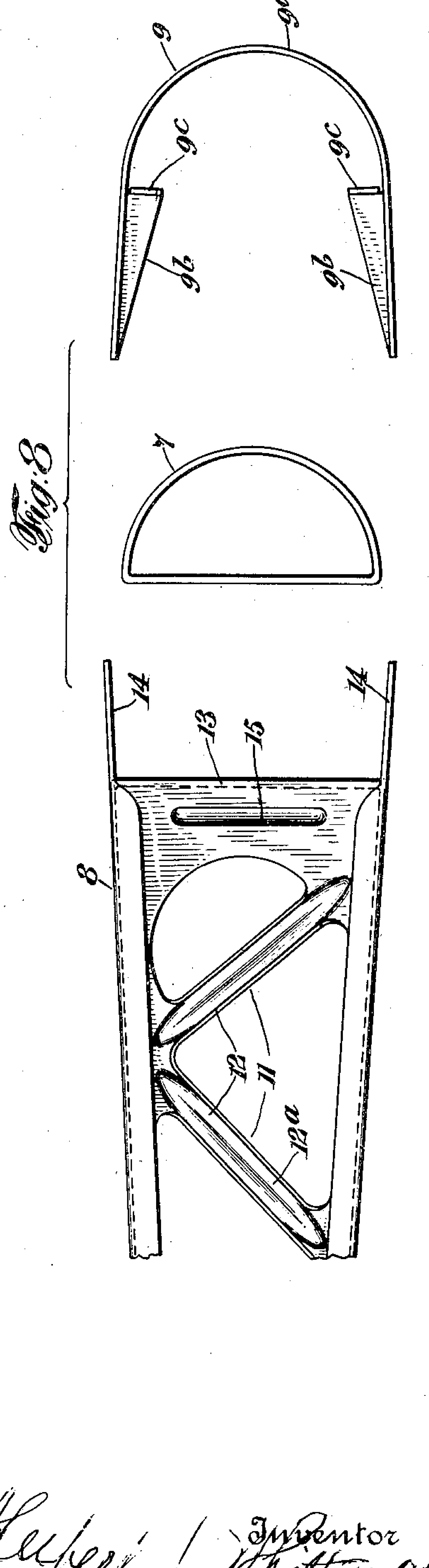

Fig. 8

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Nov. 18, 1924. 1,516,480

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Filed April 10, 1918 3 Sheets-Sheet 3

Fig: 9

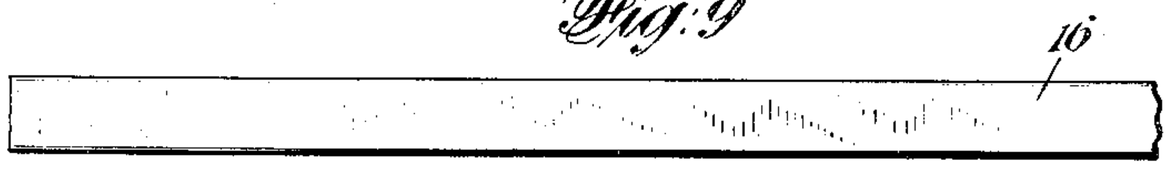


Fig: 11

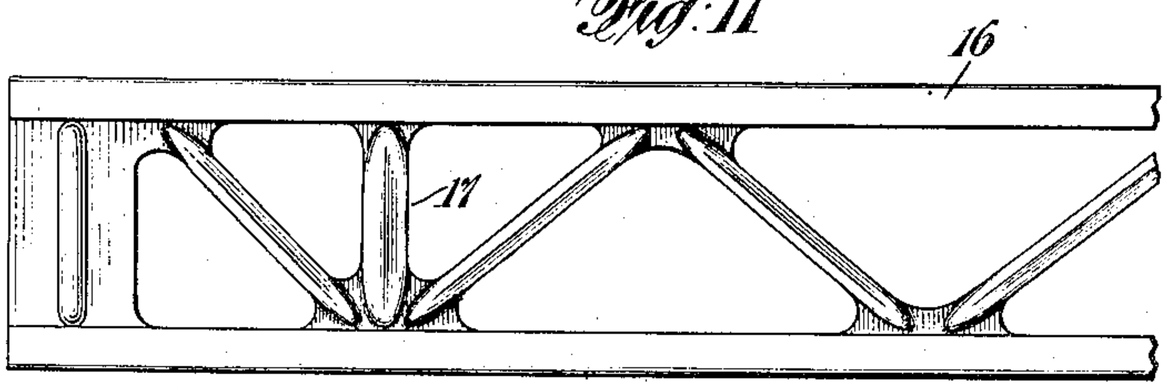


Fig: 10

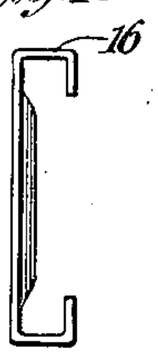
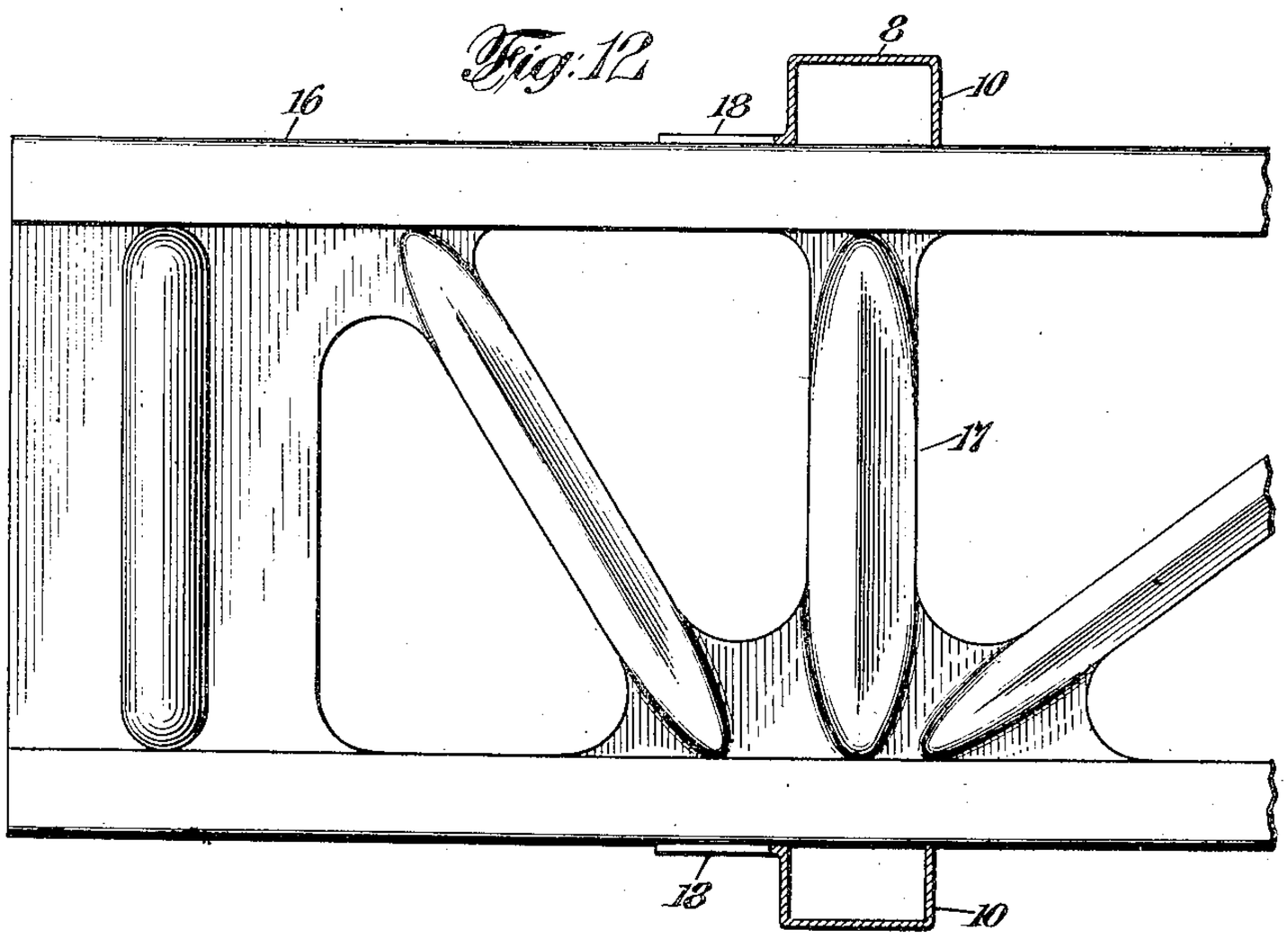


Fig: 12



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By his Attorneys
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Patented Nov. 18, 1924. 1,516,480

UNITED STATES PATENT OFFICE.

HERBERT L. WHITTEMORE, OF NEW YORK, N. Y., ASSIGNOR TO THE GOVERNMENT OF THE UNITED STATES.

BEAM.

Application filed April 10, 1918. Serial No. 227,652.

To all whom it may concern:

Be it known that I, HERBERT L. WHITTEMORE, of New York city, in the county of New York, and in the State of New York, have invented a certain new and useful Improvement in Beams, and do hereby declare that the following is a full, clear, and exact description thereof.

The object of my invention has been to provide an element for metallic frames and a beam and rudder frame formed from such element, which, while adapted for many other uses, are especially adapted for use in airplane frames, and which shall have, among other advantages, those of great strength relative to their weight, of being substantially as strong as wood for the same weight, and being cheaply and conveniently made, and to such ends my invention consists in the beam hereinafter specified.

In the accompanying drawings—

Fig. 1 is a side elevation of a beam embodying my invention;

Fig. 2 is an end view of Fig. 1;

Fig. 3 is a central, longitudinal, sectional view on the line 3—3 of Fig. 2;

Fig. 4 is a horizontal, longitudinal, sectional view taken on the line 4—4 of Fig. 1;

Fig. 5 is a perspective view of one member of the beam of Fig. 4;

Fig. 6 is a plan view of a rudder post and rib embodying my invention, and a brace adapted to connect said rib with another rib;

Fig. 7 is a side elevation of Fig. 6;

Fig. 8 is a view similar to Fig. 6, showing the parts separated;

Figs. 9, 10 and 11 are enlarged views of the brace shown in Fig. 8, and respectively showing such brace in top, side and end elevations; and,

Fig. 12 is a sectional view of Fig. 7 on the line 12—12 showing the manner of connecting the brace to the rib.

While I shall illustrate my invention by the best embodiment thereof known to me, such embodiment is to be regarded as typical only of many possible embodiments, and my invention is not to be confined thereto, but my claims are to be given the broadest possible scope consistent with the prior art.

More specifically, my object has been to provide an element adapted to be used by itself as a beam, made of metal, or to constitute an element of a composite beam made of metal, which shall be capable of standing all the strains to which wooden beams are subjected in an airplane frame, and yet which shall not be substantially heavier than a wooden beam of the same strength, and a frame of an airplane rudder in which such element shall be useful both as a rib and as a brace connecting a pair of ribs. It has been desired to adapt said constructions especially to be made from sheet metal, and particularly from sheet metal of uniform thickness.

I shall first describe the use of my element in the form of a composite beam, and will later describe its use as a rib and brace in the framework of an airplane rudder. In the illustrated embodiment of my invention in which the element is used to form a composite beam, the beam is formed, in effect, as a hollow metal shell substantially rectangular in cross-section. More particularly, the beam consists of opposite bases 1 and 2 in the form of channels, which are united by lattice works 3 and 4 which are more or less integral with said channels. For convenience of manufacture, I prefer to divide the beam into two elements, each of which consists of a channel portion or portions which are formed integrally with one of said lattice portions. In the present instance, the beam is divided into two sections by forming the lattice portion 3 integrally with the channel 1, and the lattice portion 4 integrally with the channel 2. The lattice 3 consists of diagonal members 1^a, that is, members which project at an angle to the channel bases 1 and 2 instead of parallel thereto, as shown in Fig. 1, and whose free extremities 1^b are secured to the channel 2 as by rivets 5 or welding. The members of the bracing are beaded or dished at 6, so that they are V-shape in cross-section, the angle within the V preferably being approximately 60°. The members 1^c of lattice 4 are preferably connected with each other and with the channel 1 by webs 1^d in the angles between them. The channels are preferably corrugated as shown, as this gives the channels greater compressive strength.

Tests have shown a beam constructed as illustrated to be of such strength as to be capable of withstanding, as successfully as

a wooden beam of the same weight, all of the severe stresses to which beams are subjected in airplane frames.

In the use of my element in the frame of an airplane rudder, as illustrated in Figs. 6 to 12, a rudder post formed of a D-shape piece of tubing 7 is preferably used. I desire to form a rudder brace which shall sustain a rib 8 by being secured upon the rudder post. The requirements for securing and sustaining the rib upon the rudder post, under these conditions, are severe. The rib must be so securely fastened to the rudder post that when the rudder post is turned, the structure shall withstand the tension tending to pull the rib away from the rudder post on the side toward which the rudder is turning, and the compression tending to crush the rib into the rudder post on the opposite side of the rudder. I provide a clamp 9 which is to clamp the rudder post, and to which the rib is to be fastened. This clamp consists of a U-shape band 9^a having wings 9^b formed on the ends of the band, as by being bent at right angles to the sheet metal of the band, and having shoulders 9^c formed at the inner ends of the wings, as by bending up the metal of the wings. The rib consists of one of my said elements formed of two channels 10 connected by a lattice work 11 that is preferably formed integral therewith. The lattice work consists of digaonal members 12 which are dished or beaded at 12^a, similarly to the diagonals shown in Figs. 1 to 5, except that in the case of the one element used alone and having the two channels, as in the rudder brace, the diagonals are preferably dished inward instead of outward, for in that position the dishing or beading is more in line with a strain tending to force the two channels toward each other, which is the strain to which some of the lattice members are most subjected, except at the point of its connection with the rudder post.

The sheet metal between the channels is not cut away at the end adjacent the rudder post and is formed into a lip 13 at right angles to the plane of the rib, and adapted to rest against the adjacent plane surface of the rudder post, and the channels are extended into two strips 14 that are adapted to extend around the clamp, as later to be described. In assembling the clamp and rib on the rudder post, the clamp is passed over the rudder post, and the free ends of the clamp are drawn together. The clamp is so proportioned that when these free ends are drawn together sufficiently so that the rib can be forced over them, the clamp will very tightly grip the rudder post. The rib is forced home until its lip 13 rests against the face of the rudder post, and the strips 14 extending from the channels are laid along the band of the clamp, and the parts are fastened together in the said positions, preferably by welding. For instance, the ends of the band may be "spot" welded to the insides of the channels. The clamp may be welded to the channel iron, and the strips 14 may be welded to the clamp band. The shoulders 9^c are also preferably welded to the flat face of the rudder post. I preferably form a bead 15 in the sheet metal extending across between the channels in front of the rudder post.

There are usually two or more ribs in a rudder frame, and I connect them by a brace 16 which may be formed like the ribs of two channels connected by lattice work, except that there is preferably a lattice member 17 perpendicular to the channels where the brace rests upon the channels. In order to enable the brace to be welded to the rib without heating the rib, I preferably form ears 18, each of which is integral with a channel, and is bent to lie along the adjacent channel of the brace, so that the ear can be welded as by "spot" welding to the brace.

Such a rudder frame as I have described, utilizing my said element, abundantly stands the strains put upon it. When the rudder post is turned, say, in the direction of the arrow in Fig. 7, the tendency is to separate the brace from the rudder post on the right-hand side, as seen in Fig. 7, but the welding of the rib to the band of the clamp at this point prevents such separation. At the same time, the tendency is to cause the left-hand side of the rib to crush in the straight wall of the rudder post, and this is resisted by the lip 13 on the rib and the shoulder 9^c bearing on the plane face of the rudder post. I find that one of my elements used as a brace connecting the ribs, prevents the said ribs from twisting.

By the term "beam," as used in this specification, I have intended to include not only straight beams, but beams which are curved, and not only beams which are of uniform cross-section throughout, but beams which vary in cross-section. I also mean to include by that term not only the main beams running longitudinally of the wings, but braces, struts, and other members of the frame subjected, or which may be subjected, to compression or bending, etc.

The features of my invention which are illustrated in the rudder frame are applicable to ailerons and elevators and other surfaces which are movable relative to the frame of the airplane.

I claim:

1. An element for beams, consisting of a channel having lattice work formed integral therewith, and projecting at an angle to the web of said channel, said element being formed of a single piece of sheet metal.

2. A beam consisting of the combination

of two elements, each element consisting of a channel and lattice work formed integral therewith, said parts being formed of sheet metal, each element being formed of a single piece of sheet metal.

3. A beam consisting of the combination of two elements, said elements being formed of a single piece of sheet metal, each element consisting of a channel and lattice work integral with each other, the lattice work being dished or beaded.

4. A beam consisting of the combination of two elements, said elements being formed of a single piece of sheet metal, each element consisting of a channel and lattice work integral with each other, the channel being corrugated.

5. A beam consisting of the combination of two elements, said elements being formed of sheet metal, each element consisting of a channel and lattice work integral with each other, the lattice work being dished or beaded, and the channel being corrugated.

6. A beam consisting of two elements, said elements being formed of a single piece of sheet material, each of said elements consisting of a channel and lattice work formed integral with one wall of the channel, the free ends of the lattice work being secured to a wall of the opposite channel.

7. A framework for airplane rudders, comprising the combination of a rudder post and rib, said rib comprising two opposite channels connected by lattice work.

8. A framework for airplane rudders, comprising the combination of a rudder post and rib, said rib comprising two opposite channels connected by lattice work, and all formed in one piece of sheet material.

9. A framework for airplane rudders, comprising the combination of a D-shape rudder post, a rib comprising channels connected by sheet material, said sheet material being formed into a lip to rest against the flat face of said rudder post, and means connecting said channels with said rudder post.

10. A framework for airplane rudders, comprising the combination of a D-shape rudder post, a rib comprising channels connected by sheet material, said sheet material being formed into a lip to rest against the flat face of said rudder post, and means connecting said channels with said rudder post, said means comprising strips extending from said channels along said rudder post.

11. A framework for airplane rudders, comprising the combination of a D-shape rudder post, a rib comprising channels, and a clamp embracing said rudder post and lying within said channels.

12. A framework for airplane rudders, comprising the combination of a D-shape rudder post, a rib comprising channels, and a clamp embracing said rudder post and lying within said channels, said rib having a lip adapted to lie along the flat face of said rudder post.

13. A framework for airplane rudders, comprising the combination of a D-shape rudder post, a rib comprising channels, and a clamp embracing said rudder post and lying within said channels, said clamp having shoulders adapted to lie against the flat face of said rudder post.

14. A framework for airplane rudders, comprising the combination of a D-shape rudder post, a rib comprising channels, and a clamp embracing said rudder post and lying within said channels, said rib having a lip adapted to lie along the flat face of said rudder post, said clamp having shoulders adapted to lie against the flat face of said rudder post.

15. A framework for airplane rudders, comprising the combination of a D-shape rudder post, a rib comprising channels, and having a shoulder adapted to lie against the flat face of said rudder post, a clamp surrounding said rudder post and having ends extending into said channels, and strips extending from said channels along said clamp.

16. A framework for airplane rudders, comprising the combination of a D-shape rudder post, a rib comprising channels, and having a shoulder adapted to lie against the flat face of said rudder post, a clamp surrounding said rudder post and having ends extending into said channels, and strips extending from said channels along said clamp, said clamp having shoulders adapted to lie against the flat face of said rudder post.

17. A framework for airplane rudders, comprising the combination of a D-shape rudder post, a rib comprising channels, a clamp surrounding said rudder post and having ends extending into said channels, and strips extending from said channels along said clamp, said clamp having shoulders, and said rib having a lip adapted to lie against the flat face of said rudder post.

18. A framework for airplane rudders, comprising the combination of a D-shape rudder post, a rib comprising channels, a clamp surrounding said rudder post and having ends extending into said channels, and strips extending from said channels along said clamp, said clamp having shoulders, and said rib having a lip adapted to lie against the flat face of said rudder post, said clamp having wings adapted to rest upon metal connecting said channels.

19. A framework for airplane rudders, comprising the combination of a frame, a rudder post, a plurality of ribs connecting said rudder post to said ribs, each rib consisting of sheet metal channels connected

together, and a brace connecting said ribs, said brace comprising sheet metal channels connected together.

20. A framework for airplane rudders, comprising a rudder post, a plurality of ribs connected to said rudder post, said ribs comprising channels connected by sheet metal, a brace connecting said ribs, said brace comprising channels connected by sheet metal, said brace lying between the channels of each rib, and each channel of each rib having an ear formed thereon, and adapted to lie along a channel of said brace to afford means for securing the brace to the adjacent channel.

21. An element for aerofoils formed of sheet metal, substantially rectangular in cross-section having top and bottom portions formed of continuous and unperforated sheet metal and integral web portions between the top and bottom portions having metal cut away to provide struts and inter-strut openings, the metal comprising the said struts being increased in width at the middle portion thereof and reduced at opposite ends, and the edges of said struts being bent at an angle to the plane of the web or strut to provide marginal wings as and for the purpose specified.

In testimony that I claim the foregoing I have hereunto set my hand.

HERBERT L. WHITTEMORE.

Witnesses:
EDWIN J. PRINDLE,
RUTH J. RIEMAN.