July 12, 1938. I. I. SIKORSKY 2,123,665

WING ATTACHING HULL SUPERSTRUCTURE

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Fig. 1

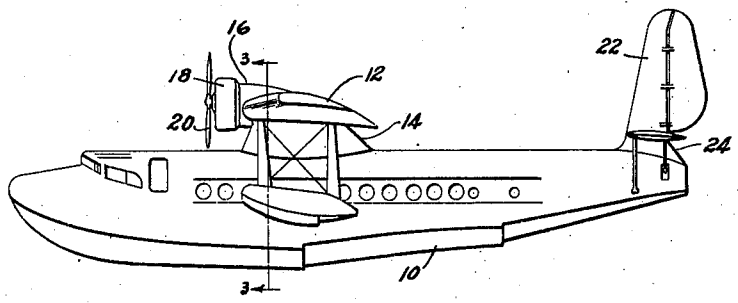


Fig. 2

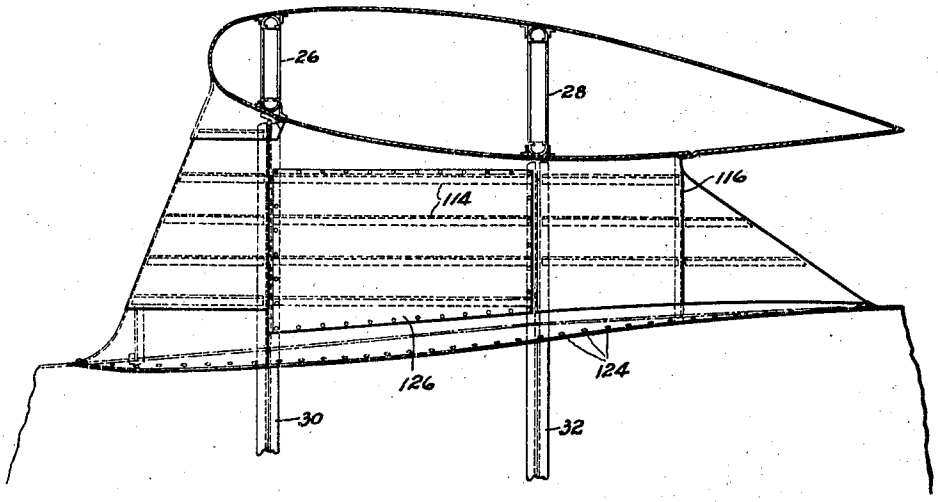


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Fig. 3

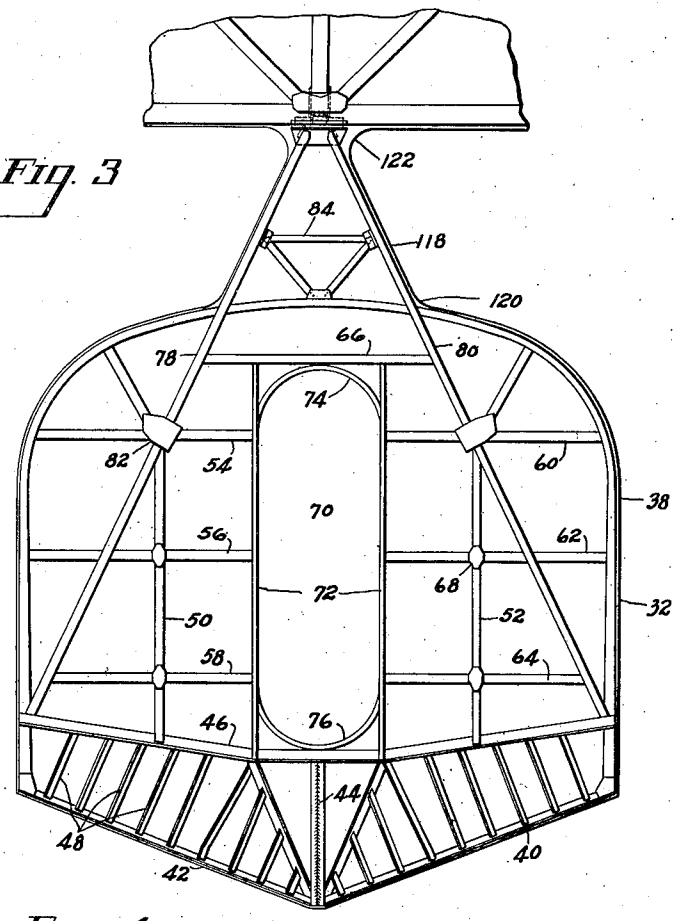


Fig. 4

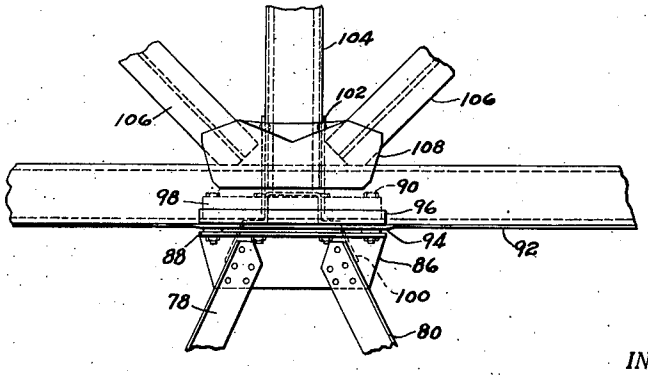


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Fig. 5

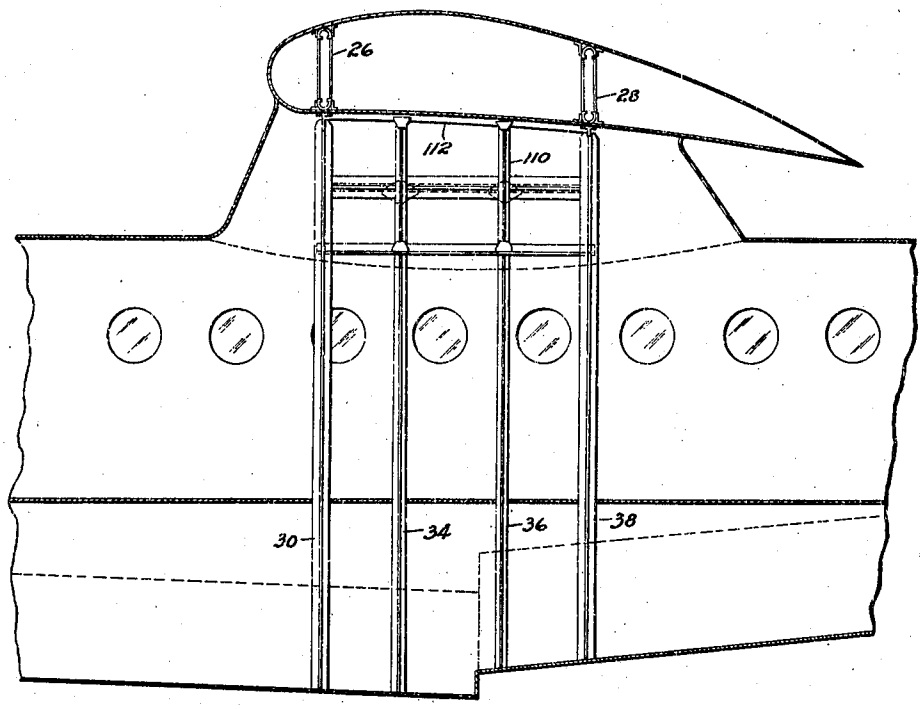
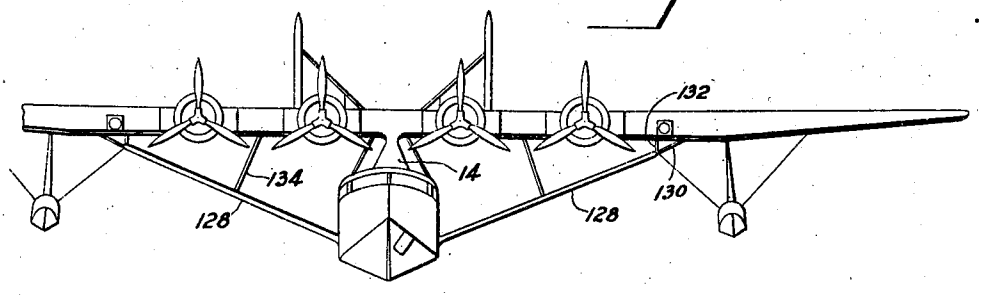



Fig. 6

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Patented July 12, 1938 2,123,665

# UNITED STATES PATENT OFFICE

2,123,665

## WING ATTACHING HULL SUPERSTRUCTURE

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Application March 17, 1936, Serial No. 69,354

3 Claims. (Cl. 244—119)

This invention relates to improvements in airplanes and has particular reference to improved means for attaching a wing to the hull or fuselage of an airplane.

One of the objects of the invention resides in the provision of means for firmly and securely attaching a hull or fuselage to a wing disposed above such hull or fuselage in such a manner that the hull and wing structure will not be subjected to undue strain.

An additional object resides in the provision of a hull superstructure body faired and stream lined to offer the minimum resistance to the progress of the airplane through the air.

Other objects and advantages will be more particularly pointed out hereinafter, or will become apparent as the description proceeds.

In the accompanying drawings in which like reference numerals are used to designate similar parts throughout, there is illustrated a suitable mechanical embodiment of what is now considered to be the preferred form of the invention. The drawings, however, are for the purpose of illustration only and are not to be taken as limiting the invention, the scope of which is to be measured entirely by the scope of the appended claims.

In the drawings, Fig. 1 is a side elevational view of a flying boat having the main wing disposed above the hull, and a hull superstructure constructed according to the idea of this invention interposed between the hull and the wing to operatively connect the hull and wing together.

Fig. 2 is a vertical sectional view on an enlarged scale of the wing and superstructure, and a fragmentary portion of the hull illustrated in Fig. 1.

Fig. 3 is a cross sectional view on the line 3—3 of Fig. 1 showing in elevation one of the main hull bulkheads and the manner of connecting the bulkhead with the wing.

Fig. 4 is a detail view on an enlarged scale showing the connection between the bulkhead and wing as illustrated in Fig. 3.

Fig. 5 is a vertical sectional view of a fragmentary portion of the flying boat illustrated in Fig. 1 showing the arrangement of bulkheads and hull frames by means of which the wing is attached to the hull and the forces between the wing and the hull are distributed to the various portions of these members.

Fig. 6 is a front elevational view of a flying boat having a hull and a main wing disposed above the hull, a tower support connecting the wing to the hull constructed according to the idea of this invention, and suitable braces extending between the hull and the wing to maintain the hull in its normal position with respect to the wing.

In the drawings the improved wing attaching superstructure is shown as applied to a large flying boat having a passenger carrying hull and a wing disposed at some distance above the hull and provided with nacelles for supporting the engines. It is to be understood, however, that the subject matter of this invention is not limited to the particular type of aircraft illustrated, but may be applied to land aircraft of various types as well as to flying boats or amphibians and may also be readily applied to aircraft of different sizes.

Referring to the drawings in detail, the numeral 10 generally indicates the body portion of an aircraft such as the hull of a flying boat or amphibian and the numeral 12 indicates a single wing by which the boat is supported in the air. The wing and hull are connected by a superstructure generally indicated at 14. The wing is provided with one or a plurality of nacelles indicated at 16 which support motors 18 and propellers 20 for propelling the aircraft. The aircraft is also provided with an empenage 22 which may also be connected to the hull by means of a suitable superstructure or tower support 24.

As is well-known, considerations of weight are essential in the construction of aircraft, for which reason the various parts of the aircraft such as the wings and hull or fuselage are made up of a large number of light and relatively weak elements which are so united together as to provide an integral structure having the requisite strength provided excessive forces are not concentrated in any one point of the structure. These structures also include a few heavy and relatively strong main frame members which are adapted to receive localized forces and distribute them throughout the structure of the unit of which they are a part. In the aircraft illustrated, the wing is provided with two main spar members 26 and 28 which run substantially the entire length of the wing and are adapted to distribute the load forces imposed on the wing throughout the wing structure. The wing also includes various other elements such as ribs, braces, and stays, but as these elements may be of usual and conventional construction as far as the purpose of illustrating this invention is concerned, they have been omitted from the drawings for the sake of clearness.

The hull is provided at spaced intervals with rigid transverse bulkheads, two of which are in-

dicated at 30 and 32 to which the stringers, keel and various other elements of the hull frame are attached. Between the main bulkheads the hull is provided with contour frames as indicated at 34 and 36 in Fig. 5. The hull is so balanced and the bulkhead stations are so arranged that when the wing is superimposed upon the hull in its proper position the wing spars 26 and 28 will exactly overlie two of the main bulkheads 30 and 32.

The bulkhead 32 is illustrated in elevation in Fig. 3. As the bulkhead 30 is exactly the same in construction except for slight changes in shape incident to the contour of the hull and wing, an illustration of only one of these bulkheads has been considered sufficient for the purpose of this illustration. This bulkhead comprises a substantially U shaped outer member or hull former 38 to the ends of which are connected the bottom ribs 40 and 42. These ribs extend from the respective ends of the outer member 38 to the bottom of the keel 44. Spaced above the bottom ribs 40 and 42, and extending entirely across the bulkhead, is a deck beam 46 which is preferably constructed in one unitary piece, although it may be made up of separate portions suitably secured together. Between the deck beam 46 and the bottom ribs there is a system of diagonal bracing generally indicated at 48. The deck beam 46 is connected at its ends to the legs of the U shaped hull former 38 somewhat above the ends thereof and is attached at its center to the top of the keel 44. From this construction it will be observed that the deck beam, the bottom ribs, the keel, and the diagonal braces 48, form a rigid truss structure in the lower part of the hull.

Above the deck beam 46 the bulkhead is provided with vertical members 50 and 52 and horizontal members 54, 56, 58, 60, 62, 64, and 66, which brace the outer member 38 with respect to the lower truss structure and also provide supports for the partition material by means of which the bulkheads divide the hull up into a series of separate compartments. These vertical and horizontal members also provide the supports for seat backs, berths and other equipment installed in the aircraft. At their intersections the members are secured together by suitable means such as the gusset plates 68.

A door opening 70 is provided in the central portion of the bulkhead and is bounded by vertical members 72 and curved upper and lower members 74 and 76, the upper ends of the vertical member 72 and the upper portion of the curved member 74 being connected to the horizontal member 66 positioned above the door opening.

A pair of relatively heavy brace members 78 and 80 extend diagonally across the opposite halves of the bulkhead and have their lower ends disposed adjacent to the point of intersection of the deck beams 46 with the legs of the outer member 38 and their upper ends terminating at a point above the hull in line with the center line of the bulkhead. These brace members 78 and 80 constitute an A frame extending across and above the bulkhead to provide an attachment point above the hull for the wing and also to distribute the load between the wing and the hull to the various component frame members of the bulkhead and from the bulkhead to the keel and other structural parts of the hull in substantially equal degree. The frame members are rigidly attached to the bulkhead members by suitable means such as the gusset plates 82 and may be provided in the space which they include above the upper surface of the hull with an additional framework 84 to further increase their rigidity. Each of the brace members 78 and 80 comprise a pair of angle irons disposed one upon each side of the bulkhead and at their upper ends including between them the web portion of a flange plate illustrated at 86 in Fig. 4. This flange plate 86 is provided with horizontally extending flanges 88 which are secured by means of the bolts 90 to the lower flanges 92 of the wing spar 28. Particularly where the wing carries the engines as in the aircraft illustrated, the joint between the flange plate 86 and the spar is preferably made somewhat resilient by the inclusion of resilient spacer members 94 between the flange 88 and the spar flanges and resilient spacer members 96 between the upper surfaces of the spar flanges and pressure plates 98 against which the heads of the bolts 90 bear. This resilient construction serves to reduce the transmission of engine noises and vibrations from the wing to the hull. The connection is continued from the lower spar member to the upper spar member by means of a U shaped saddle plate 100 which overlies and is connected to the upper ends of the tension brace members 78 and 80. This saddle member is connected by means of the side plates 102 to a vertical brace member 104 which extends between the upper and lower members of the spar. The connnection is also made secure to the diagonal spar braces 106 by means of gusset plates 108 which are secured to the lower spar member, the vertical brace member 104 and the diagonal brace members 106. It will be observed that the above construction provides a strong and durable, and slightly resilient connection transmitting the load of the weight of the hull to the wing spar. The bulkhead member 38 is similar in construction to the bulkhead 32 and is connected to the front wing spar 26 in a similar manner.

Between the main bulkheads as indicated at 30 and 32 are light hull frame members 34 and 36 which assist in maintaining the hull against distortion and which are also connected at their upper ends to the undersurface of the wing by means of frame extensions 110 which are connected to a substantially horizontal member 112 which extends between the connections between the bulkheads 30 and 32 and the wing spars 26 and 28.

The super-structure is faired by means of a plurality of horizontal rib members 114 having, in plan view an airfoil section, attached to the A frame members of the bulkheads and hull frames and substantially equally spaced from each other in the space between the top of the hull and the bottom of the wing. These horizontal frame or rib members are preferably interconnected by vertical rib members as indicated at 116 to provide in the space between the top of the hull and the bottom of the wing a tower of stream lined form.

The tower frame is covered by a faired covering or skin 118 suitably curved as indicated at 120 and 122 to make smooth joints with the top of the hull and the bottom of the wing. This tower covering is preferably separate from the covering of the hull and wing and is secured to the hull by suitable means such as the rivets 124 illustrated in Fig. 2. If desired, a door as indicated at 126 may be provided in one side of the superstructure to provide access to the interior thereof.

From the above description taken in connection with the accompanying drawings, it will be observed that there has been provided a simple and rugged connection for attaching the wing to the hull or fuselage of an aircraft and for

transmitting the loads acting between the hull and wing and distributing such loads through the hull and wing structure in such a manner as to prevent localized stresses at any one point except those points which are specially reinforced to carry such stresses.

As illustrated in the accompanying drawings and described above, the tower support attaches the hull to the center of the wing with a connection sufficiently strong to support the weight of the hull upon the wing with a reasonable factor of safety. As this connection extends for only a short distance longitudinally of the wing it has been considered desirable to provide additional stays or braces to relieve this load carrying support of twisting stresses due to any tendency of the hull to swing or rotate relative to the wing. Suitable braces for this purpose are illustrated in Fig. 6 and indicated by the numeral 128. The braces 128 illustrated, are the front braces and extend from a position adjacent to the bottom of the hull to a position approximately one quarter of the wing span from the center support on each side. These braces are rigidly secured at the hull end to the adjacent bulkhead frame illustrated in Fig. 3 and at their outer ends, by means of pairs of angular struts 130 and 132, to the wing spar. Only one brace on each side is illustrated in Fig. 6, but it is understood that there is a similar brace immediately behind the brace 128 which connects the rear bulkhead forming a part of the hull superstructure to the rear wing spar. These braces may be reinforced by additional struts as indicated at 134 extending from substantially the mid-point of the brace upwardly to the respective wing spar. These two sets of braces which comprise two main braces upon each side of the hull and auxiliary struts and wires for reinforcing the main braces, transmit substantially all of the side or twisting loads from the hull to the wing spars and relieve the superstructure attachments from carrying any material part of such loads.

While there has been illustrated and described a particular mechanical embodiment of the idea of the invention, it is to be understood that the invention is not limited to the particular form so illustrated and described, but that such changes in the size, shape, and arrangement of parts may be resorted to as come within the scope of the sub-joined claims.

Having now described the invention so that others skilled in the art may clearly understand the same, what it is desired to secure by Letters Patent is as follows.

What is claimed is:

1. In an aircraft having a body portion provided with spaced transverse bulkheads, and a wing disposed above said body portion and provided with spaced longitudinal spars, means for operatively connecting said body portion and said wing together and distributing the load stresses between said wing and said body portion through the structure of each, said means comprising, a pair of diagonal tension members disposed across the opposite halves of each of the bulkheads aligned with respective wing spars, said diagonal tension members each comprising a pair of angle irons disposed one on each side of said bulkheads and extending to a common point above said bulkhead to form frames for attaching said body portion to said wing, and a reinforced connection between the upper end of each frame and the respective wing spar.

2. In an aircraft having a body portion provided with spaced transverse bulkheads, and a wing disposed above said body portion and provided with spaced longitudinal spars, means for operatively connecting said body portion and said wing together and distributing the load stresses between said wing and said body portion through the structure of each, said means comprising, a pair of diagonal tension members disposed across the opposite halves of each of the bulkheads aligned with respective wing spars, said diagonal tension members each comprising a pair of angle irons disposed one on each side of said bulkheads and extending to a common point above said bulkhead to form frames for attaching said body portion to said wing, and a reinforced connection between the upper end of each frame and the respective wing spar, said connection comprising, a flange plate having a web portion disposed and secured to the angle irons of each frame and a flange portion secured to the lower flange of said wing spar.

3. In an aircraft having a body portion provided with spaced transverse bulkheads, and a wing disposed above said body portion and provided with spaced longitudinal spars, means for operatively connecting said body portion and said wing together and distributing the load stresses between said wing and said body portion through the structure of each, said means comprising, a pair of diagonal tension members disposed across the opposite halves of each of the bulkheads aligned with respective wing spars, said diagonal tension members each comprising a pair of angle irons disposed one on each side of said bulkheads and extending to a common point above said bulkhead to form frames for attaching said body portion to said wing, and a reinforced connection between the upper end of each frame and the respective wing spar, said connection comprising, a flange plate having a web portion disposed between and secured to the angle irons of each frame and a flange portion secured to the lower flange of said wing spar, a saddle plate secured to the upper end of each of said frames and means connecting said saddle plate with the upper rail and with the diagonal bracing of said wing spar.

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