July 8, 1941. R. J. WOODS 2,248,520

WING BEAM

Filed Jan. 26, 1939 3 Sheets-Sheet 1

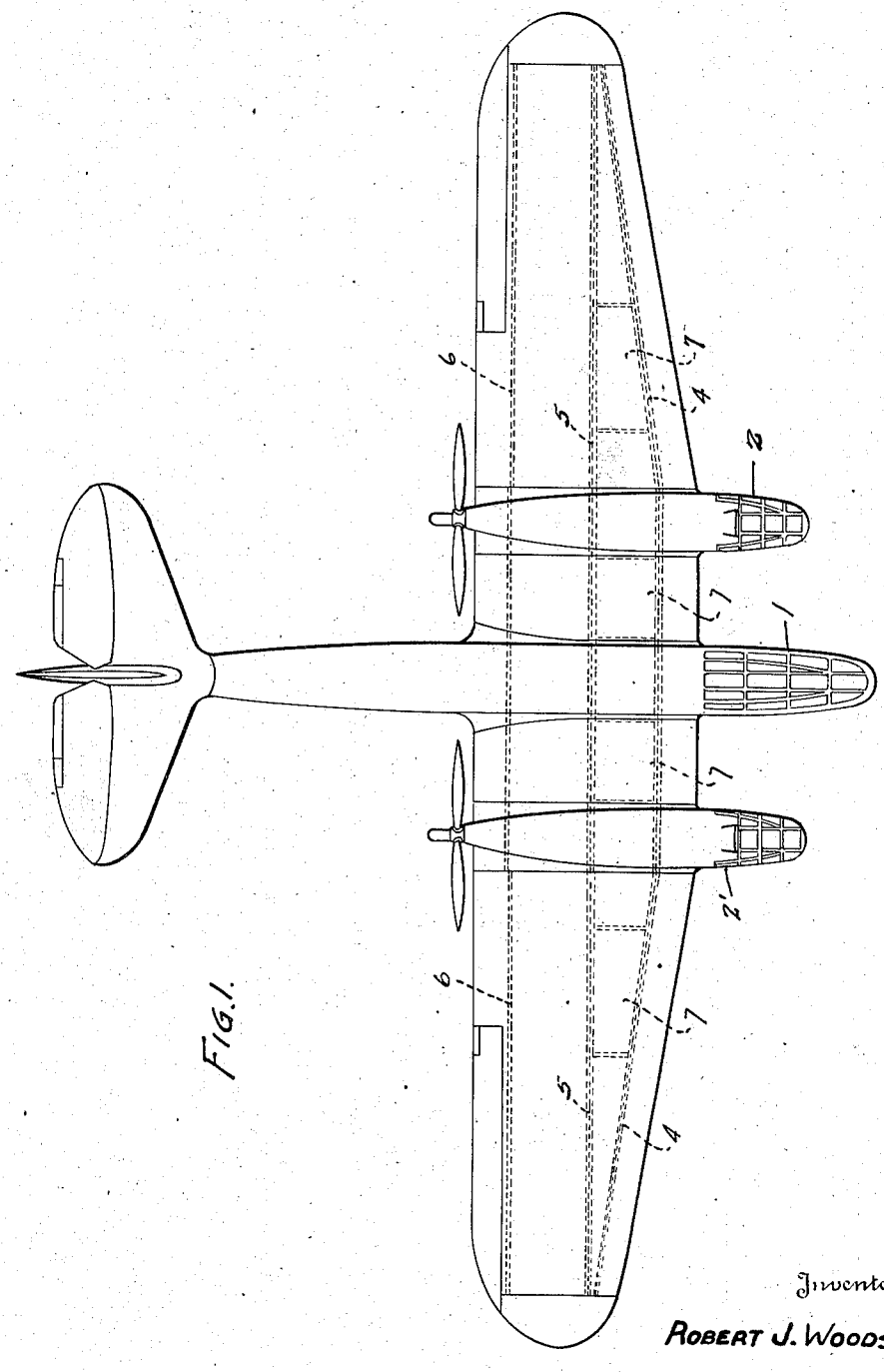


FIG. 1.

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FIG. 2.

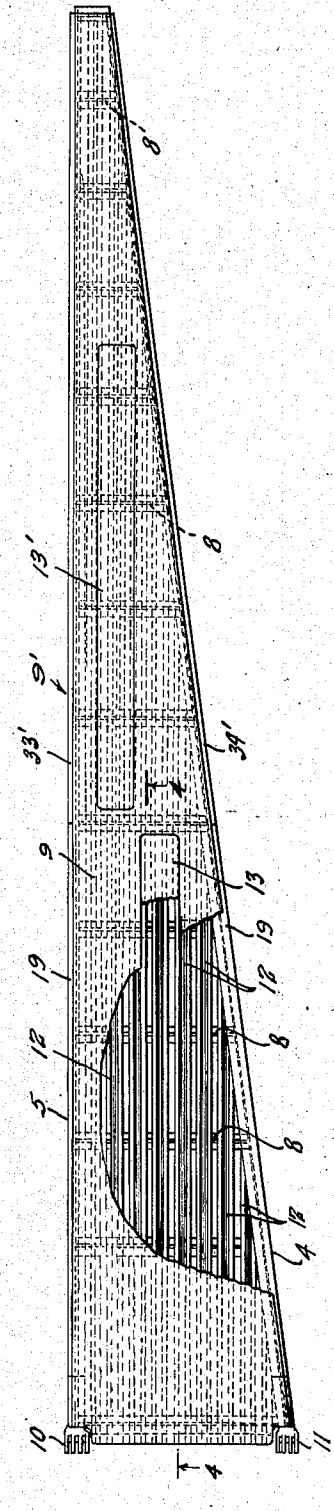
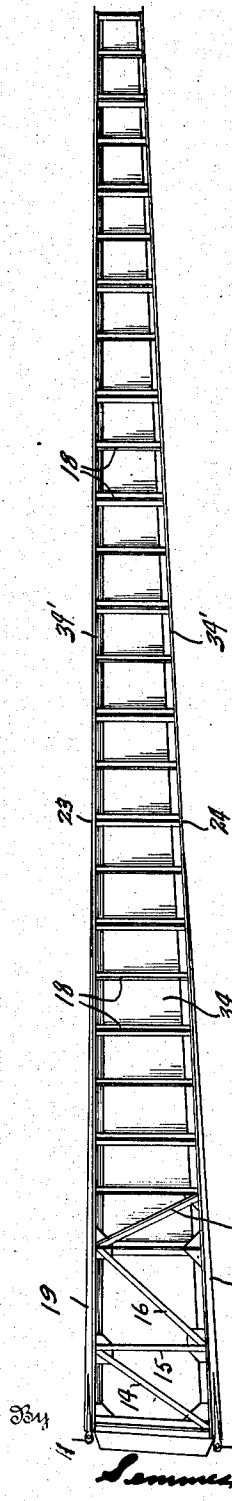


FIG. 3.



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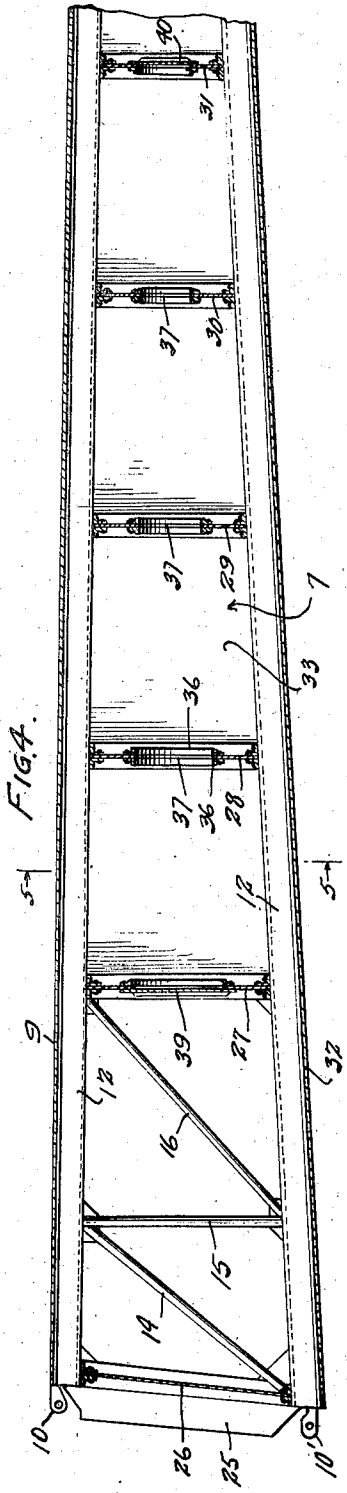


FIG. 4.

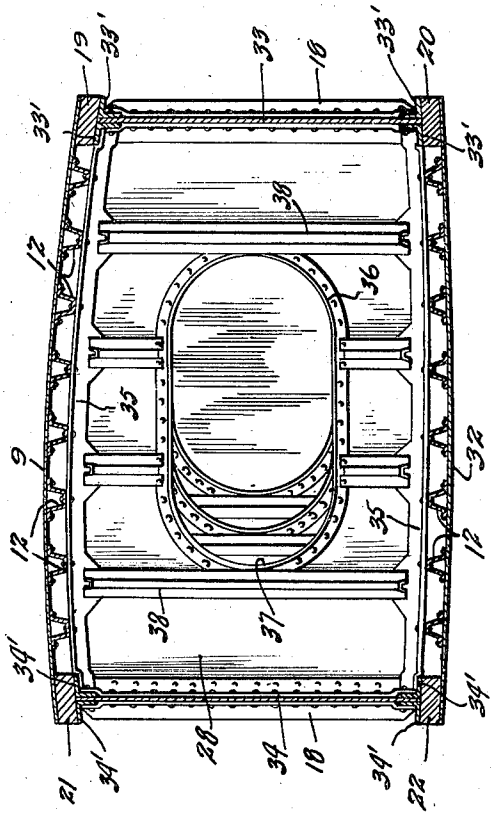


FIG. 5.

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UNITED STATES PATENT OFFICE

2,248,520

WING BEAM

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Application January 26, 1939, Serial No. 252,962

6 Claims. (Cl. 244—123)

My invention relates to airplane construction, more particularly to the construction of a box beam in a wing which also forms an integral fuel tank. Heretofore, it has been difficult to provide a constant strength beam for the wing of an airplane without excessive splicing of members to reduce gages. The saving in weight inherent in reducing the absolute strength of a beam progressively from its point of load toward the end of its sustaining length, has in the past been considerably dissipated by the necessity of using different sized members which must overlap and receive rivets at their junction areas. Thus the saving in weight has been overcome by the adding weight of overlapping parts and of rivets. Another difficulty has been that the weight of fuel tanks with their skin and baffle plates has been added to that of the wing even where those tanks approach the outside dimension of a portion of the wing.

One of the objects of my invention is to overcome the above mentioned difficulties.

Another object of my invention is to provide a box beam having reenforcing blocks that taper to zero, from the inboard to the outboard ends of the wing.

Still another object of my invention is to provide a box beam composed of the front and rear beams, the skin of the wing, reenforcing blocks, and bulkheads joined in monocoque construction.

A further object of my invention is to provide a box beam for the front portion of a wing part of which forms an integral fuel tank, the supporting structure of the beam allowing only a retarded flow of fuel longitudinally of the wing.

A still further object of my invention is to cause the bulkheads of my box beam construction to act as surge plates.

With these and other objects of my invention which will be apparent from the succeeding explanation I have shown, for the purpose of making my invention more clearly understood, the following drawings, as the preferred embodiment of my invention, it being understood that they are to be taken in an illustrative rather than in a limiting sense.

Figure 1 shows a plan view of an airplane of outboard powered monoplane construction, showing the location of the beam structure pertinent to this invention, in dotted lines.

Figure 2 is a plan view partially broken away of my tapered box beam.

Figure 3 is a side elevation of the beam shown in Figure 2.

Figure 4 is an enlarged section taken vertically and longitudinally of the beam shown in Figure 2, taken along the lines 4—4 of Figure 2.

Figure 5 is a section taken along the lines 5—5 of Figure 4.

Referring to Figure 1, it will be seen that a fuselage 1 and nacelles 2 and 2' are joined by beam structure 3. Extending symmetrically out from the nacelles 2 and 2' are beams which need only be described as to one side. The beams extending out from nacelle 2 to the wing tip are front beam 4, rear beam 5 and auxiliary beam 6. A fuel tank indicated generally by the numeral 7 is shown to be formed integrally with the front beam 4 and the rear beam 5 a short distance out in the wing from the nacelle.

As shown in Figures 2 and 3 the front beam 4 and the rear beam 5 are joined in box beam construction by bulkheads 8 and skin 9 to form monocoque spar 9'. It can be seen that front beam 4 is angularly disposed in relation to the hinges 10 and 11 forming a tapering box beam with the rear beam 5. The stringers 12 extending longitudinally of the box beam fade out as they encounter the front beam 4. Flush hatches 13 and 13' allow access to certain of the stringers 12.

As best shown in Figure 3 struts 14, 15, and 16 together with a stiffener 17 and reenforcers 18 strengthen the spar 9'. Hinges 10 and 10' are fitted into notches into the inboard ends of the reenforcing blocks 19 and 20 which are secured to the top and bottom of the rear beam 5. As shown in Figure 5 reenforcing blocks 21 and 22 similarly carrying hinges 11 and 11' are supplied for the top and bottom of the front beam 4. It will be seen that the reenforcing blocks 19 to 22 inclusive have their outboard ends at a point near the longitudinal mid-point of the wing as illustrated by the terminal points 23 and 24.

As shown in Figures 4 and 5 the upper portion of the rear beam 5 carried by hinge 10 and the lower portion of the rear beam 5 carried by hinge 10' are joined by stress member 25 and bulkhead 26.

Outboard from hatches 13, 14 and 15 are bulkheads 27 to 31 inclusive forming with spar 9' the fuel tank 7. It can be seen that stringers 12 lie between the outer skin 9 and the bulkheads and are joined to both the skin and the bulkheads. Upper skin 9 and lower skin 32 vertically connecting webs 33 and 34 of the beam 4 and 5, form the longitudinal walls of the integral fuel tank. These webs 34 and 35 terminate into longitudinally extending angles 33' and 34'. The

cross sectional area of these angles taper as they approach the wing end of the beam.

Bulkhead 28 is seen to have the angle pieces 35 at its top and bottom joining the bulkhead 28 to the stringers 12. Border angles 36 protect and brace apertures 37 in the bulkhead 28 allowing a restricted passage of fuel between the compartments formed by the bulkheads 27 to 31 inclusive. Ribs 38 unite the angles 35 at the top and bottom of the spar 9' and provide for their further strength. Bulkheads 29 and 30 are similarly constructed. Bulkheads 27 and 31 on the other hand do not have an aperture extending through them, but on the contrary have sealing panels 39 and 40 respectively on one side instead of the border angles 36 in the case of bulkheads 28, 29 and 30. Sealing panel 39 fits on the inboard side of bulkhead 27 and overlapping the aperture thereof. In the case of bulkhead 31 sealing panel 40 is similarly affixed to the outboard side.

It will thus be seen that I have provided an easily constructed constant strength wing spar having bulkheads in a portion of the wing spar which acts as sides for an integral fuel tank while the intervening bulkheads have apertures enabling them to act as surge plates. Furthermore it can be seen that my box beam construction allows a constant diminution in absolute strength from the inboard to the outboard end without the necessity of splicing members and without the multiplicity of parts.

It will also be seen that I have so positioned my wing spar as to eliminate a passage of structural members therethrough other than to which contribute to the proper functioning of the fuel tank. It will further be seen that my construction enables the constant tapering of absolute beam strength by the tapering of reenforcing blocks at the top and bottom of the front and rear beams. It will also be seen that I secure the wing hinges to the reenforcing blocks by interfitting them with reenforcing blocks and securing them as by welding.

While I have shown and described the preferred embodiment of my invention, I wish it to be understood that I do not confine myself to the precise details of construction herein set forth by way of illustration, as it is apparent that many changes and variations may be made therein, by those skilled in the art, without departing from the spirit of the invention, or exceeding the scope of the appended claims.

I claim:

1. In an airplane wing construction, a spar comprising a front beam and a rear beam, the front beam being angularly and rearwardly inclined from its inboard to its outboard ends, relatively to the rear beam, reenforcing blocks for the beams tapering constantly when considered from their inboard to their outboard ends, said outboard ends for said reenforcing blocks being at points subsantially midway of the longitudinal dimension of the spar, said reenforcing blocks having notches in their inboard end, hinges for the front beam and the rear beam, said hinges interfitting with said notches in said reenforcing blocks, a foundation plate lying substantially in the plane passing through said hinge, stringers extending from said foundation plate longitudinally of the spar, said stringers fading out as they approach the front beam, an inner skin joined to the inner side stringers and an outside skin joined to the outside of said stringers.

2. In a wing construction for an airplane, a spar of monocoque construction comprising a front and a rear beam, the front beam being angularly and rearwardly inclined from its inboard to its outboard end relative to the rear beam, a plurality of bulkheads joining the two beams, reinforcing blocks forming the top and bottom of each beam, an angle iron attached to each reinforcing block, the said reinforcing blocks and angle irons extending longitudinally of the spar and tapering constantly when considered from their inboard to their outboard ends, and the said reinforcing blocks terminating at a point substantially midway of the longitudinal dimension of the spar.

3. In a wing construction for an airplane, a spar of monocoque construction comprising a front and a rear beam, the front beam being angularly and rearwardly inclined from its inboard to its outboard end relative to the rear beam, a plurality of bulkheads joining the two beams, reinforcing blocks forming the top and bottom of each beam, an angle iron attached to each reinforcing block, the said reinforcing blocks and angle irons extending longitudinally of the spar and tapering constantly when considered from their inboard to their outboard ends, and the said reinforcing blocks terminating at a point substantially midway of the longitudinal dimension of the spar, hinges mounted on the inboard extremities of the front and rear beams, said hinges being designed to aid in attaching the spar to an airplane, and stringers connecting the bulkheads.

4. In a wing construction for an airplane, a spar of monocoque construction comprising a front and a rear beam, the front beam being angularly and rearwardly inclined from its inboard to its outboard end relative to the rear beam, a plurality of bulkheads joining the two beams, reinforcing blocks forming the top and bottom of each beam, an angle iron attached to each reinforcing block, the said reinforcing blocks and angle irons extending longitudinally of the spar and tapering constantly when considered from their inboard to their outboard ends, and the said reinforcing blocks terminating at a point substantially midway of the longitudinal dimension of the spar, notches in the inboard ends of the said reinforcing blocks, hinges adapted to aid in attaching the spar to an airplane mounted on the front and rear beams, said hinges interfitting the said notches, and stringers connecting the bulkheads, said stringers fading out as they approach the front beam.

5. In a wing construction for an airplane, a spar of monocoque construction comprising a front and a rear beam, the front beam being angularly and rearwardly inclined from its inboard to its outboard end relative to the rear beam, each of said beams comprising a web member, a reinforcing block mounted on the top and bottom of each web, the said reinforcing blocks and webs extending longitudinally of the spar and tapering constantly when considered from their inboard to their outboard ends, and the said reinforcing blocks and webs terminating at a point substantially midway of the longitudinal dimension of the spar, an angle iron attached to each of the reinforcing blocks, said angle irons tapering constantly from their inboard to their outboard ends, their inboard ends lying at a point substantially midway of the longitudinal dimension of the spar, bulkheads joining the two beams, stringers connecting the bulkheads, said

stringers fading out as they approach the front beam, and hinges mounted on the front and rear beams, said hinges being designed to aid in attaching the spar to an airplane.

6. In a wing construction for an airplane, a spar of monocoque construction containing an enclosed fuel tank comprising a front and a rear beam, the front beam being angularly and rearwardly inclined from its inboard to its outboard end relative to the rear beam, each of said beams comprising a web member, a reinforcing block mounted on the top and bottom of each web, the said reinforcing blocks and webs extending longitudinally of the spar and tapering constantly when considered from their inboard to their outboard ends, and the said reinforcing blocks and webs terminating at a point substantially midway of the longitudinal dimension of the spar, an angle iron attached to each of the reinforcing blocks, said angle irons tapering constantly from their inboard to their outboard ends, their inboard ends lying at a point substantially midway of the longitudinal dimension of the spar, a pair of spaced solid bulkheads joining the two beams, said bulkheads forming with the web members a fuel tank, and apertured bulkheads intermediate the said solid bulkheads, said apertured bulkheads being designed to act as surge plates within the tank.

ROBERT J. WOODS.

CERTIFICATE OF CORRECTION.

Patent No. 2,248,520. July 8, 1941.

ROBERT J. WOODS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 46, for the word "hatches" read --struts--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 14th day of October, A. D. 1941.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.