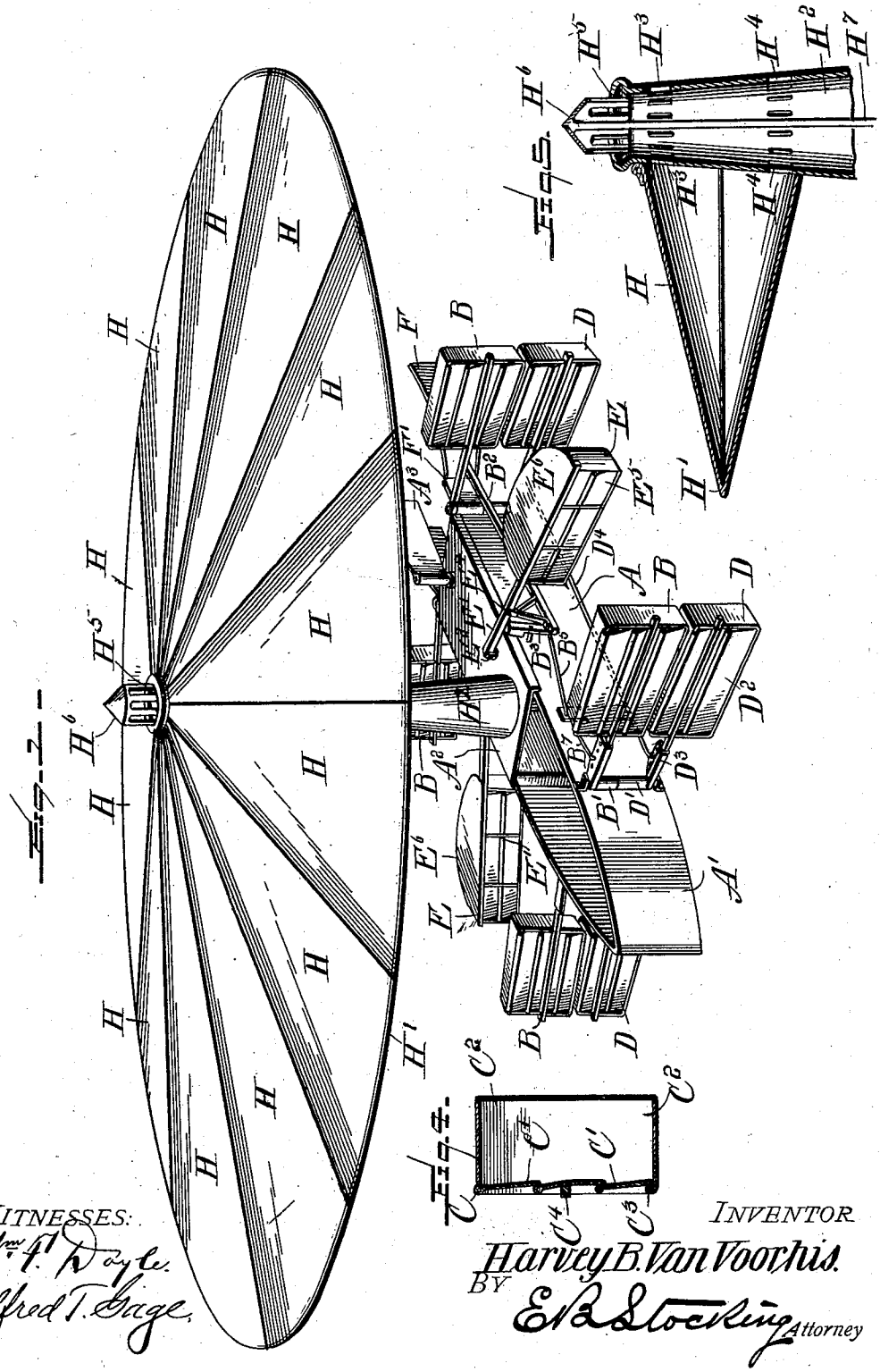
No. 702,120. Patented June 10, 1902.

# H. B. VAN VOORHIS.

## AIR SHIP.

(Application filed Dec. 11, 1901.)

(No Model.) 2 Sheets—Sheet 1.




WITNESSES:
Wm. F. Doyle.
Alfred T. Gage.

INVENTOR
Harvey B. Van Voorhis.
BY
E. L. Stocking Attorney

No. 702,120. Patented June 10, 1902.

# H. B. VAN VOORHIS.

## AIR SHIP.

(Application filed Dec. 11, 1901.)

(No Model.) 2 Sheets—Sheet 2.

Fig. 3.

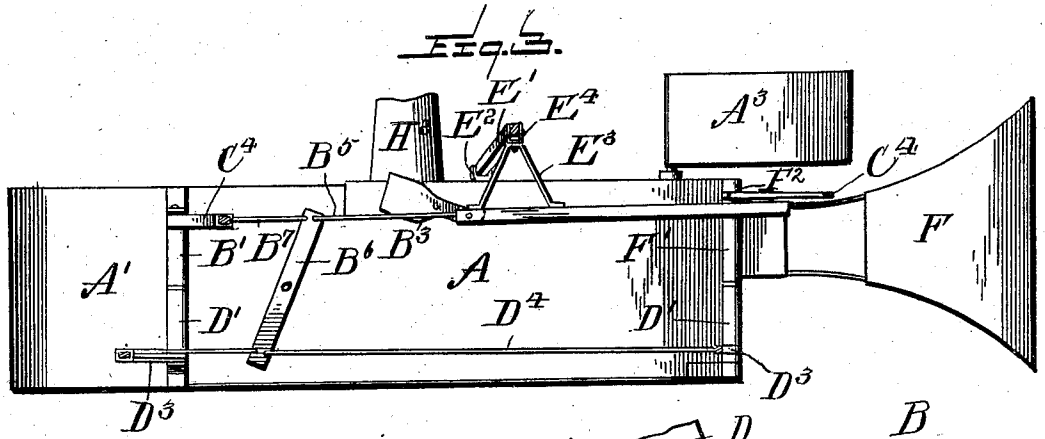
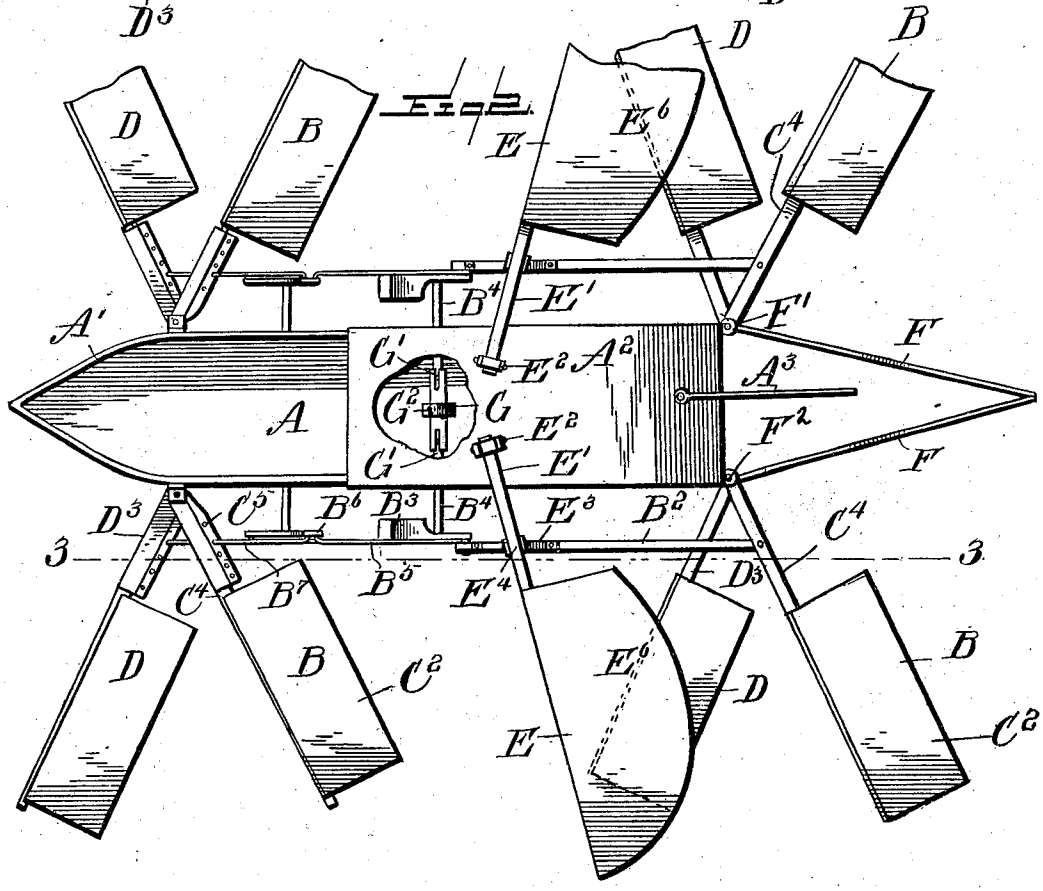



Fig. 2.




WITNESSES:
Wm. F. Doyle.
Alfred I. Gage.

INVENTOR
Harvey B. Van Voorhis.
BY E. B. Stocking
Attorney

# UNITED STATES PATENT OFFICE.

HARVEY B. VAN VOORHIS, OF PITTSBURG, PENNSYLVANIA.

## AIR-SHIP.

SPECIFICATION forming part of Letters Patent No. 702,120, dated June 10, 1902.

Application filed December 11, 1901. Serial No. 85,488. (No model.)

*To all whom it may concern:*

Be it known that I, HARVEY B. VAN VOORHIS, a citizen of the United States, residing at Pittsburg, in the county of Allegheny, State of Pennsylvania, have invented certain new and useful Improvements in Air-Ships, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to an air-ship, and particularly to a supporting-balloon and propelling mechanism for the same.

The invention has for an object to provide an improved construction of balloon formed in sections and supported upon a gas-conveying stack having communicating ports with each section and an escapement-valve into the atmosphere.

A further object of the invention is to provide an improved propelling mechanism comprising oscillating wings upon opposite sides of the car alternating in movement together with rotatable wings and laterally-oscillating blades at the rear of the car.

Other and further objects and advantages of the invention will hereinafter be set forth and the novel features thereof specifically defined by the appended claims.

In the drawings, Figure 1 is a perspective of the invention. Fig. 2 is a plan thereof with the balloon removed; Fig. 3, a longitudinal section on the line 3 3 of Fig. 2; Fig. 4, a vertical section through one of the wings, and Fig. 5 a vertical section through part of the balloon and stack.

Like letters of reference refer to like parts throughout the several figures of the drawings.

The letter A designates a car which may be of any desired construction and configuration, preferably formed with a tapered forward end A′ and provided with a cover-section $A^2$, upon which an oscillating rudder $A^3$ may be suitably supported and operated to guide the car. This car is supported by any desired construction of balloon or buoyant device, preferably the form of balloon hereinafter shown and described. At the front and rear of each side of the car oscillating wings B are suitably journaled—for instance, by a sleeve B′ upon a vertical axis—and the wings at the opposite ends are connected by any desired means—for instance, a rod $B^2$, extending from the crank $B^3$, carried by the power-shaft $B^4$, and the rod $B^5$, extending through the lever $B^6$ to the front wing B, so that said wings are operated in unison. Each of these wings is formed of a framework C, of suitable material, within which a series of slats C′ are pivotally mounted and overlap each other, so as to form an air-tight closure in the movement of the wing in one direction and to permit the free passage of air therethrough in the returning movement of the wing. To assist this propelling action of the wing, an open hood $C^2$ extends to the rear of the slats C′, beneath which they extend when open, and the slats are adapted to abut against a stop $C^3$ and the frame $C^4$ of the wing, which leads to the pivoting sleeve B′ and is provided with a series of apertures $C^5$, by means of which a connecting-link $B^7$ may be adjusted in position to secure the desired extent of movement of the wing.

Beneath the wings B a series of wings D are similarly supported by means of a sleeve D′ and provided with slats $D^2$ of similar construction of those described in connection with the wings B. The supporting-arms $D^3$ for the wings are provided with the adjusting apertures before described, and a connecting-rod $D^4$ extends from the forward to the rear wing. This arm $D^4$ is secured to the lever $B^6$, before described, pivoted to the side of the car, so that the wings D receive a movement in opposite direction to the wings B, thus providing a propelling action alternately from each set of wings and a consequent continual forward movement of the ship. These wings B and D produce the natural flying action of a bird as the slats are opened in the forward movement and closed in the rearward propelling action.

Between the wings B, upon each side of the car, a pair of wings E are mounted to rotate in a vertical plane in any desired manner—for instance, by the arms E′, swiveled at their inner ends $E^2$ and driven from the crank $B^3$, carried by the power-shaft $B^4$ by means of a supporting-standard $E^3$, mounted on the connecting-rod $B^2$, in which standard the arm is swiveled at the upper portion, as shown at $E^4$. It will be seen that the rotation of the crank $B^3$ will rotate the outer end of the rod $B^2$ in a vertical plane, and consequently the

wing E, carried by this rod. This wing is provided with flaps $E^5$, similar to those described in connection with the wing B, and is provided with a covered portion $E^6$ at the top and open at the rear, by means of which a pressure and propelling action is exerted in the rotary downward movement of the wing. This wing E reproduces the propelling or driving action of the insect or bee wing and secures maximum of power to both propel and sustain the car.

Pivotally mounted at the rear of the car a pair of blades F are provided, which oscillate toward and from each other and are of a slightly-flexible character, so that in their movement laterally of the car they reproduce the propelling action of the tail of a fish. These blades F are pivoted at F', and the rear wings B are supported therefrom by means of a socket $F^2$, adapted to receive the arm $C^4$ from the wings.

For the purpose of independently driving the propelling means upon either side of the car in turning the same the driving-shaft $B^4$ may be formed in two parts connected by a collar G, slidably mounted, so as to engage a projection G' upon each of the parts or to be shifted free of said projection on either one of the parts, leaving the remaining part to be driven from any suitable power device connected to the driving-pulley $G^2$ upon the collar G.

The balloon before mentioned is composed of a series of sections H, which are closed independently of each other and form the segments of a complete circle substantially V-shaped in vertical section, as shown in Fig. 5. This form presents an edge H', which will offer the least possible resistance to the movement of the balloon through the air. This balloon is supported by means of a stack $H^2$, communicating with any desired source of heated air or gas, and each of the compartments H of the balloon communicates with the stack at its upper portion by an inlet $H^3$ for the heated air and an outlet $H^4$ at its lower portion for the cool air expelled from the balloon by the entrance of the heated air. This cool air is displaced by the heated air entering the balloon, and thus carried downward and heated for the purpose of supplying the buoyant expansion necessary for lifting the car. The upper portion of the stack is provided with an opening $H^5$, closed by a governing-valve $H^6$, carried upon a stem $H^7$, so that by opening this valve the heated air is permitted to escape from the balloon and the descent of the car permitted.

In the operation of the invention it will be seen that the rotation of the driving-shaft $B^4$ produces a simultaneous oscillation of the wings B and blades F and an oscillation in the opposite direction of the lower wings D and the rotation of the wings E, thus providing the simultaneous driving action for three separate devices reproducing, respectively, the propelling movement of a bird, a fish, and an insect, such as a bee. In the continued rotation of the crank-shaft the wings B return to their initial position, and the wings D' produce a continuous propelling action in alternation therewith. It will also be observed that the construction of slats upon the wings provides for the least possible resistance to the forward movement thereof and also the formation of the balloon materially assists in this regard. The disposition of the several propelling means in their relation to each other produces a driving action at both the front and rear of the car, and by the disposition of the blades at the rear the moving body of air at that point is utilized as an additional driving action. Furthermore, the wings E, mounted to rotate in a vertical plane, act against the moving body of air between the forward and rear wings B, thus securing the desired resistance of air to propel and assist in raising the car. The wings E travel in a rotary path and vertical plane, so that the slats thereof open during the vertical movement upward and offer much less resistance to the air than in the downward movement when the slats are closed and, with the part $E^6$, exert a propelling action. The blades F, which are pivoted to the opposite sides at the end of the ship and are of slightly-flexible character, move toward and from each other. The movement toward each other and apart produces the sculling action of a fish's tail, which in part is due to the flexible character of the blade. The heated air passing upward in the stack enters the upper openings into the balloon-section and forces outward the cooler air, which forms a natural channel downward to the heating means, so that while a partition might be used it is not absolutely necessary.

It will be obvious that changes may be made in the details of construction and configuration without departing from the spirit of the invention as defined by the appended claims.

Having described my invention and set forth its merits, what I claim, and desire to secure by Letters Patent, is—

1. In an air-ship, a car, oscillating wings secured to the sides thereof in different horizontal planes, and means for moving said wings in parallel horizontal planes and alternately in opposite directions; substantially as specified.

2. In an air-ship, a car, oscillating wings secured to the sides thereof in different horizontal planes, means for moving said wings in parallel horizontal planes and alternately in opposite directions, and wings pivotally mounted at one end to rotate in a vertical plane at each side of said car; substantially as specified.

3. In an air-ship, a car, oscillating wings secured to the sides thereof in different horizontal planes, means for moving said wings in parallel horizontal planes and alternately in opposite directions, wings pivotally mount-

ed at one end to rotate in a vertical plane at each side of said car, and blades at the rear of the car connected to oscillate laterally toward and from each other in unison with said oscillating wings; substantially as specified.

4. In an air-ship, a car, oscillating wings secured to the sides thereof in different horizontal planes, means for moving said wings in parallel horizontal planes and alternately in opposite directions, wings pivotally mounted at one end to rotate in a vertical plane at each side of said car, blades at the rear of the car adapted to oscillate laterally toward and from each other, a balloon for supporting said car, and driving means at each side of the car for connecting said wings and blades and operating them simultaneously; substantially as specified.

5. In an air-ship, a car, oscillating wings mounted in a vertical plane at opposite sides thereof and at the front and rear, a driving-shaft and connections for operating said wings in unison, oscillating wings in the same vertical plane as said first-mentioned wings and in a different horizontal plane, and means for oscillating said wings alternately in opposite directions to the first-mentioned wings; substantially as specified.

6. In an air-ship, a car, oscillating wings mounted in a vertical plane at opposite sides thereof and at the front and rear, a driving-shaft and connections for operating said wings in unison, oscillating wings in the same vertical plane as said first-mentioned wings, and in a different horizontal plane, means for oscillating said wings alternately in opposite directions to the first-mentioned wings, a rotating wing having an arm swiveled at one end to said car, and a crank-arm from said driving-shaft connected to said rotating wing for actuating the same in a vertical plane, substantially as specified.

7. In an air-ship, a car, a rotary propelling-wing swiveled thereto at one end and provided with overlapping slats, a solid top section to said wing, and means beyond its swiveled connection for rotating said wing in a vertical plane; substantially as specified.

8. In an air-ship, a circular balloon formed of a series of segmental sections disposed with their edges together, and means for introducing buoyant fluid into said sections; substantially as specified.

9. In an air-ship, a balloon, a filling-stack for supporting the same having inlet and outlet openings communicating with said balloon in different planes, and a valve at the upper end of said stack; substantially as specified.

10. In an air-ship, a circular balloon formed of a series of sections substantially V-shaped in vertical section, disposed with their edges together and a filling-stack having openings communicating with each section; substantially as specified.

11. In an air-ship, a car, a supporting-balloon therefor, independent wings disposed in a vertical plane at each end of said car on opposite sides thereof, a driving-shaft provided with a crank-arm, a pivoted lever upon said car, a connection between said crank-arm, lever, and one set of said wings, and a connection between the opposite end of said lever and another set of said wings to oscillate the wings alternately in opposite directions; substantially as specified.

12. In an air-ship, a car, a supporting-balloon therefor, independent wings disposed in a vertical plane at each end of said car on opposite sides thereof, a driving-shaft provided with a crank-arm, a pivoted lever upon said car, a connection between said crank-arm, lever and one set of said wings, a connection between the opposite end of said lever and another set of said wings to oscillate the wings alternately in opposite directions, a standard carried by the connection from said crank-arm, a rotating wing having a swiveled support upon said standard and a swiveled connection at its inner end to the car, and a top section to said wing; substantially as specified.

13. In an air-ship, a car, a supporting-balloon therefor, independent wings disposed in a vertical plane at each end of said car on opposite sides thereof, a driving-shaft provided with a crank-arm, a pivoted lever upon said car, a connection between said crank-arm, lever and one set of said wings, a connection between the opposite end of said lever and another set of said wings to oscillate the wings alternately in opposite directions, a standard carried by the connection from said crank-arm, a rotating wing having a swiveled support upon said standard and a swiveled connection at its inner end to the car, a top section to said wing, opposite blades pivoted at the rear of said car and adapted to move toward and from each other in the movement of the wings, a rudder for guiding said car, and means for driving the wings and blades upon either side of the car independently of the other side; substantially as specified.

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

HARVEY B. VAN VOORHIS.

Witnesses:

ALFRED T. GAGE,

APPLETON P. CLARK.