E. A. NORRIS.

AERIAL VESSEL.

APPLICATION FILED OCT. 12, 1908.

998,978.

Patented July 25, 1911.

5 SHEETS—SHEET 1.

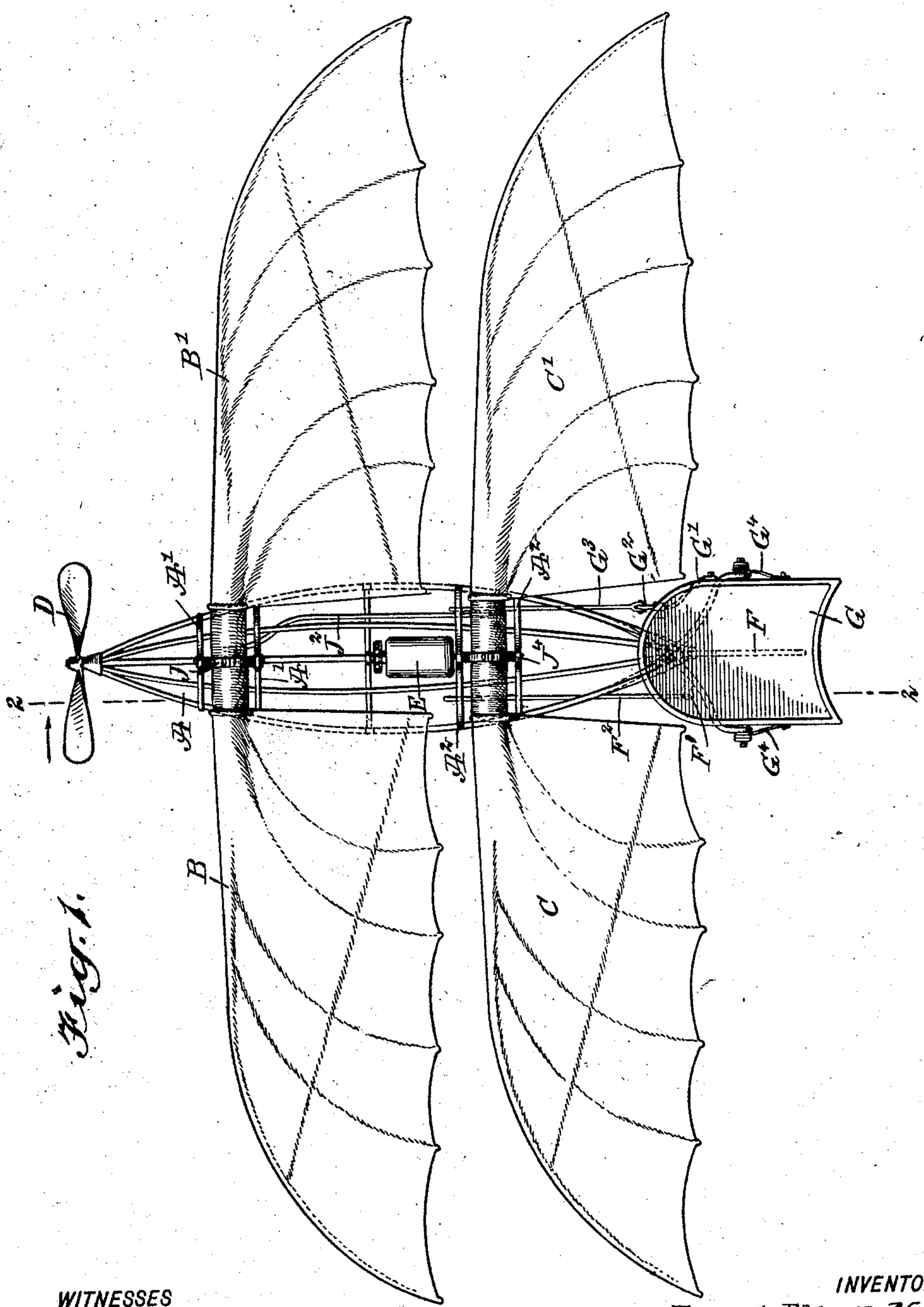

Fig. 1.

WITNESSES

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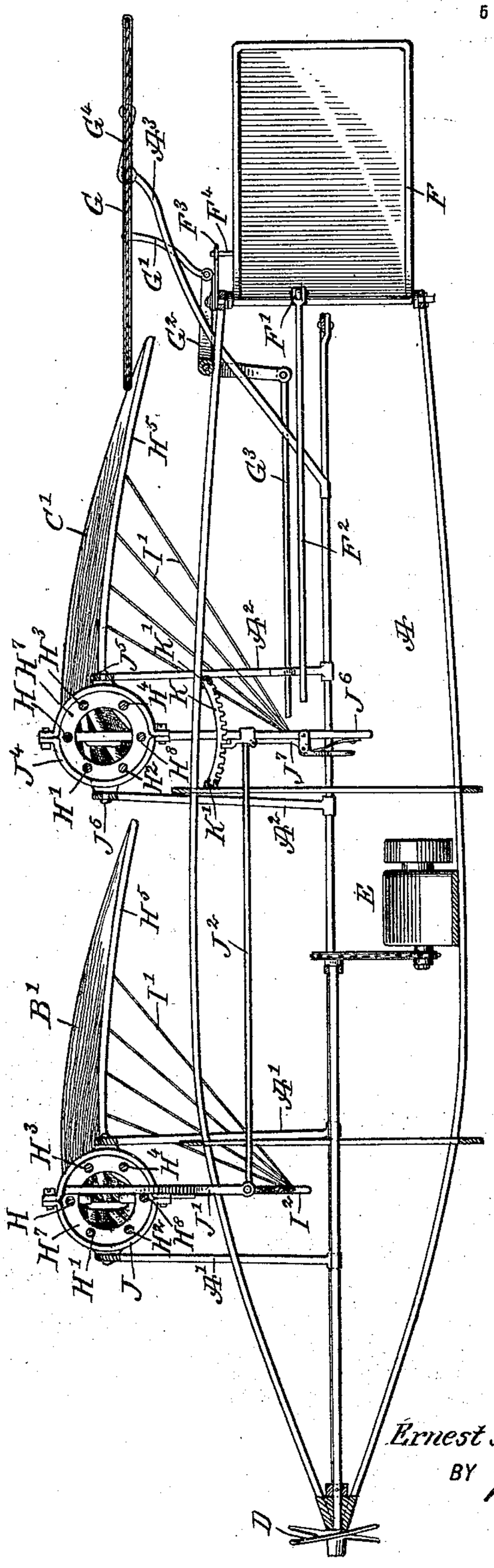
5 SHEETS—SHEET 2.

Fig. 2.



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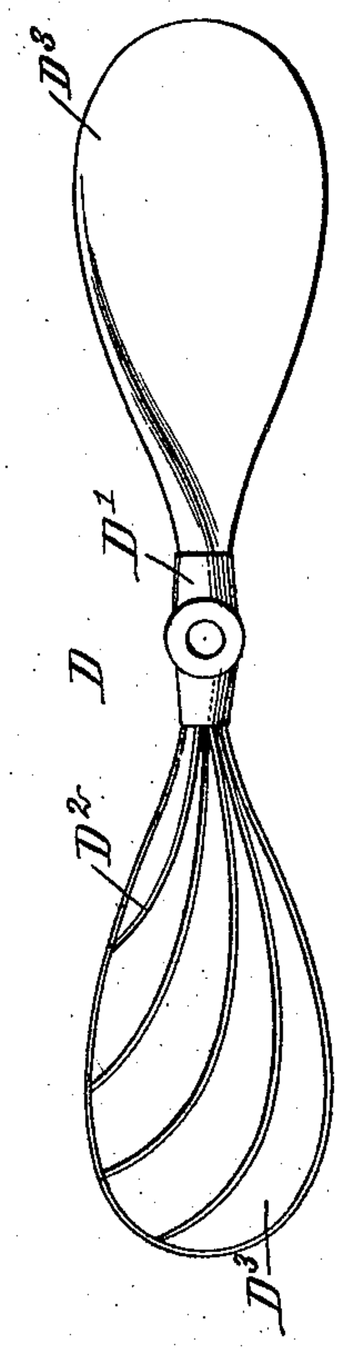

Fig. 4.

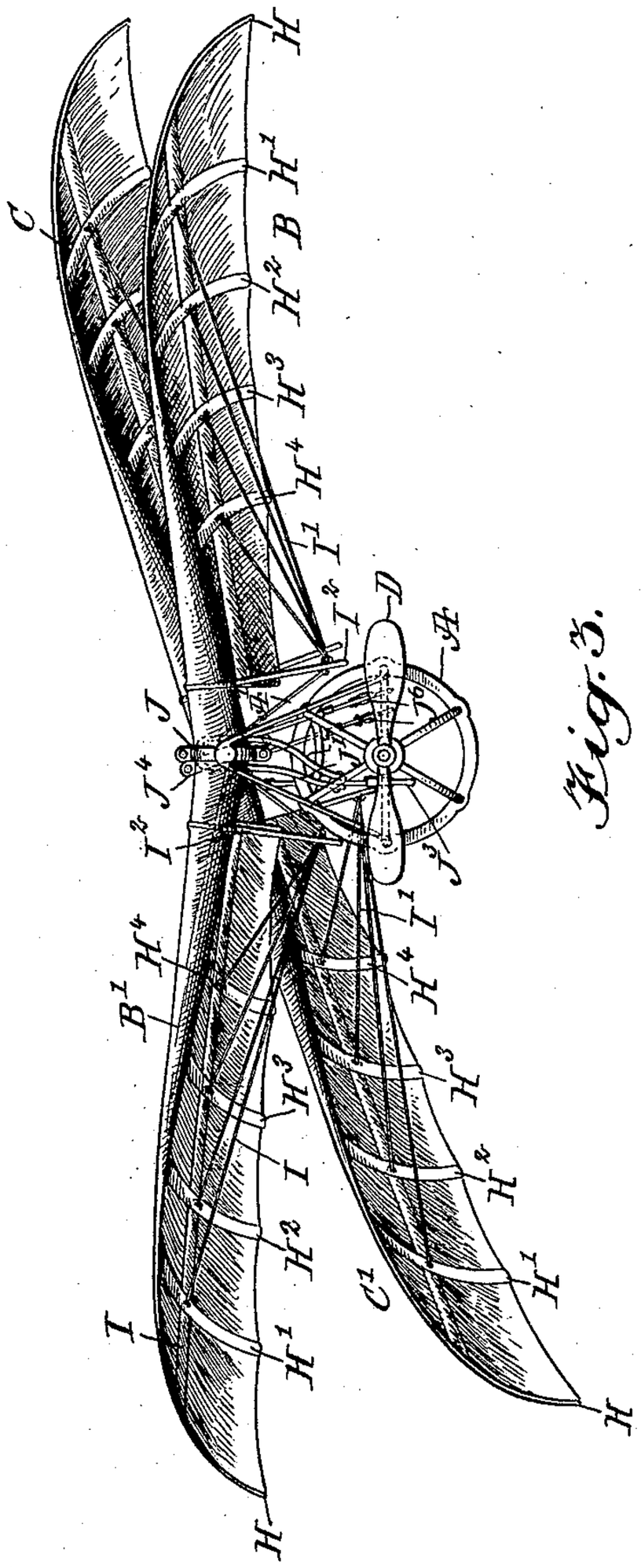

Fig. 3.

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5 SHEETS—SHEET 4.

Fig. 5.

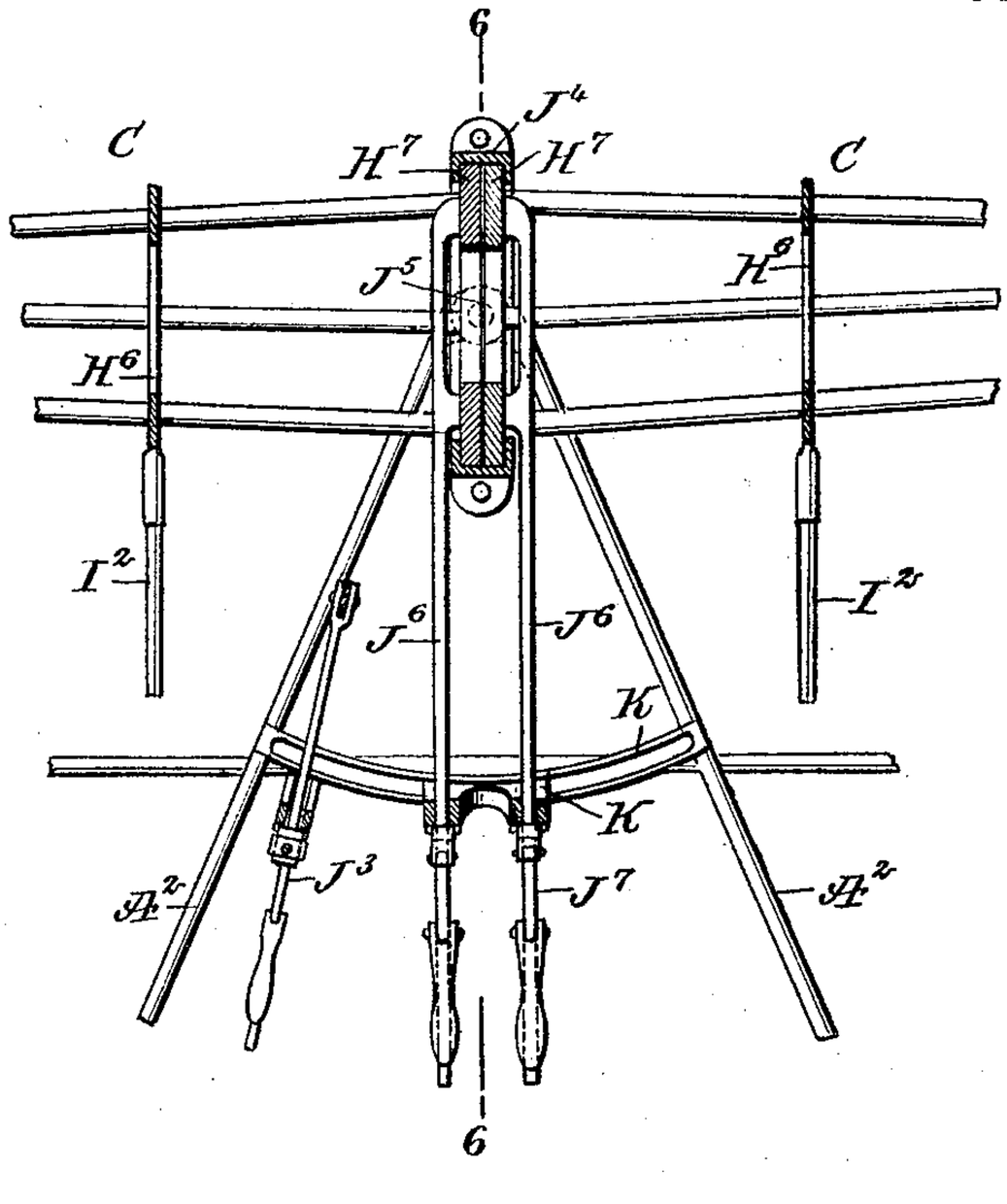

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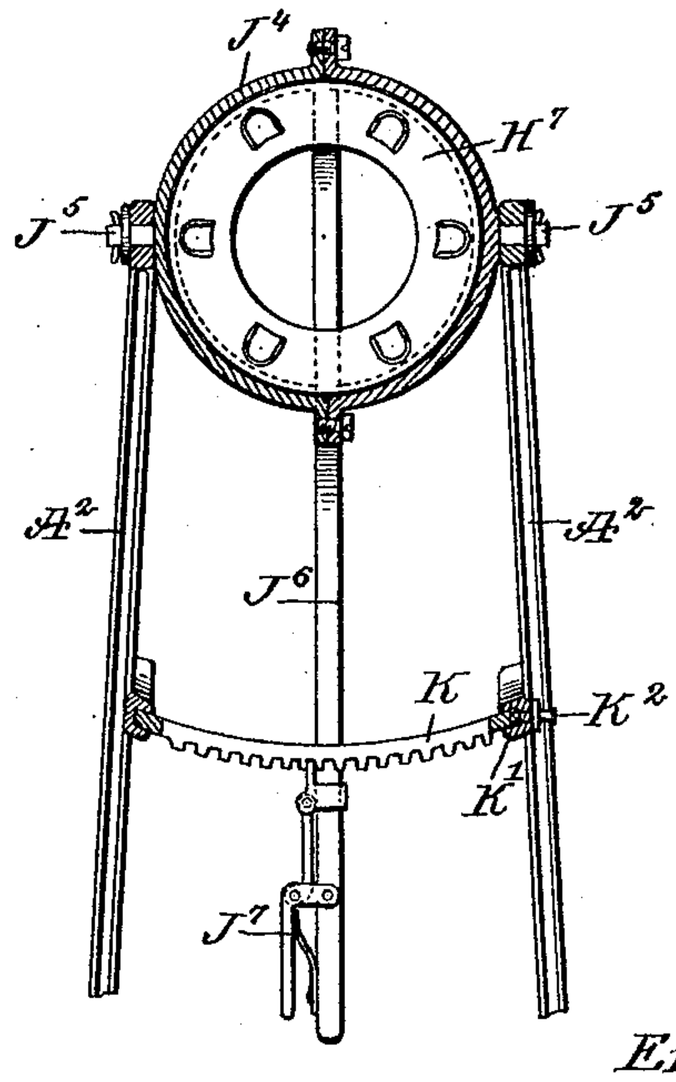
Fig. 6.



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5 SHEETS—SHEET 5.

Fig. 7.

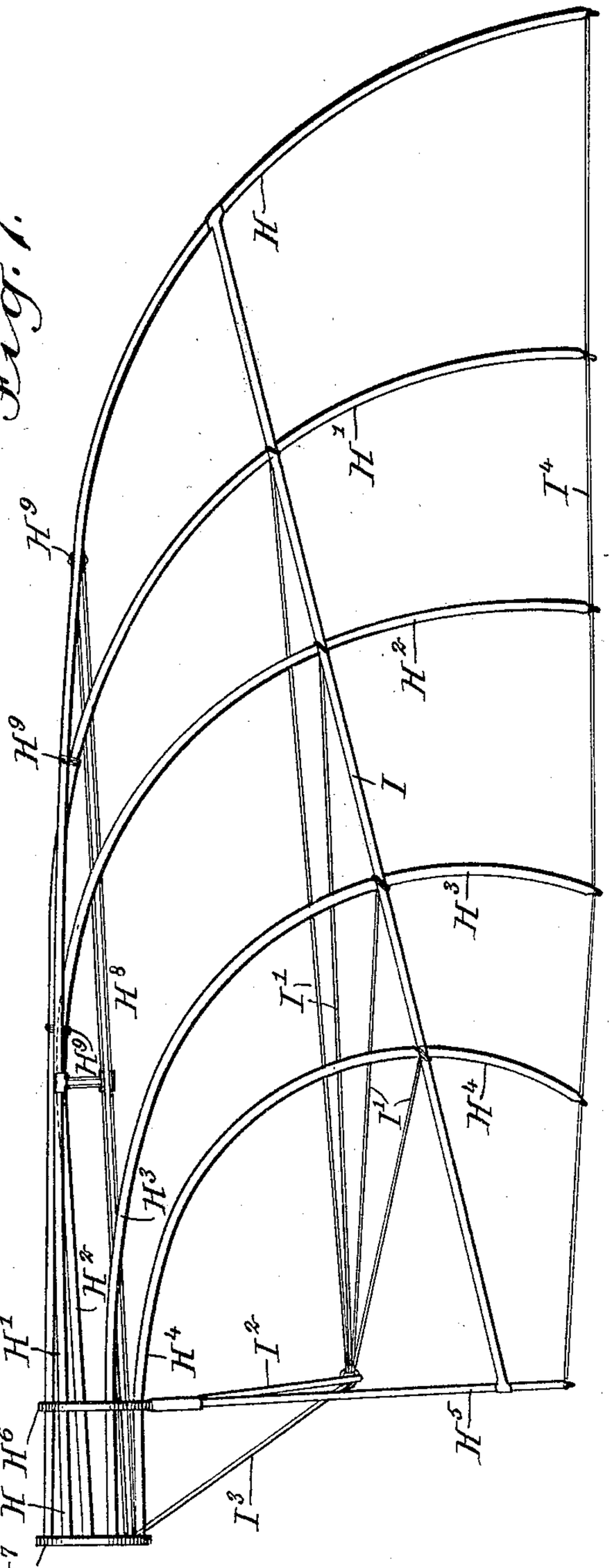
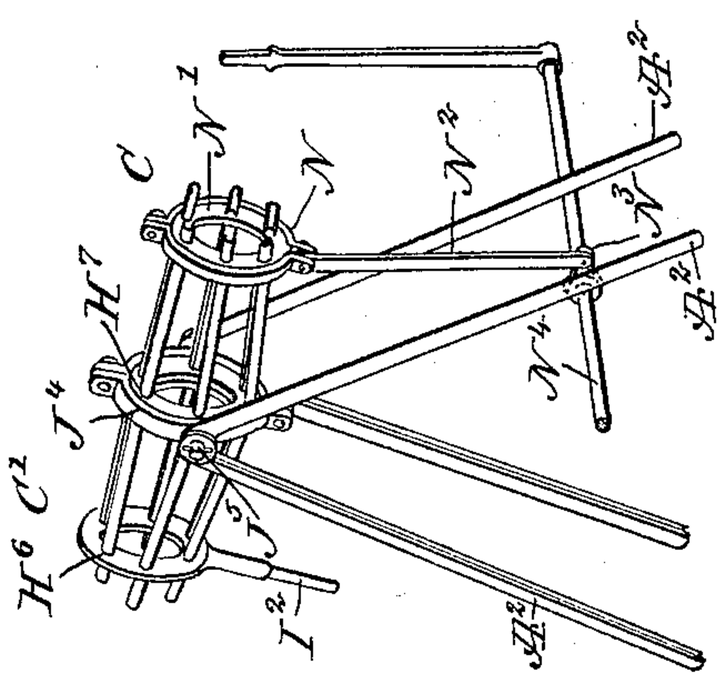


Fig. 8.



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UNITED STATES PATENT OFFICE.

ERNEST ALFRED NORRIS, OF ALBANY, NEW YORK.

AERIAL VESSEL.

998,978. Specification of Letters Patent. Patented July 25, 1911.

Application filed October 12, 1908. Serial No. 457,240.

To all whom it may concern:

Be it known that I, ERNEST ALFRED NORRIS, a citizen of the United States, and a resident of Albany, in the county of Albany and State of New York, have invented a new and Improved Aerial Vessel, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved aerial vessel or aeronef, of the kind known as heavier-than-air flying machines, the improved aerial vessel being provided with large sustaining surfaces capable of being moved to support the vessel, to elevate or lower the same, to propel and steer in the desired direction and to automatically restore the equilibrium of the aerial vessel when struck by contrary air currents.

The invention consists of novel features and parts and combinations of the same, which will be more fully described hereinafter and then pointed out in the claims.

A practical embodiment of the invention is represented in the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a plan view of the improvement; Fig. 2 is an enlarged longitudinal sectional elevation of the same, on the line 2—2 of Fig. 1; Fig. 3 is a front end elevation of the improvement and showing the rear pair of wings tilted relatively to the front pair of wings; Fig. 4 is an enlarged face view of the propeller wheel; Fig. 5 is an enlarged transverse section of the operating mechanism for the rear pair of wings; Fig. 6 is a sectional side elevation of the same, on the line 6—6 of Fig. 5; Fig. 7 is an enlarged plan view of the skeleton frame for one of the wings; and Fig. 8 is a perspective view of a modified form of the operating mechanism for a pair of wings.

The improved aerial vessel is mounted on a cigar-shaped skeleton frame A, supporting at its top a pair of front wings B, B′ and a pair of rear wings C, C′, and on the forward end of the said frame A is mounted to rotate a propeller wheel D driven by a motor E mounted on the frame A. On the rear end of the frame A is mounted a vertical rudder F above which is located a horizontal rudder G, both rudders being under the control of the operator seated on the frame A at or near the middle thereof, so as to readily control the stopping and starting mechanism of the motor E as well as to manipulate the wings B, B′, C, C′ and the rudders F and G. The skeleton frame A may be covered with a fabric material, preferably impervious to water, to allow the vessel to float on a body of water, and this skeleton frame A may be provided with inclosed or guarded platforms, cages or the like, for the accommodation of operators and passengers. The wings B, B′, C, C′ are alike in construction and each consists essentially of a skeleton frame and a covering of silk, canvas or other fabric material. The skeleton frame (see Fig. 7) is formed of a plurality of ribs H, H′, H^2, H^3, H^4 and H^5, of which the ribs H, H′, H^2, H^3 and H^4 have their outer ends curved rearwardly and arched transversely, to give the wing a convex under surface when covered with the fabric material, stretched over the said wings. The inner ends of the ribs H, H′, H^2, H^3, and H^4 are arranged in tubular form bound by a ring H^6 at the end of the innermost straight rib H^5, and which extends approximately at right angles to the inner ends of the other ribs H^2 to H^4, inclusive. The ribs H, H′, H^2, H^3 and H^4 are fixed at their inner ends in a ring H^7, and the forward rib H is braced by a brace H^8 attached to the rings H^6, H^7 at the bottom thereof, and said ribs and the brace H^8 are connected with each other by ties H^9 at or near the beginning of the rearwardly curved portions. A diagonal tie rod I connects the several ribs H, H′, H^2, H^3, H^4 and H^5 with each other, the tie rod I, beginning near the outer end of the rib H^5 and terminating at the forward rib H, approximately midway of the curved portion thereof. Stays I′ lead from the junction of the ribs H′, H^2, H^3, H^4 with the tie rods I to the lower end of a post I^2 depending from the bottom of the ring H^6, and a brace I^3 connects the lower end of the post I^2 with the ring H^7. A connecting cord I^4 connects the terminals of the several ribs H, H′, H^2, H^3, H^4 and H^5 with each other. Over this skeleton frame is stretched the fabric material, as previously mentioned, and by the arrangement described a wing is produced which is flexible at the tip and along the

rear inner margin from the tie rod I to the said margin, while the remainder of the wing is comparatively rigid. Now by having the rear portion and the tip made flexible, it is evident that when contrary winds strike the under side of a wing from an angle, then instead of the wing being forced over to one side and with it the apparatus, the flexible portion yields and assumes an upward curve and tends to turn the outer portion of the surface, so that a small portion of the outer margin toward the tip is turned in a downward direction. This movement is made possible by the difference in area and the difference in flexibility of the parts of the wing surface subject to movement. The twist given to the flexible portion of the wing is in the form of a propeller blade or a screw, and tends to neutralize the possible disturbance of the equilibrium of the vessel by contrary currents striking the wings.

The rings H^7 of the forward wings B, B′ are mounted to turn in a ring-shaped bearing J, secured on the upper ends of standards A′ erected on the skeleton frame A, and the said rings H^7 are provided with downwardly-extending arms J′ connected by a link J^2 with a hand lever J^3, fulcrumed on the skeleton frame A (see Fig. 5), and under the control of the operator, so that when the hand lever J^3 is swung forward the wings B, B′ are turned in a downward direction, and when the hand lever J^3 is moved rearward the wings B, B′ are swung upward. Thus by the arrangement described, the angle of incidence of the wings B, B′ can be readily changed. The rings H^7 of the rear wings C, C′ are mounted to turn in a ring-shaped bearing J^4 having trunnions J^5 journaled in bearings formed on the upper ends of standards A^2 erected on the skeleton frame A.

On the rings H^7 are secured downwardly-extending arms J^6 under the control of the operator, and having hand levers J^7 adapted to be locked to a sliding frame K, mounted to slide longitudinally in guideways K′ attached to the standards A^2 previously mentioned. Now by the arrangement described, the operator by unlocking the arm J^6 from the block K can swing the arm forward or backward, to turn the corresponding wing C or C′ in the bearing J^4, to change the angle of incidence of this wing, and when it is desired to tilt the wings C, C′ in a transverse direction, then the arms J^6 remain locked to the block K, and a lateral movement is given by the operator to the arms J^6, so as to rock the bearing J^4 and with it the rings H^7 of the wings C and C′. Thus by the arrangement described the wings C and C′ can be turned in the bearing J^4 independently to change the angle of incidence, and the wings can be rocked in a transverse direction to cause the wings C and C′ to assume an inclined position relatively to the front wings B, B′, as will be readily understood by reference to Fig. 3.

It is understood that the sliding block K is slotted in a longitudinal direction, to permit swinging of the arms J^6 forward and backward without disturbing the position of the sliding block K in the guideways K′, and suitable fastening means K^2 (see Fig. 6) are preferably employed for holding the block K normally in a fixed position in the guideways K′.

The vertical rudder F is provided with a sidewise extending arm F′, from which leads an arm F^2 toward the middle of the skeleton frame A, to bring the said arm under the control of the operator and to allow the latter to swing the rudder F to the right or left according to the direction in which the aerial vessel is to be steered. A spring F^3 attached to the frame A and connected with a pin F^4 on the rudder F serves to normally hold the latter in a central position.

The horizontal rudder G is fulcrumed on a bracket A^3, forming part of the frame A, and the said rudder G is connected forward of its fulcrum by a link G′ with a bell crank lever G^2 fulcrumed on the skeleton frame A, and the said bell crank lever G^2 is connected with a rod G^3 extending forward to be within convenient reach of the operator. A spring G^4 normally holds the rudder G in a horizontal position, but when it is desired to ascend or descend, the operator pushes the rod G^3 forward or backward, so as to impart a swinging motion to the rudder G, to move the latter into an inclined position, either upwardly and forwardly or upwardly and rearwardly, as the case may be.

The propeller D, shown in detail in Fig. 4, is preferably constructed similar to the wings above mentioned, that is, the hub D′ of the propeller wheel D is provided with curved ribs D^2, over which is stretched silk, canvas or other fabric material D^3, to render the propeller wheel exceedingly light and at the same time strong and durable.

If desired, a continuous rocking motion can be given to the wings C, C′ and in this case use is made of a collar N (see Fig. 8) fitting onto a ring N′, attached to the ribs H, H′, H^2, H^3, H^4 adjacent to the ring H^7, and the collar N is connected by a link N^2 with an arm N^3 on a shaft N^4, worked either by hand or from the motor E, so as to impart a continuous up and down swinging motion to the wings C, C′, thus causing the wings to beat against the wind.

It is expressly understood that when contrary winds strike the under sides of the wings from any angle, then the flexible portions of the wings are bent upward and

given the form of a spiral twist, so that the wind is spilled from under the wings without forcing the vessel over on one side as would be the case if the wings were rigid throughout. Now if the aerial vessel is moving forward, the twist in the wings tends to direct the vessel downward, while the remaining rigid portion tends to move the vessel upward, and consequently the effect of the contrary winds on the wings is neutralized and the equilibrium of the vessel is maintained. When the wings are swung up and down, they act as beating wings, and the flexible portions of the wings assume a twisted shape on every down stroke, and hence the wings act as propellers, the flexible portions assuming their normal arched shape on the up-stroke of the wings, and readily glide over the air, thus utilizing the whole surface of the wings for sustaining purposes on the upward stroke.

It is understood that by the use of wings having large sustaining surfaces, the aerial vessel is readily supported in the air, and by having the tip and rear marginal portions of the wings flexible, the equilibrium of the vessel is not disturbed when the vessel is struck by contrary currents, and by having the wings capable of being turned the angle of incidence can be changed at the will of the operator, and the rear wings can be tilted in a transverse direction for sidewise steering purposes.

It is understood that I do not limit myself to the two sets of wings as shown and described, as more pairs of wings or only one of the said pairs of wings B, B′ or C, C′ may be used; and the front pair of wings B, B′ may also be mounted to tilt in a transverse direction, the same as the rear pair of wings C, C′.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. An aerial vessel provided with sustaining surfaces, each comprising a skeleton frame having a plurality of main ribs, the base ends of said ribs being arranged in a circle and rigidly connected with each other, the outer portions of the main ribs being spaced apart and curved rearwardly, the main ribs being arranged in a curved surface, a radial rib extending rearwardly from the base end of the said ribs and approximately at right angles thereto, a diagonal brace extending diagonally from the said radial rib to the forward rib a distance from the tip thereof, means for connecting the tips of the ribs with each other and a fabric covering for the said skeleton frame.

2. An aerial vessel provided with sustaining surfaces, each in the form of a wing, comprising a skeleton frame having a plurality of main ribs, the base ends of which are arranged in tubular form and rigidly connected with each other, the outer portions of the main ribs being spaced apart and curved rearwardly, the ribs being arranged in approximately the same plane, a radial rib extending rearwardly from the base ends of the said ribs, a diagonal brace connecting the said radial rib with said ribs and terminating at the forward rib a distance from the tip thereof, a post depending from the base end of the said ribs, and tie rods extending from the terminal of the said post to the juncture of the said diagonal brace with the said ribs, and a fabric covering for the said skeleton frame.

3. An aerial vessel provided with sustaining surfaces, each in the form of a wing, comprising a skeleton frame having a plurality of main ribs, the base ends of which are arranged in tubular form and rigidly connected with each other, the outer portions of the main ribs being spaced apart and curved rearwardly, a tie rod connecting the terminals of the said ribs with each other, and a fabric covering for the said skeleton frame.

4. An aerial vessel provided with sustaining surfaces, each comprising a skeleton frame having a plurality of main ribs, the base ends of which are arranged in a circle and rigidly connected with each other, the outer portions of the main ribs being spaced apart and curved rearwardly, means for bracing the said ribs, means for connecting the terminals of the ribs with each other, and a fabric covering for the said skeleton frame.

5. An aerial vessel provided with a pair of sustaining surfaces terminating in rings at their inner ends or points of junction, a bearing in which said rings are mounted to turn, the said bearing being supported above the center of the vessel, and mounted to be turned transversely, and manually controlled means for turning said bearing, substantially as described.

6. An aerial vessel provided with a pair of sustaining surfaces, terminating in rings at their inner ends, a ring shaped bearing for the rings of said pair of surfaces and mounted to turn transversely, manually controlled means for turning said bearing, and manually controlled means for turning each ring in the bearing independently of the other ring, substantially as described.

7. An aerial vessel provided with a pair of sustaining surfaces, each in the form of a wing, a bearing in which the inner or adjacent ends of the wings are mounted to turn independently of each other, the said bearing being provided with trunnions at its front and rear, and supports extending above the vessel and in which the trunnions are

mounted, the said bearing being mounted to be rocked in a direction transverse of the vessel to swing the said wings up and down.

8. An aerial vessel provided with a pair of sustaining surfaces each in the form of a wing, a bearing in which the inner or adjacent ends of the wings are mounted to turn independently of each other, the said bearing having trunnions at its front and rear, supports in which the trunnions are mounted, the supports being arranged to hold the bearing above the center of the vessel and the bearing being mounted to be rocked in a direction transverse of the vessel, to move both of said wings up and down, and means for rocking the bearing and for turning each wing in the bearing.

9. An aerial vessel provided with a pair of sustaining surfaces terminating in rings at their inner ends, and a ring shaped bearing in which said rings are mounted to turn, the said bearing being supported above the center of the vessel and mounted to be turned transversely.

10. An aerial vessel provided with a framework, a pair of sustaining surfaces mounted on the framework, a bearing for the sustaining surfaces, the said bearing being mounted to turn transversely to swing one sustaining surface up and the other down, the said sustaining surfaces being mounted in said bearing to turn independently one of the other to change the angle of incidence of the sustaining surfaces, arms extending from the sustaining surfaces, hand levers connected with said arms, guideways, and a frame mounted to slide in said guideways and to which said hand levers are adapted to be locked.

11. An aerial vessel provided with a frame work, sustaining surfaces comprising pairs of wings mounted on the said frame work, one pair in front of the other, the wings of the rear pair of wings having rings at their inner ends, a bearing in which the wings are mounted to turn independently one of the other to change the angle of incidence of the wings, arms extending from said rings, hand levers connected with said arms, guideways and a frame mounted to slide in said guideways and to which the said hand levers are adapted to be locked.

12. An aerial vessel provided with a frame work, sustaining surfaces comprising pairs of wings mounted on the frame work one pair in front of the other, the wings terminating in rings at their inner ends, bearings for the said rings, the bearing for the rings of the rear pair of wings being mounted to turn transversely to swing one wing up and the other down, and the said rings of the rear pair of wings being mounted in said bearing to turn independently one of the other for changing the angle of incidence of the wings, arms extending from the rings of the rear pair of wings, locking levers connected with said arms, guideways, and a frame mounted to slide in said guideways, said arms being adapted to be locked to said sliding frame by said levers.

13. An aerial vessel provided with a frame work, sustaining surfaces comprising pairs of wings mounted on the said frame work one in front of the other, rings at the inner ends of the wings, bearings in which the rings are mounted to turn to change the angle of incidence of the wings, the bearing for the rings of the rear pair of wings being mounted to turn transversely to swing one wing up while the other swings downwardly, and arms extending from the rings of said rear pair of wings, and adapted to be moved forward and backward for turning the rings in the bearing independently one of the other, the said arms being adapted to be moved laterally to turn the bearing transversely.

14. An aerial vessel comprising a cigar shaped skeleton frame, a propeller wheel at one end of said frame, a horizontal rudder and a vertical rudder at the other end of said frame, two pairs of sustaining surfaces on said frame, bearings for the pairs of sustaining surfaces, the bearing for one pair of sustaining surfaces having trunnions at its front and rear, supports in which the trunnions are mounted to turn, and means for turning the said bearing transversely to cause said pair of surfaces to assume an inclined position relatively to the other pair.

15. An aerial vessel, comprising a cigar shaped skeleton frame, a propeller at one end of said frame, a horizontal rudder and a vertical rudder at the other end of said frame, sustaining surfaces mounted on said frame, bearings in which the sustaining surfaces are mounted to turn independently of each other to change the angle of incidence of said sustaining surfaces, the bearing for one of said sustaining surfaces having trunnions at its front and rear, supports in which the trunnions are mounted, and means for turning the said bearing to cause said sustaining surface to assume an inclined position relatively to the other sustaining surface.

16. An aerial vessel having a cigar shaped skeleton frame, a propeller wheel at the front end of the said frame, a horizontal rudder and a vertical rudder at the rear end of said frame, sustaining surfaces comprising a front pair of wings and a rear pair of wings, bearings for said wings supported on the frame, means for turning the front pair of wings upward or downward to change the angle of incidence, means for turning the rear pair of wings upward or downward independently one of the other, the bearing for the rear pair of wings being provided with trunnions at its front and

rear and supports in which the said trunnions are mounted to permit the bearing to turn in a transverse direction, and means for turning said bearing to cause said wings to assume an inclined position relatively to the front wings.

17. An aerial vessel provided with a frame work, sustaining surfaces mounted on said frame work and comprising a pair of wings terminating in rings at their inner ends, a bearing for the said rings provided with trunnions and mounted to turn transversely, and manually controlled arms extending downward from the said wings, for turning the said bearing.

18. An aerial vessel provided with a frame work, sustaining surfaces comprising a pair of wings mounted on the said frame work and terminating in rings at their inner ends, a bearing for the said rings provided with trunnions and mounted to turn transversely, arms extending downward from the said rings and adapted to be moved forward and backward to turn the rings in the said bearing, a frame mounted to slide and means for locking the arms to said frame.

19. An aerial vessel provided with a cigar shaped skeleton frame, sustaining surfaces comprising a pair of wings terminating in rings at their inner end, the rings meeting each other, standards on the skeleton frame, a ring shaped bearing supported in the said standards above the center of the skeleton frame and mounted to be turned transversely, the rings at the inner ends of the wings being mounted to turn in said ring shaped bearing.

20. An aerial vessel provided with a frame work and sustaining surfaces mounted on the frame work and each comprising a skeleton frame having a plurality of main ribs, the base ends of which are arranged in tubular form and rigidly connected with each other, the outer portions of the main ribs being spaced apart and curved rearwardly, means for connecting the terminals of the said ribs with each other, and a fabric covering for the said skeleton frame.

21. An aerial vessel provided with a frame work, and sustaining surfaces mounted on the frame work, and each comprising a skeleton frame having a plurality of main ribs, the base ends of which are arranged in tubular form and rigidly connected with each other, the outer portion of the main ribs being spaced apart and curved rearwardly, a radial rib extending from the base ends of the said ribs, a diagonal brace connecting the radial rib with said main ribs, a post depending from the base end of said ribs, tie rods connecting the post with the diagonal brace at the junction of the latter with the said main ribs, and a fabric covering for the said skeleton frame.

22. An aerial vessel provided with a frame work and sustaining surfaces, mounted on the frame work and each comprising a skeleton frame having a plurality of main ribs, the base portions of which are arranged in tubular form, a ring binding said base portions of the ribs together, a straight rib extending from the said ring, a post extending from said ring, the base ends of the main ribs extending beyond said rings, a ring in which the ends of the said base portions of the ribs are fixed, a brace connecting said last mentioned ring with the said post, means for bracing the ribs, and a fabric covering for the said skeleton frame.

23. An aerial vessel provided with sustaining surfaces, each comprising a skeleton frame having a plurality of ribs the base ends of which are arranged in tubular form and rigidly connected with each other, the outer portions of the ribs being spaced apart and curved rearwardly, a fabric covering for the skeleton frame, the tip and rear margin of the sustaining surface being flexible and arranged to spirally yield to the pressure of the air, and means for bracing the ribs to render the remainder of the sustaining surface comparatively rigid.

24. An aerial vessel provided with sustaining surfaces, each comprising a skeleton frame having a plurality of ribs, the base ends of which are arranged in tubular form and rigidly connected with each other, means for connecting the terminals of the ribs with each other, means for bracing the ribs, the said bracing means permitting the rear margin and tip of the sustaining surface to yield to the pressure of the air while the remainder of said sustaining surface is comparatively rigid, and a fabric covering for the said skeleton frame.

25. An aerial vessel provided with a pair of sustaining surfaces, each concave on the under side and convex on the upper side and flexible at the tip portions, a bearing supported above the vessel in which the inner or adjacent ends of the sustaining surfaces are mounted to turn, independently one of the other to change the angle of incidence of the sustaining surfaces, the said bearing being provided with trunnions at its front and rear and mounted to turn transversely and manually controlled means for turning the said bearing.

26. An aerial vessel provided with a pair of sustaining surfaces, a bearing in which the adjacent ends of the sustaining surfaces are mounted, the said bearing being provided with trunnions extending in a direction longitudinally of the vessel, and supporting means in which the said trunnions are mounted to turn, the said bearing being located approximately above the center of the vessel, the said sustaining surfaces being mounted to turn on said bearing independ-

ently of each other and in a direction at right angles to the direction of movement of the bearing.

27. An aerial vessel provided with a framework, sustaining surfaces mounted on said framework and comprising a pair of wings, and a ring-shaped bearing arranged above the vessel and mounted to be turned transversely, the said bearing having inwardly extended marginal flanges, the adjacent ends of the wings being mounted to turn in said bearing between the said marginal flanges.

28. An aerial vessel provided with a pair of sustaining surfaces having their inner ends adjacent to each other and terminating in rings, a ring shaped bearing supported above the center of the vessel, and in which the said rings are mounted to turn independently of each other to change the angle of incidence of the sustaining surfaces, and arms extending downward from said rings, and adapted to be moved backward and forward to turn the rings in said bearing.

29. An aerial vessel provided with sustaining surfaces terminating in rings at their inner ends, a ring shaped bearing supported above the vessel and having inwardly extending marginal flanges, the rings of said sustaining surfaces being mounted to turn in said bearing between the said marginal flanges, and manually controlled arms extending downward from the said rings and adapted to be moved forward or backward to turn the said rings in the bearing.

30. An aerial vessel provided with a pair of sustaining surfaces, terminating in rings at their inner ends, and a ring shaped bearing supported above the vessel in which said rings are mounted to turn, the said bearing being provided with oppositely arranged trunnions on its periphery, and mounted to be turned in a direction transverse of the vessel.

31. An aerial vessel comprising a cigar shaped skeleton frame, a pair of sustaining surfaces terminating in rings at their inner ends, a ring shaped bearing in which the said rings are mounted to turn, the said bearing being provided with oppositely arranged trunnions on its periphery, supports on the frame located one in front of the other and in which the said trunnions are mounted to turn, arms connected with the said rings and adapted to be moved forward and backward to turn the rings in said bearing, the said arms also being adapted for lateral movement to turn the said bearing.

32. An aerial vessel provided with a pair of sustaining surfaces, supporting means in which the inner or adjacent ends of the sustaining surfaces are mounted to turn, the said supporting means permitting of the up and down movement of each sustaining surface independent of the other, the said supporting means being mounted to turn in a direction transverse of the vessel, arms rigidly connected with the inner end of the sustaining surfaces to move the same up or down, and means for locking the said arms, the said arms being adapted for lateral movement in either direction to turn the said supporting means.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ERNEST ALFRED NORRIS.

Witnesses:

H. L. GILLETTE,

RALPH C. HOLLEY.