May 9, 1933. H. A. DOUGLAS 1,907,423

AEROPLANE

Filed March 5, 1930 3 Sheets-Sheet 1

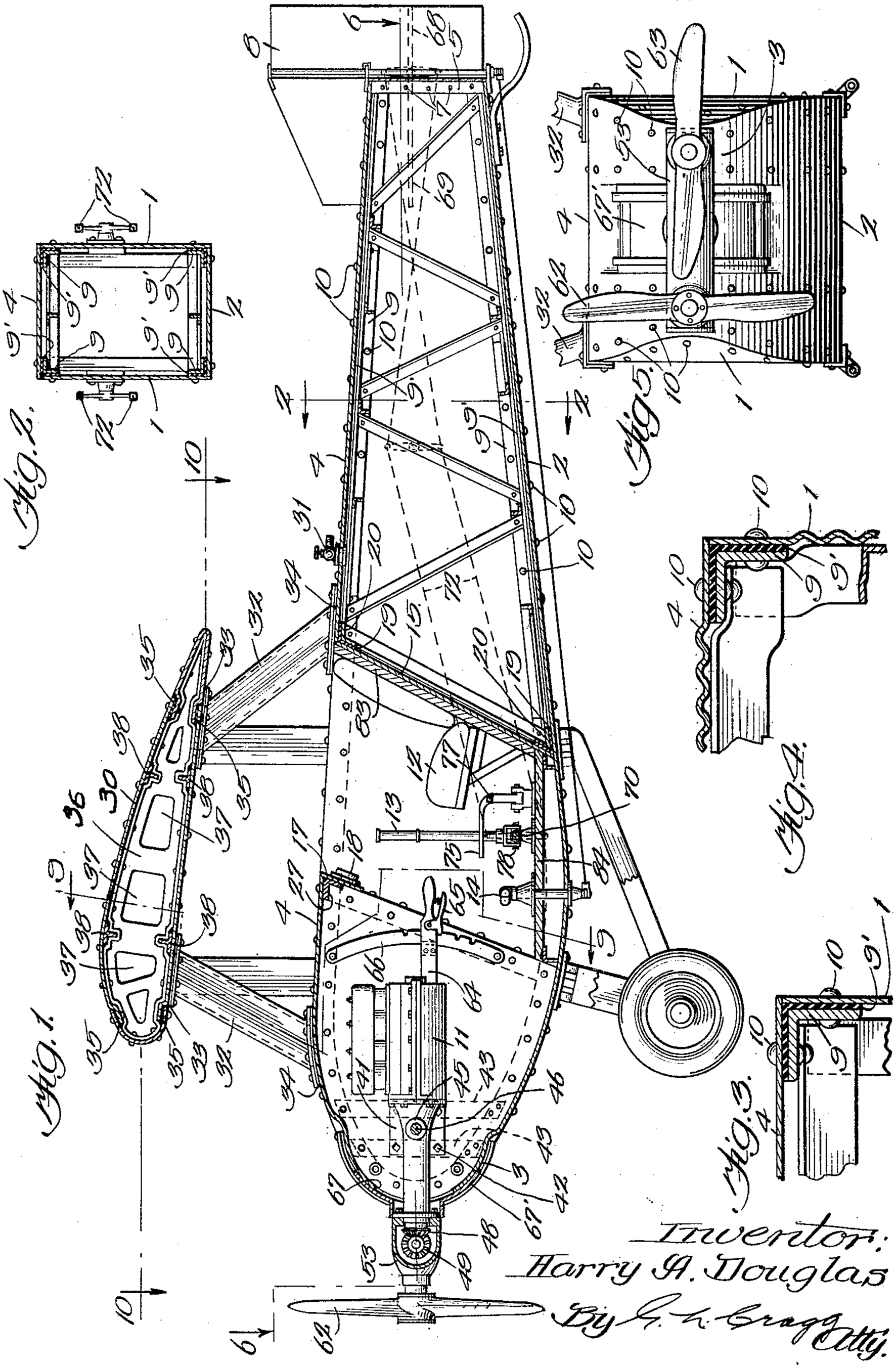

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Inventor:
Harry A. Douglas
By G. A. Gregg
Atty.

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AEROPLANE

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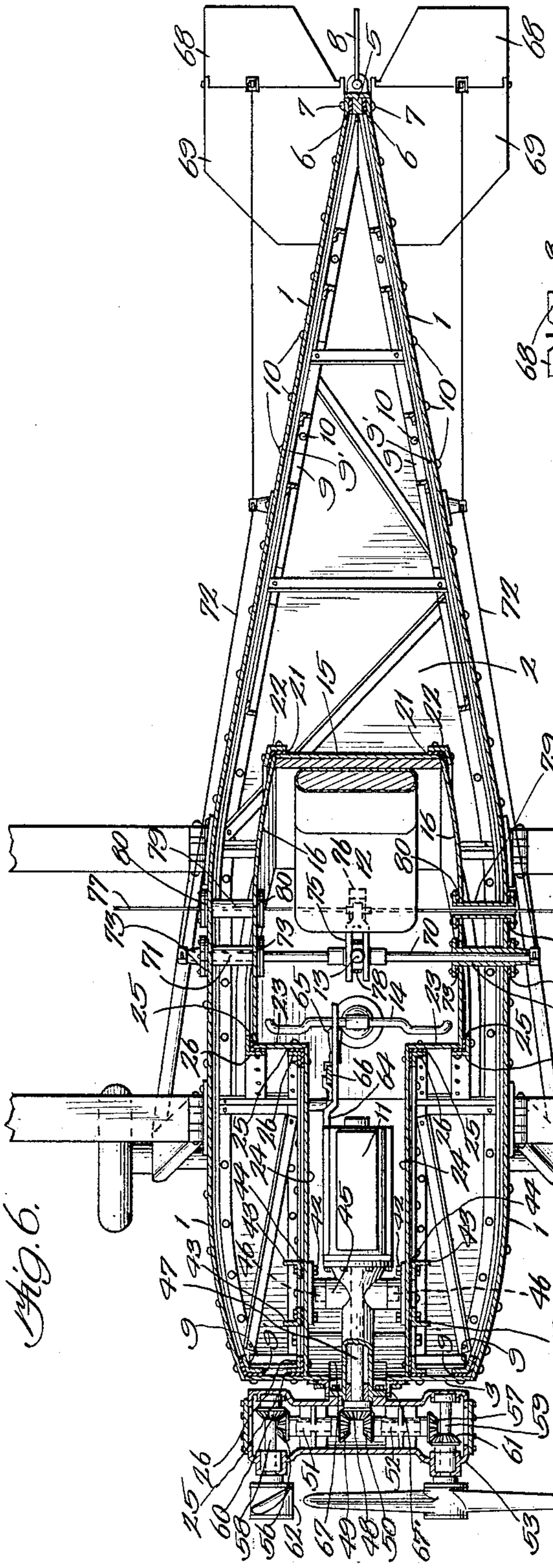

Fig. 6.

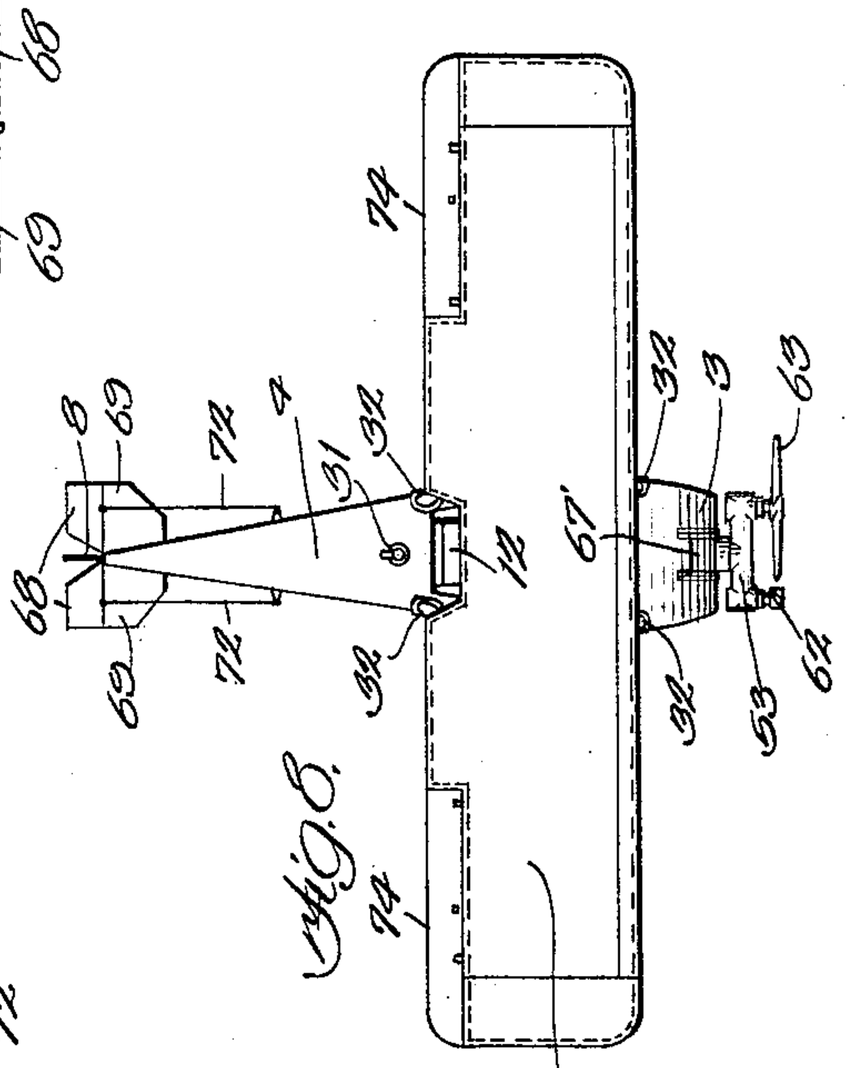

Fig. 8.

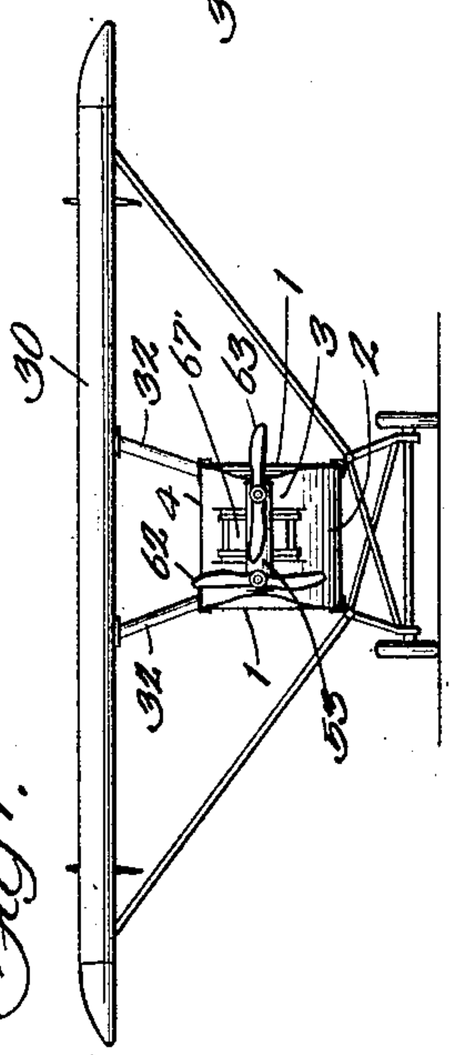

Fig. 7.

Inventor:
Harry A. Douglas
By G. L. Cragg
Atty.

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Fig. 9.

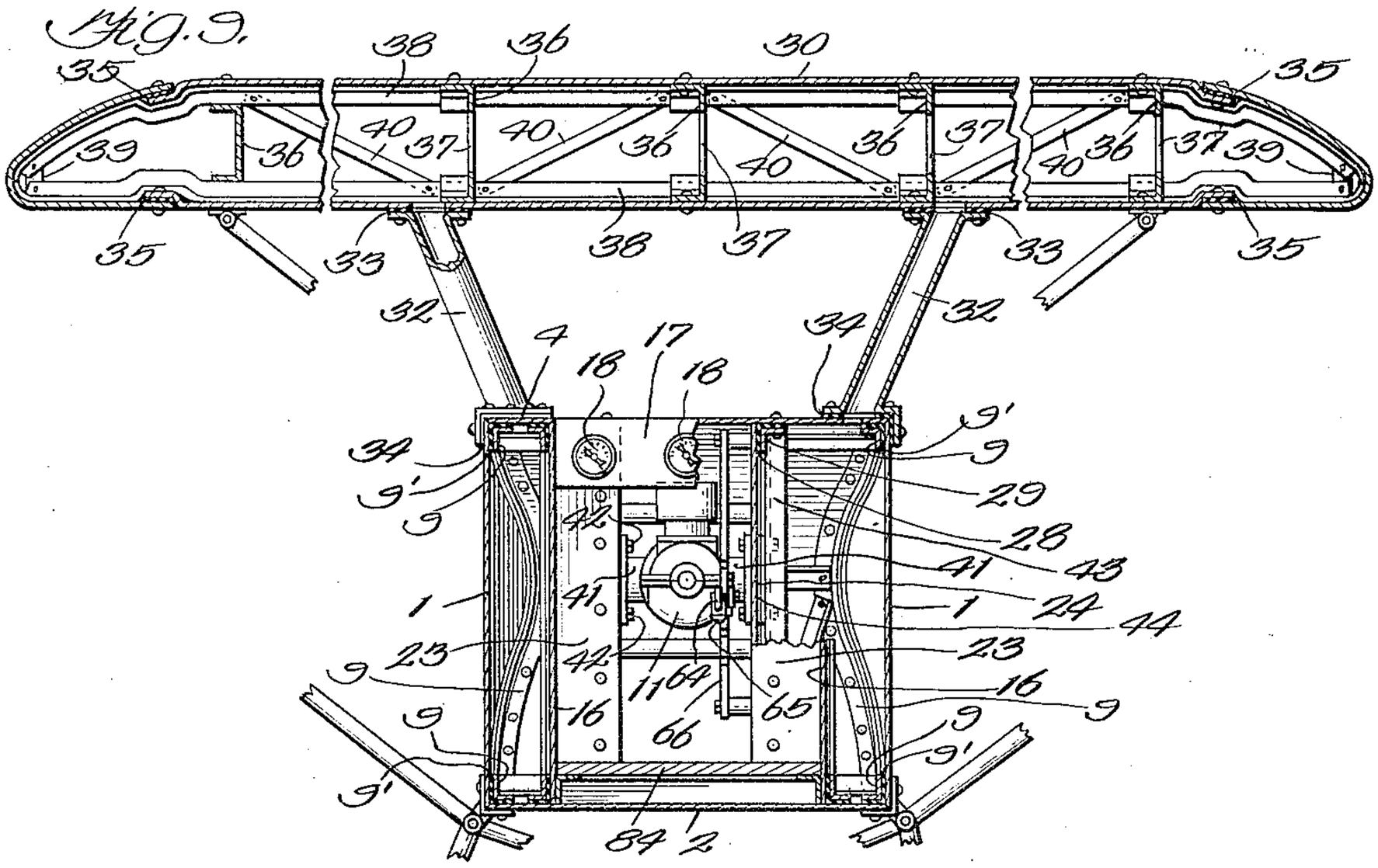
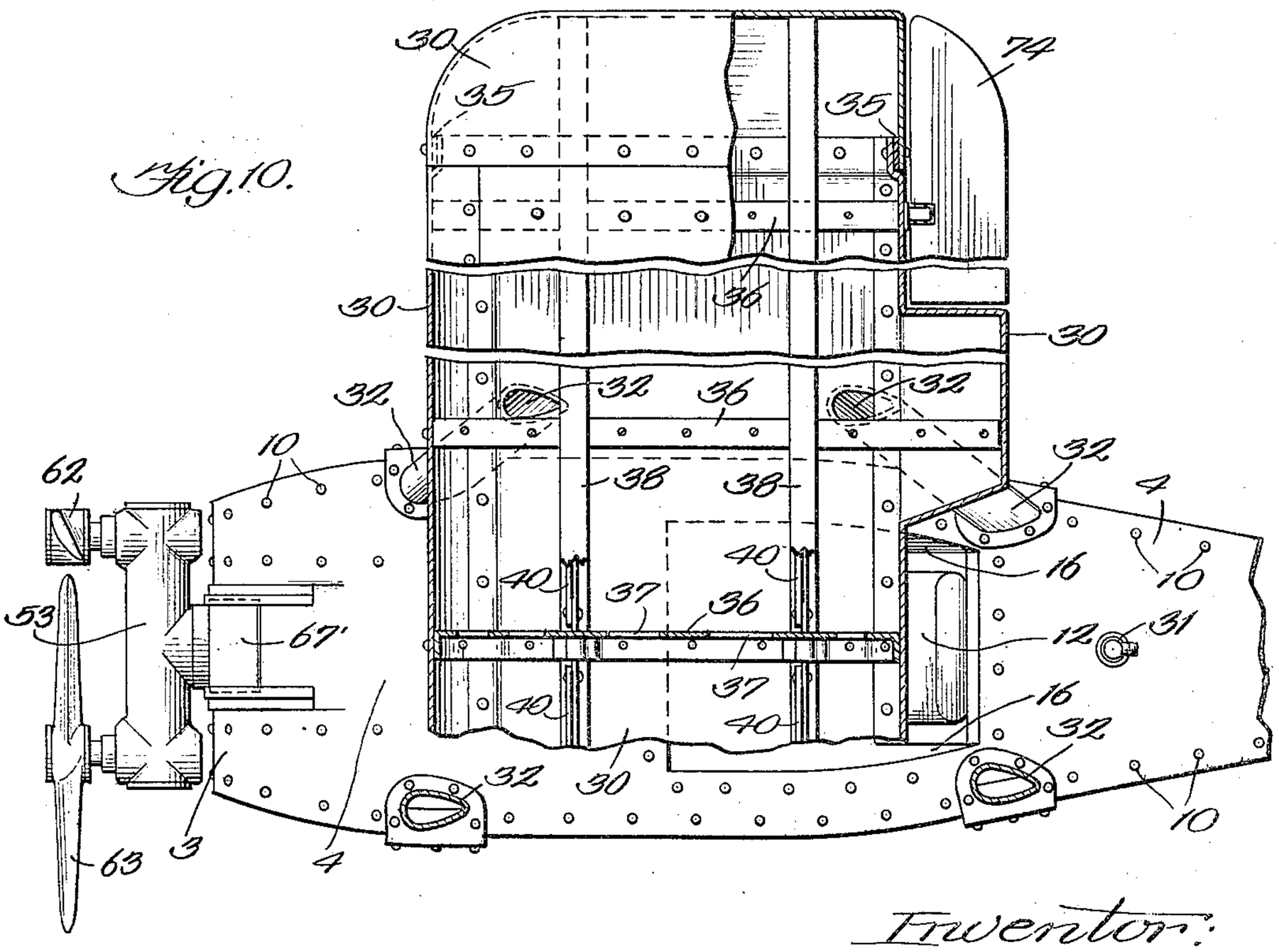


Fig. 10.



Inventor:
Harry A. Douglas
By L. L. Cragg Atty.

Patented May 9, 1933

1,907,423

UNITED STATES PATENT OFFICE

HARRY A. DOUGLAS, OF BRONSON, MICHIGAN

AEROPLANE

Application filed March 5, 1930. Serial No. 433,310.

My invention relates to aeroplanes and, generally speaking, resides in the provision of means whereby the planes of rotation of the propellers may be altered to furnish assistance and guidance for the ascent of the aeroplanes and controlling their descent. In the preferred embodiment of the invention the engines which are in driving relation with the propellers are, themselves, adjustable to change the direction of the axes of their rotation, the propellers being adjustable therewith. In accordance with another feature of the invention I employ two sets of propellers, the blades of each set being pitched oppositely to the blades of the other to form so to speak a right hand threaded screw of one propeller and a left hand threaded screw of the other. The two sets of propellers, thus oppositely pitched, avoid a disturbance by the propellers in the balance of the aeroplane and eliminate sidewise thrusting tendency of the propellers. In carrying out this feature of the invention a single engine may be employed which, through the intermediation of suitable gearing, will drive the propellers of the two sets in opposite directions.

I will explain my invention more fully by reference to the accompanying drawings in which Fig. 1 is a longitudinal sectional view, with parts in elevation, of an aeroplane constructed in accordance with the preferred embodiment of the invention; Fig. 2 is a sectional view on line 2—2 of Fig. 1; Fig. 3 is an enlargement of a portion of Fig. 2; Fig. 4 illustrates another form of the structure shown in Fig. 3, the structure of Fig. 4 being preferred; Fig. 5 is a front end view of a part of the aeroplane; Fig. 6 is a sectional elevation on line 6—6 of Fig. 1, parts being shown in plan and parts being broken away; Fig. 7 is a front elevation taken throughout the extent of the wing; Fig. 8 is a plan view of the structure as it appears in Fig. 7; Fig. 9 is a sectional view on line 9—9 of Fig. 1, parts being broken away and other parts being shown in elevation; and Fig. 10 is a view taken on line 10—10 of Fig. 1, parts being shown in plan and other parts broken away.

The fuselage is inclusive of metallic side plates 1 and a third plate which is formed and disposed to constitute the bottom 2 of the fuselage, the fuselage nose or front wall 3 and the fuselage top wall 4. The side walls are converged to nearly meet at the rear end of the fuselage, the upright rear edges of these walls being united through the intermediation of a metallic T member 5. The stem of this T member is embraced between the rear upright portions of said side walls with strips 6 of rubber or other sealing material interposed between the stem of the member 5 and the adjacent portions of the walls 1. Rivets 7 are passed through the stem of the member 5, the strips 6 and the contiguous portions of the side walls 1, these rivets compressing the sealing strips 6 to make the union between the member 5 and the walls 1 fluid tight. The corners defined by the parts 1, 2, 3 and 4 receive the angle iron 8 which is bent to conform to the contour of these corners. An angle sealing member 9, shaped similarly to the angle iron 8, receives the said iron 8 and is received in the corners defined by the parts 1, 2, 3 and 4. Rivets 10 are passed through the angle iron 8 and through the sealing strip 9 and the contiguous portions of the parts 1, 2, 3 and 4. All of the outside corner portions of the fuselage are thus thoroughly sealed by the strips 6 and 9. The fuselage is thus a metallic shell within which the internal combustion engine 11 of the power plant is disposed together with the pilot seat 12, the control stick 13 and the rudder pedal 14. An inner shell contains the parts 11, 12, 13 and 14 and includes a downwardly and forwardly sloping metallic plate 15 located between the upright metallic side plates 16 of the inner shell and about midway in the length of the fuselage. The plates 16 of the inner shell are located between and are spaced apart from the fuselage side walls. The fuselage top wall 4 is discontinued in the region of the shell walls 16 and is inwardly bent, as indicated at 17, to form an instrument board upon which the various instruments 18 are mounted within view of the pilot occupying the seat 12. Angular seal-

ing pieces 19 are received in the transverse horizontal corners which are defined by the metallic walls 15, 2 and 4 and receive the angle irons 20, rivets being passed through these angle irons, the strips 19 and the contiguous portions of the parts 2, 4 and 15. The angular sealing members 21 receive the corners defined by the walls 15 and 16 and are received in the angle irons 22, rivets being passed through these angle irons and the contiguous portions of the walls 15 and 16. Inwardly extending metallic plates 23 are joined with the front edge portions of the walls 16. Longitudinal wall portions 24 are joined with the inner edge portions of the parts 23 and are, themselves, joined with the nose 3. The corners defined by the meeting edge portions of the parts 16, 23, 24 and 2 are also sealed by suitable angular sealing strips 25 and the angle irons 26 which are riveted against said sealing strips and by such riveting hold the sealing strips in sealing engagement with the wall portions 16, 23, 24 and 2. An angle iron 27 extends between the fuselage side walls 1 and is received within the corner defined by the top fuselage wall 4 and the instrument board 17, the parts 17 being between the inner shell wall 16. Sealing strips 28 are received in the corners defined by the wall portions 4 and 23 and these sealing strips receive angle irons 29. Without further description it may be mentioned that all corners of the inner shell, all corners of the fuselage and all corners defined by the inner shell and fuselage are similarly sealed fluid tight. The inner shell is thus sealed from communication with the balance of the fuselage interior. All of the upright walls of the inner shell being spaced apart from the side fuselage walls 1 define with said side walls and the remaining walls of the fuselage a U-shaped space which is effectively sealed from the interior of the inner shell.

Buoying gas, such as helium gas, fills this U-shaped space to counteract the weight of the aeroplane. Such buoying gas is desirably also received within the hollow aeroplane wing 30. The gas may be admitted through a valve 31 in the top wall of the fuselage and some of it, after entering the fuselage, passes through the hollow struts 32 which assemble the wing and fuselage. The buoying gas thus not only fills the fuselage but also said wing and struts to further increase the volume of such gas to further counteract the weight of the aeroplane. The struts and wing, similarly to the fuselage and inner shell, are desirably formed of metal throughout. The holes in the bottom wall of the wing where communication is established with the interior of the struts are surrounded by sealing washers 33 which are clamped between the flanges at the upper ends of the struts and the bottom wall of the wing by means of rivets. The holes in the top wall 4 of the fuselage where communication is established with the interior of the struts are surrounded by sealing washers 34 which are clamped between the flanges at the lower ends of the struts and the fuselage wall 4 also by rivets, all joints through which the buoying gas might pass to the internal atmosphere being thoroughly closed. Where a number of metallic plates compose the wing, as illustrated in Fig. 9, such plates are in lapping relation, where they are contiguous, and sealing strips 35 are clamped between the lapping portions of these plates by means of rivets, it being important that no joints through which the buoying gas might escape are left unsealed. The top and bottom metallic wall plates of the wing are braced apart by joist members 36 which may be in the form of plates having numerous openings 37 therethrough and provided with marginal flanges which are riveted to the wing plates or otherwise secured thereto. The joist members 36 extend longitudinally of the fuselage and crosswise of the wing and maintain the wing surfaces in shape. Two trusses extend lengthwise of the wing for further strengthening the same, each truss comprising two beams 38 which meet in the side edges of the wing, the connecting bars 39 uniting the contiguous ends of the beams 38 and sloping bracing members 40 which join the beams. The beams 38 and the parts 39 of each truss thus constitute a frame which surrounds the struts 36, the bracing members 40 being in the spaces between these struts. The struts 36 are desirably formed with pockets which snugly receive the beams 38, these beams being T-shaped in cross-section.

The sheet metal plates composing the walls of the fuselage are desirably corrugated throughout as much of their areas as possible, as illustrated in Fig. 4, the corrugation being omitted where the walls are contiguous. The entire engine 11 is desirably fulcrumed upon fulcrum bearings 41 which are mounted upon the wall portions 24 of the inner shell by means of bolts or rivets 42 which pass through flanges upon the trunnion bearings, said wall portions 24 and the angle irons 43 which are provided to strengthen the walls 24 where the trunnion bearings are disposed. Suitable sealing strips 44 are interposed between these angle irons and walls to seal the openings through which the bolts or rivets 42 pass. The engine casing is provided with lateral extensions 45 which carry the shafts 46 that are received in the aforesaid trunnion bearings, the arrangement being such that a horizontal axis of movement is provided for the entire engine, this axis being arranged transversely of the axis of the fuselage and the axis of the engine shaft 47. This engine shaft carries a beveled pinion

48 which is in mesh with two beveled pinions 49 and 50 that are located upon opposite sides of the shaft 47. The beveled pinions 49 and 50 are provided upon shafts that are journaled in bearings 51 and 52 supported within a gear casing 53. This gear casing is bolted upon a forward continuation 54 of the engine casing that surrounds the engine shaft and supports a forward bearing 55 for said shaft. The shafts that carry the beveled pinions 49 and 50 also carry beveled pinions 56 and 57 that are at the outer ends of these shafts. The beveled pinions 49, 50, 56 and 57 are upon a common horizontal axis that is disposed transversely of the axis of the fuselage and the engine shaft 47. Shafts 58 and 59 carry beveled pinions 60 and 61 that are respectively in mesh with the pinions 56 and 57. These shafts are journaled in bearings that are carried by the gear casing 53 and extend lengthwise of the fuselage, the axes of the shafts 47, 58 and 59 being parallel and coplanar. Propellers 62 and 63 are provided upon the forward ends of the shafts 58 and 59, these propellers being foremost parts of the aeroplane structure. The plane of rotation of these propellers are coincident, normally upright and transverse to the axis of the fuselage in the engine shaft. The propellers 62 and 63 are so angularly related that they, so to speak, intermesh as they rotate. The engine may be partly swung upon its trunnion bearings and maintained in the position to which it is swung for which purpose I may provide the engine with an adjusting arm 64 carrying a spring pressed holding dog 65 which may be received in the notches of a holding segment 66 that is mounted upon one of the walls 24 of the inner shell and in spaced apart relation to the shell walls. In order that the engine may be swung the nose 3 of the fuselage is provided with an arcuate slot 67 which extends above and below the normal axis of the engine shaft, that is above and below the axis of the fuselage. The engine may be turned to shift the propellers from their normal planes of rotation which are at right angles to the fuselage axis to planes that are oblique with respect to this axis. When the engine is adjusted clockwise from its normal position, Fig. 1, the planes of rotation of the propellers slope downwardly and forwardly, whereby the propellers may take part in effecting the ascent of the aeroplane. When the engine is adjusted counterclockwise from its normal position the plane of rotation of the propellers slope downwardly and rearwardly, whereby the propellers may take part in guiding the descent of the aeroplane. The engine and the propellers driven thereby may thus supplement the function of the elevators 68 which are hinged at the rear margins of the stabilizers 69. To avoid a draft through the slot 67 I provide a closure 67′ which engages the portions of the nose 3 that margin said slot. The meeting faces of the closure 67′ and nose are curved and coaxial with the trunnion axis about which the engine is turned, so that said slot is closed in all positions to which the engine is swung. Said elevators are governed by the stick 13 through the intermediation of the horizontal transversely arranged shaft 70 which turn within bearings 71. The outer ends of these shafts are connected with the elevators by cables 72. The bearings 70 pass through the side walls 16 of the inner shell across the space between these walls and the side walls 1 of the fuselage and through these latter side walls. The openings in these slots through which these bearings pass are sealed by sealing gaskets 73 of rubber or other suitable packing material to preserve the separation of the interior of the inner shell from the surrounding space in the fuselage. The stick 13 also governs the ailerons 74 through the intermediation of the sides of the forked lever 75. This lever is journaled upon a bearing 76 that defines the horizontal axis of rotation that extends along the fuselage. The cables 77 connect the lever 75 with the ailerons. The stick 13, which is given a fore and aft movement to regulate the elevators 68 is given a sidewise movement to regulate the ailerons, the stake being universally mounted at its lower end at 78 as is well understood. The cables 77 pass through tubular housings which pass through the walls 16 of the inner shell and the side walls 1 of the fuselage, these housings being flanged and in sealed connection with these walls 16 and 1 to preserve the separation between the sealed space of the fuselage and the interior of the inner shell, gaskets 8 surround the said housings and are clamped between the flanges upon the housings and the walls 16 and 1 respectively adjacent these flanges. The rudder pedal is connected in a manner well understood with the rudder 81 by means of the cable 82. The wall 15 of the inner shell may be provided with a front wooden facing 83, enabling the seat 12 to be readily positioned. A flooring 84 may be provided within the inner shell for carrying the rudder and the mountings for the stick 13 and the lever 75. This flooring also serves as a foot-rest for the pilot.

The buoying gas trapped within the fuselage wings and struts of the aeroplane lightens the aeroplane and lessens the duty of the engine and enables the employment of a lighter engine which is thus more adapted to be adjustable to alter the planes of rotation of the propellers to enable the propellers to cooperate with the aeroplane wing in effecting the travel and selecting the direction of travel of the aeroplane. Features not herein claimed are claimed in my copending

application Serial No. 433,309 filed March 5, 1930.

The propeller blades of each of the sets 62 and 63 are oppositely pitched with respect to the propeller blades of the other set, the pitching of the blades of the two sets being of the general nature of the right and left hand threading of bolts or screws. Each propeller is turned oppositely to the other, a result which is readily accomplished where a single engine is employed through the intermediation of the transmission gearing which couples the engine in driving relation with the propellers.

Changes may be made without departing from the invention.

Having thus described my invention, I claim:

1. An aeroplane having a fuselage comprising a solid wall, a plurality of propellers upon the exterior of the wall; a single engine upon the interior of said wall in driving relation to the propellers through the intermediation of a driving shaft and gearing; a casing rigid with respect to the engine surrounding said shaft and providing a bearing upon the exterior of the wall for the shaft and gearing; an arcuate slot in the wall through which the casing passes; means for adjusting the axis of the engine shaft with respect to the axis of the fuselage; and a closure for said slot adapted to move with the casing to maintain said slot closed in all positions of the shaft.

2. An aeroplane comprising: a fuselage; an engine; a plurality of angularly offset interlapped propellers driven by said engine; and means for changing the positions of said engine and said propellers to change the direction of movement of said aeroplane.

3. An aeroplane comprising: a fuselage; an engine; a plurality of angularly offset interlapped propellers of opposite pitch and movement driven by said engine and having the axes of rotation thereof disposed in fixed relation to said engine; and means for tilting said engine and said propellers to change the direction of movement of said aeroplane.

4. An aeroplane comprising: a fuselage; a single engine; transversely extending jack-shafts driven by said engine; a plurality of propellers driven by said jack-shafts; and means for swinging said engine and jack-shafts about a common axis to change the position of said propellers and the direction of movement of said aeroplane.

5. An aeroplane comprising: a fuselage; a single engine; transversely extending jack-shafts carried by said engine; a plurality of propellers driven by said jack-shafts; and means for tilting said engine and jack-shafts to vary the position of said propellers and the direction of movement of said aeroplane.

6. An aeroplane comprising: a fuselage; a single engine; a T-shaped housing carried by said engine; jack-shafts carried by said housing and driven by said engine; a plurality of propellers carried by said housing and driven by said jack-shafts; and means for swinging said engine and housing about a common pivot to change the position of said jack-shafts and said propellers and the direction of movement of said aeroplane.

7. An aeroplane comprising: a fuselage; a single engine mounted for swinging movement; jack-shafts driven by said engine; a plurality of propellers driven by said jack-shafts; and means for adjusting the angular position of said engine about a common axis to change the position of said jack-shafts and propellers and the direction of movement of said aeroplane.

8. An aeroplane comprising: a fuselage; a single engine mounted for swinging movement; a T-shaped housing carried by said engine; jack-shafts carried by said housing and driven by said engine; a plurality of propellers carried by said housing and driven by said jack-shafts; and means for swinging said engine and housing about a common pivot disposed between said engine and said jack-shafts to change the position of said jack-shafts and propellers and the direction of movement of said aeroplane.

9. An aeroplane comprising: a fuselage having a slot in a wall thereof; an engine; a drive-shaft driven by said engine and extending through said slot; a pair of transversely extending jack-shafts driven by said drive-shaft and located exteriorly of said fuselage; propellers driven by said jack-shafts; and means for tilting said drive-shaft in said slot to change the position of said jack-shafts and said propellers and the direction of movement of said aeroplane.

10. An aeroplane comprising: a fuselage; a single engine; a plurality of angularly offset propellers driven by said engine and having the axes thereof spaced from one another a distance less than the diameter of said propellers and disposed in fixed relation to said engine; and means for tilting said engine to change the position of said propellers and the direction of movement of said aeroplane.

11. An aeroplane comprising: a fuselage; a single engine; a plurality of angularly offset propellers of opposite pitch and movement driven by said engine and having the axes thereof spaced from one another a distance less than the diameters of said propellers and disposed in fixed relation to said engine; and means for tilting said engine to change the position of said propellers and the direction of movement of said aeroplane.

12. An aeroplane comprising: a fuselage; a single engine; jack-shafts driven by said engine; a plurality of angularly offset inter-

lapped propellers driven by said jack-shafts; and means for swinging said engine and jack-shafts about a common axis to change the position of said propellers and the direction of movement of said aeroplane.

13. An aeroplane comprising: a fuselage; a single engine; transversely extending jack-shafts carried and driven by said engine; a plurality of angularly offset interlapped propellers driven by said jack-shafts; and means for adjusting the angular position of said engine and jack-shafts about a common axis to change the position of said propellers and the direction of movement of said aeroplane.

14. An aeroplane comprising: a fuselage having a slot in a wall thereof; an engine; a plurality of propellers having a driving connection with said engine extending through said slot; and means for tilting said driving connection in said slot to vary the position of said propellers and the direction of movement of said aeroplane.

15. An aeroplane comprising: a fuselage having a slot in a wall thereof; a single engine having a drive-shaft extending through said slot; jack-shafts driven by said drive-shaft; a plurality of propellers driven by said jack-shafts; and means for swinging said drive-shaft in said slot to change the position of said jack-shafts and said propellers and the direction of movement of said aeroplane.

In witness whereof, I hereunto subscribe my name.

HARRY A. DOUGLAS.