C. V. BACKUS.

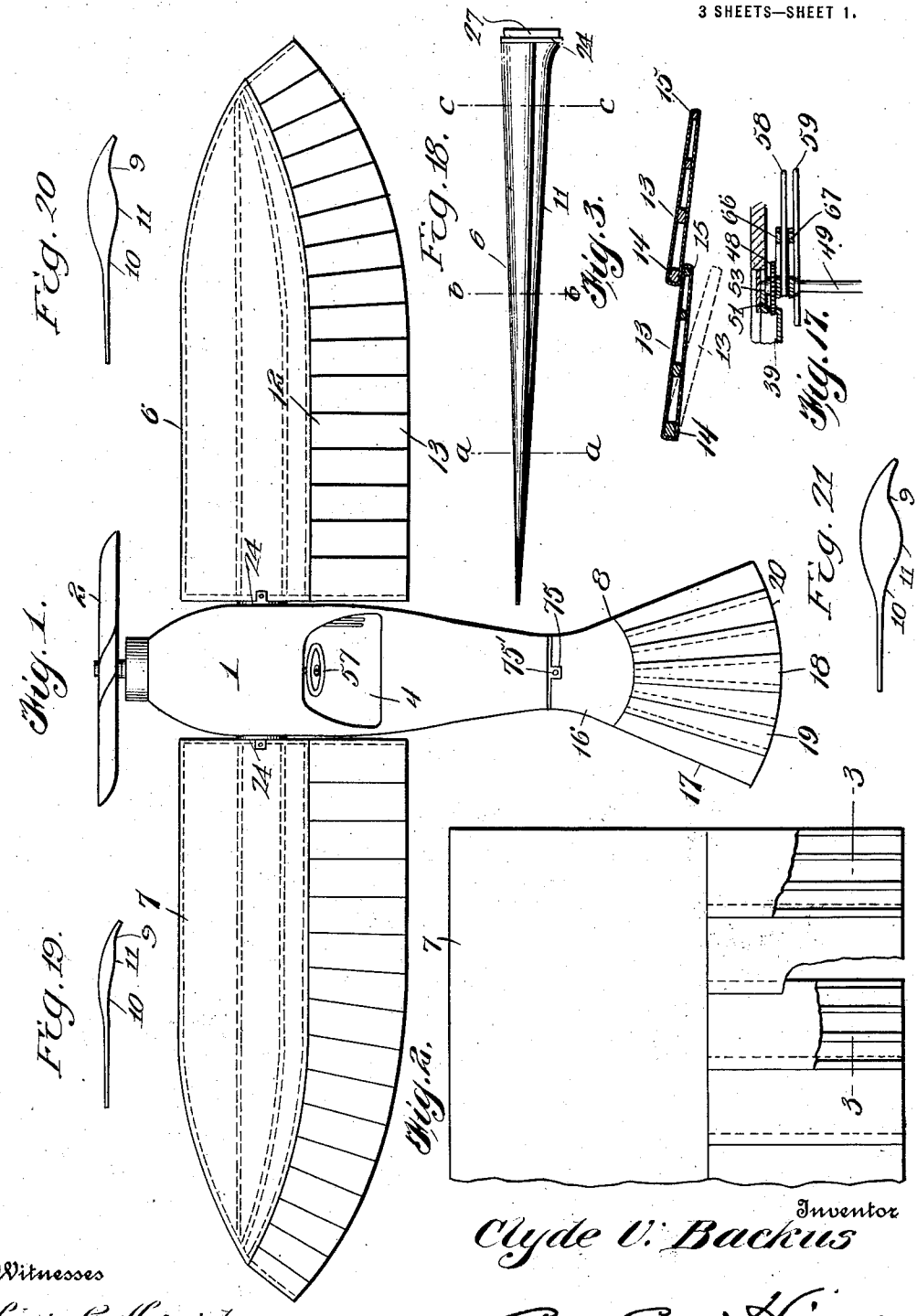
FLYING MACHINE.

APPLICATION FILED DEC. 3, 1913.

1,167,874.

Patented Jan. 11, 1916.

3 SHEETS—SHEET 1.



Witnesses

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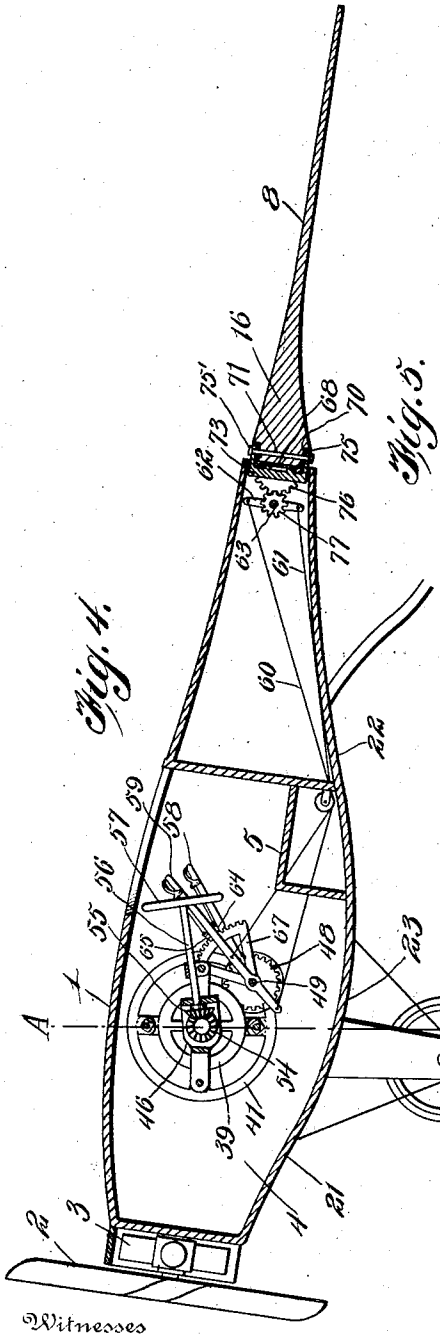

Fig. 4.

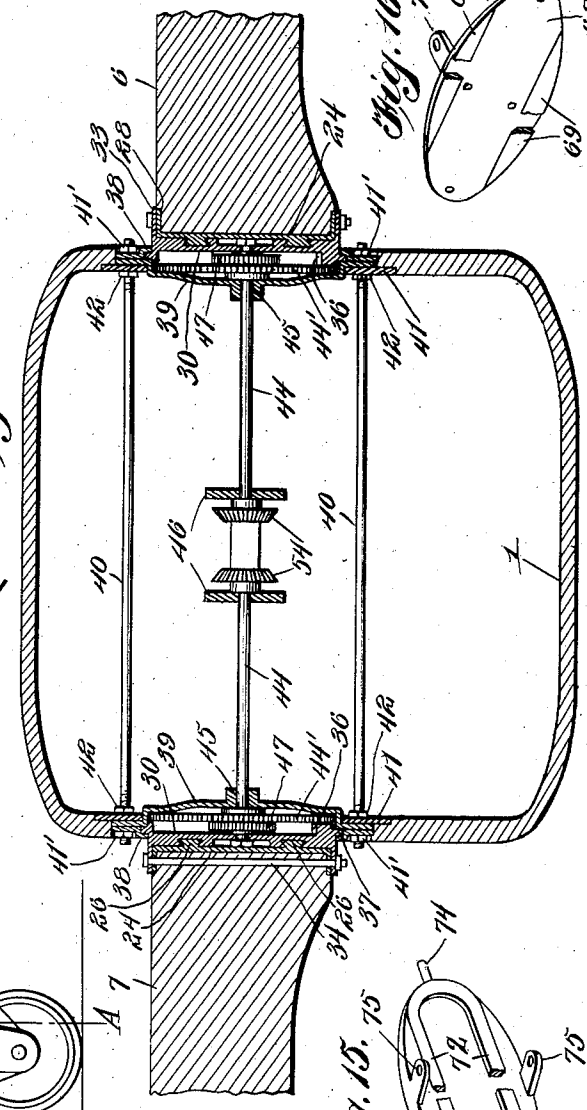

Fig. 5.

Fig. 16.

Fig. 15.

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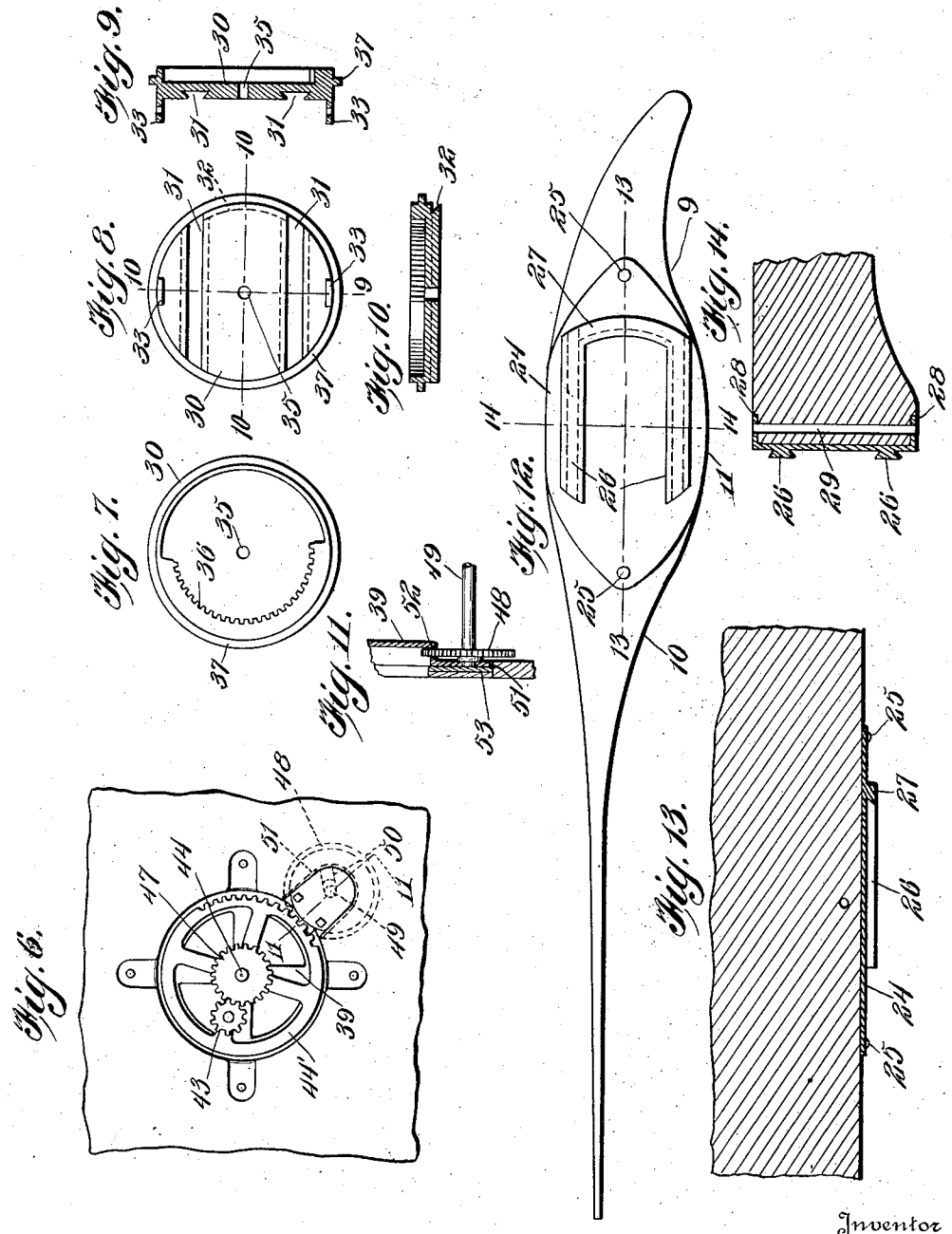

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UNITED STATES PATENT OFFICE.

CLYDE V. BACKUS, OF JEFFERSON, OHIO.

FLYING-MACHINE.

1,167,874. Specification of Letters Patent. Patented Jan. 11, 1916.

Application filed December 3, 1913. Serial No. 804,392.

To all whom it may concern:

Be it known that I, CLYDE V. BACKUS, a citizen of the United States, residing at Jefferson, in the county of Ashtabula and State of Ohio, have invented certain new and useful Improvements in Flying-Machines, of which the following is a specification.

This invention relates to aeroplane flying machines, and one of the objects of the invention is to provide a construction of machine having a body and wings of novel form or contour whereby wings of greater flotation efficiency are provided and whereby the body is adapted to serve also as a lifting surface coöperating with the wings to give increased lifting capacity.

A further object of the invention is to provide a flying machine of the character defined in which the body and wings are provided with reaction surfaces of such form as to secure, in addition to the primary lifting impulse resulting from the reaction of the air, a secondary lifting impulse by which the lifting pressure of the air is increased, such secondary lifting impulse serving also to give a forward impulse to the machine by which its speed of travel is increased, the lifting impulses being further so relatively disposed as to provide two centers of pressure acting to resist longitudinal tilting motion of the machine on its transverse axis, whereby inherent stability is obtained.

A still further object of the invention is to provide a flying machine of the character defined in which the wings and tail are demountable in a ready and convenient manner, so that the machine may be easily stored or transported and equipped for service, and in which provision is also made for removing or giving access to the controlling and steering gearing, whereby the elements thereof may be readily and easily cleaned, repaired or replaced, as occasion requires.

A still further object of the invention is to provide a flying machine of the character described which will, to a large extent, possess inherent stabilizing properties, and in which steering and controlling devices of a construction and arrangement for ready and efficient use are employed.

With these and other objects in view, which will appear in the course of the subjoined description, the invention consists of the features of construction, combination and arrangement of parts, hereinafter fully set forth and claimed, reference being had to the accompanying drawings, in which:—

Figure 1 is a top plan view of a flying machine embodying my invention; Fig. 2 is a fragmentary plan view of one of the wings, portions being broken away to clearly show the construction of the posterior feathered edge; Fig. 3 is a detail vertical transverse section taken on the line 3—3 in Fig. 2; Fig. 4 is a central vertical longitudinal section through the machine; Fig. 5 is a vertical transverse section through the body and inner ends of the wings of the machine on a line coincident with the axes of the wings; Fig. 6 is a view in side elevation of a portion of the body with the adjacent wing removed, and showing the elements of the coöperating wing adjusting mechanism on the machine body; Fig. 7 is an inner face view of the coupling head or member forming part of the adjusting gearing on the body; Fig. 8 is an outer face view of the same; Figs. 9 and 10 are detail sectional views on the lines 9—9 and 10—10 of Fig. 8; Fig. 11 is a detail section on the line 11—11 of Fig. 6; Fig. 12 is an inner end view of one of the wings; Figs. 13 and 14 are sectional views taken substantially on the lines 13—13 and 14—14 of Fig. 12; Figs. 15 and 16 are detail views of the coupling members for demountably connecting the detachable tail piece with the body; Fig. 17 is a detail view showing the arrangement of parts of the steering and controlling gear for adjusting the wings and the tail piece; Fig. 18 is a front elevation of one of the wings; and Figs. 19, 20 and 21 are views showing the fore and aft contour of the wing at different points in the length thereof, as indicated respectively by the lines *a*—*a*, *b*—*b* and *c*—*c* of Fig. 18.

The machine comprises a hollow body 1, upon the head portion of which may be suitably arranged and mounted a propeller 2 and driving motor 3, of any preferred type. The body is of streamline contour, and preferably of aviform shape and may be constructed of any suitable strong, light and durable material, and its forward portion is constructed to provide a compartment or cockpit 4, inclosing the aviator's or pilot's seat 5 and the operating elements of the steering and controlling gearing, as hereinafter fully described. In practice, the body may be provided with any suitable type of launching and alighting gear, and is de-

signed to have a standing and flying attitude of substantially the same angle, about eight degrees.

The supporting, steering and stabilizing surfaces of the machine consist of the right and left hand wings 6 and 7 and the tail piece 8. The wings 6 and 7, in addition to serving as the main supporting surfaces, are adjustable simultaneously in the same or opposite directions at will to vary their angle of incidence, as well as to act as steering elements for horizontally steering and banking the machine and as stabilizing devices, to maintain lateral stability, thus obviating the use of warping wing tips, ailerons or other auxiliary steering and balancing devices, while the tail piece 8 not only serves as an auxiliary steering and balancing devices, but also as an elevator or horizontal rudder to steer the machine vertically and maintain its longitudinal balance. Each wing is preferably of bird's wing shape and is composed of a suitable frame work covered with fabric or other preferred material. The formation of the wing is such that its normal means center of pressure lies at a point in advance of its longitudinal center and coincides with the vertical plane indicated by line A—A, Fig. 4, of the transverse axis of the machine, the upper or rarefaction surface of the wing being convexly curved between its lead and trail edges, while the lower or reaction surface of the wind has a compound fore and aft curvature, being concavely curved at a point in advance of its mean center of pressure, as shown at 9, and similarly curved in rear of its mean center of pressure, as shown at 10, the proximate portions of the surfaces 9 and 10 intersecting each other at a point in line with the center of gravity of the wing at which point the wing is of maximum depth, producing a convex rib or bulged portion 11. By this construction the air striking the surface 9 and impelled down in the form of a tumbling mass, reacts against the surfaces 9 and 11 to give the usual lifting impulses, and then on its rearward travel forms a reverse eddy which produces a partial vacuum in line with the surface 10, which the air rushes to fill, thus securing a secondary reaction and lifting impulse against the surface 10, which impulse against such inclined surface also acts to give a forward push or impetus to the wing, whereby increased lifting capacity and speed are obtained. From a point about midway of its length, the body of the wing tapers longitudinally to a point at its outer extremity or tip, while the reaction and rarefaction surfaces of the wing relatively incline and converge throughout the length of the wing toward the tip, by which the depth or thickness of the wing, as well as the depth or thickness of the bulged portion 11, gradually and progressively decreases from the butt to the tip of the wing. As a result, the camber and angle of incidence of portions of the wing vary progressively throughout the length of the wing, whereby counteracting pressures are produced tending to resist tilting of the wing or of the machine as a whole on either its longitudinal or transverse axis; thus giving a high degree of inherent stability against loss of equilibrium when the machine is in flight. The posterior portion 12 of each wing from the rear edge of the surface 10 to the trail edge of the wing is reduced or attenuated to secure increased flexibility, and such portion of the wing is feathered or separated by divisions into a longitudinal row of angularly disposed overlapping vanes or flaps 13, the outer edge of each flap or vane being disposed so as to slightly overlie the inner edge of the adjacent flap or vane. The extreme longitudinal edges 14 and 15 of the respective flaps or vanes are free for a yielding action in a vertical plane, the ribs of the frame work being of such relative thickness as to render the edge 14 of each flap or vane somewhat stiff or rigid, while the other edge 15 thereof, which underlies the stiffened edge 14 of the next adjacent vane, is of greater flexibility. Air vents or passages are thus produced between the adjacent edges of the flaps or vanes which, under normal conditions or when the wings are subjected on their reaction and rarefaction surfaces to ordinary pressures, are closed to cause the air to pass completely across the wing. When, however, an excess air pressure from above strikes the vanes or flaps of the feathered posterior portion of either wing, the flexible edges 15 of the flaps or vanes are forced down, as indicated in dotted lines in Fig. 3, thus opening the air passages and allowing the excess air pressure to escape, so that the stability of the machine will not be disturbed. These flaps or vanes also provide a corrugated, riffled, stepped or Venetian blind-like surface, presenting vanes at such an angle of inclination, in a direction transversely to the line of flight, as to provide resisting surfaces operating to prevent the machine from skidding or having side drift.

The tail piece 8 is preferably fan shaped and comprises a substantially rigid or inflexible front portion 16 and a feathered rear portion 17 consisting of a central longitudinal flap or vane 18 and a series of side flaps or vanes 19 and 20, the central flap being rigid, while the side flaps 19 and 20 have outer rigid edges and inner flexible edges, presenting vanes which control intervening air escape passages to relieve excess air pressure upon the upper surface of the tail piece, while inclining on opposite sides of the tail piece in reverse directions so as to steady the tail piece when in flight,

the opposing pressures upon the sets of vanes 19 and 20 counteracting each other and tending to maintain travel in a straight line. For the purpose of further increasing the lifting power and stability of the machine, I provide the bottom of the body 1 with concaved reaction surfaces 21 and 22 and an intervening convexed or bulged portion 23, performing the same functions as the parts 9, 10 and 11 of the wings and adapting the body to also serve as an efficient lifting and sustaining element capable of supporting a portion of its own weight. The surface 22 leads back to the tail piece 8, which operates as a part of the lifting surface of the body, performing with respect to the body the same function as the flexible posterior portion 12 of each wing.

The wings and tail piece are pivotally mounted to tilt vertically on horizontal transverse axes, for steering and balancing operations, and are also demountably connected with the body 1 so that the parts of the machine may be readily and conveniently assembled and disassembled for greater advantage in storing and transporting the machine and setting it up for use. Associated with the pivotal supports of the wings and tail piece are devices which provide for the adjustment of said parts and for their steering and controlling actions. The mode of mounting the wings and tail piece and gearing for adjusting the same are preferably, but not necessarily, of the construction and arrangement herein disclosed, which I will now proceed to describe.

Secured to the thickened portion of the inner end of each wing is a coupling member or head 24 secured thereto by suitable fastening devices 25 and provided with a dove tailed guideway formed by spaced parallel guide ribs 26 and a forward cross rib or abutment 27, closing the guideway at the front, the said guideway being open at the rear. For additional security in fastening the member 24 to the wing I provide said member with apertured ears 28, which overlap the top and bottom surfaces of the wing and whose apertures register with the passage 29 in the wing. The said coupling head or member 24 is adapted for coupling engagement with a coupling member 30 mounted on the body, said member 30 comprising a circular plate or disk provided on its outer face with dove tailed guide grooves 31 to receive and interlock with the ribs 26 and an undercut abutment shoulder 32 to engage the dove tailed cross piece 27, whereby the coupling heads are held from endwise displacement in one direction when united but may be disconnected by a relative endwise movement in the opposite direction. The outer face of the head 30 is also provided with a pair of apertured ears 33 adapted to extend over the ears 28 of the head 24, through which ears and the passage 29 a locking pin or bolt 34 is passed to hold the head against relative movement and fasten the wing securely in position. The head 30 is provided with a central bearing aperture 35 and is channeled and formed upon its inner face with a mutilated internal gear 36. As clearly shown in Fig. 5, the coupling head 30 of each wing support is rotatably mounted in the side of the body 1, said head being provided for this purpose with a peripheral bearing flange 37 which is mounted to turn in a bearing raceway formed between an outer retaining ring or plate 38 and an inner bearing plate or spider 39, the respective parts 38 and 39 being provided with apertured portions or ears receiving the threaded ends of cross rods or bolts 40. The opposite ends of such rods or bolts pass through the ears of both sets of plates at the opposite sides of the body and also through perforations in inner stationary retaining rings 41 suitably fastened to the sides of the body, whereby the sets of retaining rings or plates are detachably secured in position and when applied firmly fastened to the body and rods. The construction is thus such that upon the removal of outer clamping nuts 41′ the retaining plates 38 and 39 will be disconnected from the body for removal, the rods 40 being held from outward displacement by inner clamping nuts 42. The internal gear 36 meshes with a gear pinion 43 carried by a mutilated floating or idler gear 44′ loosely mounted upon the outer end of a controlling shaft 44, two axially alined controlling shafts 44 being employed and constituting divided sections of a transverse shaft adjustable simultaneously in the same or opposite directions. The shafts 44 are journaled at their outer ends in bearing openings 45 in the inner retaining plates 39 and at their inner ends in stationary bearing plates 46 forming a yoke supported by certain of the rods 40. Feathered upon the outer end of each shaft 44 between the head 30 and retaining plate or member 39 is a gear 47 meshing with the pinion 43, which is adapted to be carried around with the gear 44′ as well as to be rotated independently thereof by the gear 47 on its own axis. The teeth of the mutilated gear 44′ mesh with a transmission gear or pinion 48 fixed or feathered to a second transverse shaft 49 journaled at its ends in open bearing slots 50 formed in ears or extensions 51 from the retaining plates or members 39, each of which is provided with a slot 52 through which the gear 48 projects, the shaft being held seated within each bearing slot by a detachable keeper plate 53, upon the removal of which the shaft and gear may be withdrawn from the slots to permit of the disassemblage of the parts.

It will be understood from the foregoing

that each wing is detachably secured in position and may be removed by simply detaching the fastening pin 34, and it will also be evident that by disconnecting the outer clamping nuts 41′ from the rods 40, the adjusting gearing associated with the clamping heads forming the wing support may be together removed from the body, leaving the rods 40 in position and supported by the stationary rings 41, it being understood that upon removing the nuts 41′ the coupling member 30, inner retaining plate 31 and the gears 44′ and 47 may be withdrawn, by simply sliding them off the end of the shaft 44, to which the gear 47 is feathered, so that the aforesaid parts of the wing supporting and adjusting devices may be easily reached or detached for cleaning, oiling, repairing or renewal, as occasion may require, leaving the rods 40 and shafts 44 in position. It should be stated that as the shaft 49 is held in position by the plates 53, and the gears 48 hold the members 30 normally from withdrawal, it is necessary, if it should be desired to also remove the plates 39, to first detach the plates 53 and then slip the shaft 49 out of its bearing slots 50, whereupon the gears 48 will be withdrawn from the slots 52, leaving the plates 39 free for withdrawal.

The inner ends of the shafts 44 are provided with beveled gears 54 which mesh with a gear 55 on an operating shaft 56 journaled upon the yoke 46 and provided with a hand wheel 57, by which it may be manipulated. When the hand wheel is turned in one direction or the other it will be evident that the shafts 44 will be simultaneously turned in opposite directions, and that the gears 47 will be rotated and will rotate the pinions 43 on their axes, without turning the gears 44′, to communicate motion to the internal gears 36 of the respective coupling heads 30, whereby the wings will be simultaneously tilted in opposite directions to different angular positions, thus enabling the wings to be employed for steering the machine to the right or left, to bank the machine in making turns to a proper degree and to maintain the lateral balance or equilibrium of the machine. An operating lever 58 is fixed to the shaft 49 and is movable in a fore and aft direction to correspondingly adjust said shaft, whereby the gears 48 may be turned to communicate motion to the floating gears 44′, which gears will act through the pinions 43 to transmit motion to the mutilated gears 36, whereby the coupling heads 30 may be turned to simultaneously adjust both wings in the same direction either upward or downward to vary their angle of incidence and lifting effect or to enable them to be employed alone or in conjunction with the tail piece to steer the machine vertically or to maintain longitudinal stability. In this operation, it will be understood, the pinions 43 have a planetary action around the gears 47, in which they simply traverse said gears without turning them. Another lever 59 is loosely mounted on the shaft 49 and to this lever, above and below the shaft, are connected the forward ends of controlling cables 60 and 61, which pass rearwardly over suitable guides to the tail end of the body, where their opposite ends are secured to crank arms 62 projecting from a transverse shaft 63, whereby the tail piece 8 is adjusted, as hereinafter described. The levers 58 and 59 are provided with spring-actuated dogs or pawls 64 and 65 to respectively engage racks 66 and 67 suitably supported by the yoke or adjacent rods 40, whereby the levers may be conveniently locked in adjusted position and released for manipulation when desired.

The tail piece 8 has secured thereto a coupling plate or member 68 having coupling ribs 69 provided with dove tailed inner edges, the plate being further provided, like the plate 24, with apertured ears 70 which project over upon the head 16 of the tail piece and whose openings register with a passage 71 in the tail piece. The undercut inner edges of the ribs 69 are adapted to engage the undercut outer edges of ribs 72, formed upon a head or coupling member 73 pivotally mounted upon the rear end of the body to turn vertically upon a horizontal transverse pin or axis 74. The ribs 69 and 72 are formed for a wedging interlocking engagement, and the coupling head or member 73 is provided with apertured ears 75 adapted to lap over upon the tail piece and overlie the ears 70, so that the pin or bolt 75′ may be passed through the registering openings in the ears and the passage 71 to hold the tail piece against displacement, while permitting of its ready removal when occasion requires. The head or member 73 carries a gear segment 76 meshing with a pinion 77 on the shaft 63, so that by the adjustments of the lever 59 the tail piece may be elevated or depressed to any desired extent within its range of movement.

From the foregoing description, taken in connection with the drawings, the construction and mode of operation of my improved flying machine will be readily understood, and it will be seen that the invention provides a flying machine of the aeroplane type which possesses maximum lifting capacity, a high degree of inherent stability, a wide range of balancing and steering control without the use of auxiliary balancing and steering devices, which provides wing surfaces having a novel wind shedding action, and which embodies simple and effective means providing for the ready and convenient demounting of the wings and gear-

ing and for the adjustment of the wings and tail to serve the described functions, the advantages of which will be manifest.

It will, of course, be understood that the essential features of the invention may be embodied in monoplanes, biplanes or multiplanes.

Having thus described my invention, I claim:

1. A flying machine including a body of streamline form having an upper convex rarefaction surface and a lower compoundly curved reaction surface, a vertically adjustable tail piece at the rear end of said body, said tail piece forming a continuation of the reaction surface, said reaction surface of the body including a bulged breast portion arranged substantially in line with the centers of gravity and pressure of the machine and dividing said reaction surface into anterior and posterior lifting portions, and wings mounted upon the body and having similarly shaped rarefaction and reaction surfaces.

2. A flying machine including a body of stream line form having an upper convex rarefaction surface and a lower compoundly curved reaction surface, a vertically adjustable tail piece at the rear end of said body, said tail piece forming a continuation of the reaction surface, said body having a bulged breast portion arranged substantially in line with the centers of gravity and pressure of the machine and dividing said reaction surface into anterior and posterior lifting portions, wings mounted upon the body and provided with similarly shaped rarefaction and reaction surfaces, and means for tilting said wings vertically upon horizontal transverse axes to vary the angle of incidence of said surfaces.

3. A flying machine including a body having an upper convex rarefaction surface and a compoundly formed bottom forming front and rear lifting surfaces, and wings carried by the body and provided with similarly shaped rarefaction and reaction surfaces, said wings being mounted to tilt upon horizontal transverse axes coinciding with the line of division between the front and rear lifting surfaces, the lifting surfaces of the body and wings being arranged, respectively, in front and rear of the centers of gravity and pressure of the machine.

4. In a flying machine, a supporting surface comprising a wing of birdlike contour having an upper convexly curved rarefaction surface, and a lower compoundly curved reaction surface, said wing being provided upon its reaction side with a bulged portion rendering it of maximum depth at a point coincident with the centers of gravity and pressure thereof, said breast portion separating the said reaction surface in front and rear lifting portions, each having a lifting curvature.

5. In a flying machine, a supporting surface comprising a wing of birdlike contour and having an upper convexly curved rarefaction surface and a lower compoundly curved reaction surface, said wing being provided upon its reaction side with a bulged breast portion rendering it of maximum depth at a point substantially coincident with its centers of gravity and pressure, said breast portion separating the reaction surface into front and rear lifting surfaces, each having a lifting curvature, the tail portion of said wing forming the extremity of the rear lifting surface being provided with flaps or vanes arranged in lapping relation and forming passages for the escape of air under excess pressure.

6. In a flying machine, a supporting surface comprising a wing of birdlike contour and having an upper convexly curved rarefaction surface and a lower compoundly curved reaction surface, said reaction surface being formed with a bulged breast portion rendering the wing of maximum depth substantially at a point coincident with its centers of gravity and pressure, said breast portion separating the reaction surface into front and rear lifting portions, each having a lifting curvature, said wing being of gradually decreasing depth in the plane of the breast portion from butt to tip thereof, and having its trailing edge forming a continuation or vanes arranged in lapping relation and forming passages for the escape of air under excess pressure.

7. A flying machine including a body, a tail rudder carried thereby, said body and rudder being formed to provide front and rear lifting surfaces arranged respectively anteriorly and posteriorly of the transverse axis of the body, and wings upon the body having correspondingly formed reaction portions forming lifting surfaces in front and rear of the mean center of pressure thereof.

8. In a flying machine, a supporting surface comprising a wing of substantially bird wing contour, said wing having a convex rarefaction surface and a compoundly curved reaction surface, said reaction surface being formed to provide front and rear lifting surfaces, and an intervening bulged or breast portion, the said bulged or breast portion being arranged in line with the normal mean center of pressure of the wing and progressively varying in depth throughout the length of the wing.

9. In a flying machine, a supporting surface comprising a wing of substantially bird-like contour in plan, said wing having a convex rarefaction surface and a compoundly curved reaction surface, said reac-

tion surface forming front and rear lifting portions intersecting a bulged breast portion disposed in advance of the longitudinal center of the wing, the posterior portion of the wing being provided with a longitudinal series of over and underlapping flaps for wind shedding action.

10. In a flying machine, a body, a coupling member movably mounted on the body and having dovetailed grooves, a supporting surface, a coupling member on the supporting surface having dovetailed ribs to slidably engage and interlock with the grooves of the first named coupling member, means for holding said coupling members assembled, and means for imparting motion to the said first named coupling member for adjusting said supporting surface.

11. In a flying machine, a body, coupling members rotatably and demountably secured at the sides of the body, supporting wings provided with co-acting coupling members, gearing associated with the coupling members for adjusting the wings, means for operating said gearing to adjust the wings simultaneously in the same direction, and means for operating the gearing for adjusting the wings simultaneously in opposite directions.

12. In a flying machine, a body, demountable wings at the opposite sides of the body, demountable coupling means carrying said wings, said coupling means being rotatably mounted upon the body, control shafts, gearing operated by said shafts for simultaneously adjusting the wings in the same direction, and gearing formed in part by the first named gearing for simultaneously adjusting the wings in opposite directions.

13. In a flying machine, a body, wings journaled upon the opposite sides of the body and provided with gears, control shafts provided with gears, gears loosely mounted on the control shafts and provided with pinions meshing with gears thereon and with said pinions on the wings, means for simultaneously adjusting the control shafts in opposite directions, and means for simultaneously turning the loose gears in the same direction independently of the first named means.

14. A connector between an aeroplane body and wing comprising a ribbed plate upon the inner end of the wing, a second plate having grooves slidably receiving the ribs of the first plate, and a bolt passing through said wing in a transverse direction and detachably securing both plates to the wing.

15. A connector between an aeroplane body and wing comprising a ribbed plate upon the inner end of the wing, a second plate having grooves slidably receiving the ribs of the first plate, a bolt passing through said wing in a transverse direction and detachably securing both plates to the wing, a segmental toothed ring secured to said second plate, and means coöperating with said ring for giving oscillating movements to the wing.

16. A connector between an aeroplane body and wing comprising a ribbed plate upon the inner end of the wing, a second plate having grooves slidably receiving the ribs of the first plate, a bolt passing through said wing in a transverse direction and detachably securing both plates to the wing, a segmental toothed ring secured to said second plate, means coöperating with said ring for giving oscillating movement to the wing, and auxiliary means coöperating with said last means for giving movements to said wing.

17. In an aeroplane, a body, a pair of wings, a pair of ribbed plates carried by the inner extremities of the wings, a second pair of plates having grooves slidably receiving the ribs of the first plates, segmental toothed rings carried by said second plates, and rotatable means passing through the body and coöperating with said rings for giving oscillating movements to the said wings.

18. In an aeroplane, a body, a pair of wings, a pair of ribbed plates carried by the inner extremities of the wings, a second pair of plates having grooves slidably receiving the ribs of the first plates, segmental toothed rings carried by said second plates, and rotatable means passing through the body and coöperating with said rings for giving simultaneous arcuate movements to said wings in the same direction or opposite directions.

19. In an aeroplane, a body, a pair of wings, a pair of ribbed plates carried by the inner extremities of the wings, a second pair of plates having grooves slidably receiving the ribs of the first plates, segmental toothed rings carried by said second plates, and rotatable means passing through the body and coöperating with said rings for simultaneously giving arcuate movements to said wings in opposite directions.

20. In an aeroplane, a body, a pair of wings, a pair of ribbed plates carried by the inner extremities of the wings, a second pair of plates having grooves slidably receiving the ribs of the first plates, segmental toothed rings carried by said second plates, rotatable means passing through the body and coöperating with said rings for simultaneously giving arcuate movements to said wings in opposite directions, and means cooperating with a portion of the last means for giving simultaneous arcuate movements to said wings in the same direction.

21. In an aeroplane, a body, a pair of wings, a pair of ribbed plates carried by the inner extremities of the wings, a second pair of plates having grooves slidably receiving

the ribs of the first plates, segmental toothed rings carried by said second plates, rotatable means passing through the body and cooperating with said rings for simultaneously giving arcuate movements to said wings in opposite directions, and detachable means coöperating with a portion of the last means for giving simultaneous arcuate movements to said wings in the same direction.

22. In combination, an aeroplane body, a wing therefor, a ribbed plate carried by the inner extremity of said wing, a second plate provided with grooves slidably receiving the ribs of the first plate, an annulus abutting one side of said second plate, and a spider abutting the opposite side of the second plate, and secured to said annulus, said spider and annulus being supported by said body.

23. In combination, an aeroplane body, a wing therefor, a ribbed plate carried by the inner extremity of said wing, a second plate provided with grooves slidably receiving the ribs of the first plate, an annulus abutting one side of said second plate, a spider abutting the opposite side of the second plate and secured to said annulus, and a retaining ring detachably secured to the inner surface of the body and detachably supporting said annulus and spider.

24. In combination, an aeroplane body, a wing therefor, a ribbed plate carried by the inner extremity of said wing, a second plate provided with grooves slidably receiving the ribs of the first plate, an annulus abutting one side of said second plate, a spider abutting the opposite sides of the second plate, and secured to said annulus, a retaining ring embedded in the inner surface of one side of the body, and supporting said annulus and spider, and bolts secured to said ring and engaging the opposite side of the body.

25. In combination, an aeroplane body, a wing therefor, a ribbed plate carried by the inner extremity of said wing, a second plate provided with grooves slidably receiving the ribs of the first plate, an annulus abutting one side of said second plate, a spider abutting the opposite side of the second plate and secured to said annulus, a retaining ring embedded in the inner surface of one side of the body and supporting said annulus and spider, bolts secured to said ring and engaging the opposite side of the body, a manually rotatable shaft mounted in said spider, a gear secured thereto, a second gear in mesh therewith, and a segmental toothed ring secured to said second plate and cooperating with said second gear.

26. In combination, an aeroplane body, a wing therefor, a plate secured to one extremity thereof, a second plate detachably secured to said first plate and the wing, a spider abutting one side of said second plate, an annulus secured to said spider and abutting the remaining side of said second plate, a retaining ring detachably connected to the body and supporting said annulus and spider, a segmental toothed ring secured to said second plate, a shaft mounted in said spider, a gear secured thereto, a second gear in mesh with said first gear and said toothed ring, a mutilated gear supporting said second gear, and a second shaft geared to said mutilated gear.

27. In combination, an aeroplane body, a wing therefor, a plate secured to one extremity thereof, a second plate detachably secured to said first plate and the wing, a spider abutting one side of said second plate, an annulus secured to said spider and abutting the remaining side of said second plate, a retaining ring detachably connected to the body and supporting said annulus and spider, a segmental toothed ring secured to said second plate, a shaft mounted in said spider, a gear secured thereto, a second gear in mesh with said first gear and said toothed ring, a mutilated gear supporting said second gear, and a second shaft geared to said mutilated gear, said second shaft being removably supported by said spider.

28. In combination, a body, a supporting wing therefor, a ribbed plate detachably secured to the inner end of said wing, a second plate provided with grooves engaging with the ribs of the first plate, overlying said first plate and secured to the sides of the wing, and means carried by the body for rotatably supporting said second plate.

In testimony whereof I affix my signature in presence of two witnesses.

CLYDE V. BACKUS.

Witnesses:
J. A. LAUTENSCHLAEGER, Jr.,
PAUL W. MALONE.