(No Model.) 4 Sheets—Sheet 1.

L. P. MOUILLARD.

MEANS FOR AERIAL FLIGHT.

No. 582,757. Patented May 18, 1897.

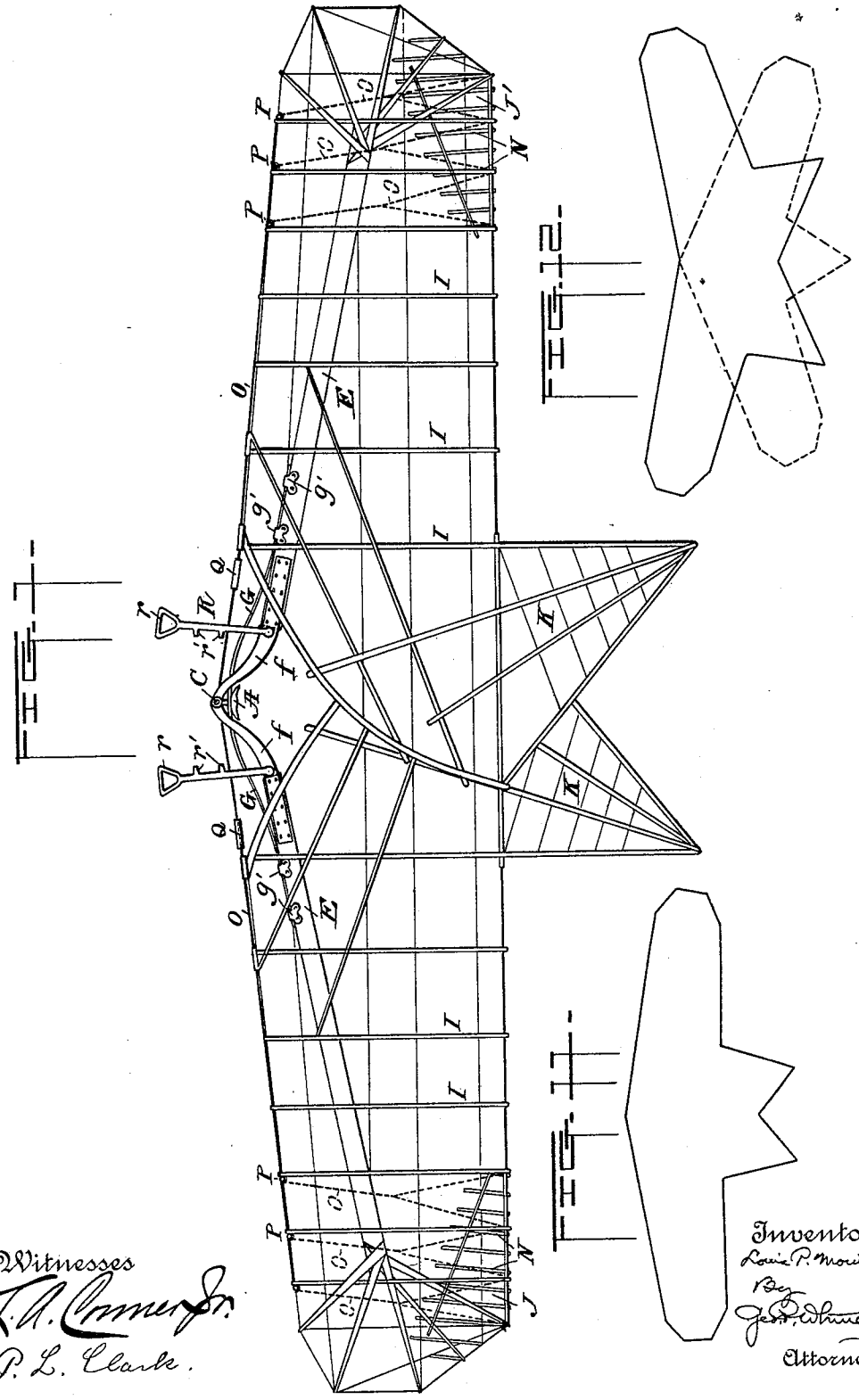

FIG. 12.

FIG. 7.

FIG. 11.

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MEANS FOR AERIAL FLIGHT.

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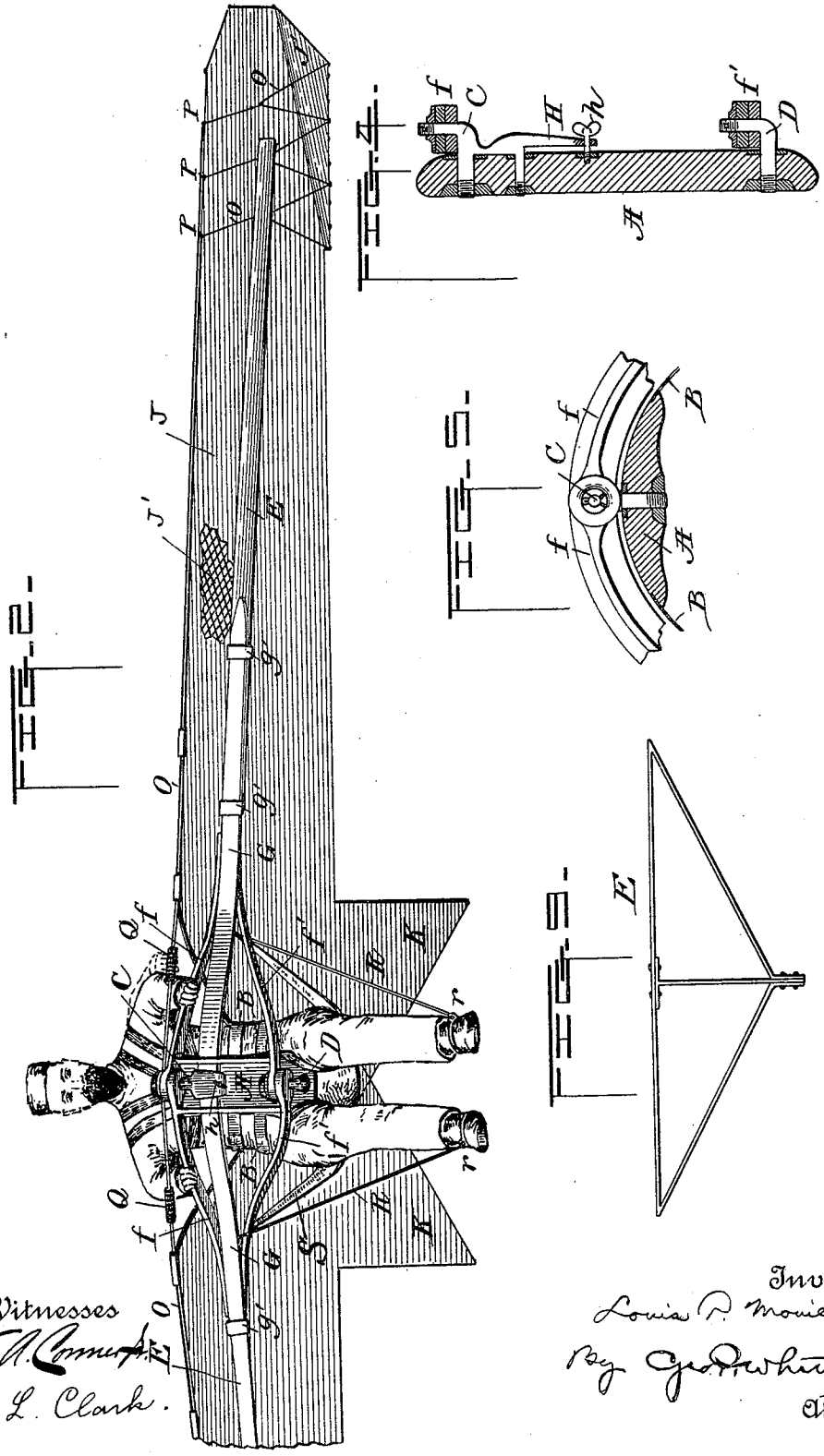

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(No Model.) 4 Sheets—Sheet 3.

L. P. MOUILLARD.

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FIG. 5.

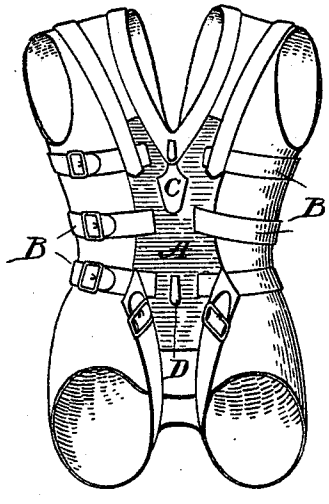


FIG. 6.

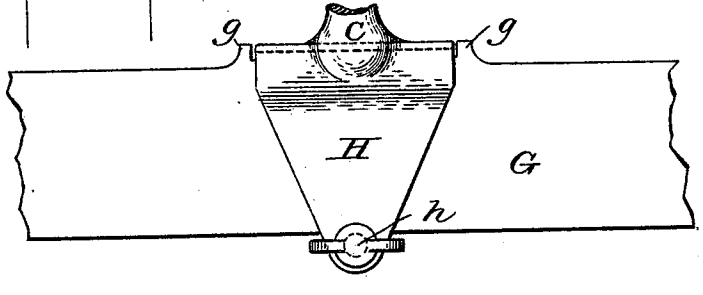


FIG. 7.

FIG. 8.

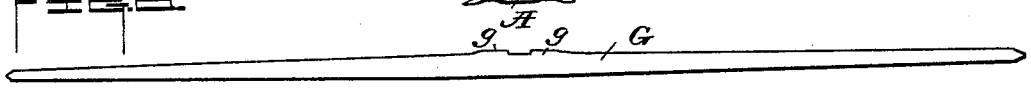
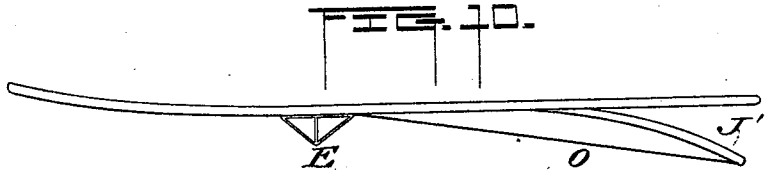


FIG. 10.



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(No Model.) 4 Sheets—Sheet 4.

L. P. MOUILLARD.

MEANS FOR AERIAL FLIGHT.

No. 582,757. Patented May 18, 1897.

FIG. 13.

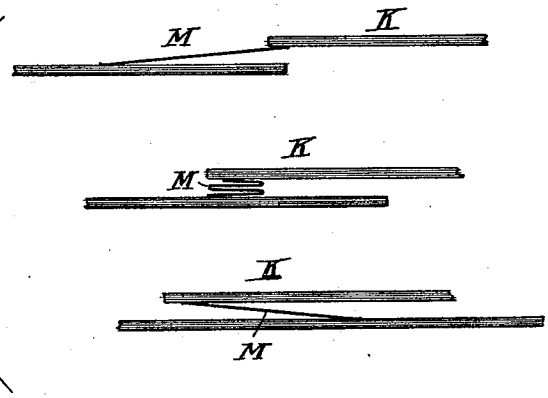


FIG. 14.

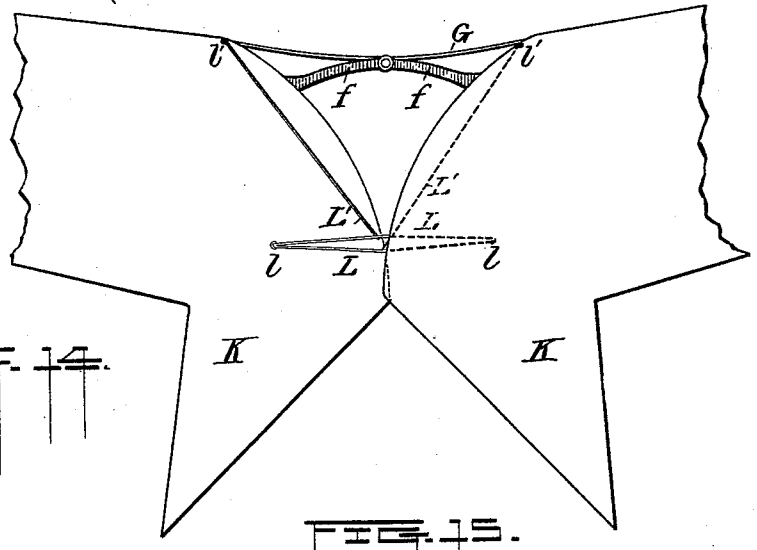
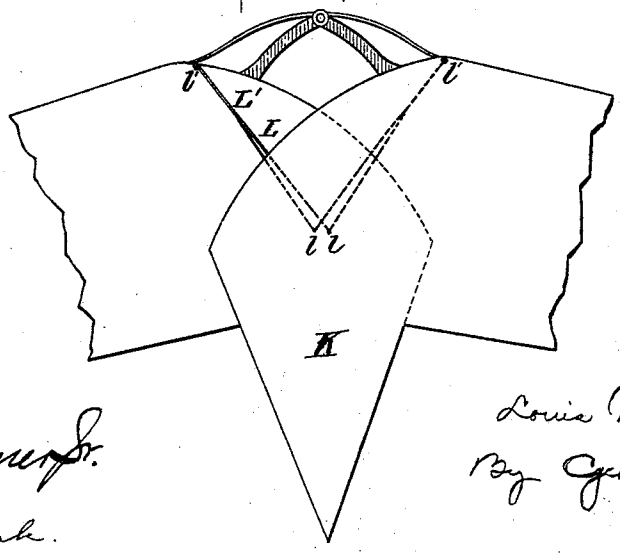


FIG. 15.



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UNITED STATES PATENT OFFICE.

LOUIS PIERRE MOUILLARD, OF CAIRO, EGYPT, ASSIGNOR OF ONE-HALF TO OCTAVE CHANUTE, OF CHICAGO, ILLINOIS.

MEANS FOR AERIAL FLIGHT.

SPECIFICATION forming part of Letters Patent No. 582,757, dated May 18, 1897.

Application filed September 24, 1892. Serial No. 446,786. (No model.)

To all whom it may concern:

Be it known that I, LOUIS PIERRE MOUILLARD, a citizen of the Republic of France, residing at Cairo, Egypt, have invented certain new and useful Improvements in Means for Aerial Flight; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to a machine for navigating the air by the force of the wind, and has for its object the imitation of the soaring of large birds, which I have been watching for thirty years in tropical latitudes. I know from abundant personal observation that such birds can, without a single flap of their wings, float up into the air on a sufficient wind, sail about at pleasure, circle and rise to great altitudes, glide down in any direction, and come back to their original starting-point upon fixed rigid wings, solely by the skilful use of the power of the wind. This I propose to imitate.

It is well known that if a plane surface, or one slightly concave, be exposed to the wind at an acute angle the resulting wind-pressure will affect it in two directions. One is a vertical reaction, which lifts it up, and the other reaction either drifts it back or drives it forward, according as the surface be inclined, either above or below the horizon. It is also known that as the angle which the current of air makes with the surface is changed there is a corresponding change in the position of the center of pressure on the surface. In order to utilize these forces derived from the wind, three essential requisites may be observed: first, equilibrium must be maintained under all conditions of angle of incidence and speed of translation; second, the angle of incidence with the wind must be changed in order that the apparatus may rise or descend; third, the apparatus must be susceptible of direction horizontally, so that it may go to the right or left, or, in other words, be steered.

My invention consists in certain novel features of construction and combination of parts for the purpose of complying with these essential requisites and of imitating in a simple way the principal maneuvers performed by soaring birds. It comprises an aero plane or planes or concave surfaces provided with devices for firmly attaching it or them to the body of the aviator and arranged to permit movement of the plane or planes in a horizontal direction only with reference to the body of the aviator. The apparatus is thus essentially different from those in which a flapping or vertical motion is imparted to the wings. I rely entirely upon the wind-pressure to sustain my apparatus and not upon any downward thrust upon the air, either by flapping wings or revolving propeller-wheels.

The horizontal movements of my aero plane or planes or concave surfaces are solely for the purpose of changing the relative position of the load or center of gravity in order to cause the apparatus to rise or descend. When the planes are thrust forward, the load is relatively farther back and the aerodrome rises. When the planes are pulled back to the rear, the load is farther to the front and the apparatus glides downward.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate the same parts in all the figures.

Figure 1 is a plan of the apparatus. Fig. 2 is a front elevation showing the operator in position. Fig. 3 is the cuirass or corset which attaches the wings to the body of the operator. Fig. 4 is a vertical section of the breastplate of the cuirass or corset. Fig. 5 is a horizontal section thereof. Fig. 6 is a front elevation of the spring-clamp. Figs. 7 and 8 are plan and front views of the spring. Fig. 9 is a section of a main beam. Fig. 10 is a transverse section of a wing, showing the horizontal steering devices. Figs. 11 and 12 show the various positions taken by the wings. Fig. 13 shows the various positions of the stop-cords. Figs. 14 and 15 show the arrangement for closing the tail portions.

The apparatus comprises, first, a cuirass or corset composed of a rigid breastplate A, provided with strong straps B or a close-fitting

garment, or both, for firmly fastening it to the body of the aviator. The breastplate is specially made to fit each operator, being preferably composed of wood. It provides the operator with an artificial sternum, an organ largely developed in the bird, but practically lacking in man.

The wings, which constitute the aerial plane of the apparatus, are hinged to the breastplate, each on a vertical axis, so as to be capable of movement forward and backward only. It is preferred to hinge them upon the hooks C D, which are rigidly attached to the breastplate, one above the other. The wings consist, essentially, of a light but strong framework covered with silk or some other suitable material. The main beams E of the wings may be of bamboo or of metal tubing, but I prefer to construct them as hollow-plate girders of aluminium. To their inner ends are riveted the curved metallic arms, having eyes *f f'*, which fit on the hooks C D, respectively. The tips of the wings are normally thrown forward in advance of the axis on which they are hinged by means of a strong spring. This may be of any suitable construction and may be attached in any suitable manner, but it is preferred to use a flat steel spring G, the middle of which is firmly clamped between a plate H and the breastplate by a thumb-screw *h*, giving the requisite pressure. The spring may have lugs *g* to fit against the edges of the plates and prevent endwise movement of the spring. The ends of the spring are fastened to the beams E, as by slips *g'*. The spring does not have a great range of movement, and can therefore be made very strong. Normally it curves forward in order to throw the wings into the position shown in Fig. 11, which is their disposition when at rest. Fastened rigidly to the main beams E are cross-bars I, preferably pieces of bamboo. Under the frame of the wings is tightly stretched a light net of silk twist J' with meshes about two inches square. Under this is spread a covering of silk or other fabric J, which is attached to the net at a sufficient number of points to fasten it thoroughly.

I do not, however, wish to confine myself to any particular mode of constructing the framework. It may be built of any suitable material and in any suitable manner. I may even duplicate the planes, placing one above the other and connecting them by braces or trusses to secure vertical stiffness.

The wings are preferably long and narrow, and they are preferably provided at their inner rear ends with rearwardly-projecting triangular portions K, which together constitute a tail. This, however, is not intended for steering, but merely to permit the effective surface of the aeroplane to be varied by closing one tailpiece over the other. In order to accomplish this without danger of rubbing or fouling, one wing is set higher than the other, but in approximately a parallel plane therewith. A difference of four inches between the planes is sufficient.

To positively effect the closing of the tail, the wings may be pulled back by hand, but it is preferred to arrange also some means by which the movement can be given by the feet of the operator. The arrangement illustrated is as follows: At the points 1 1 on the wings are fastened two cords L L. To the middle of each cord is attached a cord L', which runs through an eye 1' near the front of the wing and thence to a stirrup 12. A pull on the cord L' carries the middle of the cord L toward the eye 1' and causes the wings to swing back one over the other, as shown in Fig. 15, the cords lying in the space between the wings. Other modes of accomplishing this will be readily devised, and I do not intend to confine myself to the one shown and described.

To limit the movement of the wings, stop-cords M are attached to the wings.

In order to provide for the horizontal steering of the apparatus—that is, the guiding it to the right or left—I substitute for the ordinary rudder a novel and more effective arrangement. A portion J' of the fabric at the rear of each wing is free from the frame at its outer edge and at the sides. It is stiffened with suitable blades or slats N, of flexible material, and normally rests up against the netting. Cords O are attached to the rear edge of the portion J' and pass forward to rings P, where they unite and run to the handles Q near the inner ends of the wings. A pull upon one of these handles causes the portion J' to curve downward, as shown in Fig. 10, and thus catch the air, increasing the resistance upon that side of the apparatus and causing it to turn in that direction. Any other equivalent device for creating at will an additional resistance to the air on either side of the apparatus may be employed, and I do not limit myself to the one shown and described.

The forward movement of the wings is usually produced by the arms of the aviator, but in case of emergency the feet may be used, operating upon the rods R, fastened to the main beams and provided with stirrups *r* and foot-rests *r'*.

A strap S is fastened to the beams E to afford a seat for the aviator.

Upon preparing to start the aviator stands upright, carrying the apparatus by the broad shoulder-straps of the cuirass. The aeroplane can glide upon the air in two ways only—viz., by a fall from a height sufficient to procure a speed which shall cause the air to support the apparatus or by a skilful utilization of the force of the wind, which must blow at least ten miles an hour to enable the aeroplane to operate. This wind-pressure and the force of gravity provide for translation in any direction, and this constitutes the great economy of soaring flight.

The life of the aviator depends upon the spring, which should be of sufficient strength to hold the two wings with their front edges on a straight line at a speed of twenty-two miles an hour. At a higher speed the increased pressure upon the wings, produced by the forward motion through the air, throws them backward, and the center of gravity thus being moved relatively forward the wings tend to assume a more horizontal position and thus compensate for the otherwise increased vertical reaction of the air-pressure. Should the speed diminish, the spring pulls the wings forward, opening the tail portion and tilting the wings upward, so that they present a greater angle to the air and thus increase the lifting power of the pressure.

A well-proportioned spring will produce, automatically, most of the changes in the horizontal angle which the wings make with each other in order to maintain the vertical equilibrium and level flight of the apparatus under varying speeds. It is necessary, however, to frequently regulate the position of the wings with the hands or feet. When the tips of the wings are pulled back, a forward movement or a downward plunge results. To counteract too violent a movement of this sort, the wings must be thrown forward.

Should the spring break, the wings must be pulled forward vigorously to prevent a sudden headlong plunge, and the aviator should therefore be strong enough to operate the wings in case the spring fails. It is therefore possible to dispense with the spring and depend entirely upon the strength of the operator to hold the wings in their proper position; but this is not recommended.

From the foregoing statements it will be seen that vertical steering or equilibrium depends upon the forward and backward movement of the wings, whereby the center of gravity is carried, respectively, backward and forward. The horizontal steering is effected by the downwardly-movable rear portion J′ of the fabric in the manner already described. When both sides are pulled down together, they serve as an effective brake to check the speed. The amount of surface of the wings should be varied in proportion to the weight to be carried and in accordance with the speed of the wind by which it is proposed to sail. The apparatus here shown is designed to furnish, when the wings are fully open, a surface of about one square foot to the pound of total weight, (including both aviator and apparatus,) this being about in the proportion of most soaring birds. The apparatus is intended to sail with winds varying between ten and twenty-five miles per hour.

The weight of the apparatus will vary, of course, with the substance used in its construction, but the one shown and described should not exceed fifty-five pounds, and may possibly be reduced below that figure.

This apparatus is intended as elementary rather than to indicate the best that may be accomplished. The surfaces and proportions may be departed from, but the description and illustration are regarded as closely setting forth a new type of aerodrome.

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

1. A soaring-machine consisting of an aeroplane composed of two wings, each hinged upon a vertical axis and capable of forward and backward movement only, substantially as described.

2. A soaring-machine consisting of two wings, each hinged upon a vertical axis, an automatic regulating device controlling the angular position of the wings with the variation in speed, substantially as described.

3. A soaring-machine consisting of two wings, each hinged upon a vertical axis, and a mechanical device attached to said wings for throwing forward the tips of the wings, substantially as described.

4. A soaring-machine consisting of two wings, each hinged upon a vertical axis, and a spring attached to said wings, substantially as described.

5. A soaring-machine consisting of two wings, each hinged upon a vertical axis, and a spring normally holding the tips of the wings in advance of said axis, substantially as described.

6. A soaring-machine consisting of two wings, each hinged upon a vertical axis but in different approximately parallel planes, so that one can close partly over the other, substantially as described.

7. A soaring-machine consisting of two wings, each hinged upon a vertical axis, and each having a tail portion adapted to close one over the other, substantially as described.

8. A soaring-machine consisting of two wings, each hinged upon a vertical axis, and adapted to close one over the other, and a mechanical device attached to said wings for positively closing them at will, substantially as described.

9. A soaring-machine consisting of two wings, each hinged upon a vertical axis, and a cord attached to each wing and running through an eye in the other wing, for closing said wings together substantially as described.

10. A soaring-machine consisting of two wings, each hinged upon a vertical axis, and provided with stop-cords to limit their angular movement, substantially as described.

11. A soaring-machine consisting of two wings, each hinged upon a vertical axis, and having a portion movable out of the plane of the wing, substantially as described.

12. A soaring-machine having wings adapted to move in horizontal planes, a portion of the fabric covering each wing being stiffened by flexible slats and having its rear edge free from the frame of the wing, and cords attached to said rear edge for pulling it downward, substantially as described.

13. A soaring-machine consisting of two wings, each composed of a framework, a net spread under the framework, and a covering of fabric fastened below the net, substantially as described.

14. A soaring-machine consisting of an artificial sternum adapted to be fastened to the body of the aviator and two wings, hinged to said sternum on an upright axis, substantially as described.

15. A cuirass or corset for an aviator consisting of a rigid breastplate provided with means for firmly attaching it to the body, and having attachments for receiving and supporting an aeroplane, substantially as described.

16. A cuirass or corset for an aviator, consisting of a rigid breastplate provided with means for firmly attaching it to the body, and having hooks upon which a pair of wings may be hinged on a vertical axis, substantially as described.

17. The combination with the cuirass having a rigid breastplate A, of the hooks C, D, one above the other, and a clamp, as H, adapted to hold a spring, as G, substantially as described.

18. The combination with the rigid breastplate A carrying the hooks C, D of the wings, each having arms F provided with eyes *f f'* to fit on the hooks, substantially as described.

19. The combination with the rigid breastplate A having the hooks C, D and the clamp H, of the wings each having arms F hinged upon the hooks, and the flat steel spring G held at its middle by the clamp, and having its ends attached to the wings, substantially as described.

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

LOUIS PIERRE MOUILLARD.

Witnesses:

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C. P. LUGOLD.