April 25, 1933. F. R. SUNDLING 1,906,018

AIRPLANE

Filed March 18, 1932 4 Sheets-Sheet 1

Fig. 1

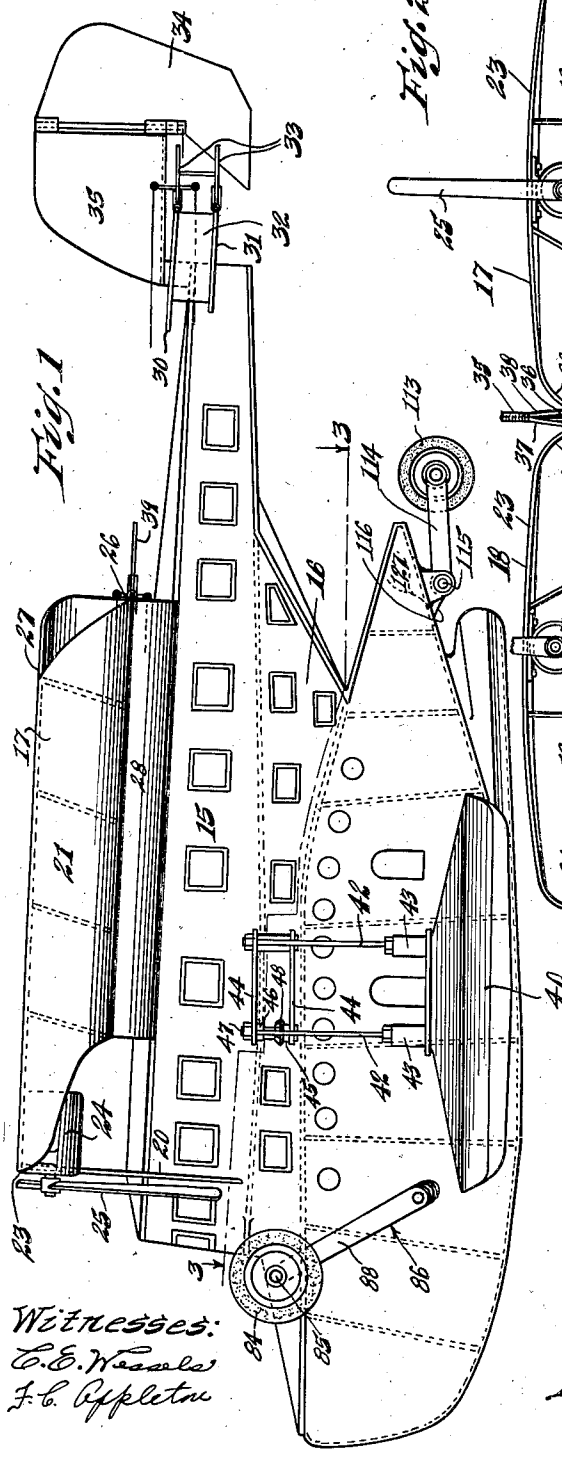
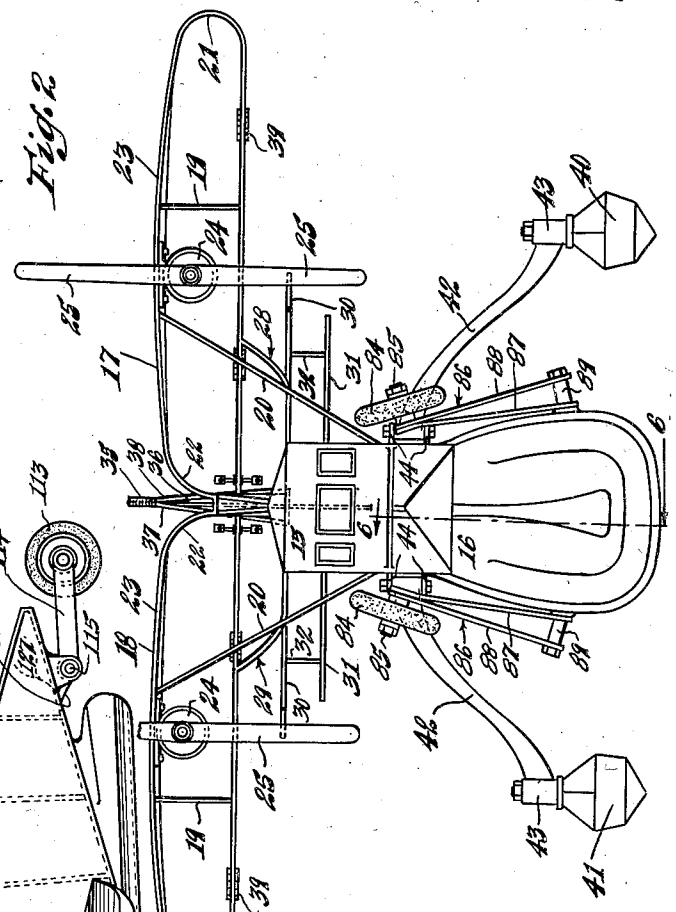


Fig. 2



Witnesses:
C. E. Wessels
F. C. Appleton

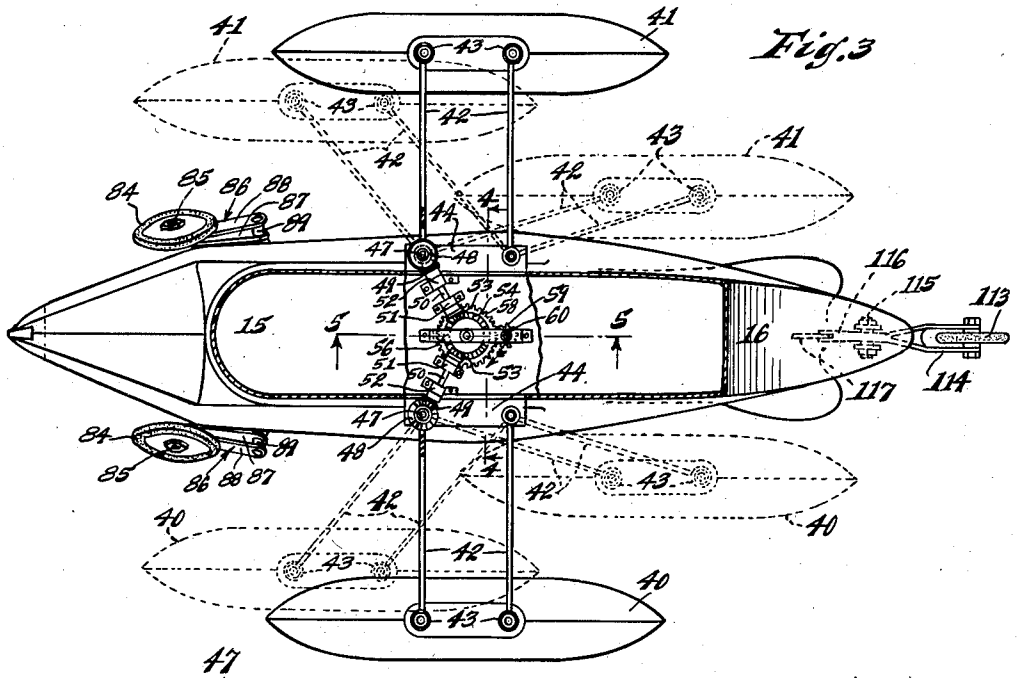
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April 25, 1933. F. R. SUNDLING 1,906,018

AIRPLANE

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Fig. 3



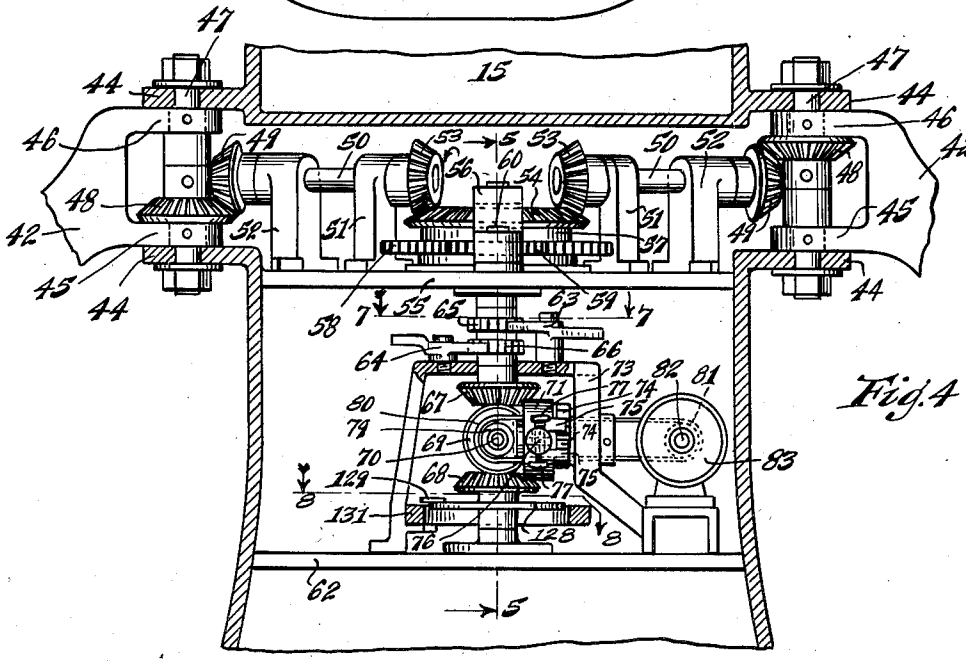


Fig. 4

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AIRPLANE

Filed March 18, 1932 4 Sheets-Sheet 3

Fig. 5

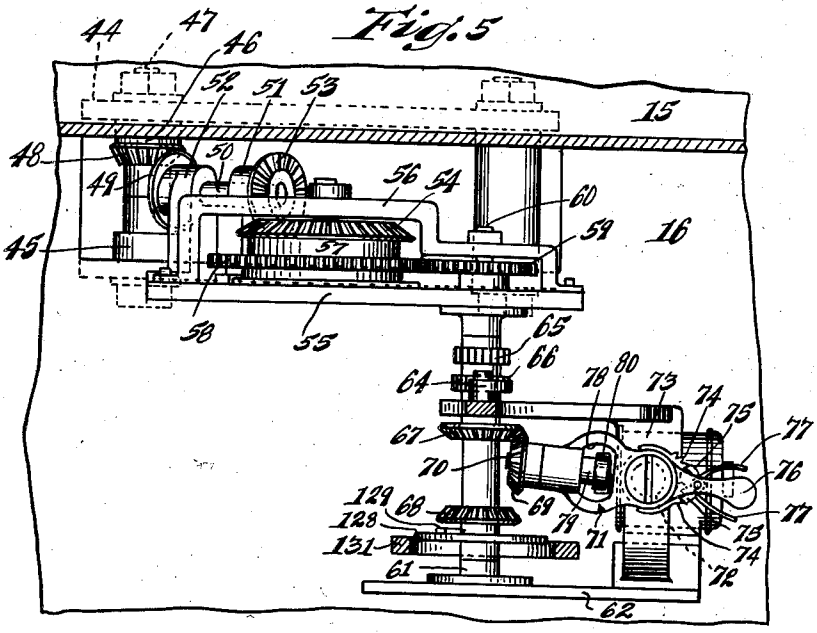


Fig. 6

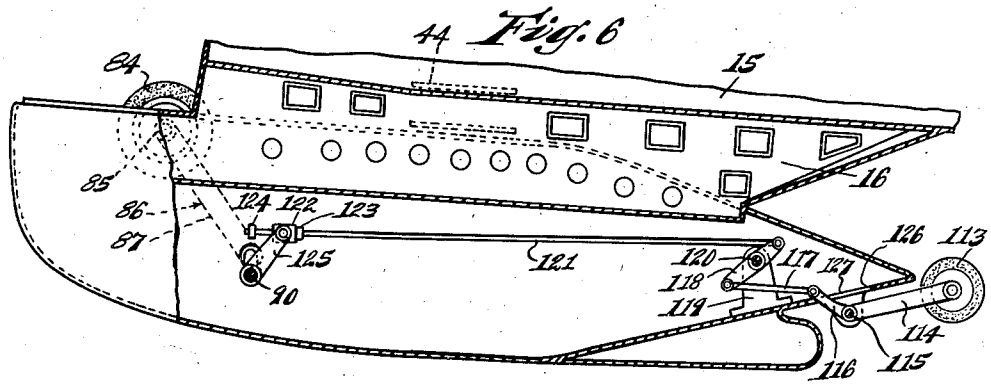


Fig. 7

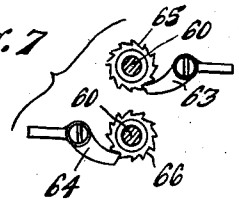
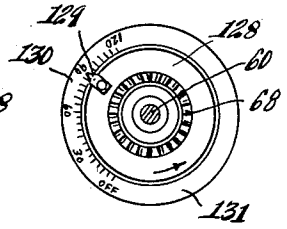


Fig. 8



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AIRPLANE

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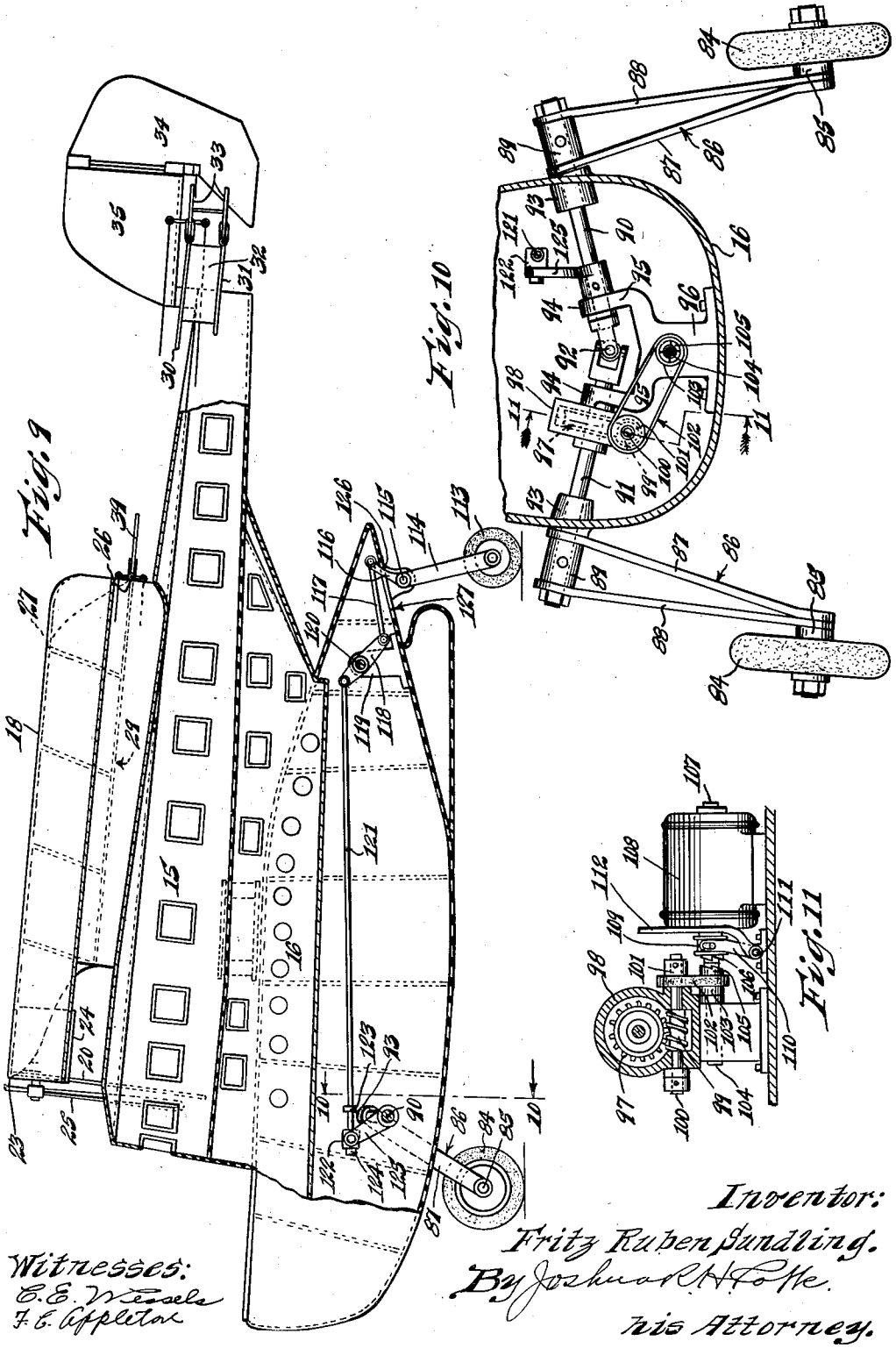


Fig. 9

Fig. 10

Fig. 11

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Patented Apr. 25, 1933 1,906,018

UNITED STATES PATENT OFFICE

FRITZ RUBEN SUNDLING, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-FOURTH TO ALBERT JOHN CHRISTENSON, OF CHICAGO, ILLINOIS

AIRPLANE

Application filed March 18, 1932. Serial No. 599,637.

This invention relates to airplanes, and more particularly to improvements in the adjuncts or parts utilized for supporting and balancing purposes in both taking off and landing when the airplane is used either as a hydroplane or for use on land. To this end the invention has for its principal object to provide for adjustability and collapsibility of the landing gear, equipped with retractible wheels in the landing gear for use on land and retractible and adjustable pontoons for use on the water. Other specific objects and advantages to be attained will hereinafter more fully appear in the following description.

The invention consists in the novel general construction and arrangement, and in the parts and combinations and arrangements of parts hereinafter described and set forth with particularity in the appended claims.

In the accompanying drawings, forming a part of this specification, and illustrating an adaptation of the invention,—

Fig. 1 is a side elevation of a complete airplane;

Fig. 2 is a front elevation thereof;

Fig. 3 is a horizontal section, taken on or about the line 3—3 of Fig. 1, illustrative more particularly of the pontoon mounting and adjustment;

Fig. 4 is a fragmentary section, on an enlarged scale, taken on or about the line 4—4 of Fig. 3, to illustrate details of the actuating and controlling mechanism for the pontoons;

Fig. 5 is a similar view, taken on or about the line 5—5 of Figs. 3 and 4;

Fig. 6 is a fragmentary longitudinal section through the lower portion of the fuselage, illustrating parts of the operating mechanism for the landing wheels;

Fig. 7 is a fragmentary view illustrating the locking ratchets of the actuating mechanism for the landing wheels;

Fig. 8 is illustrative of a device for indicating the adjusted position of the pontoons;

Fig. 9 is a view, partly in side elevation and partly in longitudinal section, of the fuselage, showing the landing wheels adjusted for landing and takeoff purposes;

Fig. 10 is a fragmentary section, on an enlarged scale, taken on or about the line 10—10 of Fig. 9; and

Fig. 11 is a fragmentary section, taken on or about the line 11—11 of Fig. 10, illustrating the power mechanism for actuating the landing wheels.

Referring now to the drawings, the preferred embodiment of the invention comprises a main fuselage which, in the particular construction illustrated, includes an upper passenger carrying section 15 and a lower freight or commodity section 16. It will be understood, however, that the present invention is not necessarily restricted to an airplane of any specific character, but may be advantageously employed in connection with any type of fuselage body or lifting and flight sustaining parts, the particular construction and arrangement to be now generally described constituting of itself no part of the present invention except as hereinafter claimed in connection therewith, but constituting the subject matter of a companion application, Serial No. 599,636, filed March 18, 1932.

As shown, the airplane comprises right and left wing members 17, 18, respectively, each of said wing members being tubular or hollow in a direction longitudinally of the airplane. It will be understood that the general framework as well as the wing and other portions may be constructed of wood or metal covered with cloth fabric. The hollow wing members may be internally braced by vertical strut members or braces 19, and further braced at their forward portions to the adjacent body portion of the fuselage by diagonal stays 20. The upper and lower portions of each wing member are connected at the outer ends of the wings by curved portions 21, the upper inner end portions of the wings merging with curvature, as at 22, adjacent the longitudinal median line of the airplane body or fuselage.

As shown more clearly in Figs. 1 and 9, the upper portion of each wing member extends a considerable distance in advance of

the forward lower portion, thereby providing a leading edge 23, by which construction and arrangement the driving motors 24 carrying the propellers 25 may be conveniently mounted on the under side of the upper portion of the wing adjacent where the diagonal stays are attached to said upper portions of the wings 17 and 18. The forward projection of the upper portion of the wing is approximately one-fourth the entire width of the wing, and, in addition to this projection, the rear edge 26 of the lower portion of each wing projects or extends rearwardly relative to the rear edge 27 of the upper portion of the wing. By this construction and arrangement the leading edge 23 not only serves as a hood over the driving motor 24, but also cuts the air stream in advance of the forward edge of the lower portion of the wing, permitting a relatively large volume of air to be received and compressed during passage through the air passageways 19 and releasing the air rearwardly and upwardly between the rear edges 26 and 27, resulting in greater lifting power.

Mounted beneath the right and left wings 17 and 18, respectively, are auxiliary air receiving members 28 and 29, which are considerably smaller in cross-sectional area than the respective wings and disposed adjacent the upper surface of the fuselage, as more clearly shown in Figs. 1 and 2 of the drawings. These members 28 and 29 are substantially equal in length to the width in a longitudinal direction of the lower wing portions.

Cooperating with the wing members 17 and 18, and also with the auxiliary members 28 and 29, are a pair of tail planes 30 and 31, comprising upper and lower members which are connected by interposed partitions 32 lying in vertical planes parallel to a vertical plane passing through the longitudinal median line of the airplane body or fuselage.

At the rear edge portions of the tail plane members 30 and 31 on opposite sides of the tail fin 35, are hingedly mounted elevators 33. As shown, the tail fin 35 is of tubular or hollow construction to afford a longitudinal passageway 36. In the preferred construction the tail fin 35, upon which the rudder 34 is pivotally mounted, is composed of a pair of side members 37 and 38 which are connected adjacent the upper edges but diverge downwardly. The mounting of the fin 35 is such that the air stream passing through the passageway 36 is centrally cut by the forward edge of the rudder 34, which tends to increase stability and ease of operation. Ailerons 39 may be pivotally mounted upon the rear edge portions of the lower portions of the wings 17, 18. Operating means for the elevators 33, rudder 34, and ailerons 39, are not shown, inasmuch as any standard equipment may be utilized for this purpose.

In the preferred construction the distance between each upper frame and the associated lower frame member is equal approximately to one-fifth or one-sixth of the lateral length of the wing, although it is to be understood that the invention is not necessarily limited to these proportions.

The essential features of the present invention will now be described, said features being the peculiar pontoon mounting and adjustment and the provision for movably mounting the landing wheels.

First referring to the pontoon arrangements, the pontoons themselves are respectively designated by the numerals 40 and 41, said pontoons being located for operation laterally on opposite sides of the fuselage or body of the airplane. These pontoons, which may be made of any suitable material, are mounted on parallel inclined supporting bars 42, the lower ends of said bars 42 being swiveled, as at 43, directly to the pontoons, the upper portions of said bars being swiveled in brackets 44 on opposite sides of the fuselage or body of the airplane. By this mounting the pontoons may, through the connected instrumentalities hereinafter described, be supported in direct lateral extension from the fuselage, as shown more clearly in full lines in Figs. 1, 2, and 3 of the drawings, in normal floating position, or they may be shifted forwardly to the dotted position indicated in Fig. 3, but while not in use said pontoons may be shifted to the rearward in position indicated in dotted lines in Fig. 3, in which latter position the pontoons are disposed closely adjacent to the sides of the fuselage.

For the operation of the pontoons in the manner just above described, said bars 42 have their upper end portions preferably forked or bifurcated, as at 45 and 46, said bifurcated portions being pinned or otherwise secured on a swivel shaft or pivot stud 47, said shafts or studs being journaled in the hereinbefore mentioned bracket members 44. Also secured, by pinning or otherwise, on one of the swivel shafts or pivot studs 44 at each side of the fuselage, preferably the forward one of each pair, is a beveled pinion 48, the pinion on one side being at the upper portion of the shaft or stud 47, and that at the other side being on the lower portion of the shaft or stud. Engaging the respective pinions 48 are pinions 49 fixed on shafts 50, which are rotatably journaled in bracket members 51 and 52, said shafts 50 being provided at their inner ends with pinions 53 meshing with a beveled crown gear 54 journaled between a base plate 55 and a yoke member 56, said crown gear having a cylindrical portion 57 on which is fixed a spur gear 58. Said spur gear in turn meshes

with a pinion 59 mounted on the upper end portion of a vertical shaft 60 whose upper end portion is journaled in said base plate 55 and yoke member 56, the lower end portion of said shaft 60 being journaled in a pedestal bearing 61 on a lower base plate 62.

Normally the shaft 60 is held from rotation by a pair of oppositely disposed dogs or pawls 63 and 64 which are located in different horizontal planes, one of said pawls, 63, engaging a ratchet wheel 65 which is fixed on the shaft 60, and the opposite pawl 64 engaging a reversely toothed ratchet wheel 66. Fixed on the shaft 60 are a pair of opposed bevel gears 67, 68, and disposed in cooperative relation between said gears 67, 68, is a gear 69 fixed on a stub shaft 70 which is journaled in an oscillatory supporting bracket 71, said supporting bracket being pivotally mounted, as at 72, on a frame member 73. In order to lock the supporting bracket 71 in adjusted position with the gear 69 in mesh with either the gear 67 or 68, as the case may be, oppositely disposed toothed sectors 74 are provided on the frame member 73 for engagement of dogs 75 pivotally mounted on a handle or operating extension 76 of said oscillatory supporting bracket 71, said dogs being provided with handle portions 77 for moving them into and out of engagement with said toothed sectors 74.

The oscillatory supporting bracket 71 has an open yoke portion 78 into which the inner end portion of the stub shaft 70 projects and is provided with a pully or a sprocket wheel 79 which is connected by a belt or chain 80 to a pulley or sprocket wheel 81 fixed on the shaft 82 of a motor 83 mounted on the base portion of the frame of which the member 73 is a part. By this arrangement the power of the motor may be transmitted at will to either of the gears 67 or 68 when the latter are alternately engaged by the gear 69 on the stub shaft 70, except at such time when the gear 69 is in a neutral position between the two gears 67 and 68. Thus the vertical shaft 60 may be normally at rest but operated in opposite directions by selective engagement between the gear 69 and the gears 67 and 68, as above described.

In practice, the supporting brackets 44 for the pontoons 40 and 41 are located centrally of the sides of the body or fuselage of the airplane so that the normal weight of the machine is distributed evenly fore and aft of the transverse axis of the pontoons, and the supporting bars 42 are of proportionate length to position the pontoons 40 and 41 at a distance from the body or fuselage sufficient to steady the craft when it is upon the water. In case the load is increased appreciably on either side of the normal transverse axis of the pontoons, the actuating mechanism may be operated to swing the parallel bars 42 forwardly or rearwardly, as the case may be, thereby shifting the pontoons correspondingly. When the craft is in flight or is to be used on land in the takeoff or landing, the pontoons are shifted to their rearmost extremities, as shown to the right in Fig. 3 of the drawings, in which condition the pontoons are located close to the body or fuselage.

The mechanism for operating and controlling the landing gear will now be described. Disposed laterally from the forward portion of the body or fuselage are the ground wheels 84 which are journaled, as at 85, at the extremities of swingable frames or standards 86. Said frames or standards, as shown, preferably comprise two members 87, 88, which are brought together at their outer ends and diverge toward their inner ends, their inner end portions being secured to intermediate tubular struts 89 which are pinned respectively to shafts 90 and 91. Said shafts 90 and 91 are disposed transversely of the lower portion of the body or fuselage and at an inclination with respect to each other with their inner end portions connected by universal coupling 92 (see Fig. 10). The outer portions of said shafts 90 and 91 are journaled in bearings 93 on the side walls of the body or fuselage, while their inner portions are journaled in bearings 94 on forked extensions 95 of a pedestal or supporting standard 96. Fixed on the shaft 91 is a worm gear 97 which is surrounded by a housing 98 mounted on the bearing extension 95 of the pedestal or standard 96, as best shown in Figs. 10 and 11, said housing having journaled therein a worm screw 99 on the shaft 100 having a pulley or sprocket wheel 101 connected by belt or chain 102 to a pulley or sprocket wheel 103 on a countershaft 104 journaled in the pedestal or standard 96. The countershaft 104 is provided with a clutch member 105 for engagement by a cooperating clutch member 106 slidably keyed on the shaft 107 of a motor 108, said clutch member 106 having an annularly grooved portion 109 with which cooperates a shifting yoke 110, pivoted as at 111, and having an operating lever or handle member 112 by which the clutch member 106 is moved into and out of engagement with the clutch member 105. By the foregoing provisions the shafts 90 and 91 are simultaneously rotatable at will of the operator and the frame members or standards 86 carrying the ground wheels 84 are accordingly moved either to operative position, as shown in Figs. 9 and 10 of the drawings, or raised to inoperative position, as shown in Fig. 1. Any suitable or approved means for releasably locking the wheels in their raised and lowered positions may obviously be provided, but, in the particular construction and arrangement shown, no special locking means are necessary as the

engagement of the worm gear 97 with the worm screw 99 prevents rotation of the connected shafts 90 and 91 except when actuated by rotation of the shaft 100 on which the worm screw 99 is fixed and controlled by the clutch and driving connections between the shaft 100 and the motor 108.

The angular disposition of the shafts 90 and 91 on which the swingable carrier frames or standards 86 for the ground wheels 84 are mounted is an important feature of the present invention in that, in addition to entering into a simplified and practical operating and controlling mechanism for the ground wheels, the requisite lateral projection and transverse spread of the wheels with respect to the body or fuselage is effected for stability in landing the craft. That is to say, in the lowered position of the ground wheels they are spread laterally with sufficient transverse supporting base to effectively prevent toppling of the craft sidewise, as the angular set of the carrier frames or standards 86 affords a natural stay, while in the raised condition of said carrier frames or standards 86 the ground wheels 84 are brought in close proximity to the sides of the body or fuselage so as to be out of the way and minimize resistance while the craft is in flight.

Provision is also preferably made for shifting the tail skid into and out of operative position. As shown, the tail skid is preferably provided with a ground contact wheel or roller 113, the skid element or arm 114 being pivotally mounted on the rear under portion of the body or fuselage as at 115, and having an angularly disposed operating arm or lever extension 116 extending into the body or fuselage and pivotally connected to the end portion of a link bar 117 whose opposite end portion is pivotally attached to a rocker element 118, which latter is pivotally mounted on a pedestal or standard 119, as at 120. The rocker arm 118 is pivotally connected to one end of a link rod or bar 121 whose opposite end portion is slidably supported in a sleeve block 122, relative endwise movement between the rod or bar 121 and said sleeve block 122 being limited by opposed stop collars or shoulders 123, 124, said shoulders being spaced a predetermined distance apart to provide certain lost motion whereby the ground wheels 84 are moved a considerable distance upwardly before the swingable arm of the tail skid 114, carrying the wheel 113, moves upwardly in retracting the landing gear, as will hereinafter more fully appear.

The sleeve block 122 is pivotally engaged with the end portion of a crank arm 125 which is fixed on the shaft 90, whereby, when the shaft is rotated the arm 125 is correspondingly swung and the block 122 moves longitudinally of the bar or rod 121 until engaged with one of the stop collars or shoulders 122 or 124, as the case may be, after which engagement and during the continued movement of the arm 125, the bar or rod 121 is accordingly moved longitudinally, thereby imparting rocking movement to the rocker element 118 and through the connecting linkage and leverage correspondingly moves the tail skid 114 upwardly or downwardly. Thus, when the swingable frames or standards 86 are swung downwardly by the power of the motor 108 and the operating mechanism including the worm gear 97 and worm screw 99, the landing gear is locked in its effective landing condition and at the same time the sleeve block 122 has engaged the stop collar or shoulder 124, thereby retracting the rod or bar 121 and effecting the movement of the rocker element 118 in the direction to lower the tail skid 114 so as to bring the ground wheel 113 into effective position, at which time, of course, the tail skid is locked by the engagement between the sleeve block 122 and stop collar or shoulder 124; that is to say, the tail skid is held against any force or resistance tending to move it from its effective operative position, as shown in Fig. 9. By reversely actuating the actuating mechanism for the forward ground wheels 84 of the landing gear, the tail skid 114 is automatically raised simultaneously therewith, the forward ground wheels, of course, being raised a considerable distance before the tail skid 114 is elevated, owing to the lost motion afforded by the spacing of the stop collars or shoulders 123 and 124, between which the sleeve block 122 operates, and this movement of the parts being effected while the airplane is in flight.

In the lowering of the forward ground wheels 84 of the landing gear the tail skid 114 drops therewith by gravity and its lowermost position is determined by the engagement of the lever arm 116 of said tail skid against the outer end 126 of the slot 127 in the bottom of the body of the fuselage through which said arm 116 works, after which positioning of the tail skid the forward ground wheels are further lowered until the sleeve block 122 again engages stop collar or shoulder 124, as more clearly shown in Fig. 9 of the drawings.

By the foregoing description, and with reference to the illustrated adaptation of the invention in the accompanying drawings, it is obvious that the ground wheels of the landing gear and tail skid, and the pontoons, may be selectively placed in effective operative condition, at will, and readily substituted the one for the other according as to whether the craft is to be operated on and above land or water and, when not in use, both the ground and water landing facilities may be retracted into close

proximity to the body or fuselage of the craft.

Any suitable means may be provided within the body or fuselage of the craft by which the pilot or observer may note the position of the float members or pontoons 40 and 41. As an illustration of such means, the vertical power shaft 60 may be provided adjacent its lower end, preferably immediately above the pedestal bearing 61, with a circular plate or disc 128 having a pointer 129 at the periphery thereof, said pointer cooperating with an arcuate dial 130 marked on an annular member 131 supported by the lower framework in which the intermediate portion of the shaft 60 is journaled. By this arrangement the operator may readily determine from the position of the pointer with relation to the dial the exact position to which the pontoons or float members 40 and 41 are adjusted.

While the preferred form and construction of craft for carrying the invention into effect is illustrated in the accompanying drawings, it is to be understood that considerable variation and modification may be made without departing from the spirit and scope of the invention as defined by the appended claims. The invention, therefore, is not limited to the precise details of construction shown and described.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In an aircraft of the character described, in combination with the body or fuselage thereof, landing gear comprising forward ground wheels, said wheels being mounted upon vertically swingable frames or standards, said frames or standards being fixed on transversely disposed inclined shafts extending laterally outward and upward from opposite sides of the body or fuselage and being operably joined for simultaneous rotation, power means for actuating said shafts, at will, to raise and lower said ground wheels, a tail skid pivotally mounted at the rear portion of the body or fuselage, and an operative connection between said tail skid and the actuating means for the forward ground wheels whereby the tail skid is raised and lowered simultaneously with the ground wheels.

2. In a ground landing gear for airplanes and the like, forward ground wheels, means for raising and lowering said ground wheels, a retractible tail skid at the rear end of the body or fuselage, means for operably connecting said tail skid and said forward ground wheels whereby to effect substantial simultaneous actuation thereof, said connection having provision for lost motion whereby the forward ground wheels and tail skid are operated the one in advance of the other.

3. In an aircraft of the character described, a landing gear comprising transverse angularly disposed shafts operably joined at their inner ends for simultaneous actuation, said shafts extending laterally outward and upward at an inclination from the opposite sides of the body or fuselage, swingable members fixed on said shafts so as to rotate therewith, ground wheels at the free ends of said swingable members, a worm gear on one of said shafts, a worm screw for actuating said worm gear and for locking the shaft in adjusted position, and power means for actuating said worm screw.

4. In an aircraft of the character described, a landing gear comprising transverse angularly disposed shafts operably joined at their inner ends for simultaneous actuation, swingable members fixed on said shafts so as to rotate therewith, ground wheels at the free ends of said swingable members, a worm gear on one of said shafts, a worm screw for actuating said worm gear and for locking the shaft in adjusted position, power means for actuating said worm screw, a swingably mounted tail skid, said skid having a lever extension, a rocker element, a pivotal link connection between said rocker element and said lever extension of said tail skid, and a connecting bar pivotally attached to said rocker element and having a slidable, limited stop connection with a lever arm on one of said inclined shafts.

5. In an aircraft of the character described, in combination with the body or fuselage thereof, a pair of inclined transversely disposed shafts having an operable universal connection at their meeting ends, swingable members on said shafts, ground wheels journaled on said swingable members, power means for actuating one of said shafts and for locking the shaft in adjusted position, a lever arm on one of said shafts, a sleeve block pivoted to said lever arm, a rod slidable through said sleeve block, opposed spaced stop members on said rod between which said sleeve block operates and alternately engages said stop members to effect reciprocation of said rod, a rocker element to which said rod is pivotally connected, a tail skid having a lever extension, and a pivotal link connection between said lever extension and said rocker element.

6. In an aircraft of the character described, water landing and takeoff means comprising float members movably supported at opposite sides of the body or fuselage, said float member being pivotally attached at the outer ends of parallel supporting arms, said supporting arms being hingedly mounted for swingable movement about vertical axes at their inner ends, and power means for simultaneously actuating one of said supporting arms on each side of the body or fuselage and effecting forward

and rearward movement of said float members in parallel relation.

7. In an aircraft of the character described, water landing and takeoff means comprising float members pivotally attached at the outer ends of parallel supporting arms, said supporting arms being hingedly mounted at their inner ends upon bracket members disposed on opposite sides of the body or fuselage of the craft, power means for simultaneously actuating one of said supporting arms on opposite sides of the body or fuselage and effecting forward and rearward movement of said float members in parallel relation, power means comprising companion shafts having gear connections at their outer ends with the supporting and moving means for said float members, said shafts having gears at their inner ends engaged with a driving gear, a power shaft geared to said driving gear, and means for imparting reverse rotation to said power shaft at will.

8. In an aircraft of the character described, water landing and takeoff means comprising float members pivotally attached at the outer ends of parallel supporting arms, said supporting arms being hingedly mounted at their inner ends upon bracket members disposed on opposite sides of the body or fuselage of the craft, power means for simultaneously actuating one of said supporting arms on opposite sides of the body or fuselage and effecting forward and rearward movement of said float members in parallel relation, power means comprising companion shafts having gear connections at their outer ends with the supporting and moving means for said float members, said shafts having gears at their inner ends engaged with a driving gear, a power shaft geared to said driving gear, and means for imparting reverse rotation to said power shaft, at will, said means comprising reversely arranged gears on said power shaft, an intermediate gear movable into and out of engagement with either of said opposed gears on said driving shaft, at will, and a motor for actuating said intermediate gear.

9. In an aircraft of the character described, water landing and takeoff floats retractibly and adjustably supported laterally from opposite sides of the craft, motor actuated means for shifting said float members, the supports for said float members having oppositely disposed bevel gears, companion power shafts having bevel gears at their outer ends engageable with said gears on said float supports, bevel gears at the inner ends of said shafts, a beveled crown gear engageable with said last mentioned shaft gears whereby to effect simultaneous rotation of the latter, a power shaft geared to said beveled crown gear, and means for imparting reverse rotation to said power shaft, at will.

10. In an aircraft of the character described, water landing and takeoff means comprising float members, parallel supporting arms hingedly attached at their outer ends to said float members and at their inner ends to lateral brackets on opposite sides of the body or fuselage of the aircraft, means for effecting simultaneous actuation of said floats in a forwardly or rearwardly direction, said means comprising a power shaft having provision for its reverse rotative actuation at will, and reversely operable locking elements for releasably locking said shaft against rotation in either direction.

11. The herein described float actuating mechanism for aircraft, comprising float supporting arms pivotally mounted on opposite sides of the craft, and means for actuating said arms simultaneously, said means comprising companion shafts geared at their outer ends to said arms and at their inner ends to a crown gear, a power shaft geared to said crown gear whereby to rotate the latter in either direction, oppositely disposed means for releasably locking said power shaft against rotation in either direction, opposed gears on said power shaft in spaced relation to each other, an intermediate gear operable between said opposed gears whereby to be neutral and also shiftable to engagement with either of said opposed gears on said power shaft, a motor, and an operating connection between said motor and said intermediate gear.

In testimony whereof I have signed my name to this specification.

FRITZ RUBEN SUNDLING.