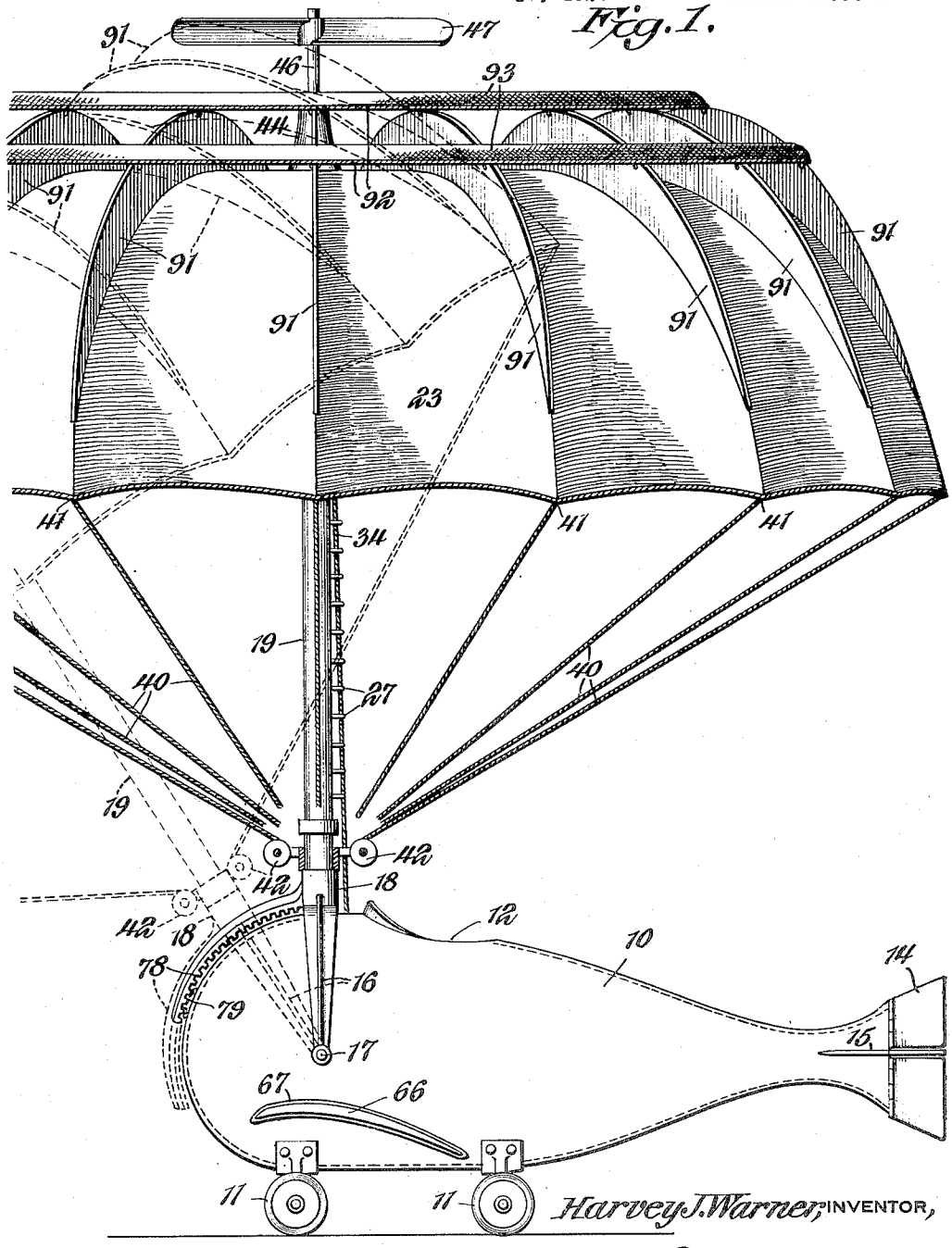
Aug. 18, 1925. 1,549,938

H. J. WARNER

HELICOPTER

Filed Dec. 18, 1924 3 Sheets-Sheet 1

Fig. 1.



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Aug. 18, 1925. 1,549,938

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Fig. 2.

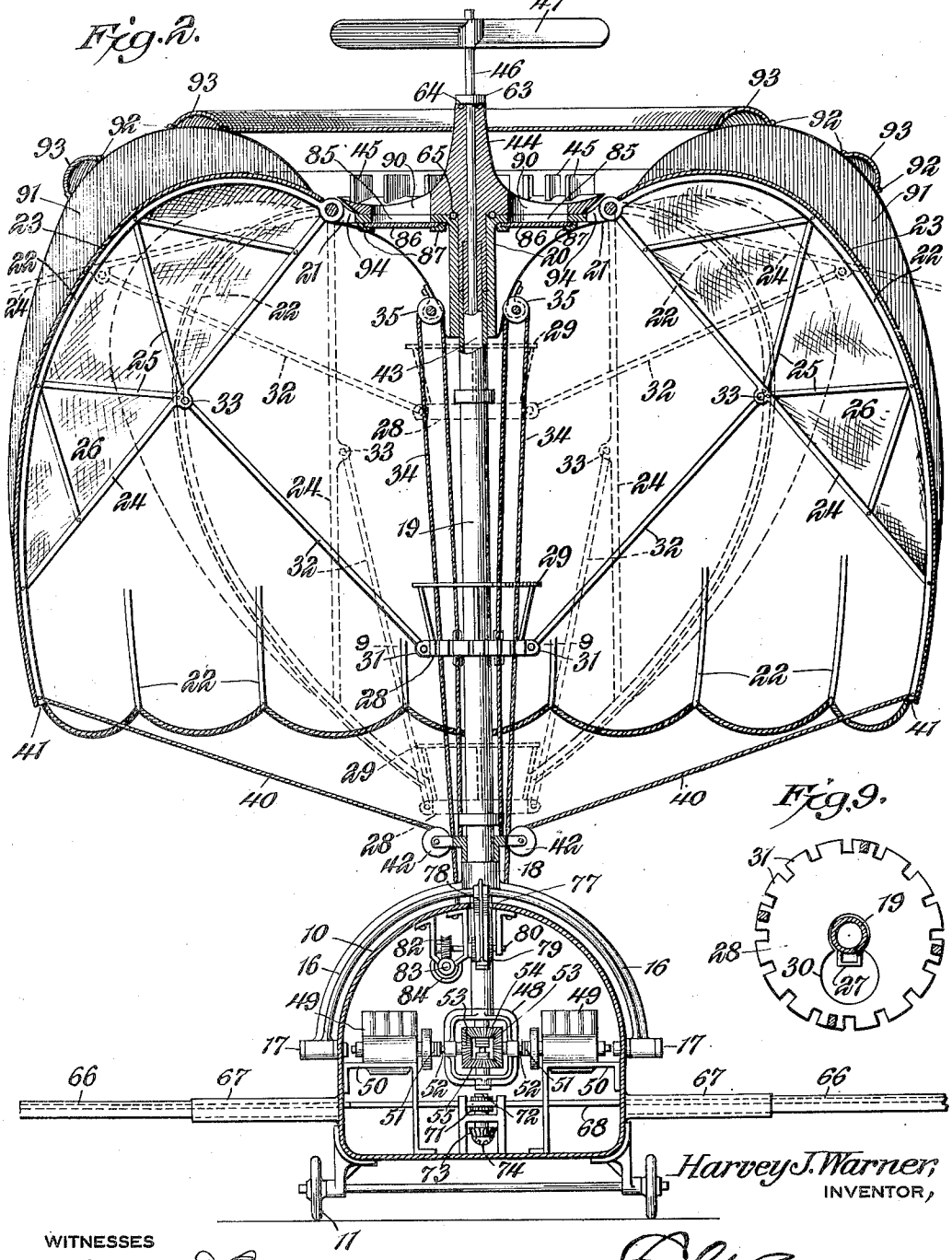


Fig. 9.

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Fig. 3.

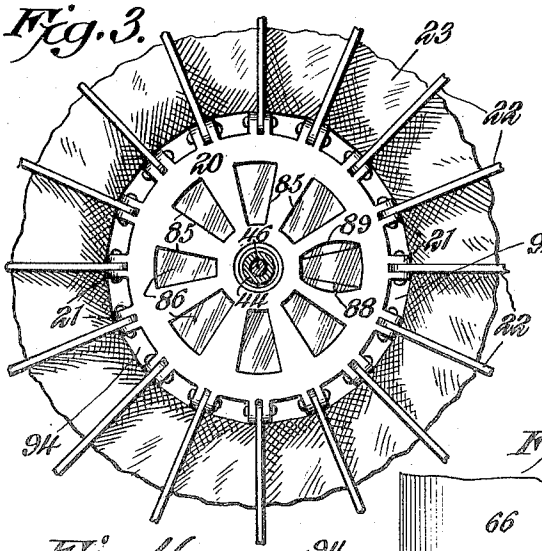


Fig. 6.

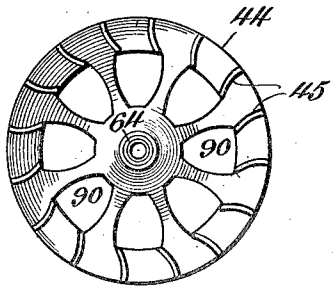


Fig. 4.

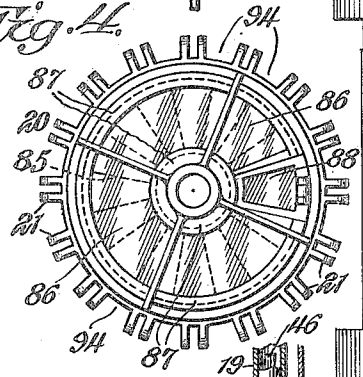


Fig. 7.

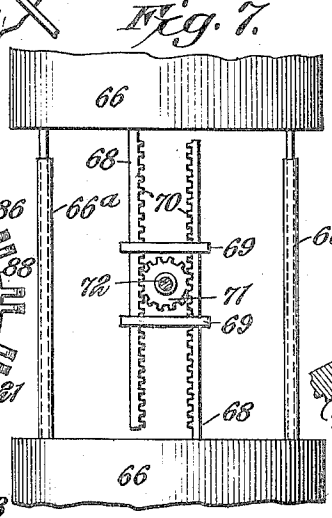


Fig. 8.

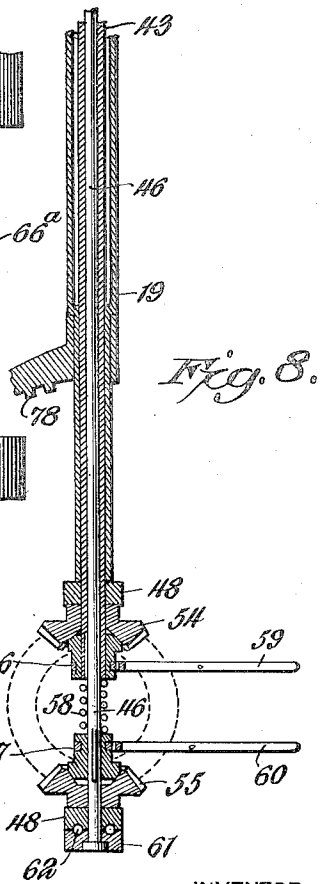
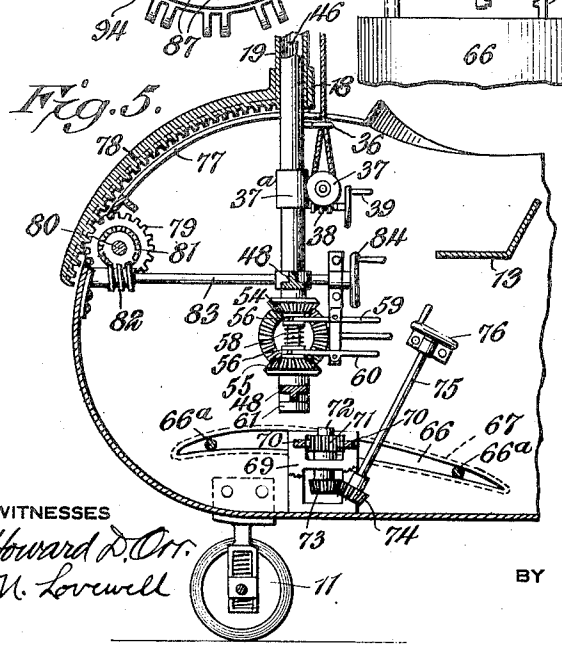


Fig. 5.



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UNITED STATES PATENT OFFICE.

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HELICOPTER.

Application filed December 18, 1924. Serial No. 756,694.

To all whom it may concern:

Be it known that I, HARVEY J. WARNER, a citizen of the United States, residing at Dearborn, in the county of Wayne and State of Michigan, have invented a new and useful Helicopter, of which the following is a specification.

This invention relates to flying machines of the helicopter type, and one of its principal objects is to provide a construction by which sufficient lifting power may be developed to lift the machine vertically from the ground, and when properly directed, to propel it forwardly at a high speed.

Helicopters as heretofore constructed, which relied wholly upon air pressure for their lifting power, have proved to be impractical, and in the majority of cases, it is impossible to get them to leave the ground by their own power. In the present invention, however, I have made use of suction, as well as pressure, in developing the lifting force of the machine, utilizing the well known principle that a current of air flowing over a convex surface will create a partial vacuum.

A further object of the invention is to provide a machine which will be comparatively safe under all conditions, automatically maintaining its equilibrium when in flight, and being provided with a circular convex wing area which aids in lifting and sustaining the machine in the air, and performs the function of a parachute to ease its descent when the motor is stalled. In addition to the lifting propeller, a centrifugal blower is provided which rotates about the same axis as the propeller and blows the air outwardly over the convex surface of the circular wing, creating a partial vacuum, the action of which assists the propeller in lifting and propelling the machine.

The invention consists further in various details of construction and combinations of elements, the objects and advantages of which will be more fully explained in the following detailed description taken in connection with the accompanying drawings, which illustrate one practical embodiment of the invention.

In the drawings:

Figure 1 is a side elevation of the machine.

Figure 2 is a vertical transverse section thereof.

Figure 3 is a plan view of the central portion of the parachute frame, showing in section the mast by which it is supported.

Figure 4 is a bottom plan view of the same.

Figure 5 is a vertical longitudinal section through the front part of the fuselage.

Figure 6 is a detail plan view of the blower.

Figure 7 is a detail view of the means for supporting and adjusting the gliding wings.

Figure 8 is a detail sectional view of the mast and the means for actuating the propeller and blower.

Figure 9 is a detail sectional view taken on the line 9—9 of Figure 2.

Referring in detail to the drawings, the invention comprises a stream line body 10 provided on its under side with a landing gear 11 of any suitable type, and having an opening 12 in its upper side, beneath which is a seat 13 for the aviator. The body 10 is provided at its rear end with a vertical rudder 14 and a horizontal rudder 15 which may be of any well known type suitable for the purpose.

A yoke 16 spans the front end of the body 10, and is journaled on trunnions 17 secured to and projecting outwardly from opposite sides of the body 10. This yoke is formed with a central collar 18, in which is secured a mast 19 forming the main support for the lifting and propelling mechanism. A spider 20, secured to the upper end of the mast 19, is formed about its periphery with ears 21 arranged in pairs, between which are pivoted the inner ends of curved ribs 22, which are covered with canvas 23, after the manner of a parachute. A straight brace bar 24 is secured longitudinally of each rib, and intermediately connected thereto by suitable truss rods 25. The frames constituted by the ribs 22, brace bars 24 and truss rods 25 are covered with canvas 26, thus forming a series of individual radial pockets, for a purpose which will be later explained.

A ladder 27 is secured to the side of the mast 19, and surrounding the mast and ladder and adapted to be adjusted vertically thereof, is a platform 28, preferably provided with a railing 29, and having a man hole 30 formed therein, so as to provide easy access to the upper part of the machine. Spreader bars 32 are pivotally connected at their lower ends to ears 31 formed on the periphery of the platform 28, and are pivot-

ed at their upper ends, as at 33, to the respective brace bars 24 of the parachute frame. By raising and lowering the platform 28, therefore, the circular wing or parachute 23 may be raised or lowered in the same manner as an umbrella. The mechanism for raising and lowering the platform 28 comprises a plurality of cables 34, which are secured to the platform by elastic connections and extend over sheaves 35 mounted on the upper end of the mast 19, and extend downwardly through eyes 36 into the fuselage, and about the drum 37 mounted in a bracket 37ª, which is secured on the downwardly extended portion of the mast. A worm gear 38 is operatively connected to the drum 37, and actuated by a hand crank 39 to raise and lower the platform 28 and adjust the spread of the circular wing or parachute 23. Cords or cables 40 are connected, as at 41, to the extremities of the ribs 22, and are adapted to be wound about retrieving reels 42 mounted on the mast near the collar 18.

The mast 19 is formed with a central bore in which a sleeve 43 is rotatably mounted, and secured to the upper end of this sleeve, above the end of the mast, is the hub 44 of a centrifugal blower having vanes 45, which blow air outwardly over the upper convex surface of the circular wing. A shaft 46 is mounted to rotate within the sleeve 43, but in the opposite direction to the rotation of the sleeve, and this shaft carries at its upper end a propeller 47 of the type generally used in aeroplanes. The lower portion of the mast 19, which extends downwardly within the fuselage, carries a yoke 48, and motors 49 supported on platforms 50 have their shafts connected by clutches 51 to shafts 52, which are mounted in opposite sides of the yoke, and provided with bevelled gears 53, which are in constant mesh with bevelled gears 54 and 55, loosely mounted on the sleeve 43 and shaft 46, respectively. The gears 54 and 55 are thus driven constantly in opposite directions, and clutch members 56 and 57, splined to the sleeve 43 and shaft 46 respectively, are urged into engagement with the respective gears 54 and 55 by a coiled spring 58, so as to drive the propeller 47 and blower 45 in opposite directions. Hand levers 59 and 60, however, are provided for disconnecting either of the clutch members 56 or 57, as desired. A head 61 is secured to the lower end of the shaft 46, and thrust bearings 62 are provided between the head 61 and the yoke 48 for sustaining the thrust due to the action of the propeller. A collar 63 is also secured to the shaft 46 above the hub 44, and the latter is provided at its upper and lower ends with thrust bearings 64 and 65, respectively.

In addition to the lifting and propelling mechanism, gliding wings 66 are also provided on opposite sides of the body 10. These gliding wings are adapted to telescope in casings 67 secured to the sides of the body 10, and their inner ends are held in alinement by telescoping rods 66ª. Bars 68 are also secured to the wings 66, and extend inwardly into the fuselage, where they are slidably supported in a bracket 69 secured to the bottom of the fuselage. The bars 68 are formed with opposed racks 70, which are in constant mesh with a spur gear 71 secured to a stub shaft 72, also mounted in the bracket 69 and having a bevelled gear 73 which meshes with a bevelled gear 74 at the lower end of a shaft 75, which extends upwardly in proximity to the seat 13, and is provided with a hand wheel 76, which may be rotated to extend or retract the gliding wings.

The forward end of the body 10 is substantially arcuate in shape, and provided with a slot 77, through which the mast extends, and the collar 18 has an arcuate rack 78 extending forwardlly over this slot and meshing with a spur gear 79 secured on a shaft 80, mounted transversely of the body 10 at its front end. The shaft 80 has also a worm gear 81 secured thereto, which is engaged by a worm 82 secured to a longitudinal shaft 83, the rear end of which is provided with a hand wheel 84, which may be rotated to adjust the angle of the mast 19.

When it is desired to rise vertically from the ground, the mast is adjusted to a vertical position, as shown in full lines in Figure 1. The motors are then started, and the clutches 51, 56 and 57 are thrown into engagement. When the machine has reached the desired altitude, and it is desired to travel forwardly, the mast 19 is adjusted forwardlly toward or past the position shown in dotted lines in Figure 1. The spider 20, to which the parachute frame is pivoted, is formed with segmental openings 85, and in order to prevent the air from passing through these openings, and yet permit the aviator to obtain a view of the region above and in front of the machine, glass windows 86 are secured by cleats 87 which are attached to the under side of the spider 20. One of these windows has a section 88 hinged to swing upwardly, and large enough to permit a man to pass therethrough, so as to gain access to the top of the parachute. The opening through the spider 20, which registers with this hinged window, may be made larger than the others, as indicated at 89. The openings 90 through the blower are also large enough to permit the passage of a man. When the machine is traveling, and the propeller 47 and blower 45 are rotating rapidly, there will be no apparent obstruction of the view through the windows 86.

The propeller shaft 46 and the sleeve 43,

which carries the blower, rotate in opposite directions during the flight, so that there is no appreciable tendency of the machine to turn or twist laterally, except as it is guided by the rudder 14. The rotation of the propeller 47 develops an air pressure, which has a tendency to lift the machine, and the current of air passing downwardly travels along the surface of the hub 44, which curves downwardly and outwardly in a substantially hyperbolic curve. This air current increases in velocity as it passes the vanes 45 of the blower, and as it passes over the convex surface of the circular wing 23 creates a substantial negative pressure or partial vacuum above the same. During the flight, the platform 28 will generally be in its uppermost position, as shown in dot and dash lines in Figure 2, and the pockets between the canvas partitions 26 will contain air at normal pressure, so that a considerable upward pressure will act against the under side of the wing 23, and materially aid the action of the propeller 47 in lifting or sustaining the machine in flight.

In case the motors become stalled, the wing 23 will act as a parachute to retard the rapidity of the descent, and in case the fabric of the wing 23 becomes punctured or torn between any two of the partitions 26, the remaining pockets between the several partitions will still act in the normal manner to ease the fall. Radial fins 91 are also secured to the respective ribs 22 outside the fabric 23, and, in case of the fabric becoming torn, prevent a lateral flow of air over the surface of the fabric, which would to a large extent, neutralize the effect of the upward pressure within the pockets. The peripheral edges of the fins are guyed to each other by a number of circular ropes 92, which are preferably connected by strips of fabric 93, and the outward current of air developed by the blower vanes 45 will exert a pressure underneath the strips 93 and increase the sustaining power of the machine.

Openings 94 are provided between the pairs of ears 21 at the inner edge of the fabric 23. These openings are of comparatively small size, but are sufficient to permit a restricted current of air to pass up through the parachute during a forced descent, thus maintaining the equilibrium thereof in the same manner as in the usual type of parachute. The air in passing through the openings 94 is deflected outwardly and helps to maintain a partial vacuum above the wing surface, the same as when the propeller 47 is running.

When flying forwardly, the gliding wings 66 may be extended or retracted as may be necessary to direct the flight upwardly or downwardly, the sustaining force of the gliding wings being added to that of the propeller and the wing 23.

The machine may also be propelled over the surface of a road or over the surface of a body of water by adjusting the mast 19 downwardly to the requisite angle. When traveling in this manner, or when the machine is to be placed in a hangar, the wing 23 will ordinarily be folded, as shown in dotted lines in Figure 2.

When the motors become stalled, and the aviator sees that it is impossible to avoid a forced landing, it will be possible for him to climb up the ladder 27 onto the platform 28. In this position, in view of the retarding action of the parachute, he will be comparatively safe from injury. After the body 10 strikes the ground, the folding wings will lower the platform 28 and relieve the shock.

When the machine is in the air, the clutch member 56 may be disconnected, so that the rotation of the blower vanes 45 will cease while the propeller continues to rotate. The sustaining power of the propeller will ordinarily be sufficient to sustain the weight of the machine, and it will hover in substantially a stationary position. The weight of the body and the sustaining action of the wing 23 will maintain the machine in equilibrium, and with the blower idle, the aviator may leave the cock pit, climb the ladder 27, up through the platform 28 and through the hinged window section 88, opening 89 and one of the openings 90 in the blower, and standing beneath the propeller 47 may take observations without difficulty. It will also be possible for him to climb up through the parachute frame for safety in case the machine should fall in the water and become wholly or partially submerged.

From the foregoing description, it will be seen that the invention provides a practical machine, which is adapted to rise vertically from the ground, to hover in the air at any given point, or to glide forwardly at a high speed. The unique arrangement of the circular wing, in connection with the blower and propeller, not only provides great lifting power, but insures the safety of the aviator in case of the failure of the motors. It is not necessary for him to jump, or to depend upon the opening of a parachute attached to his body. The parachute is open at all times during flight, and will always prevent too rapid a descent.

While I have shown and described one practical embodiment of the invention, it is to be understood that this is merely for the purpose of illustration, and that the same is capable of many modifications both in the size and proportion of the various parts, and in their relative arrangement. Many of the specific features of the device may also be omitted in case it is desired to construct a less expensive machine. While I have referred to the wing 23 and the partitions 26 as being composed of canvas, it is to be

understood that any equivalent material may be substituted. It is my purpose, therefore, to include all such modifications within the scope of the appended claims.

What is claimed is:

1. In a flying machine, the combination of a body, a lifting propeller and a centrifugal blower mounted co-axially one above the other and above the body, and means for driving said propeller and blower in opposite directions.

2. In a flying machine, the combination of a body, a rotatably mounted sleeve extending upwardly from the body, a shaft rotatable within the sleeve, a lifting propeller and a centrifugal blower, one of which is secured to the upper end of the sleeve and the other secured to the upper end of the shaft, and means for driving said sleeve and shaft in opposite directions.

3. In a flying machine, the combination of an elongated body, a lifting propeller, and a centrifugal blower mounted coaxially one above the other and above the body, means for adjusting the propeller and blower angularly with respect to the body, and means for driving said propeller and blower in opposite directions.

4. In a flying machine, the combination of an elongated body, a rotatably mounted sleeve extending upwardly from the body, a shaft rotatable within the sleeve, a lifting propeller and a centrifugal blower, one of which is secured to the upper end of the sleeve and the other secured to the upper end of the shaft, means for adjusting the shaft and sleeve angularly in a longitudinal plane about a point in the body as a center, and means for driving said sleeve and shaft in opposite directions.

5. In a flying machine, the combination of a body, a mast extending upwardly from the body, a circular wing surrounding the mast, the upper face of the wing being convex, a propeller mounted centrally above the circular wing, a centrifugal blower mounted between the propeller and the wing, and means for driving the blower and propeller.

6. In a flying machine, the combination of a body, a mast pivoted to and extending upwardly from the body, a circular wing surrounding the mast, the upper face of the wing being convex, a sleeve rotatably supported by the mast and extending upwardly above the same, a shaft rotatable within the sleeve, a lifting propeller and a centrifugal blower, one of which is secured to the upper end of the sleeve and the other secured to the upper end of the shaft, means for adjusting the mast, shaft and sleeve angularly in a longitudinal plane about the pivotal connection between the mast and body, and means for driving said sleeve and shaft in opposite directions.

7. In a flying machine, the combination of a body, a mast pivoted to and extending upwardly from the body, a circular wing surrounding the mast, the upper face of the wing being convex, a propeller mounted on the mast above the circular wing, a centrifugal blower mounted on the mast between the propeller and the wing, means for adjusting the mast in a longitudinal plane about its pivot as a center, and means within the body for driving the blower and propeller.

8. In a flying machine, the combination of a body, a mast extending upwardly from the body, a circular wing surrounding the mast, the upper face of the wing being convex, a sleeve rotatably supported by the mast, a shaft rotatable within the sleeve, a lifting propeller and a centrifugal blower, one of which is secured to the upper end of the sleeve and the other secured to the upper end of the shaft, and means located within the body for driving said sleeve and shaft.

9. In a flying machine, the combination of a body, a mast extending upwardly from the body, a circular wing surrounding the mast, the upper face of the wing being convex, a sleeve rotatably supported by the mast, a centrifugal blower having a hub secured to the upper end of the sleeve, a shaft rotatable within the sleeve and projecting upwardly above the same, a lifting propeller secured to the end of the shaft above the blower, the hub of said blower having a downwardly and outwardly curved hyperbolic surface for deflecting the current of air from the propeller outwardly through the blower, and means for driving said sleeve and shaft.

10. In a flying machine, the combination of an elongated body, a mast pivoted to and extending upwardly from the body, a circular wing surrounding the mast, the upper face of the wing being convex, a sleeve rotatably supported by the mast, a shaft rotatable within the sleeve, a lifting propeller secured to the upper end of the shaft, a centrifugal blower secured to the sleeve between the blower and the wing, said blower having a hub with a downwardly and outwardly curved hyperbolic surface, whereby the current of air from the propeller is deflected outwardly through the vanes of the blower and over the surface of the wing, means for adjusting the mast with the propeller and blower longitudinally about its pivotal connection to the body, and means for driving said shaft and sleeve in any position to which they are adjusted.

11. In a flying machine, the combination of a body, a mast extending upwardly from the body and having a spider secured to its upper end, ribs hinged to the periphery of the spider so as to swing vertically, a circular wing secured to the ribs, a sleeve

rotatably supported on the mast, a shaft rotatably supported within the sleeve, a lifting propeller secured to the upper end of the shaft, a centrifugal blower secured to the upper end of the sleeve beneath the propeller, and means for driving said sleeve and shaft in opposite directions.

12. In a flying machine, the combination of a body, a mast extending upwardly from the body and having a spider secured to its upper end, frames disposed in radial planes and hinged to the periphery of the spider to swing vertically, a circular wing secured to the upper edges of said frames, means for adjusting said frames about their hinges, a sleeve extending longitudinally through the mast and rotatable therein, a shaft rotatable within the sleeve, a lifting propeller secured to the upper end of the shaft, a centrifugal blower secured to the upper end of the sleeve beneath the propeller, and means located within the body for driving said sleeve and shaft.

13. In a flying machine, the combination of an elongated body, a mast pivotally connected to the body and extending upwardly therefrom, a spider secured to the upper end of the mast, frames disposed in vertical planes and pivoted to the periphery of the spider so as to swing vertically, a circular wing secured to the upper edges of said frames, means for adjusting said frames about their pivots, a sleeve rotatably supported by the mast, a centrifugal blower secured to the upper end of the sleeve, a shaft rotatable within the sleeve and projecting above the same, a lifting propeller secured to the upper end of the shaft above the blower, means for adjusting the mast in a longitudinal plane about its pivot thereby adjusting the angular relation of the propeller and blower with respect to the body, and means for driving said sleeve and shaft in any position of adjustment.

14. In a flying machine, the combination of a body, a mast extending upwardly from the body and having a spider secured to its upper end, upwardly bowed radial ribs pivoted to the spider and covered with sheet material to form a circular wing, brace bars arranged in vertical radial planes beneath the ribs and covered with sheet material to form partitions which separate the space underneath the wing into a series of pockets, fins secured to the upper side of the wing and disposed in the same planes as the respective partitions underneath the same, a sleeve rotatably supported by the mast, a shaft rotatable within the sleeve, means for rotating said shaft and sleeve, a lifting propeller secured to the shaft, and a centrifugal blower secured to the sleeve in position to blow the air from the propeller outwardly between said fins.

In testimony that I claim the foregoing as my own I have hereto affixed my signature.

HARVEY J. WARNER.