(No Model.) 4 Sheets—Sheet 1.

N. H. BORGFELDT.

APPARATUS FOR AERIAL NAVIGATION.

No. 530,219. Patented Dec. 4, 1894.

Fig. 1.

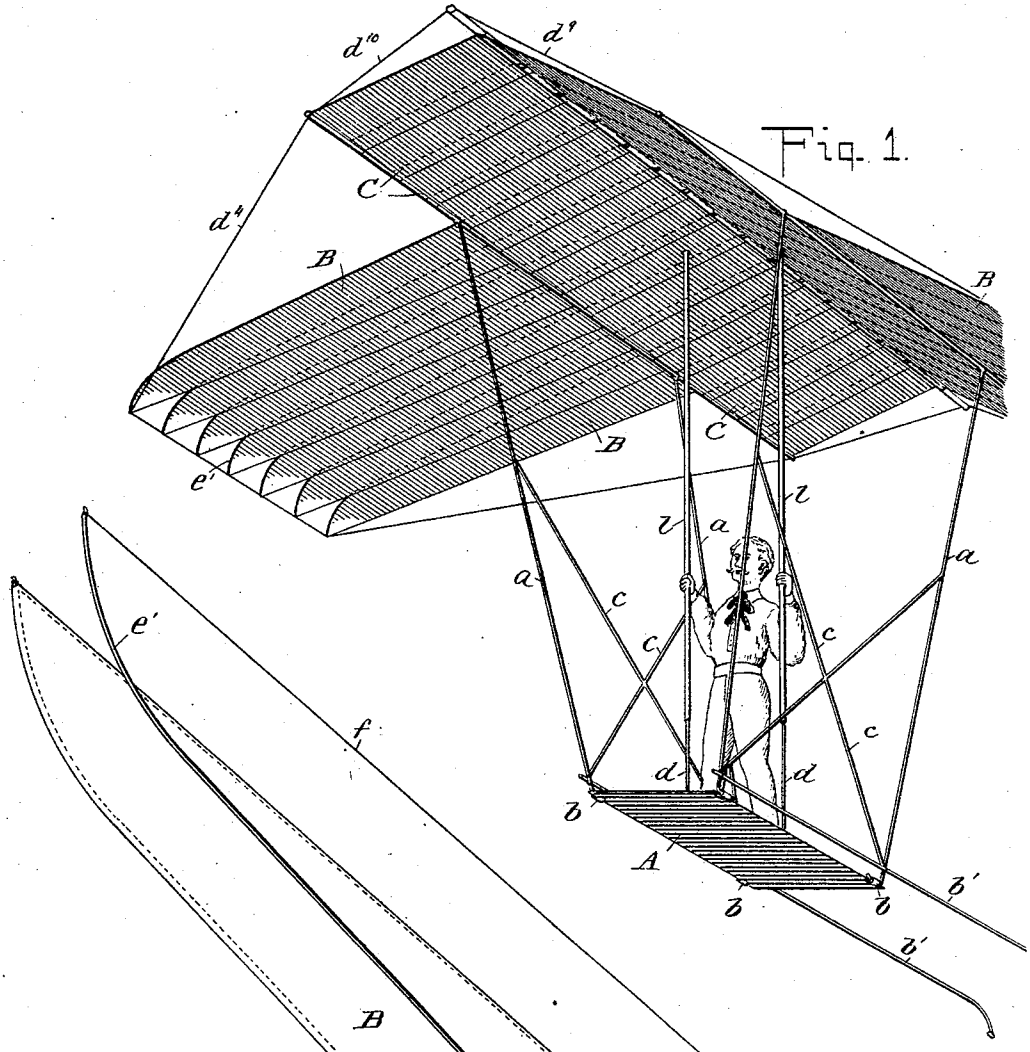

Fig. 8.

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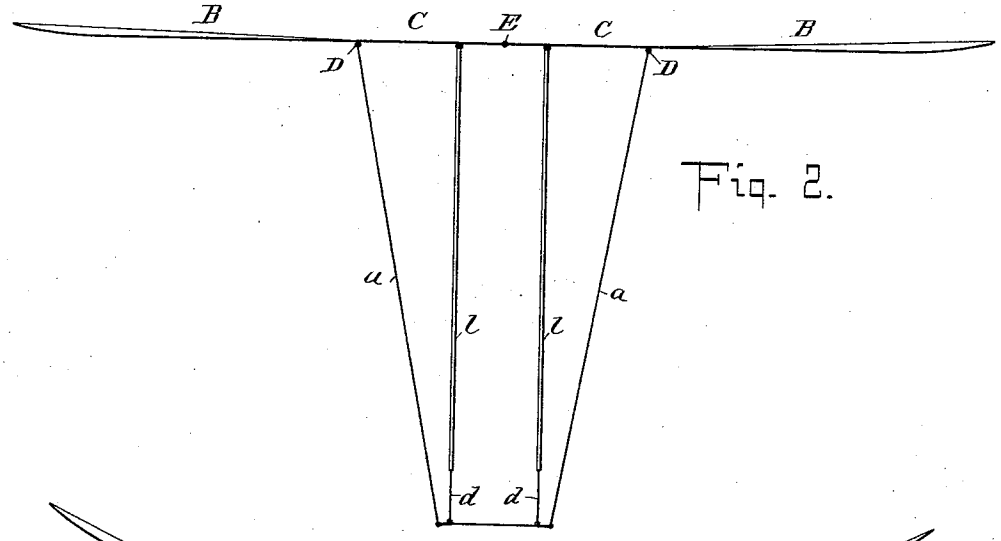

Fig. 2.

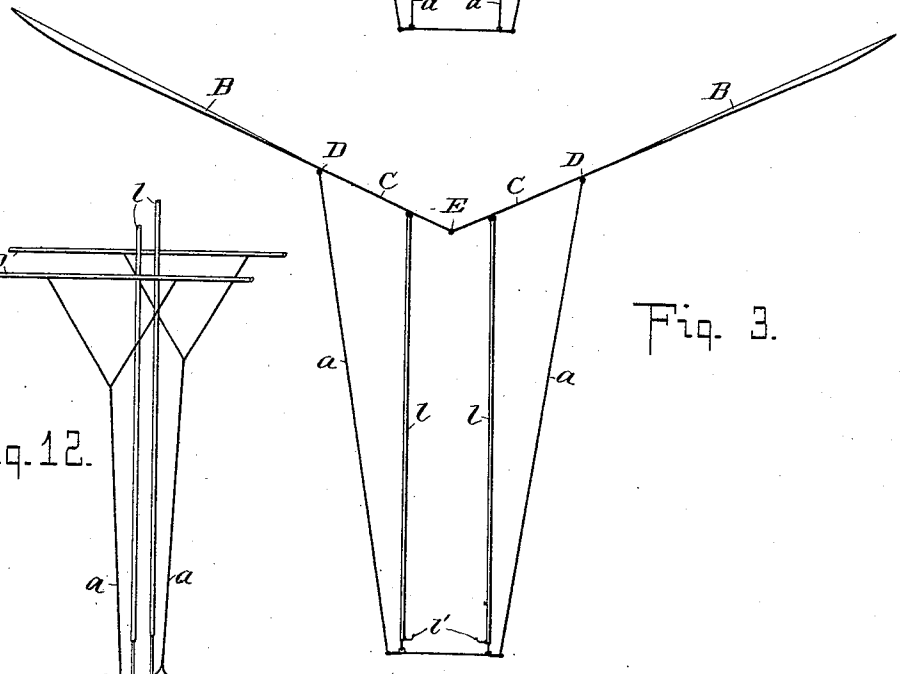

Fig. 3.

Fig. 12.

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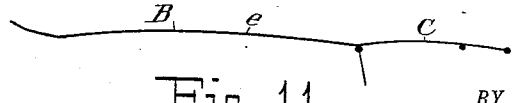

Fig. 11.

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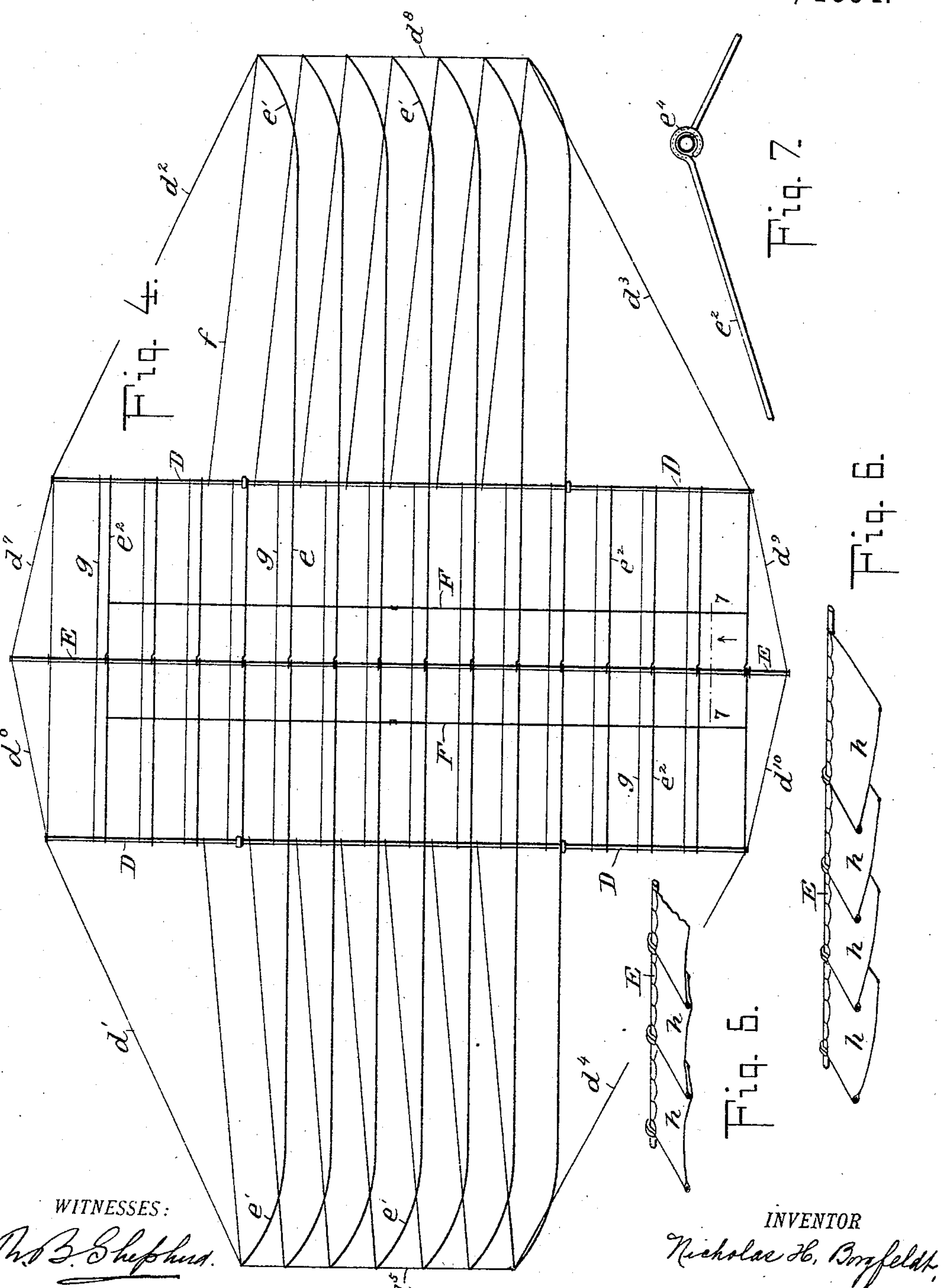

Fig. 4. Fig. 5. Fig. 6. Fig. 7.

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APPARATUS FOR AERIAL NAVIGATION.

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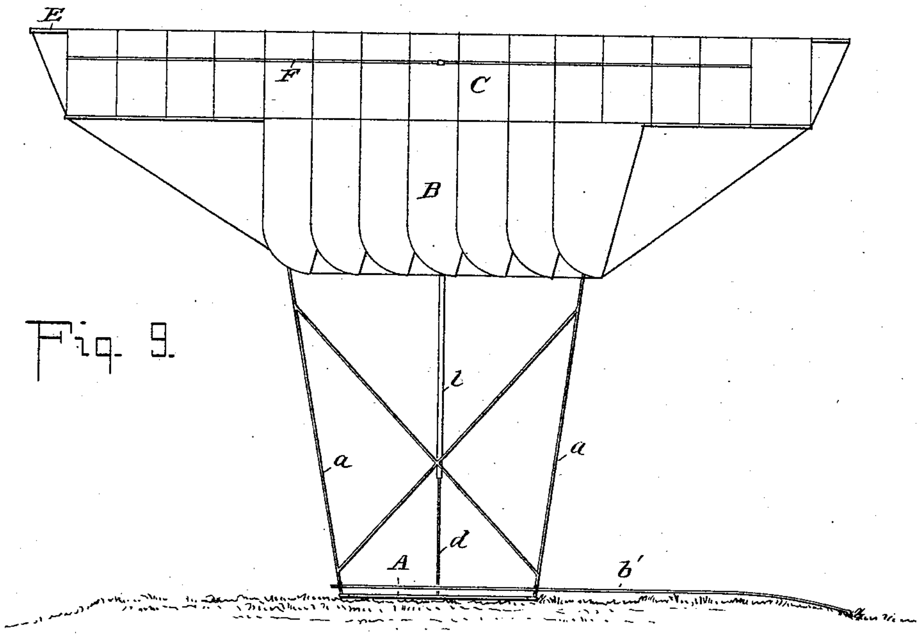

Fig. 9.

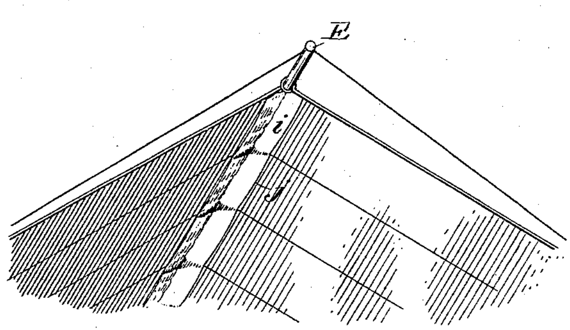

Fig. 10

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[signature]

INVENTOR

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR AERIAL NAVIGATION.

SPECIFICATION forming part of Letters Patent No. 530,219, dated December 4, 1894.

Application filed January 27, 1894. Serial No. 498,168. (No model.)

To all whom it may concern:

Be it known that I, NICHOLAS H. BORGFELDT, a resident of Brooklyn, Kings county, State of New York, have invented certain new and useful Improvements in Apparatus for Aerial Navigation, of which the following is a specification.

My invention relates to apparatus for aerial navigation, and has for its object to provide an apparatus which will navigate the air without the employment of balloons or other equivalent means for securing buoyancy—that is to say, an apparatus which is capable of being sustained and propelled in the air by the effort of the operator, advantage being taken of the dynamic force of the winds to assist such operation, as will more fully hereinafter appear.

To this end my invention consists in the construction hereinafter set forth, shown in the accompanying drawings, and more particularly pointed out in the claims, together with such structures as may be justly considered equivalent structures in view of the prior state of the art.

In principle, my invention is based upon the principles governing the flight of birds as at present understood, and presents for its chief advantage the fact that the wings or sails hereinafter described are effective to move the apparatus both on the upward and on the downward stroke of the driving mechanism, having therefore a duplex or double action instead of being effective only during half the time, as at present practiced.

In the drawings, forming part hereof—Figure 1 is a perspective view, partly broken away, showing one form of my invention. Figs. 2 and 3 are end views showing the wings in different positions. Fig. 4 is a plan view of the frame or skeleton of the wings. Figs. 5 and 6 are fragmentary views of parts of the wings, showing details thereof, as will be fully explained hereinafter. Fig. 7 is a sectional view on line 7—7 of Fig. 4 showing the method of pivoting the wing-rods to the center shaft. Fig. 8 is a detail plan view of a section of the end of a wing showing a method of attaching the fabric of the wing covering to the skeleton. Fig. 9 is a side view of the apparatus resting on the ground. Fig. 10 is a detail perspective view of the under side of the center of the wings; and Fig. 11 shows a modified form of wing-rod. Fig. 12 is a modification of the supporting-framing.

In the drawings, A is a platform to which may be pivoted, or otherwise suitably secured, suspending rods *a a*, the pivots being indicated at *b b*. These rods may be cross braced in any suitable manner, as by braces *c c*. This platform and its system of suspending rods may be variously constructed. For instance, the platform A may be a narrow board to which a single pair of suspending rods is connected, the whole being suspended by two or more rods connected to each one of the pair of suspending rods, as shown in Fig. 12.

The platform A forms a support for the operator of the machine, and has mounted thereon guide-rods *d d* on which work the tubes *l l*, forming the connection for operating the wings. These wings are secured to rock shafts D D and consist of outer sections B B and inner sections C C lying on either side of the rock shaft D, and to these rock shafts D the rods *a a* are pivoted so that the platform and its suspending rods are supported from the rock shafts D D.

Referring particularly to Fig. 4, I have shown in plan the skeleton for the wings as made up wing-rods *e e* extending from a center shaft E fastened securely to the rock shafts D D, (as shown more clearly in Fig. 8,) and having their ends bent backward at *e'*. Connecting rods e^2 pivotally secured to the center shaft E serve to connect the center shaft and the rock shafts D D.

I desire it particularly to be understood that both the wing-rods and the connecting rods may be secured to the center shaft by pivoting or otherwise in any manner that will allow the wings to have free motion on said center shaft, but I prefer to pivot them by hinge-loops, as shown in Fig. 7. To form an additional brace for the inner structure, I attach longitudinally extending stiffening rods F on the inner section C of the wings, and to these stiffening rods I connect the tubes *l l* which form the connection for operating the wings from the platform.

The entire structure is trussed or braced

by suitable guys d', d^2, d^3, d^4, d^5, d^6, d^7, d^8, d^9, d^{10}.

Cords f extend from the extremities e' of the wing-rod e to the rock shaft D. Similar cords g extend from the center shaft E to the rock shafts D D and preferably extend parallel to the wing-rods and the connecting rods, as shown. To the skeleton thus formed is secured suitable fabric, such as a textile fabric, so as to cover the same.

The method of covering the wing is specifically illustrated in Fig. 8 wherein it will be seen that a separate covering is applied to the frame formed by the outer end of the wing-rod e and the cord f, and the frame formed by the inner end of the wing-rod e, and the cord g. These separate coverings overlap each other slightly, as shown in Fig. 5, the rods of one section or frame overlapping the cord of the other section or frame, so that when the wing is moving in one direction it will serve to retain the air on account of the flexible cord of one section bearing against the overlapping rod of an adjacent section, (Fig. 5) that is to say, when the wing is swung, it will retain the air upon the downward movement of the wing section, and upon the upward movement will allow the air to pass freely through on account of the flexibility of the cords f and g, there being no stiff overlapping rod for the cord to bear against when the wing section is receiving an upward movement. (See Fig. 6.)

The detailed operation of my apparatus is as follows: I will suppose the apparatus to be resting on its base on the ground or other support facing in the direction from which the wind is blowing, and the wings to lie in the position shown in Fig. 1. The operator stands upon the base, and grasping the tubes l l, gives them a reciprocating up and down motion between the limits substantially as shown in the two extreme positions in Figs. 1 and 3. This will have the effect of rocking the wings upon the shafts D D as axes. The sections B and C of each wing are so proportioned as to produce about an equal effect, and it will be observed that upon the down stroke of the tubes the inner sections C will be brought down and the outer sections B will be raised. Thus, upon the down stroke the sections C will serve to confine the air in the manner of a wing, while the air is allowed to pass freely through the ascending outer sections B. Upon the up stroke of the tubes the inner sections C will be raised, allowing the air to pass freely therethrough, and the outer sections B will be brought down confining the air. If this reciprocating motion of the tubes be rapid enough, the rapid beating of the air being in all respects analogous to the flapping of a bird's wings, the apparatus will rise in the air with more or less rapidity, the dynamic force of the wind and the force produced by flapping the wings, forming a couple, the resultant of which will be the line of direction of the ascent of the apparatus.

When the apparatus has attained the desired elevation, the wings need not be flapped so vigorously as was necessary when setting the apparatus in motion, but a quick motion of the tubes of short amplitude assisted by the force of the wind blowing, will be sufficient to produce motion through the air, the flexible bent ends of the sections B serving to propel the apparatus forward.

It will be found that in order to get the most efficient results, advantage must be taken of any wind which may be blowing, but the apparatus may be used for slowly descending when there is no wind blowing.

When it is desired to descend, the wings may be held still, for instance, in the position shown in Fig. 2, and the dynamic force of the wind together with the weight of the operator and apparatus will form a couple, the resultant of which will be the line of direction of the descent. When the apparatus is in motion through the air, slight changes of direction may be imparted to it by the operator by swinging the rods a upon their pivots b, the guide-rods d being sufficiently flexible to allow of such movement, when the wings will act with greater force on one side of the center of gravity than on the other, and the apparatus will be given a tendency to turn. The operator may also cause the apparatus to descend, by shifting the center of gravity forward; for instance, by stepping forward on the base or platform, thereby inclining the front of the platform and wings downward, and descending on an inclined plane.

When the apparatus is in rapid motion and it is desired to ascend, the operator may facilitate the action by shifting the center of gravity to incline the platform and wings backward, and tilt the front upward.

When the changes of direction have been accomplished, the operator restores the parts to their normal position and continues his course in a straight line.

It may sometimes be found desirable, if a strong wind is blowing, to provide a base or bearing of large area for the apparatus in order that the apparatus may stand firmly on the ground, and an effective start may be made. For this purpose I may provide extensions b' b', as shown in Figs. 1 and 9. I may also find it desirable to cover the gap between the center shaft and the ends of the wing sections C C with a strip of fabric i, as shown in Fig. 10. This strip may have its edges j free, in order that the air may be free to circulate during the upward stroke of the center shaft and be confined during the downward stroke.

In Fig. 12 I have shown the wing-rods as curved or bent, in order to more effectively confine the air, and in Fig. 3 I have shown

steps or handles *l' l'* near the base for moving the tubes. These tubes may also be operated by using one or both feet and throwing the weight of the body upon the tubes. These steps may be made adjustable so that they may be turned out of the way when not required for use.

I desire it to be expressly understood that I in no wise limit myself to the construction and arrangement herein shown, as the device may be greatly varied without departing from the spirit of my invention, the main feature of which is to provide an apparatus to utilize the double acting wing principle above set forth, together with such details of construction as may be necessary to the efficient operation of the apparatus.

What I claim, and desire to secure by Letters Patent, is—

1. In an aerial apparatus, the combination of wings, each having an outer and an inner section, the inner sections of the wings being pivotally connected to each other and each wing being pivoted intermediate of its sections, together with mechanism for swinging the wings on their pivots, all arranged so that a movement of the operating mechanism will swing the sections of each wing in opposite directions as set forth.

2. In an aerial apparatus, the combination with a center shaft, of wing-rods pivoted thereto by one end and connected to rock shafts intermediate of the end of the rods, each of said wing-rods having combined therewith a section of fabric, all arranged in such a manner that each wing-rod overlaps the section of fabric attached to the next adjacent wing-rod, as set forth.

3. In an aerial apparatus, the combination of wings, each having an outer and inner section, each wing being pivoted intermediate of its sections, together with a center shaft to which the inner section of each wing is pivoted, as set forth.

4. The combination with a base A of wings provided with stiffening rods F F, of sliding tubes *l l* fastened to the stiffening rods F F together with guide-rods *d d* co-operating with the tubes and mounted on the base, substantially as described.

5. The combination with pivoted wings of a base A, suspending rods *a* attached thereto, said rods being also attached to the wing pivots, substantially as described.

6. The combination with a base A and suspending rods *a a* pivotally attached thereto and mechanism for operating wings, of wings carried by said rods and said wing operating mechanism, as specified.

7. In an aerial apparatus, a pair of double acting wings pivoted intermediate of their ends and to a center shaft and arranged to confine the air upon the down stroke and to allow free circulation upon the up stroke, in combination with operating mechanism by the wings connected to the wings by pivotal connections as set forth.

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Witnesses:
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GEO. E. MORSE.