1,237,789.

W. H. KELLY.

FLYING MACHINE.

APPLICATION FILED AUG. 5, 1912.

Patented Aug. 21, 1917.

5 SHEETS—SHEET 1.

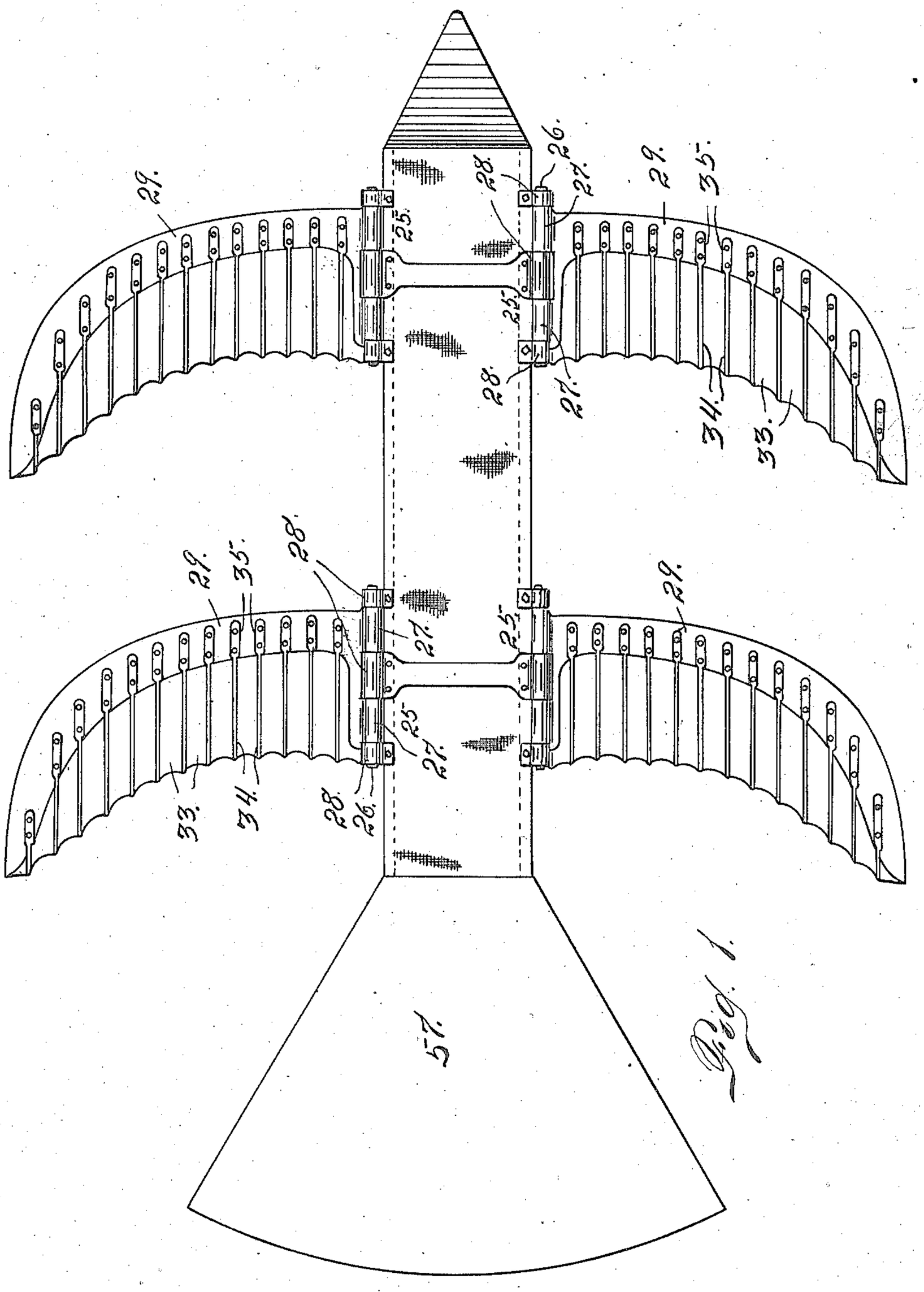

Fig. 1.

Witnesses
Otto E. Hoddick.
C. H. Rossner.

Inventor
W. H. Kelly.
By R. J. C. Stone
Attorney

W. H. KELLY.

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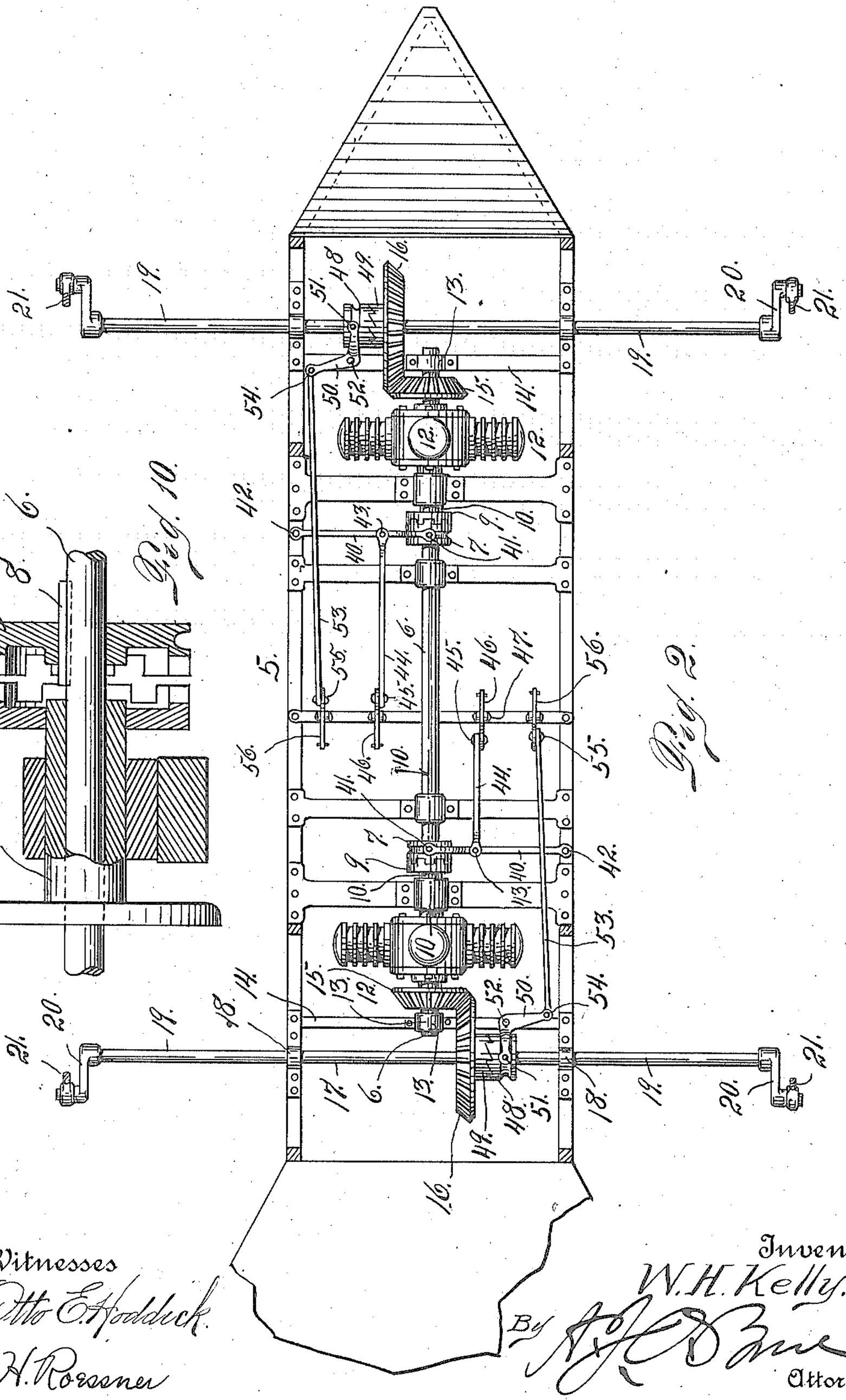

Fig. 2.

Witnesses

Otto E. Hoddick.

C. H. Rossner

Inventor

W. H. Kelly.

By

Attorney

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5 SHEETS—SHEET 3.

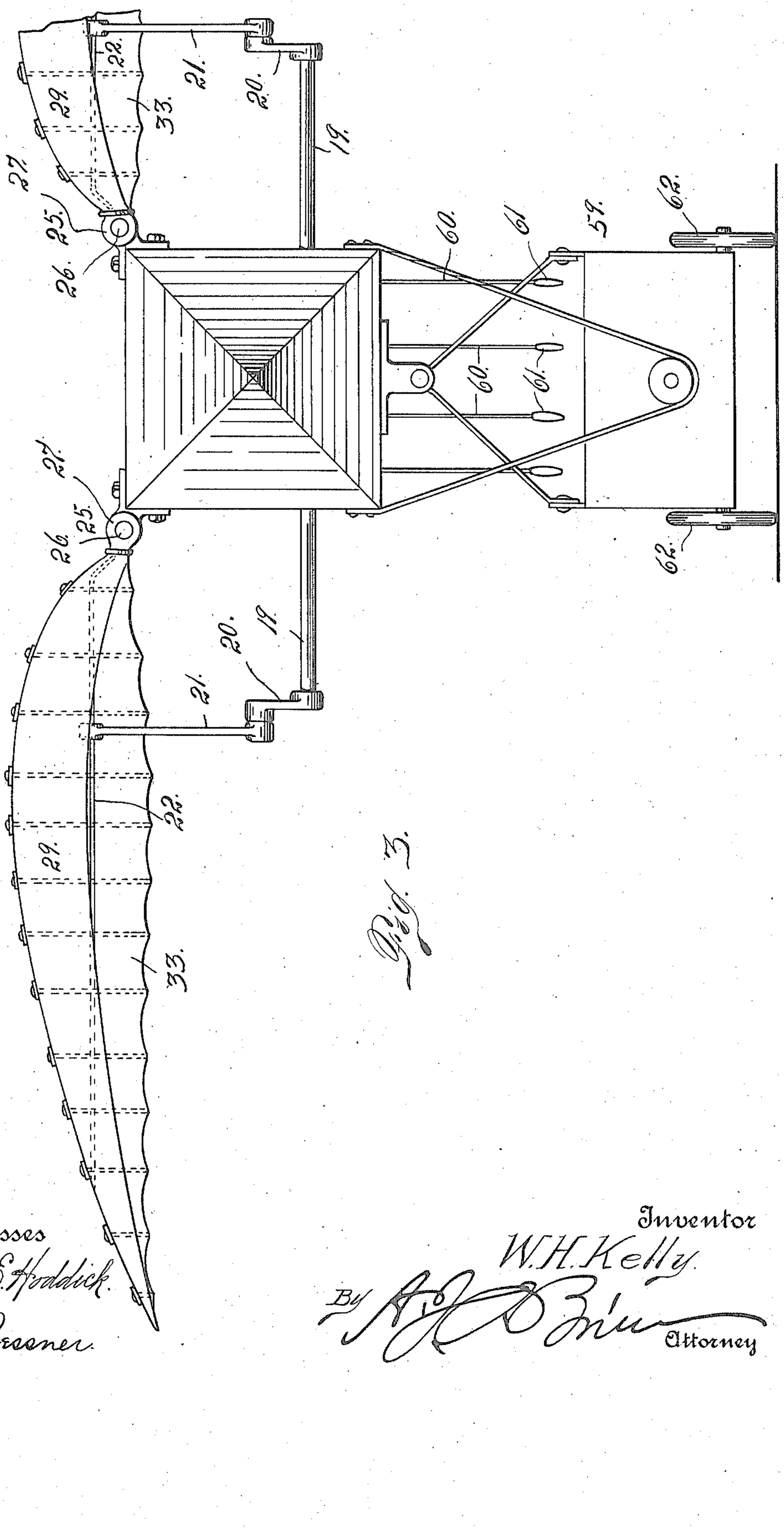

Fig. 3.

Witnesses

Otto E. Hoddick.

C. H. Roesener.

Inventor

W. H. Kelly.

By

Attorney

W. H. KELLY.

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5 SHEETS—SHEET 4.

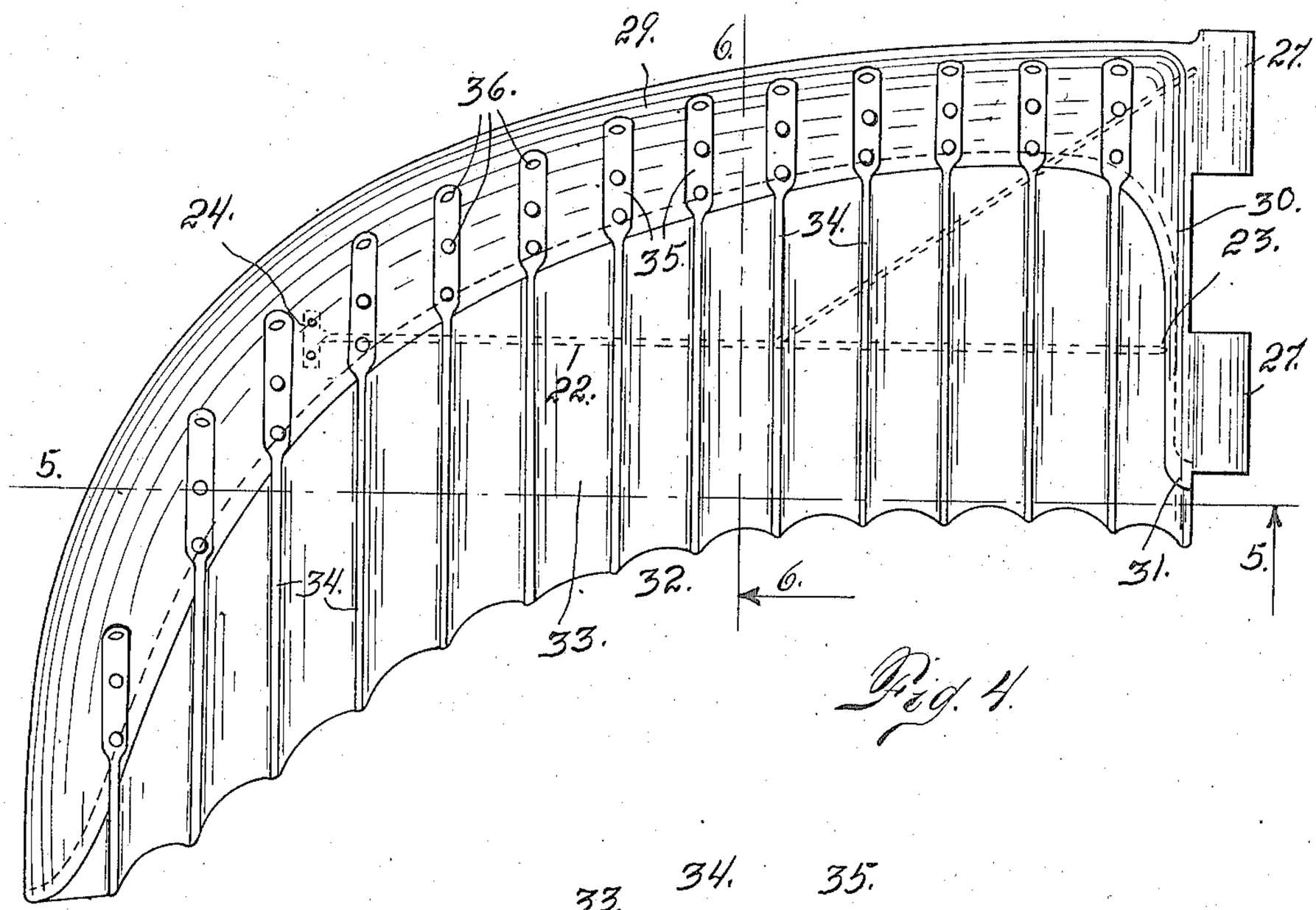

Fig. 4.

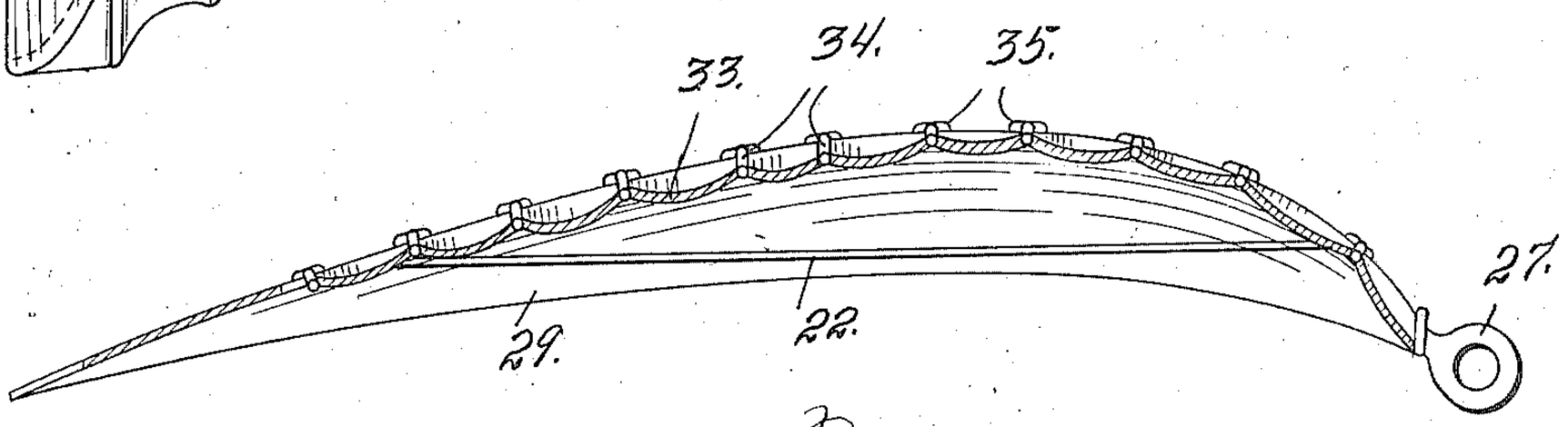

Fig. 5.

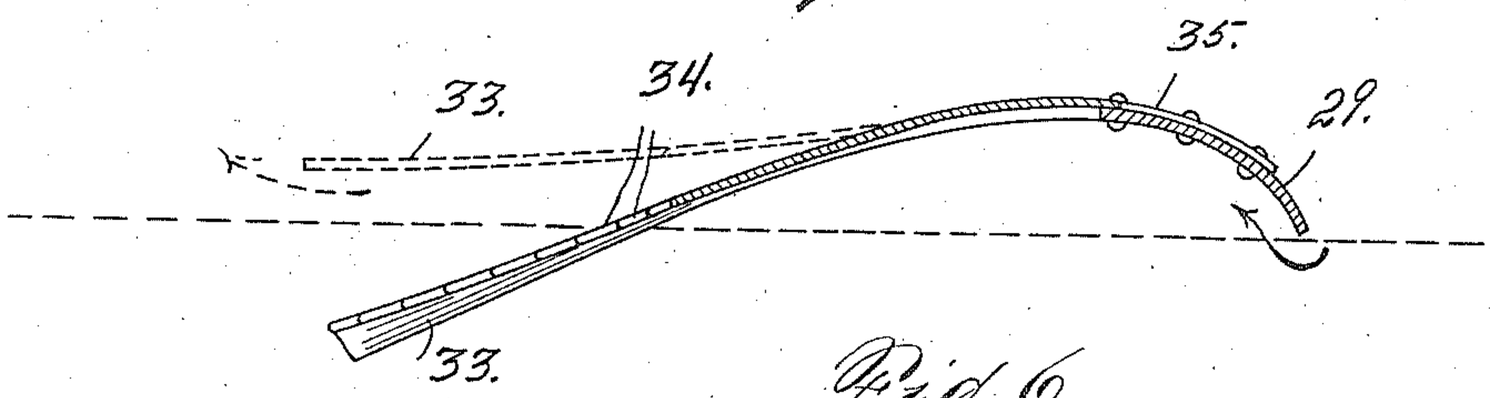

Fig. 6.

Witnesses

Otto E. Hoddick.

C. H. Rossner.

Inventor

W. H. Kelly.

By [signature] Attorney

W. H. KELLY.

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1,237,789.

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5 SHEETS—SHEET 5.

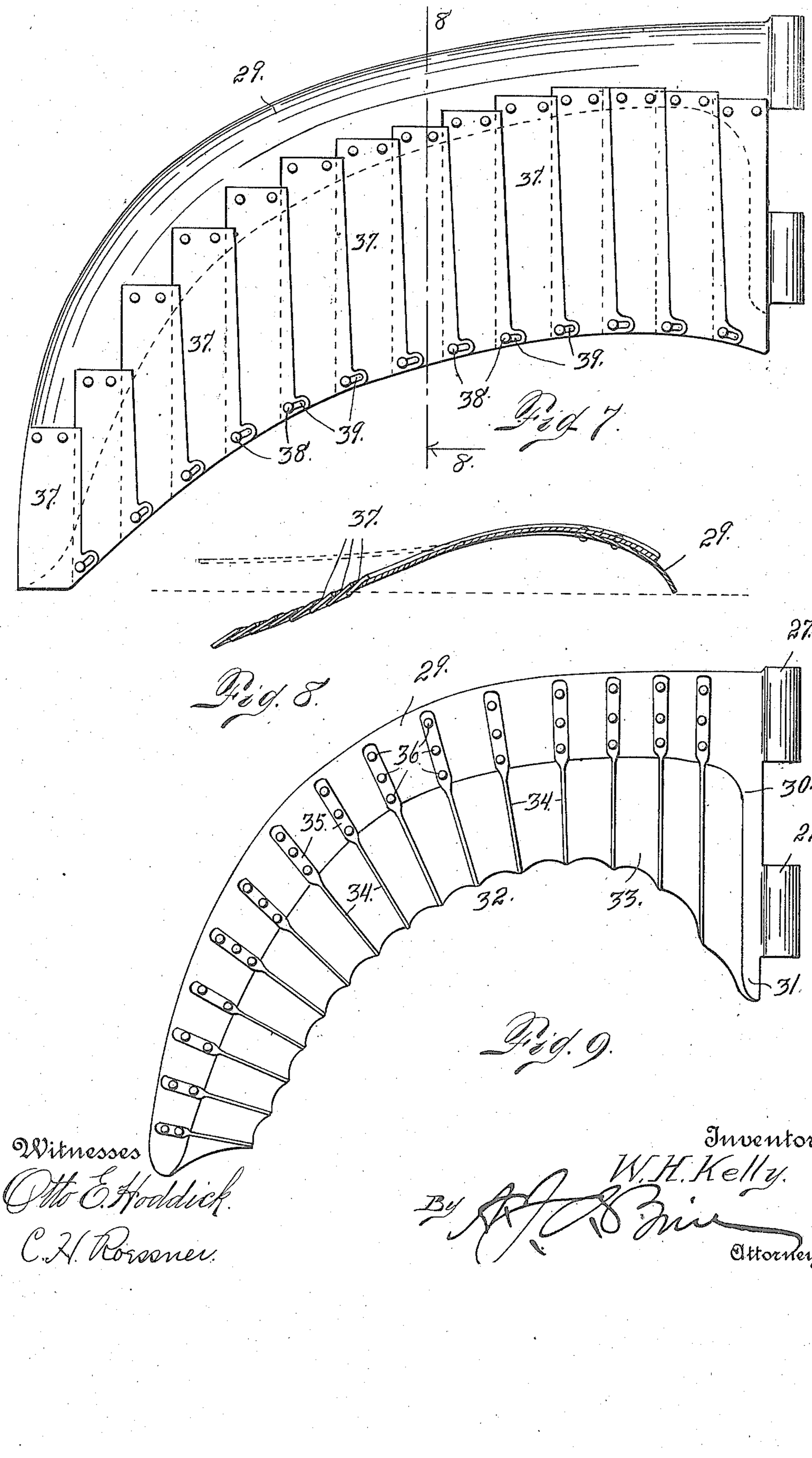

Fig. 7.

Fig. 8.

Fig. 9.

Witnesses

Otto E. Hoddick.

C. H. Rossner.

Inventor

W. H. Kelly.

By A. S. Ziesenheim

Attorney

UNITED STATES PATENT OFFICE.

WILLIAM H. KELLY, OF CHEYENNE, WYOMING.

FLYING-MACHINE.

1,237,789. Specification of Letters Patent. Patented Aug. 21, 1917.

Application filed August 5, 1912. Serial No. 713,289.

To all whom it may concern:

Be it known that I, WILLIAM H. KELLY, a citizen of the United States, residing at Cheyenne, county of Laramie, and State of Wyoming, have invented certain new and useful Improvements in Flying-Machines; 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 characters of reference marked thereon, which form a part of this specification.

My invention relates to improvements in flying machines, my object being to provide an efficient construction in which the wings of the device are operated by a flapping movement in imitation of the movement employed by birds. These wings are so constructed that, while their forward edges (using the term "forward" with reference to the direction of flight) are rigid, their portions extending rearwardly from these rigid edges are flexible, and are adapted to be flexed or bent in both directions,—that is to say, upward and downward,—during the flapping operation thereof, the shape of the wings and their flexure being such that the air is prevented from slipping from the wings in a lateral direction, or outwardly from their axes, the air being caused to escape, generally speaking, in a rearward direction, thus obtaining the greatest possible efficiency from the action of said wings upon the resisting medium, since, as the air slips rearwardly from the wings, their rearward portions being flexed upwardly during the downward movement or flap of the wings, there will be a tendency to force the machine forwardly; while, during the upward movement of the wings, their rear portions will be flexed downwardly with the same result.

By virtue of the peculiar shape of these wings, whereby both their edges are curved rearwardly and outwardly, there is also a tendency to cause the air, as it leaves the wings, to move inwardly toward the axis or center of motion. Again, the flexible portions of the wings are equipped with ribs or plates, extending rearwardly from the rigid front edge, and the shape of the wings and the arrangement of the said ribs is such that the flexible portion of each wing diminishes in proportion to the width of the wing, from its rigid forward edge from about the middle of the wing outwardly toward the tip, thus preventing such a flexure of the outer portion in the vicinity of the tip of the wing as would allow the air to escape in a lateral direction. In fact, the rigid forward edge of the wing extends entirely to the tip or outer extremity thereof, thus making the tip rigid and preventing possible flexure to allow atmospheric slip in a lateral direction.

By virtue of the fact that the wings are operated by a flapping movement, and also by virtue of their peculiar construction, as heretofore outlined, the rear and inward portion of the surface of each wing, lying toward the axis during operation, lags farther behind with reference to the movement of the wing on its axis than the rear and outward portion of the surface lying and located toward the outer extremity or tip of the wing.

The wings of the structure are hinged to the opposite sides of a suitable framework, and are connected by means of pitmen with the cranks of shafts journaled on the said framework below the wings, the said shafts being rotated by means of suitable motors, preferably explosion engines, carried by the said framework.

Provision is also made whereby a plurality of motors may be employed, each motor being an independent unit, the construction and arrangement being such that either motor may be disconnected from the operating shaft, when out of commission, or thrown out of commission, while the other motor serves to impart the necessary flapping movement to the wings for purposes of flight.

Having briefly outlined my improved construction, I will proceed to describe the same in detail, reference being made to the accompanying drawing, in which is illustrated an embodiment thereof.

In this drawing:

Figure 1 is a top plan view of a flying machine equipped with my improvements.

Fig. 2 is a similar view with the wings and the top covering of the framework removed in order to disclose the operating mechanism below, the parts being shown on a larger scale.

Fig. 3 is a front end view of the structure, on approximately the same scale as Fig. 2.

Fig. 4 is a top plan view of one of the wings shown in detail, and on a larger scale.

Fig. 5 is a section, taken through one of the wings on the line 5—5 of Fig. 4.

Fig. 6 is a sectional view, taken on the line 6—6 of Fig. 4.

Fig. 7 is a top plan view, similar to Fig. 4, showing a modified form of construction.

Fig. 8 is a cross section, taken on the line 8—8 of Fig. 7.

Fig. 9 is a top plan view showing still another form of wing.

Fig. 10 is a sectional view in detail, taken on the line 10—10 of Fig. 2, the parts being shown on a larger scale.

The same reference characters indicate the same parts in all the views.

Referring first more particularly to Figs. 1 to 6, inclusive and Fig. 10, let the numeral 5 designate a framework having the general shape in top plan view of a rectangle. This framework, as illustrated in the drawing, is square in cross section, but in plan view relatively long, as compared with its width. Journaled longitudinally on the framework is a shaft 6 carrying two clutch members 7, which are splined thereon, as shown at 8, and therefore are freely slidable longitudinally of the shaft. Each of these slidable clutch members is adapted to interlock with a coöperating member 9 fixed on a hollow shaft 10, connected with a motor 12, the said hollow shaft rotating with the rotary structure of the engine, the latter being of the class in which the cylinders rotate. The opposite extremities of the shaft 6 are journaled in bearings 13 mounted on cross pieces 14 of the frame structure. Between these bearings and each engine 12 is a beveled gear 15, which is fast on the shaft 6 and meshes with a similar gear 16 fast on a propelling shaft 17.

Each shaft 17 is journaled in the framework, as shown at 18, and projects beyond the framework on opposite sides, as shown at 19, the extremities of the shafts being equipped with cranks 20 connected by means of pitmen 21 with rods 22 mounted on the respective wings and extending longitudinally thereof, the extremities of the said rods being respectively connected with the rigid inner extremity of the wing, as shown at 23, and with the rigid forward portion of the wing, as shown at 24. These rods may be perfectly rigid, since they are not connected with the wing intermediate their extremities, thus allowing each wing capacity for flexure independently of the rods 22, through whose instrumentality the flapping or operating movement is imparted to the wings. As illustrated in the drawing, the complete machine is equipped with two pairs of wings, there being two wings on each side. Each wing is hinged to the framework, as shown at 25, by means of a hinge pin 26, passed through bearings 27 formed in each wing and coöperating bearings 28, with which the frame is equipped.

By virtue of this connection between the wings and the frame and the operating mechanism, as heretofore described, it will be understood that, as rotary movement is imparted to the shafts 19 from the engines or motors, mounted on the frame structure, a vertical oscillation will be imparted to the wings from the centers of the hinge members 26 as axes, the length of the stroke in either direction depending upon the length of the cranks 20 secured to the opposite extremities of the shafts 19, as aforesaid.

Each wing is composed of a rigid forward edge or member 29, which, at its inner extremity, merges into a relatively narrow rigid part 30 with which the bearings 27 are formed integral, the said rigid part 30 extending from the rigid part 29 rearwardly to a point 31 terminating near the rear longitudinal edge 32 of the wing.

The portion of the wing in the rear of the rigid forward part 29 is flexible, and its body portion may be formed of canvas 33, or other suitable material. In order to reinforce and strengthen this flexible portion without destroying its flexibility, each wing is equipped with a series of ribs 34, which, as illustrated in the drawing, are flattened at their forward extremities, as shown at 35, and secured to the rigid forward part 29 by means of suitable fastening devices 36. These ribs are secured to the flexible body part in any suitable manner.

The area of the flexible portion 33 of the wing gradually diminishes from about the center part of the wing on a line parallel with the direction of flight outwardly toward the tip thereof, whereby the corresponding portion of the wing diminishes in flexibility in the same proportion.

In the construction shown in Fig. 7, instead of a canvas or other suitable flexible material equipped with ribs, the rigid part 29 is equipped with plates 37 of relatively thin material, the said plates being secured to the part 29 at their forward extremities and connected together at their rear extremities by means of fastening devices 38, which are secured to the edges of certain of the plates and passed through slots 39 formed in the adjacent plates, the slots being arranged to allow the portion of the wing in the rear of the part 29 to flex during the upward and downward movement,

and, as the flexure increases the length of the rear edge of the wing, this part must gradually expand from the part 29 rearwardly.

In the form of construction shown in Fig. 9, the tip of the wing is carried farther rearwardly, and the ribs, which are substantially the same as illustrated in Figs. 1 to 6, inclusive, gradually change their direction after the fourth rib counting outwardly from the inner extremity of the wing, whereby they are caused to point inwardly, similar to a multiplicity of radii of a circle, though not with the same regularity. With this style of wing, the tendency would be to direct the air inwardly toward the axis of the wing, the said tendency increasing from the inner part of the wing outwardly toward the tip thereof.

In this way, the tendency of the air to slip away from the wing in a lateral direction is perhaps overcome to better advantage than in the other forms of construction.

It will be understood that all of these different forms of wings are to be hinged to the framework of the machine, and operate by imparting a vertical oscillatory movement thereto, the center of motion or axis of each wing being the center of the hinge, as illustrated.

Referring again to the construction illustrated in Fig. 2, when the machine is propelled by the power of both motors 12, both slidable clutch members 7 are in interlocking engagement with the members 9 and the hollow shafts 10, the members 7 being manipulated by means of arms 40, which straddle the clutch members 7 and are slidably connected therewith, as shown at 41, while their opposite extremities are pivotally connected with the frame, as shown at 42. Each arm 40 is pivotally connected intermediate its extremities, as shown at 43, with a rod 44, whose forward extremity is pivoted, as shown at 45, to one extremity of an operating lever 46, fulcrumed at 47.

By virtue of this construction, the clutch members 7 may be connected with or disconnected from their coöperating members 9, according as it is necessary to rotate the shaft 6 through the agency of either or both motors.

Now, when either shaft 19 is rotating by virtue of the fact that a clutch 48 splined on the shaft 19 is in interlocking engagement with a clutch member 49 formed integral with the gear 16, the latter being loose on the shaft 17 and it is desired to interrupt its rotation whereby one pair of wings ceases to operate, it is only necessary to operate the bell-crank lever 50, the said lever being connected, as shown at 51, to the clutch member 48, and fulcrumed at 52 on a stationary bar 14. The lever is actuated by a rod 53, connected therewith, as shown at 54, at one extremity, while its opposite extremity is connected, as shown at 55, with an operating lever 56. Hence, when the machine is in operation, it may be assumed that the operating mechanism is in the position illustrated in Fig. 2, whereby a vertical oscillation or flapping movement is imparted to the one or more pairs of wings with which the machine is equipped, this flapping movement resulting in flexing the flexible portion of the wings in both directions as the wing is moved upwardly and downwardly from its center of motion, or the center of the hinge pin which connects it with the machine. As the wing is moved downwardly, the resistance of the air acting on its flexible portion from underneath bends this portion upwardly from the rear edge of the rigid forward part 29 of the wing, this flexure increasing as the width of the flexible portion increases from the rear edge of the rigid part of the wing rearwardly.

By virtue of this operation, the air acts on an inclined plane, or rounded or curved surface, and, as it slips rearwardly from the said plane, it acts to move the machine forwardly. At the same time, there is a tendency to carry the air inwardly toward the axis of the wing by virtue of the fact that the rear and inward portion of the surface of the wing lying toward the axis during operation lags farther behind with reference to the movement of the wing on its axis than the rear and outward portion of the surface of the wing lying and located toward the outward extremity of the wing. During the upward movement of the wing, its flexible portion is flexed downwardly, forming an inclined plane or rounded surface, extending rearwardly and downwardly from the rear extremity of the rigid forward portion of the wing, and the air, acting upon this plane, or rounded surface, glides rearwardly from the plane and its pressure also propels the machine in a forward direction.

The flexure of the wing is substantially the same, during the reverse direction, as its flexure during the downward movement, as heretofore described. As illustrated in the drawing, the framework is equipped with a fan-shaped tail-piece 57, which may be of any suitable construction.

As the air escapes from the rear of the wing, whether flexed in either direction, it rushes in from the front of the wing to fill the vacuum which would otherwise be produced. In this way, there is a practically uniform resisting medium for the wing to act upon whether it is moved on its axis upwardly or downwardly.

As illustrated in the drawing, a car 59 is suspended from the main framework 5, and it is assumed that the person in charge of the machine occupies this car, and, in order to operate the various levers 46 and 47, rods

60 are pivotally connected with the said levers, the lower extremities of the rods having hand pieces 61 accessible to the aviator. The car is equipped with wheels 62, which engage the ground when the machine descends.

It may, however, be preferable to locate the operator of the machine upon the upper car in order that he may more directly control the mechanism for shifting the clutches and looking more carefully after the motors or engines mounted upon the upper car. In any event this is a feature which is not material so far as the patentable subject matter involved in this application is concerned.

Having thus described my invention, what I claim is:—

1. A wing whose front edge is rigid throughout its entire length, the surface in the rear of the front edge being flexible, the wing having a considerable degree of longitudinal curvature from axis to tip.

2. A wing whose front edge is rigid throughout its entire length from axis to tip, the surface in the rear of the front edge being flexible, the wing having a considerable degree of curvature both longitudinally or from axis to tip and transversely, or from its front edge to its rear edge.

3. A flying machine wing having a rigid front edge, the body of the wing being composed of slats extending rearwardly from the said front edge, the said slats overlapping each other, the slats being connected at the rear edge of the wing to permit expansion.

4. A wing of the class described having a rigid front edge curved rearwardly from the inner extremity toward the tip, the body of the wing being composed of flat strips of material which extend rearwardly from the rigid front edge of the wing to which they are secured, the said strips being movably connected at the rear edge of the wing to permit flexure and consequent expansion, substantially as described.

5. A flying machine wing having its front and rear edges curved rearwardly from the inner extremity of the wing which is constructed to be hinged to a support to operate on the flapping principle, the front edge of the wing being rigid and the body of the wing being composed of strips of material of suitable area, the said strips being secured at their forward extremities to the rigid front edge and extending rearwardly therefrom, portions of the edges of adjacent strips being arranged in overlapping relation, the rear extremities of the said strips being connected by means of slats and engaging pins with which they are respectively provided to permit the expansion necessary for flexure when in use.

6. A flying machine wing having a rigid front edge curved rearwardly from its inner extremity to the tip, the inner extremity of the wing being constructed to be hinged to a support for flapping purposes, the body of the wing in the rear of the rigid front edge being composed of slats whose forward extremities are secured to the rigid front edge, the said slats extending rearwardly, parts of adjacent slats being arranged in overlapping relation, the rear extremities of adjacent slats being connected by means of slots and engaging pins with which they are respectively provided, to permit the expansion necessary for up and down flexure during the movement of the wing on its axis.

7. A wing whose front edge is rigid throughout its entire length from axis to tip, the rear and inward portion of the surface lying toward the axis being more flexible than the rear and outward portion of the surface lying toward the tip of the wing.

8. A wing whose front edge is rigid throughout its entire length from axis to tip, the rear and inward portion of the surface lying toward the axis being more flexible than the rear and outward portion of the surface lying toward the tip of the wing, and means for operating the wing to pivot only about its transverse axis.

9. A wing whose front edge is rigid throughout its entire length from axis to tip, the portion of the wing in the rear of the front edge being flexible, the rear and middle portion of the surface lying between the inner and outer extremities of the wing being more flexible than the rear and outer portion of the surface lying toward the tip of the wing.

10. A wing whose front edge is rigid throughout its entire length from axis to tip, the portion of the wing in the rear of the front edge being flexible, the rear and middle portion of the surface lying between the inner and outer extremities of the wing being more flexible than the rear and outer portion of the surface lying toward the tip of the wing, and means for operating the wing to maintain it during operation in a uniform position with reference to its axis.

11. A wing whose front edge is rigid throughout its entire length from axis to tip, the rear portion of the surface adjacent the rear edge being adapted to be bent rearwardly from the direction of movement of the wing on its axis, the rear and inner portion of the surface lying toward the axis being adapted to be bent farther rearwardly with reference to the movement of the wing on its axis than the rear and outer portion of the surface lying and located toward the outer extremity of the wing.

12. A wing whose front edge is rigid throughout its entire length from axis to tip, the rear portion of the surface adjacent the rear edge being adapted to be bent rearwardly from the direction of movement of

the wing on its axis, the rear and inner portion of the surface lying toward the axis being adapted to be bent farther rearwardly with reference to the movement of the wing on its axis than the rear and outer portion of the surface lying and located toward the outer extremity of the wing, and means for operating the wing to pivot only about its transverse axis.

13. A wing whose front edge is rigid throughout its entire length from axis to tip, the rear portion of the surface adjacent the rear edge being adapted to be bent rearward from the direction of movement of the wing on its axis, the rear and middle portion of the surface lying between the inner and outer extremities of the wing being adapted to be bent farther rearward with reference to the movement of the wing on its axis than any other portion of the wing.

14. A flying machine wing whose front edge is rigid throughout its entire length from axis to tip, the body of the wing being composed of slats extending rearwardly from the said front edge, the said slats overlapping each other and being free to permit expansion due to flexure, the slat surface being closed against the passage of air during both strokes of the flapping action.

15. In a flying machine, the combination with a suitable frame, of a shaft journaled therein and a wing attached to said shaft, said wing having a rigid forward portion which extends to the outer extremity of the wing and to which is attached a flexible body portion, said body portion being less flexible at its outer extremity than at its middle part, but increasing in flexibility as it extends from its outer extremity toward the axis of the wing, the wing being longitudinally concavo-convex, the rear portion of the wing as it extends rearwardly to the rear edge being approximately straight.

16. In a flying machine, the combination with a suitable frame, of a shaft journaled therein and a wing attached to said shaft, said wing having a rigid forward portion which extends to the outer extremity of the wing and to which is attached a flexible body portion, the wing being both longitudinally and transversely concavo-convex, the longitudinally concave surface being also the transversely concave surface, the rear portion of the wing as it extends rearwardly to the rear edge being approximately straight.

17. In a flying machine, the combination with a suitable frame, of a shaft journaled therein and a wing attached to said shaft, said wing having a rigid forward portion to which is attached a flexible body portion, said body portion nearest its outer extremity being less flexible than its middle part, but increasing in flexibility as it extends from its outer extremity toward the axis of the wing, the wing being both longitudinally and transversely concavo-convex, the longitudinally concave surface being also the transversely concave surface, the rear portion of the wing as it extends rearwardly to the rear edge being approximately straight.

18. In a flying machine, the combination with a suitable frame, of a shaft journaled therein and a wing connected with said shaft, said wing having a rigid forward portion which extends to the outer extremity of the wing and to which is attached a flexible body portion, said body portion being less flexible at its outer extremity than at its middle part, but increasing in flexibility as it extends from its outer extremity toward the axis of the wing, the wing being both longitudinally and transversely concavo-convex, the longitudinally concave surface being also the transversely concave surface, the rear portion of the wing as it extends rearwardly to the rear edge being approximately straight.

19. In a flying machine, the combination with a suitable frame, of a shaft journaled therein and a wing attached to said shaft, said wing having a rigid forward portion to which is attached a flexible body portion, said body portion being composed of flexible overlapping slats attached to said rigid forward portion and extending rearwardly therefrom, said body portion nearest its outer extremity being less flexible than its middle part, but increasing in flexibility as it extends from its outer extremity toward the axis of the wing, the wing being longitudinally concavo-convex, the rear portion of the wing as it extends rearwardly to the rear edge being approximately straight.

20. In a flying machine, the combination with a suitable frame, of a shaft journaled therein and a wing attached to said shaft, said wing having a rigid forward portion which extends to the outer extremity of the wing and to which is attached a flexible body portion, said body portion being composed of flexible overlapping slats attached to said rigid forward portion and extending rearwardly therefrom, said body portion being less flexible at its outer extremity than at its middle part, but increasing in flexibility as it extends from its outer extremity toward the axis of the wing, the wing being longitudinally concavo-convex, the rear portion of the wing as it extends rearwardly to the rear edge being approximately straight.

21. In a flying machine, the combination with a suitable frame, of a shaft journaled therein and a wing attached to said shaft, said wing having a rigid forward portion which extends to the outer extremity of the wing and to which is attached a flexible body portion, said body portion being composed of flexible overlapping slats attached to said rigid forward portion and extend-

ing rearwardly therefrom, said wing being both longitudinally and transversely concavo-convex, the longitudinally concave surface being also the transversely concave surface, the rear portion of the wing as it extends rearwardly to the rear edge being approximately straight.

22. In a flying machine, the combination with a suitable frame, of a shaft journaled therein and a wing attached to said shaft, said wing having a rigid forward portion to which is attached a flexible body portion, said body portion being composed of flexible overlapping slats attached to said rigid forward portion and extending rearwardly therefrom, said body portion nearest its outer extremity being less flexible than its middle part but increasing in flexibility as it extends toward the axis of the wing, the wing being both longitudinally and transversely concavo-convex, the longitudinally concave surface being also the transversely concave surface, the rear portion of the wing as it extends rearwardly to the rear edge being approximately straight.

23. In a flying machine, the combination with a suitable frame, of a shaft journaled therein and a wing attached to said shaft, said wing having a rigid forward portion which extends to the outer extremity of the wing and to which is attached a flexible body portion, said body portion being composed of flexible, overlapping slats attached to said rigid forward portion and extending rearwardly therefrom, said body portion being less flexible at its outer extremity than at its middle part, but increasing in flexibility as it extends toward the axis of the wing, the wing being both longitudinally and transversely concavo-convex, the longitudinally concave surface being also the transversely concave surface, the rear portion of the wing as it extends rearwardly to the rear edge being approximately straight.

24. In a flying machine, the combination with a suitable framework, of a shaft journaled therein and wings attached to said shaft, said wings having a rigid forward portion to which is attached a flexible body portion, said body portion being composed of overlapping flexible slats attached to said rigid forward portion and extending rearwardly therefrom, the outer part of said body portion being less flexible than that located nearer to the axis of the wing but increasing in flexibility as it extends toward the axis, the only connection between each slat and the said rigid forward portion being at one of the extremities of said slats.

25. In a flying machine, the combination with a suitable framework, of a shaft journaled therein and wings attached to said shaft, said wings having a rigid forward portion to which is attached a flexible body portion, said body portion being composed of overlapping flexible slats attached to said rigid forward portion and extending rearwardly therefrom, the only connection between each slat and the said rigid forward portion being at one of the extremities of said slats.

26. In a flying machine, the combination with a suitable framework, of a shaft journaled therein and wings attached to said shaft, said wings having a rigid forward portion to which is attached a flexible body portion, said body portion being composed of overlapping flexible slats attached to said rigid forward portion and extending rearwardly therefrom, the only connection between each slat and the said rigid forward portion being at one of the extremities of said slats, and each of said wings as it extends from its outer extremity toward the axis of the wing extending away from a plane passing longitudinally through said axis and through said outer extremity of the wing.

27. In a flying machine, the combination with a suitable frame, of a shaft journaled therein and a wing attached to said shaft, said wing having a rigid forward portion to which is attached a flexible body portion, said flexible body portion being transversely flexible as it extends rearwardly away from said rigid forward portion, said body portion being less flexible at its outer end than nearer to the axis, but increasing in flexibility as it extends from its outer extremity toward said axis, said wing being longitudinally concavo-convex, the rear part of said flexible body portion being expansible longitudinally of the wing when subjected to pressure on the longitudinally concave surface.

28. In a flying machine, the combination with a suitable frame, of a shaft journaled therein and a wing attached to said shaft, said wing having a rigid forward portion which extends to the outer extremity of the wing and a flexible body portion attached to said rigid forward portion and extending rearwardly therefrom, said body portion being transversely flexible as it extends rearwardly away from said rigid forward portion, said body portion being less flexible near its outer extremity than nearer to the axis of the wing, but increasing in flexibility as it extends from its outer extremity toward said axis, said wing being both longitudinally and transversely concavo-convex, the longitudinally concave surface being also the transversely concave surface, the rear part of said flexible body portion being expansible longitudinally of the wing when subjected to pressure on its longitudinally concave surface.

29. A wing having a rigid front edge, the surface in the rear of the front edge being flexible, longitudinally curved from axis to

tip and composed of slats overlapping each other, the said slats being arranged approximately parallel to the said axis.

30. A wing whose front edge is rigid throughout its entire length, the surface in the rear of the front edge being flexible, longitudinally curved from axis to tip, and composed of slats overlapping each other, the longitudinal extent of said slats being approximately parallel to the said axis.

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

WILLIAM H. KELLY.

Witnesses:
A. J. O'Brien,
May Clements.