A. H. FRIEDEL.

FLYING MACHINE.

APPLICATION FILED MAY 10, 1908.

940,866.

Patented Nov. 23, 1909.

2 SHEETS—SHEET 1.

Fig. 1.

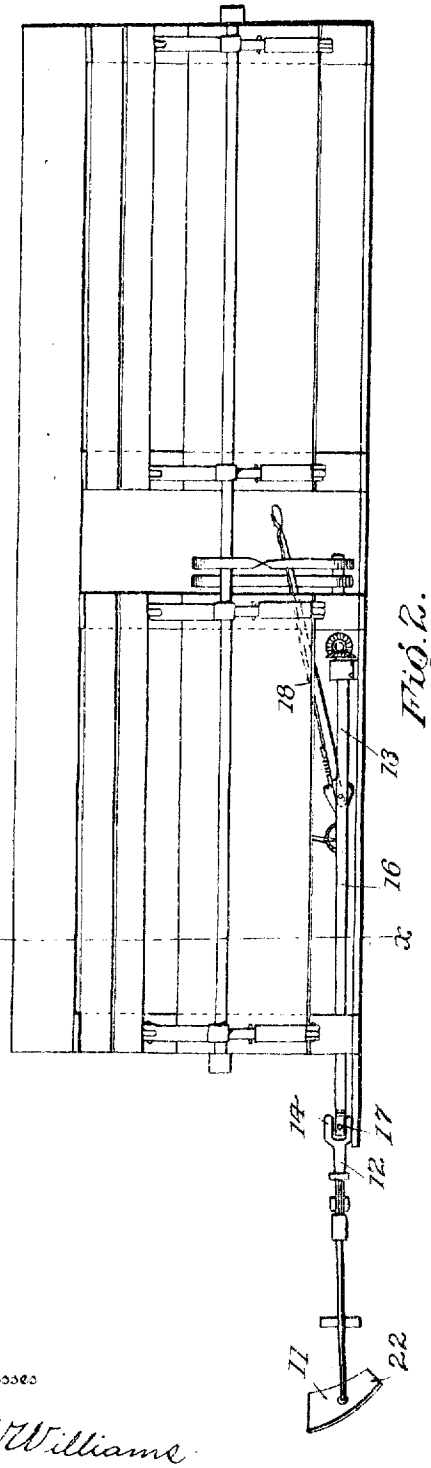
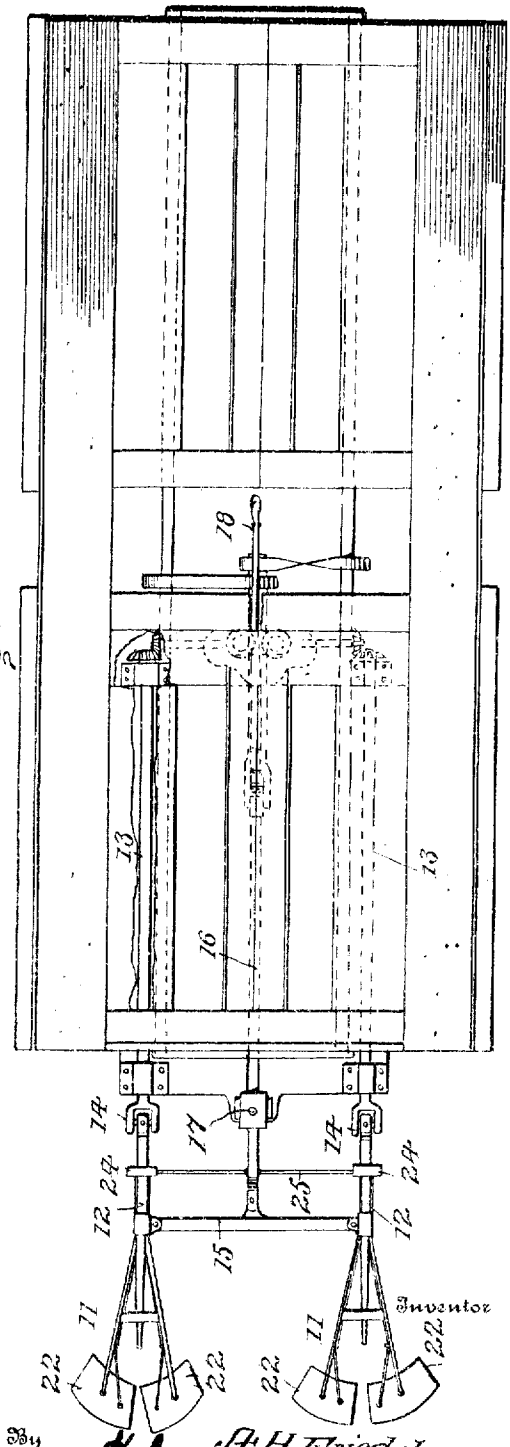



Fig. 2.




Witnesses

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FLYING MACHINE.

APPLICATION FILED MAY 19, 1908.

940,866.

Patented Nov. 23, 1909.

2 SHEETS—SHEET 2.

Fig. 9.

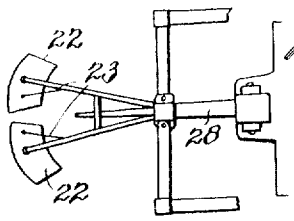



Fig. 3.

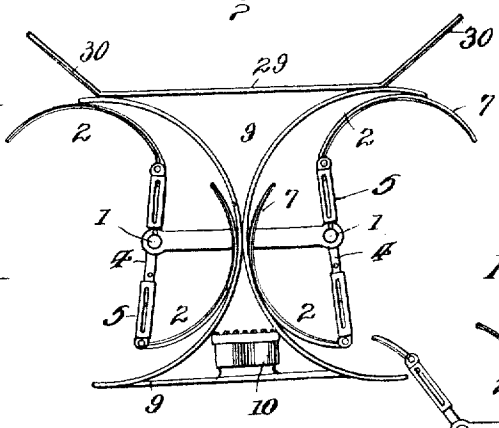



Fig. 8.

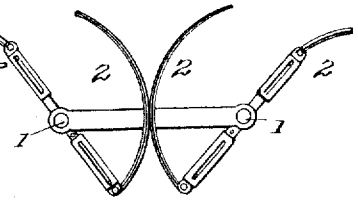



Fig. 4.

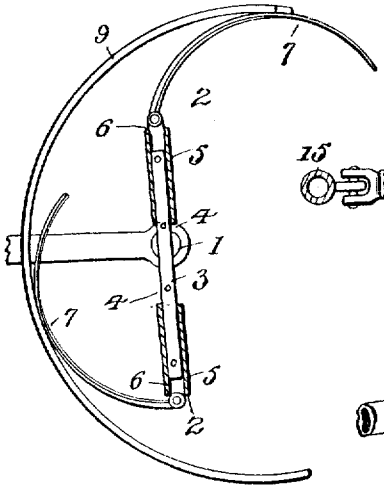



Fig. 5.

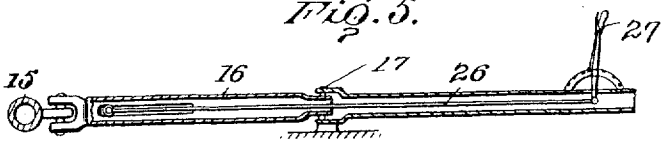



Fig. 6.

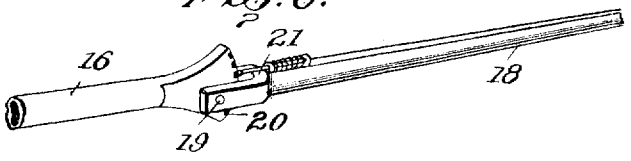
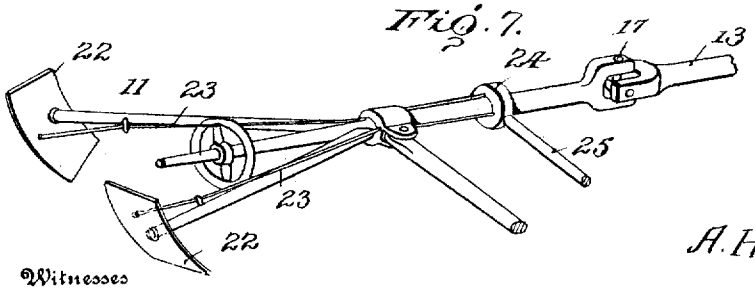



Fig. 7.




Witnesses

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# UNITED STATES PATENT OFFICE.

ALBERT H. FRIEDEL, OF BALTIMORE, MARYLAND.

## FLYING-MACHINE.

940,866. Specification of Letters Patent. Patented Nov. 23, 1909.

Application filed May 19, 1908. Serial No. 433,713.

*To all whom it may concern:*

Be it known that I, ALBERT H. FRIEDEL, citizen of the United States, residing at Baltimore, State of Maryland, have invented certain new and useful Improvements in Flying-Machines, of which the following is a specification.

The present invention appertains to appliances designed for navigating the air, the purpose being to supply a novel lifting means which presents a maximum amount of surface to the resistance of the air upon the down stroke and a minimum amount of resistance upon the up stroke, and to means for propelling and steering the machine, said means being at all times under control and of such construction as to admit of running the machine either forward or backward, or at any relative speed without requiring the reversing of the engine or a modification of the speed thereof.

For a full understanding of the invention and the merits thereof and also to acquire a knowledge of the details of construction and the means for effecting the result, reference is to be had to the following description and accompanying drawings.

While the invention may be adapted to different forms and conditions by changes in the structure and minor details without departing from the spirit or essential features thereof, still the preferred embodiment is shown in the accompanying drawings, in which:

Figure 1 is a side view of a lifting, propelling and steering mechanism for flying machines embodying the invention. Fig. 2 is a top plan view thereof. Fig. 3 is a cross section on the line $x$—$x$ of Fig. 1. Fig. 4 is a sectional view of a propeller, showing one of the wings compressed. Fig. 5 is a longitudinal section of the lever for moving the propelling and steering means. Fig. 6 is a detail perspective view of the inner or operating end of said lever. Fig. 7 is a detail perspective view of a propelling and steering means. Fig. 8 is a modification in which the guides are dispensed with, the propellers being arranged so that their wings come together upon the up stroke and mutually compress each other. Fig. 9 is a modification illustrating a single set of motor and steering propellers.

Corresponding and like parts are referred to in the following description and indicated in all the views of the drawings by the same reference characters.

Inasmuch as the present invention deals more particularly with the lifting, propelling and steering means, the same are shown exclusive of the gas field or balloon.

The lifting means contemplate similar propellers which are arranged upon opposite sides of a vertical plane, each consisting of a shaft 1 and wings 2, the latter having an opposite arrangement so as to balance each other. The shafts 1 are mounted in bearings. Each of the wings 2 is of such construction as to be flexed or compressed, as indicated most clearly in Figs. 3 and 4. A series of rods or bars 3 are radially movable with reference to their supporting shafts 1 and are provided with stops 4 to limit their movements by engagement with the respective shafts. Sleeves 5 are provided at the ends of the rods or bars 3 and receive joint sections 6 which are adapted to telescope therein, whereby further provision is had for contraction and expansion of the wings. The joints 6 may be of any construction to admit of their telescopic action so as not to interfere with the rotation of the lifting propellers when the machine is in operation. The sleeves 5, as shown most clearly in Figs. 3 and 8 are provided in their sides with longitudinal slots in which the ends of pins applied to the rods 3 project and limit the movement of said sleeves upon the rods. It will thus be understood that the wings 2 have a two-fold radial sliding movement in addition to their flexing, one movement being due to the sliding of the rods 3 in openings of the shaft 1 and the other movement resulting from the movement of the sleeves 5 upon the rods 3. The outer portions 7 of the wings are flexible to admit of their contraction and expansion.

The lifting propellers comprise a series of arms which may be connected by tie rods or bars, the outer portions being covered by silk or other light and strong material, so as to provide the necessary extent of surface to obtain a purchase upon the air in the operation of the machine. Curved guides 9 are located upon opposite sides of an imaginary vertical plane arranged midway of the shafts 1, and these guides curve in opposite directions, their hollow sides facing the lifting propellers and approximately concentric with the shafts thereof. As the

propellers rotate, their outer wings move downward and their inner wings upward. The downwardly moving wings expand so as to present a maximum amount of surface for the resistance of the air, thereby attaining the best results for lifting, whereas the inner wings are contracted or compressed, as indicated in Figs. 3 and 4, to offer a minimum amount of surface to resist the ascent of the machine. The wings are compressed or reduced in extent by a twofold action, the one by the folding or bending of the wings and the other by the telescoping of the joint 6, supplemented by the sliding of the wings relatively to their supporting shafts. A motor 10 of any desired type is provided and connected with the shafts 1 of the lifting propellers to drive the same in opposite directions, whereby the outer wings move downward and the inner wings upward.

At one end of the machine is located a pair of propellers 11 for effecting movement of the machine through the air and to direct such movement in any line. The propellers are carried by shafts 12 which are connected to other shafts 13 by universal or gimbal joints 14, whereby said propellers may be moved up or down, or laterally, according to the required direction of travel of the machine. The propellers 11 are connected by means of a transverse rod or bar 15 which in turn is connected to an operating lever 16, the same extending within convenient reach of the operator. The lever 16 is fulcrumed at 17 in such manner as to admit of its movement in every direction. For convenience, the lever 16 is provided with a section 18 pivoted thereto at 19 and connected therewith by means of a segment 20 and latch bolt 21. This construction admits of the inner or operating end of the section 18 being raised or lowered to suit the adjustment of the propellers 11 to the convenience of the operator. The shafts 13 are geared to a single motor and the propellers 11 are at all times under control so as to be raised or lowered, or moved laterally, according as the machine is to be driven straight ahead or to the right, or left, or up or down.

The blades 22 of the propellers 11 are connected to their arms so as to have their inclination changed, whereby the machine may be driven forward or backward. Rods 23 have connection with the blades 22 and are connected to rings 24 slidably mounted upon the shafts 12 and connected by a tie 25, which latter is connected at a middle point to a rod 26 passed through the operating lever 16 and having connection with a lever 27. Movement of the lever 27 causes the tie 25 to move forward or backward, with the result that the rings 24 are slid forward or backward upon the shafts 12, thereby changing the inclination of the blades 22, as will be readily comprehended.

The rod 26 is adapted to be sprung out of line to a limited extent by movement of the handle section 18 of the operating lever, hence in any adjusted position of said handle section the blades 22 may be adjusted to the required inclination. Movement of the handle section 18 with reference to the main portion of the operating lever 16 is small and is not prevented by the connecting rod 26.

In the modification illustrated in Fig. 8, the guides 9 are dispensed with, the propellers being so arranged that their wings come together on the up stroke and mutually compress each other. This construction is much more simple than that embodying the guides 9 and results in a lighter machine and a more economical mechanism. The coöperating parts, such as the shafts and wings, are substantially the same as herein disclosed, the only material difference being the omission of the guides, and the connecting of the propellers to insure a like rotation to compel the wings to come together upon the up stroke.

In the construction shown in Fig. 9, a single set of motor and steering propellers is provided, instead of two sets illustrated in Fig. 2. The shaft 12 provided with the blades 22 is coupled directly to a centrally disposed shaft 28. This construction is preferably for small machines, but for large machines it is preferable to provide a series of motor and steering propellers, as illustrated in Fig. 2.

An aeroplane 29 is located above the propellers and occupies an approximately horizontal position. Other aeroplanes 30 are located along the edges of the aeroplane 29 and incline upwardly and outwardly and serve to steady the movements of the machine and to prevent rocking while in flight or when alighting.

Having thus described the invention, what is claimed as new is:

1. A propeller having a resilient wing, and means for compressing said wing to reduce its effective resisting surface upon the return side of the propeller.

2. A propeller of the character set forth, comprising a wing adapted to contract and expand and to move radially, and means cooperating with said wing to effect both a compression and a radial movement thereof.

3. A propeller of the character set forth, comprising a wing mounted to move radially and comprising telescoping joints and made flexible so as to contract and expand.

4. In a propeller, the combination of a curved guide, a shaft located upon the hollow side of the guide, wings mounted upon said shaft to move radially and comprising flexible and telescoping portions.

5. In a flying machine, a propeller mount-

ed to be moved up or down, or laterally, so as to drive the machine and steer the same and including propeller blades, means for changing the angle or inclination of the blades, and an operating lever independent of the blade adjusting means for moving said propeller to the required position, said operating lever embodying an adjustable handle section, and means for securing the latter in the required position.

6. In a flying machine the combination of spaced propellers each comprising adjustable blades and mounted to be moved up and down or laterally, an operating lever having connection with both propellers for moving the same simultaneously to the required position, and means mounted upon the operating lever and having connection with the blades of both propellers to adjust the same simultaneously to the required inclination.

7. In a flying machine, a curved guide, an operating shaft eccentrically mounted with respect to the concave face of the guide, and flexible propeller blades carried by the shaft and arranged to be compressed by engagement with the concave face of the guide.

8. In a flying machine, a concavo-convex guide, an operating shaft eccentrically mounted with relation to the concave face of the guide, a rod carried by and adjustable radially of the operating shaft, and propeller blades mounted on the opposite ends of the rods and adapted to engage the concave face of said guide when the shaft is rotated.

9. In a flying machine, a concavo-convex guide, an operating shaft eccentrically mounted with relation to the concave face of the guide, a rod extending through and adjustable radially of the shaft, sleeves slidably mounted on the opposite ends of the rod, and pivoted propeller blades having their inner portions housed within the sleeves.

10. In a flying machine, concavo-convex guide, an operating shaft eccentrically mounted with respect to the concave face of the guide, a rod carried by and adjustable radially of the shaft and provided with laterally extending stop pins, sleeves slidably mounted on the rod and having slots formed therein for the reception of the pins, joint sections slidably mounted within the sleeves, and flexible propeller blades pivotally connected with the outer ends of the joint sections.

11. In a flying machine, the combination with an aero-plane, of concavo-convex guides disposed beneath the aero-plane, spaced shafts eccentrically mounted with respect to the concave faces of the guides, radially adjustable rods carried by said shafts, flexible propeller blades operatively connected with the opposite ends of the rods, a motor, and means forming a connection between the motor and both shafts for simultaneously rotating the same.

12. In a flying machine, the combination with spaced propeller shafts, adjustable blades operatively connected with said shafts, a bar connecting the shafts, a tubular member connected with the bar and extending longitudinally of the machine, a rod extending through a slot in the tubular member and provided with bearing collars slidably mounted on the propeller shafts, means forming a connection between the propeller blades and collars, an operating lever, and means disposed within the tubular member and forming a connection between the operating lever and rod for adjusting the blades of both propellers.

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

ALBERT H. FRIEDEL.

Witnesses:
W. N. WOODSON,
V. B. HILLYARD.