L. G. SCHROEDER.

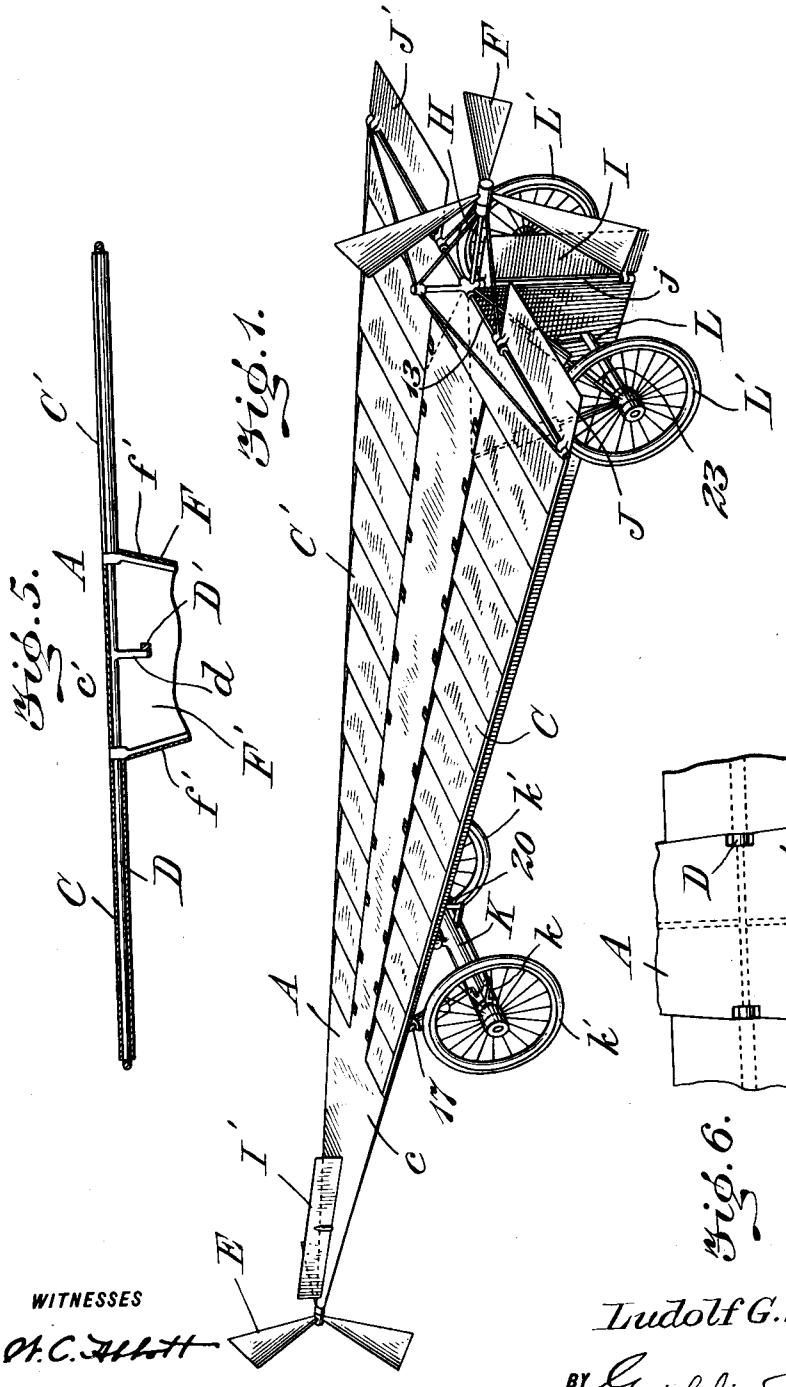
AERIAL CRAFT.

APPLICATION FILED JUNE 12, 1908. RENEWED OCT. 14, 1914.

1,175,307.

Patented Mar. 14, 1916.

8 SHEETS—SHEET 1.



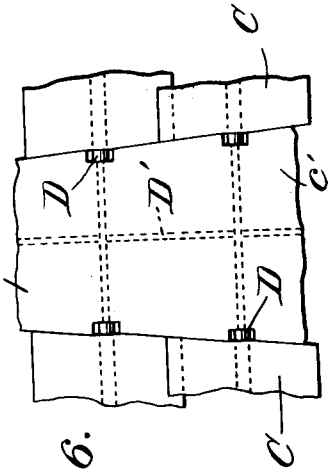


Fig. 6.

WITNESSES

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8 SHEETS—SHEET 2.

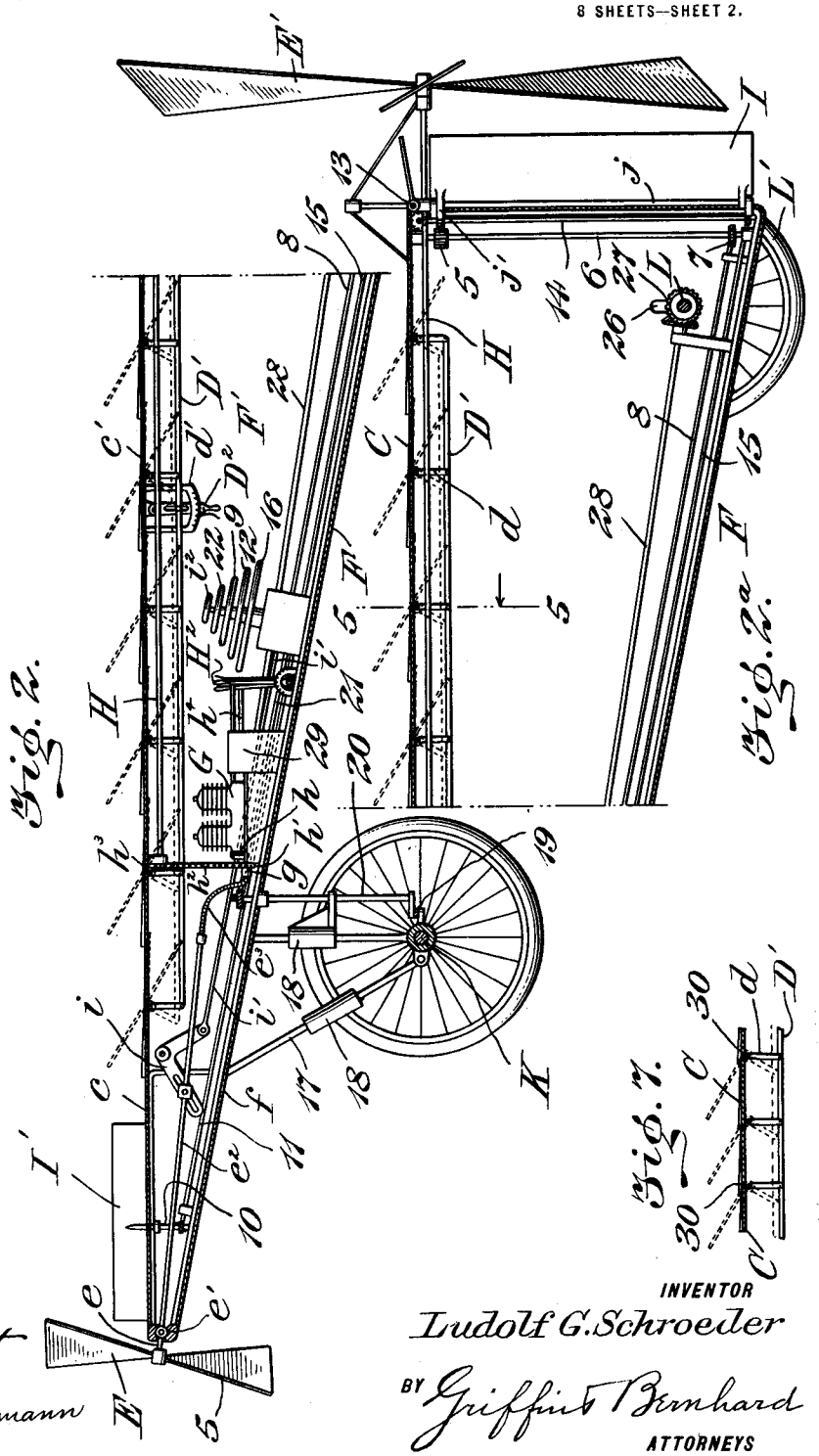


Fig. 2.

Fig. 2a.

Fig. 7.

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8 SHEETS—SHEET 3.

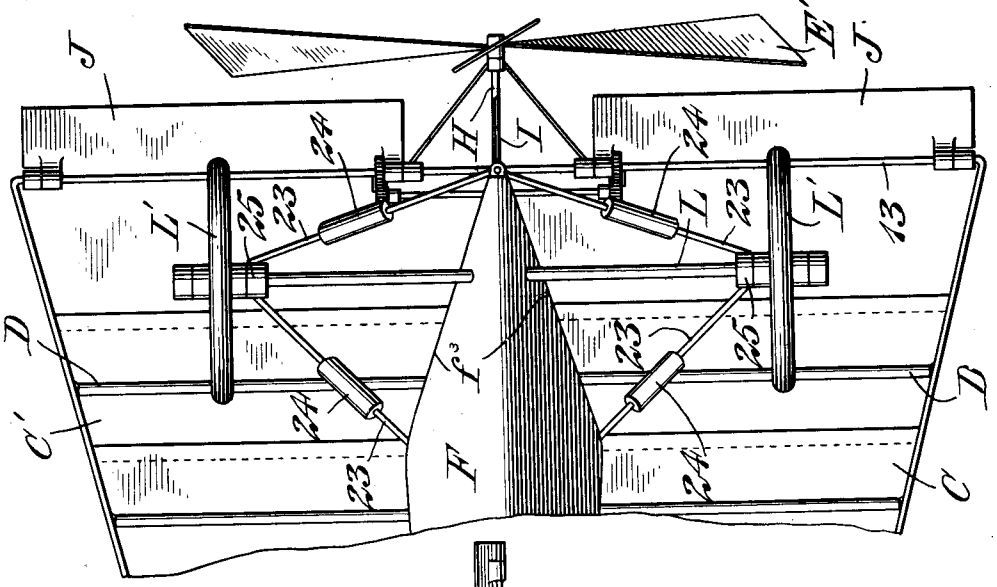


Fig. 4.

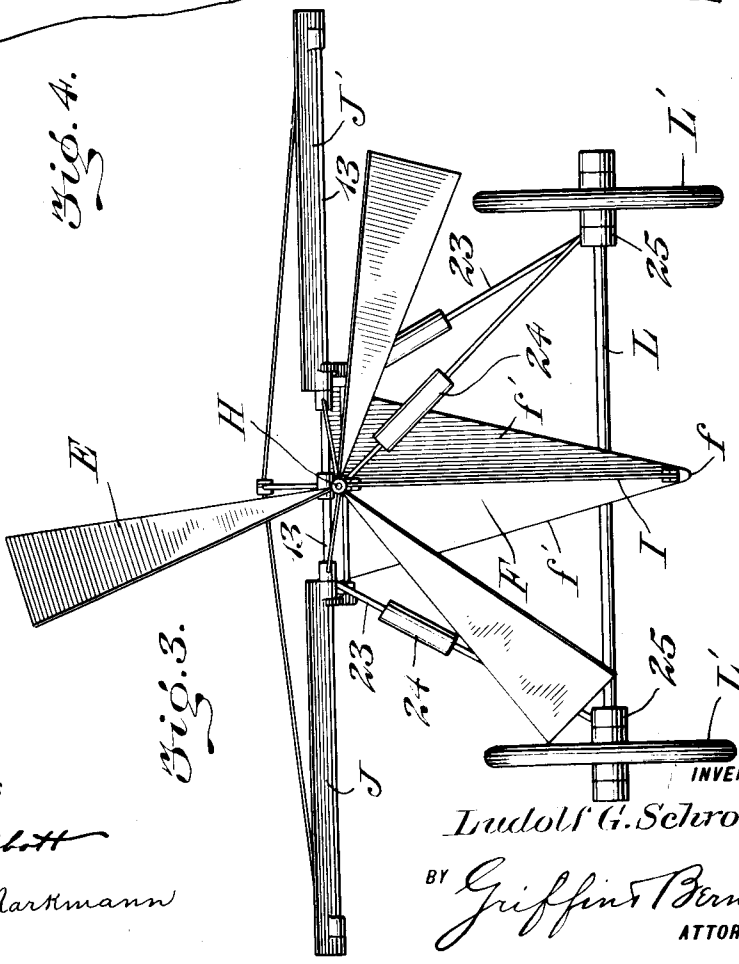


Fig. 3.

WITNESSES

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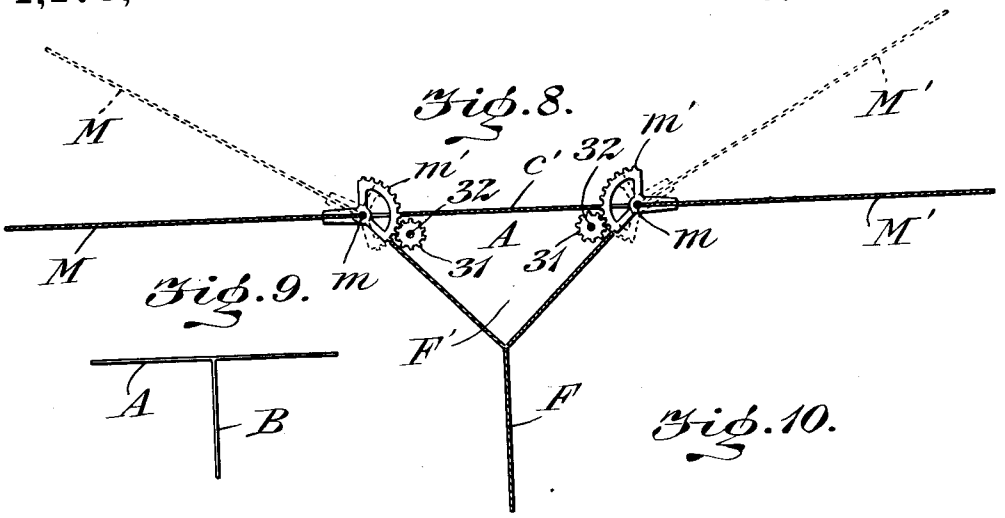


Fig. 8.

Fig. 9.

Fig. 10.

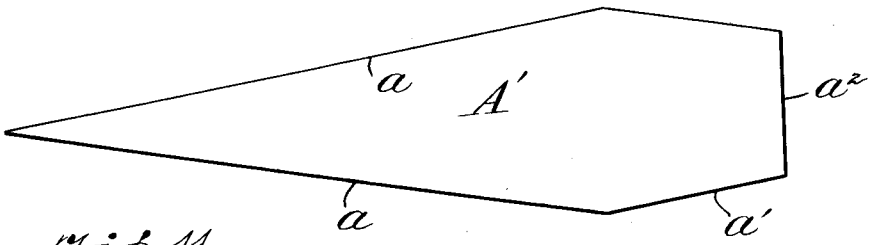


Fig. 11.

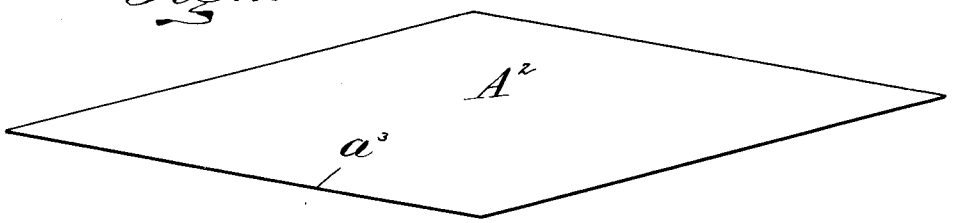


Fig. 12.

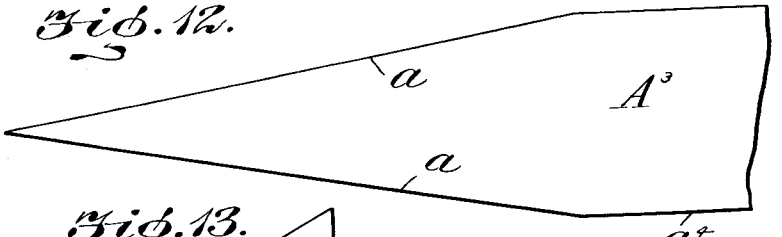
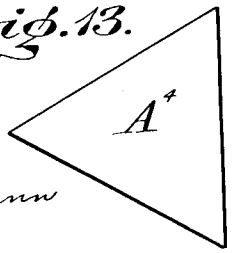


Fig. 13.



WITNESSES

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1,175,307.

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Fig. 14.

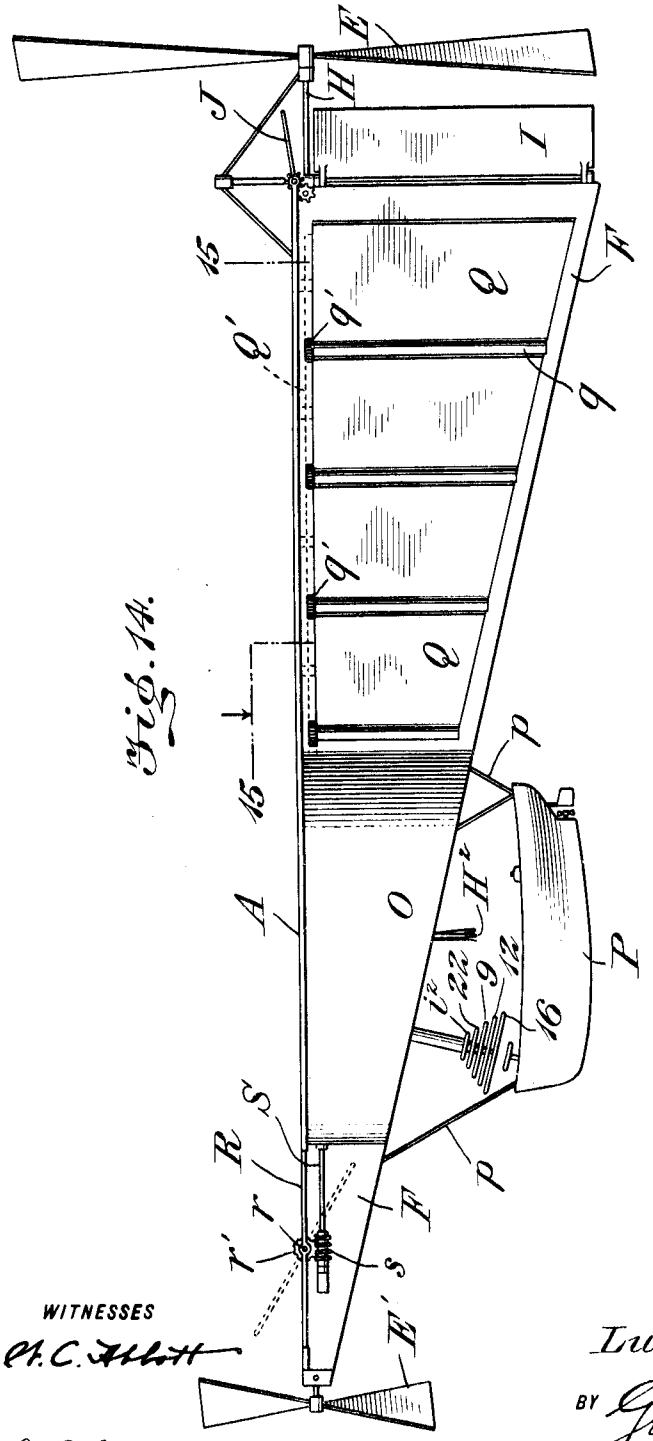


Fig. 15.



WITNESSES

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AERIAL CRAFT.

APPLICATION FILED JUNE 12, 1908. RENEWED OCT. 14, 1914.

1,175,307.

Patented Mar. 14, 1916.

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Fig. 16.

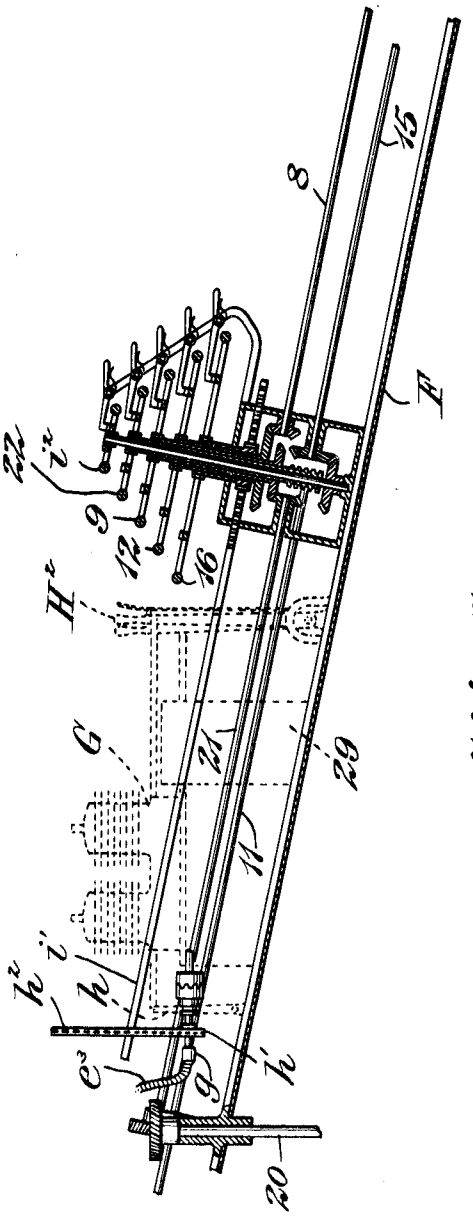
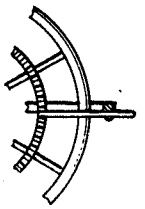


Fig. 17.



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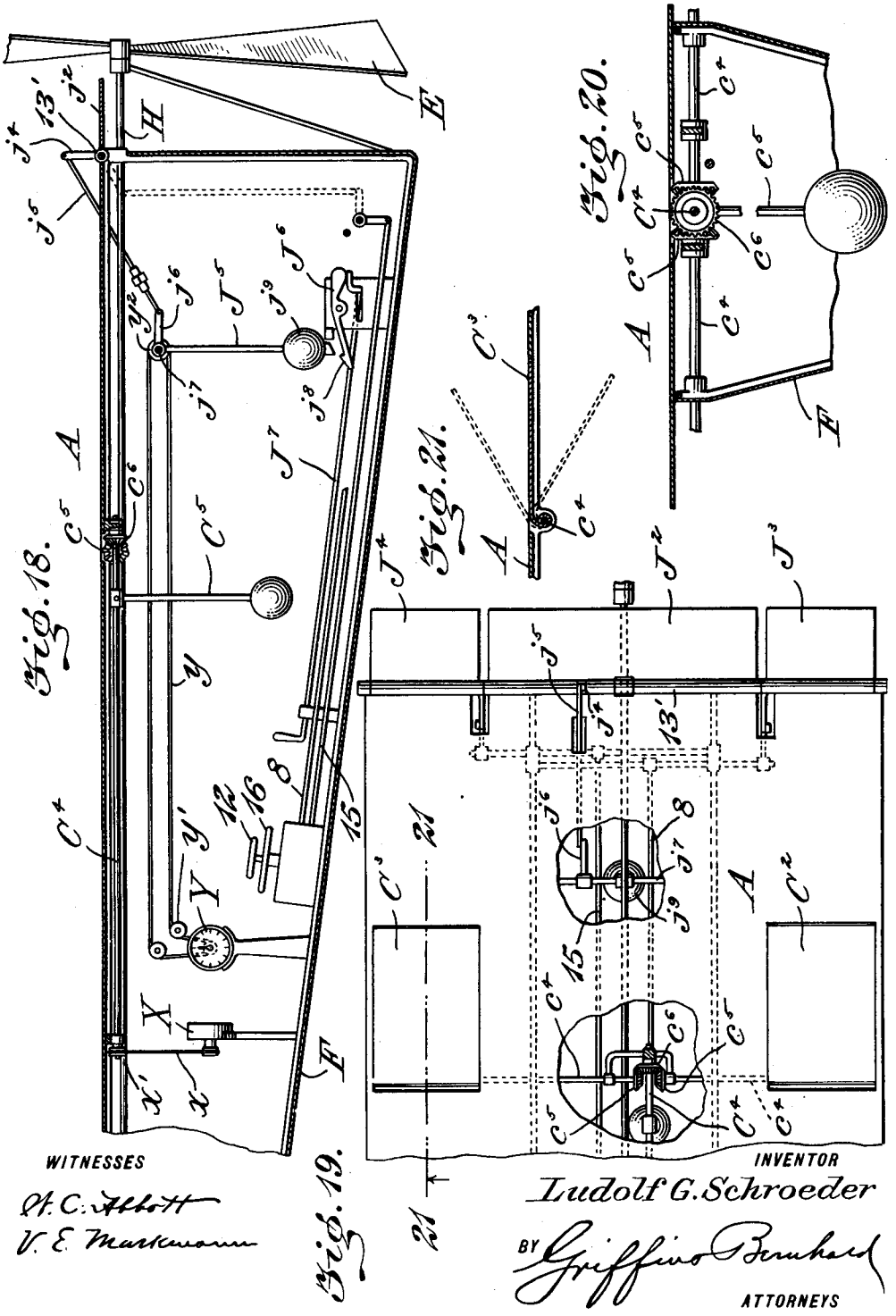
AERIAL CRAFT.

APPLICATION FILED JUNE 12, 1908. RENEWED OCT. 14, 1914.

1,175,307.

Patented Mar. 14, 1916.

8 SHEETS—SHEET 7.



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AERIAL CRAFT.

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1,175,307.

Patented Mar. 14, 1916.

8 SHEETS—SHEET 8.

Fig. 22.

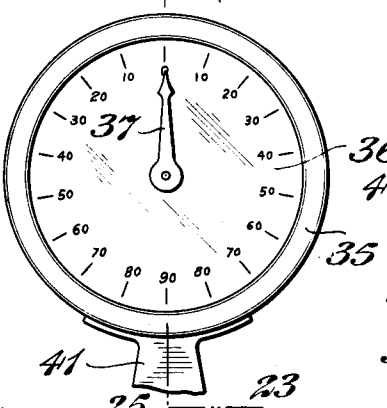


Fig. 23.

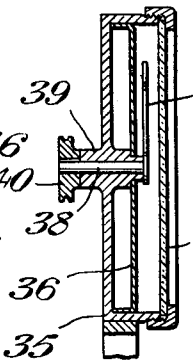


Fig. 25.

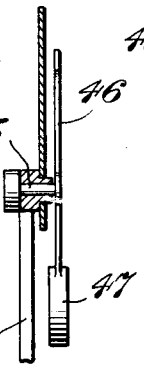


Fig. 27.

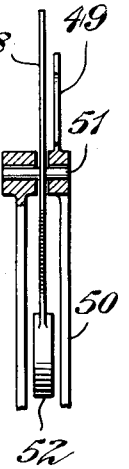


Fig. 24.

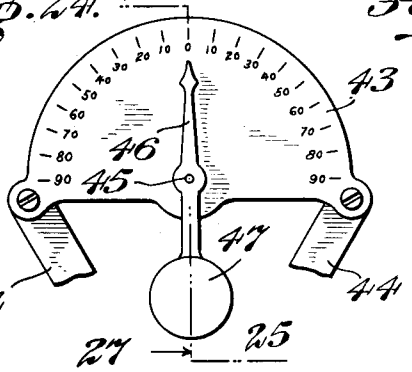


Fig. 28.

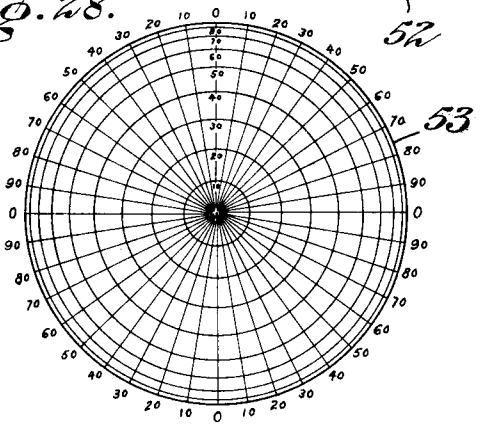


Fig. 26.

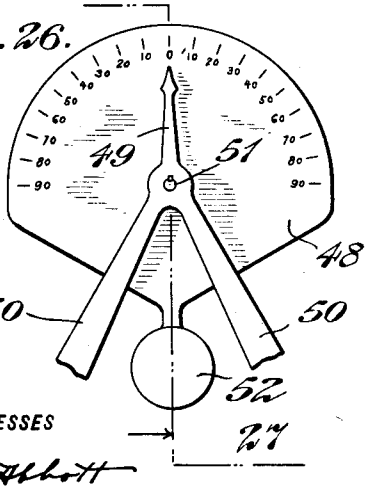
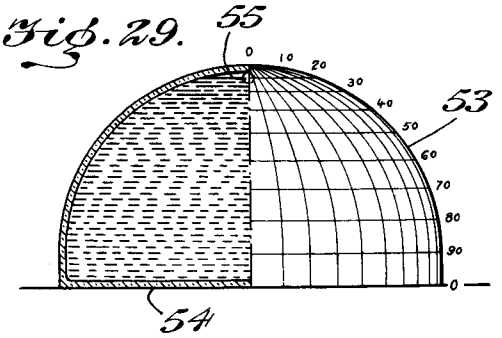


Fig. 29.



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UNITED STATES PATENT OFFICE.

LUDOLF G. SCHROEDER, OF NEW YORK, N. Y.

AERIAL CRAFT.

1,175,307. Specification of Letters Patent. Patented Mar. 14, 1916.

Application filed June 12, 1908, Serial No. 438,122. Renewed October 14, 1914. Serial No. 866,730.

To all whom it may concern:

Be it known that I, LUDOLF G. SCHROEDER, a citizen of the United States, residing in the city of New York, borough of Manhattan, county and State of New York, have invented a certain new and useful Aerial Craft, of which the following is a specification.

This invention is an aerial craft, or apparatus for navigating the air, of that type known as the aeroplane.

This invention, in one aspect, comprises an aeroplane deck having a depending keel or fin extending lengthwise of said deck, it being preferred to employ a keel of the same general shape as would be secured were the deck divided in two equal parts by making the dividing line run from the forward point of the craft's bow to the center line at the point where certain rear wings are joined. In contradistinction to aerial crafts heretofore constructed or experimented with involving the principle of the aeroplane, my newly designed craft embodies a structure which is adapted to move forward in the direction of its length, that is to say, the length of the aeroplane counting from the forward point of its forward movement is from one and one half ($1\frac{1}{2}$) to several times the length of its width, or as it may be expressed the spread of its wings or vanes, an essential feature of the invention being an elongated aeroplane moving longitudinally, whereas many of the prior aeroplane crafts, which have been designed to operate on the principle of the winged flight of birds, embody structures which move sidewise, the direction of movement being in a path at right angles to the longitudinal axis through the craft.

It is preferred to embody the invention in a craft, the deck of which is substantially triangular in shape, or in a deck having substantially parallel sides and a triangular bow shaped portion, the deck being extended for a suitable distance. Preferably, also, the keel is triangular, said keel conforming substantially to the outline of the deck and the wings or vanes which may be used in connection therewith.

In order to adapt this structure for use as an air navigating apparatus, it will be provided with a suitable propeller, or propellers, said propeller, where a single one is employed, being located, preferably, near the bow of the deck, while if two propellers are employed, a second one will be located at the rear or stern of the deck. Means will be provided, also, for driving the propeller or propellers.

In a preferred form of the invention, certain parts or sections of the deck will be made movable with reference to other parts thereof, whereby said movable parts constitute aeroplanes or vanes to assist in the ascent or descent of the craft.

In practice the apparatus will be provided, preferably, with various adjuncts and expedients, such as a wheeled running gear, which serves the purpose of transporting the craft from one place to another on the ground, as well as to assist in imparting to it an impetus in ascending into the air; one or more rudders for determining the path of the craft in a horizontal plane; and other features of assistance when the craft alights.

In one form of the invention, the keel of the craft may be made hollow and of the form substantially triangular in cross section, both vertically and longitudinally, this construction of the keel providing a surface which offers a minimum resistance to the air. The hollow keel provides a housing for the motor and operating mechanism, and in one form of the invention a separated compartment may be provided in the hollow keel for such purpose.

The keel may be provided with vanes which may be operated for the purpose of permitting the air to pass through said keel without exerting substantial pressure thereon when such effect is deemed desirable.

In the accompanying drawings I have illustrated different practical embodiments of the invention, but the constructions shown therein are to be understood as illustrative, only, and not as defining the limits of the invention.

Figure 1 is a perspective view of my aerial craft illustrating one embodiment of the invention. Figs. 2 and 2^a are together a longitudinal section taken centrally through the craft. Fig. 3 is an elevation looking at the rear or stern of the craft. Fig. 4 is an inverted or bottom plan view of the rear portion of the craft. Fig. 5 is

a detail cross section taken in the plane indicated in the dotted line 5—5 of Fig. 2[a], illustrating one means for pivotally supporting and operating a pair of movable vanes, the latter adapted to form a part of the deck. Fig. 6 is a plan view on an enlarged scale showing a portion of the deck and of certain vanes. Fig. 7 is a sectional detail view illustrating a modified construction of the deck and vanes. Fig. 8 is a vertical cross section through the deck and the keel illustrating a modified form of the vanes, and operating means for said vanes. Fig. 9 illustrates diagrammatically an end view of the deck and the keel composing the body of the craft. Figs. 10, 11, 12, and 13 show diagrammatically and in plan various shapes of the body of the craft. Fig. 14 is a side elevation illustrating another embodiment of the invention. Fig. 15 is a horizontal section on the line 15—15 of Fig. 14 showing means for simultaneously adjusting a plurality of keel vanes. Fig. 16 is an enlarged detail view, partly in section and partly in elevation, showing means for controlling the engine and operating the several devices entering into the construction of the craft. Fig. 17 is a detail in plan of one means for locking an operating wheel in position, one of the locking devices being associated with each wheel. Fig. 18 is a view in vertical longitudinal section through a part of the craft illustrating equilibrium devices associated with the wings or vanes and the rear steering rudders. Fig. 19 is a plan view of the parts shown in Fig. 18, omitting the rear propeller. Fig. 20 is a vertical cross section through a part of the keel and deck of the craft illustrating one of the equilibrium devices. Fig. 21 is a longitudinal section on the line 21—21 of Fig. 19. Fig. 22 is a detail view of an indicator associated with one of the equilibrium devices. Fig. 23 is a vertical section on the line 23—23 of Fig. 22. Figs. 24 and 25 are, respectively, an elevation and a vertical section of another form of the indicator device. Figs. 26 and 27 are, respectively, a front view and a vertical section of another embodiment of the indicator device. Figs. 28 and 29 are a plan view and a vertical sectional elevation of a liquid operated indicator device wherein a moving part, such as a float, will indicate the longitudinal or side dip of the aerial craft.

An essential part of the present invention is a deck, A, and a keel, F, shown diagrammatically in Fig. 9, said keel being below and lengthwise of, the deck, whereby the body of the craft is substantially T-shaped in cross section.

Generally speaking, the deck, A, constitutes an aeroplane adapted to sustain the craft when in flight, whereas the keel, F, operates, mainly, to insure stability to the craft and counteract the effect of wind pressure on either side, which wind pressure otherwise would tend to capsize the aeroplane, *i. e.*, invert it. In flight, the craft is driven in the direction of its length, either forward or backward, by the action of propelling mechanism, which will be hereinafter described in detail, and the direction or movement of the craft is controllable by the action of certain steering devices, to be also hereinafter described.

Some of the shapes of the craft are shown in Figs. 10, 11, 12 and 13, but in each instance the deck is an aeroplane with a tapering forward portion.

As shown in Fig. 10, the craft, A′, is provided with two long tapering sides, a, and short tapering sides, a', the latter being inclined reversely to the sides, a, and meeting the same at an obtuse angle, the stern, a^2, of the craft being rather blunt and at right angles to the longitudinal axis of said craft.

Fig. 11 shows a craft, A^2, which is substantially diamond or lozenge shaped, the same having four inclined sides, a^3, meeting each other at sharp angles at the bow and stern. The shape may be further modified, as represented diagrammatically in Fig. 12, wherein the craft, A^3, is formed with long inclined sides, a, similar to Fig. 10, but the remaining sides, a^4, are straight and parallel for an indefinite length. The shapes shown in Figs. 10, 11 and 12 are designed primarily to secure speed in the flight of the craft, but the triangular shape of craft shown at A^4 in Fig 13 is especially designed to produce a craft having maximum load carrying capacity.

I will now proceed to describe in detail the construction of one form of aerial craft which is shown in Figs. 1 to 5, inclusive, of the drawings. The deck, A, is a plane surface substantially triangular in shape. This deck may be unbroken, or substantially so, as to produce an areoplane, the surface of which is continuous, but as shown the side portions of the deck are cut away for a part of its distance thereby producing a longitudinal central stem, c', in the rear of the bow portion, c, of said deck. In the cut away side portions of the deck are two series of vanes, C, C′, adapted to occupy the closed positions shown in Fig. 1 so as to constitute a part of the deck, A. The vanes, C, C′, are adapted to overlap at their edge portions, and these vanes are connected pivotally with the stem, c', for the purpose of turning them into the inclined position shown in dotted lines in Fig. 2, or to substantially vertical positions.

The deck and the vanes may each be composed of any appropriate material, such as a light frame with a covering of textile, or a light weight metal sheet may be used, but these details may be modified as desired.

The vanes may be connected pivotally to the deck in a variety of ways, one pivotal means being shown in Figs. 5 and 6, another in Fig. 7, and a still further method is disclosed in Fig. 8. In Figs. 5 and 6, cross shafts, D, are journaled on the stem, c', of the deck so as to extend into the cut away portions at the respective sides thereof, and each shaft is equipped with two vanes, one from each series of vanes, C, C'. The vanes are attached rigidly to the shafts, and said shafts are adapted to be operated by suitable means, such as the longitudinal rod, D', which is connected pivotally to the arms, d, said arms being rigid with the cross shafts, D. The operating rod, D', is connected to a hand lever, D^2, having a suitable locking contrivance adapted to engage with a fixed segment, d', as shown in Fig. 2. By moving the lever, D^2, one direction, the rod, D', is correspondingly shifted, and the vanes, C, C', are adapted to be moved to the inclined positions, substantially as shown in Fig. 2, but a movement of the lever and the rod in a reverse direction shifts the vanes to their closed positions, the vanes of the two series being operated simultaneously.

The apparatus is equipped with appropriate propelling mechanism, and in the embodiment shown in Figs. 1 to 5, I employ a plurality of propellers, E, E'. The propeller, E, is positioned at the front end of the deck, or as it may be termed, the bow of the craft, whereas the propeller, E', is at the stern of the craft, and at a suitable distance from the rear of the deck and the keel, F. The propellers, E, E', are composed of suitable light material, and are of appropriate sizes and construction to answer the purpose, it being preferred to make the rear propeller somewhat larger than the front propeller. The front propeller, E, is mounted at the bow so as to be shifted for the purpose of aiding in the control of the craft, and while any suitable means may be employed to secure this result, I have shown the shaft, e, of said front propeller as being mounted in a shiftable bearing, e', which is movably supported at the extreme front end of the deck A. This propeller shaft has a part, e^2, thereof extending into a chambered or hollow portion of the keel, F, and to the inner extremity of said part e^2, of the shaft is connected a flexible shaft, e^3, the latter being operated from the shaft, g, of the motor or engine, G. The engine shaft is provided with a clutch, h, whereby the shaft may be thrown into and out of gear, and said engine shaft is provided, also, with a sprocket wheel, h', with which engages a sprocket chain, h^2, the latter operating another sprocket wheel, the position of which is indicated at h^3, in Fig. 2. This sprocket wheel, h^3, is secured rigidly on a horizontal shaft, H, extending through the hollow keel and protruding beyond the rear portion thereof, said shaft, H, having the rear propeller E, secured rigidly to its protruding rear end. The clutch, h, is operated by a rod, h^4, which is connected to an operating lever, H^2, whereby the clutch may be operated to make the shaft, g, fast with the engine shaft, or said shaft, g, may be disconnected from said engine shaft. From this description, it will be seen that the front propeller and the rear propeller are operated by separate connections with a common motor or engine; that the two propellers E may be thrown into and out of operative connection with the engine driven shaft by the movement of the clutch h, and that the front propeller may be shifted to various positions relative to the plane of the deck, A. Any means for adjusting the front propeller may be employed, but as shown in Fig. 2, a bell crank lever, i, is connected pivotally with the shaft, e^2, and from this lever extends an operating rod, i', which is adapted to be shifted by one of a series of operating wheels 16.

The keel F, is rigid with the central stem, c', of the deck plate, and it is preferred to make this keel tapering in longitudinal and vertical cross sections. The keel is inclined along its bottom edge from the bow end of the craft toward the stern thereof, as indicated at f; said keel consists of side walls, f', which converge from the stem, c', of the deck plate toward the bottom inclined line, f, of said keel. It is preferred, however, to taper the side walls, f', at the rear part of the keel on converging lines, as indicated at f^3, in Fig. 4. The described construction of the keel with the downwardly converging side walls, f', and with the base line, f, of the keel inclined upwardly from the stern to the bow provides a form of craft wherein the keel gradually increases in depth from the bow toward the stern so as to present a substantially triangular structure in both longitudinal and transverse section. This particular form or shape of the keel is advantageous for the reasons that it offers the least possible resistance to the air when the craft is in flight, it provides a chamber, F', for the accommodation of the motor and operating mechanisms and, at the same time, the keel adds stability to the craft.

Vertical rudders, I, I', are provided at the stern and bow of the craft for the purpose of steering it in a horizontal plane. The stern rudder is carried by a vertical shaft, j, which is supported at the rear of the keel, F, and this shaft is shown in Fig. 2 as having a toothed segment, j', near its upper portion. Said segment meshes with a gear 5 which is secured fast to the upper part of a steering shaft, 6, the latter being within the hollow keel, F, and said shaft being

provided at its lower part with a pinion 7. Said pinion is geared to an operating shaft, 8, which runs lengthwise along the keel, F, near the bottom thereof to an operating device 12, the latter being positioned above the operating device, 16. The described construction provides means whereby the vertical rudder, I, may be shifted either to the right or the left, and in a horizontal plane, for the purpose of steering the craft. The other steering rudder, I′, at the bow of the craft, is disposed above the deck plate, *c*, and in the rear of the propeller, E. Said rudder, I, extends lengthwise of the deck plate, and it is secured to the upper part of a short vertical shaft, 10, the latter extending into the shallow forward part of the hollow keel, F. The shaft 10 is geared to an operating shaft 11 which runs lengthwise of and within the hollow keel, F, for a certain distance, and this shaft 11 is adapted to be operated by a wheel 22, positioned between the wheels, i^2, and 9. The fore and aft vertical rudders are thus adapted to be operated independently by turning the wheels 22 and 12 respectively, said rudders being operated independently of each other.

In addition to the vertical rudders and the pivoted vanes, C, C′. the craft is provided with diving rudders, J, J′. Said rudders are positioned at the stern of the craft, substantially parallel to the deck, A, and at the respective sides of the keel, F, and the steering rudder, I. Said diving rudders are secured firmly to a horizontal shaft 13 which is journaled at the rear edge of the deck, A, and to this shaft is geared a vertical countershaft 14, the lower part of which is geared to an operating shaft 15. Said shaft 15 is parallel to the shaft 8 and, at its front end, this shaft 15 is adapted to be operated by a shaft that is provided with the hand wheel 22.

For the purpose of transporting the machine over the ground, as well as for starting the machine at the beginning of its flight, the craft is provided with a wheeled running gear which is normally sustained below the keel. Near the front part of the machine is a horizontal front axle, K, having short stub axles, *k*, see Fig. 1, said stub axles supporting the front steering wheels, *k′*. The front axle is connected to the body of the machine by rods 17 which are provided, preferably, with shock absorbing devices 18, and to the stub axles, *k*, is connected a rod 19 adapted to be shifted in one direction or the other by a steering spindle 20. This spindle extends upwardly into the keel, and is geared at its upper portion to a longitudinal adjusting shaft 21. the latter being operated by a hand wheel 22.

The rear axle, L, of the running gear is connected by a plurality of rods 23 with the body and the keel, each of said rods having a shock absorbing device 24, see Figs. 3 and 4, said axle having the rear carrying wheels, L′. The rear axle is adapted to turn freely in bearings 25 which are supported on the rods 23, and this axle extends through slots 26 at the rear part of the keel. Within said keel the axle is provided with a bevel gear 27 which meshes with a similar gear on a longitudinal driving shaft 28, the latter extending forwardly into a gear housing or casing 29. Said housing incloses the front end of the shaft 28, and the rear part of the shaft is adapted to be driven or operated by the motor, G, whereby the rear axle, L, is geared to the motor, G, for the purpose of driving the machine when it travels on the ground.

The shock absorbing devices 18 and 24 may be of any approved construction for the purpose of easing the jar on the machine when it descends into engagement with the ground.

In Fig. 7 of the drawings, the vanes, C, are shown as being attached rigidly to rock shafts 30, each vane being secured at one edge of said rock shaft. This slightly modifies the construction of Figs. 5 and 6, wherein the vane is secured centrally to the cross shaft, D.

The construction and arrangement of vanes heretofore described embodies two series of vanes moving on axes at right angles to the longitudinal axis of the deck, A, the vanes of each series being operated simultaneously. In Fig. 8, however, I have shown a construction wherein two side vanes, M, M′, or two series of side vanes, M, M′, are mounted for movement on axes which are parallel to the longitudinal axis of the deck. At each side of the deck is a longitudinal vane, M, M′, or a series of longitudinal vanes, said side vane, or series of side vanes, being secured on a longitudinal shaft, *m*. The two shafts, *m*, *m*, are disposed lengthwise of the deck at the respective sides of the central stem, *c′*, thereof, and these shafts are provided with toothed sectors, *m′*, which mesh with gear pinions 31 on operating shafts 32. It is evident that the vanes, M, M′, may lie in the horizontal plane of the deck so as to coöperate with said deck in producing the aeroplane, whereby the craft may be suspended in the air when in flight, but when it is desired to descend in safety, the shafts 32 may be rotated for the purpose of moving the vanes, M, M′, to the upwardly inclined positions shown in dotted lines in Fig. 8, whereby the longitudinally ranging vanes are adapted to displace the air outwardly and laterally with respect to the descending craft. The angle of inclination of the vanes, M, M′, to the horizontal plane of the deck may be varied as desired by the adjusting mechanism so as to control the speed of the craft in descending.

In Figs. 14 and 15 of the drawings, I have illustrated another embodiment of the invention wherein the craft is provided with the deck, A^{10}, the keel, F^{10}, the rear and front propellers, E^{10}, E^{11}, the rudder, I^{10}, and the diving rudder or rudders, J^{10}, J^{11}, all as hereinbefore described. It is to be understood that the deck A^{10} of the craft shown in Fig. 14 is, preferably, composed of movable vanes similar to the vanes C C′ employed in the craft of Figs. 1, 2, 3, 4, 5, 6, 7 and 8 of the drawings. The keel, F^{10}, in this form of the craft is solid at its front part, and at a point intermediate its ends, said keel, F^{10}, is provided with a hollow section, O, the latter producing a chamber which contains the engine and some of the operating means heretofore described. Below this chambered part of the keel is suspended a marine vessel, P, said vessel being connected by cables, stays or other devices, p, to the keel in a manner which enables the marine vessel to be readily disconnected from the craft. The suspended vessel, P, accommodates one or more operators, and the operating means for the several rudders and other adjuncts are suspended from below the chambered part, O, of the keel, preferably above the suspended vessel, P. It will thus be manifest that, in the embodiment of the invention illustrated in Fig. 14, the running gear shown in conjunction with the other embodiments of the invention illustrated is omitted and in lieu thereof a marine vessel substituted. Thus, while the devices illustrated in the remaining figures of the drawings are adapted particularly for use on land, the embodiment of the invention illustrated in Fig. 14 is adapted for marine use, *i. e.*, it may rise from the water, descend thereonto, or be propelled along the surface thereof. The keel, F^{10}, at the rear of the chambered part, O, is cut away so as to provide a plurality of openings, which openings are occupied normally by the suitably operated vanes, Q. While any preferred means may be employed for operating the vanes, Q, in the keel, and while the vanes may be arranged to slide in either horizontal or vertical paths, and while the vanes may be pivoted to turn on horizontal axes, yet in the present embodiment of the invention I have shown each vane, Q, as being fixed at its front end to a vertical shaft, q, which is provided with pinions, q', see Fig. 15. A series of the vanes, shafts and pinions are employed, and the said vanes are adapted to be operated simultaneously by a rack, Q′, which extends lengthwise of the keel so as to engage with the pinions, q'. The vanes, Q, normally lie in the plane of the keel, F^{10}, so as to be disposed in end to end series, but by moving the rack, Q′, in one direction, the vanes may be adjusted to the dotted line positions of Fig. 15, whereby the openings in the keel are exposed for the wind to pass through the rear part of the keel, thus reducing the lateral wind pressure on the craft.

Instead of pivoting the vanes, Q, for movement on vertical axes, as shown in Figs. 14 and 15, it is evident that said vanes may be mounted in the side walls of the chambered keel in the construction of Fig. 2ª, said vanes being adapted for movement on horizontal axes as will be evident to a skilled constructor. Said horizontally pivoted vanes in the keel would be of advantage for the reason that they would, when opened, add to the stability of the craft.

In addition to the diving rudder or rudders, J, at the rear of the craft, I employ the horizontal rudder, R, the latter being carried by a horizontal shaft, r, having a worm gear, r', which meshes with the worm, s, on an operating shaft, S. Said rudder, R, may be positioned in the deck and at any point intermediate the ends thereof. The shaft, S, and the rack, Q′, extend into the hollow part, O, of the keel so as to be associated with suitable operating means (not shown).

In my machine, the weight of the load is imposed on the craft at a point below the deck and in front of the transverse axis of the craft. This disposition of the weight and the employment of the keel tends to keep the craft normally in a horizontal or slightly inclined position when in flight. The disposition of the weight forward of the center of the craft applies to what may be designated as the loose or transportable load. It applies, also, to the permanent load of the craft, and to the construction of the craft which may be, and preferably is, so built that if the transportable load be carried at the rear of the central portion of the craft, or even in the farthest part of the stern, the forward part of the craft will still be the heavier so that if the craft is balanced at the central part, it will still have a tendency to dip forward, or at least, to balance.

The craft is, or may be, equipped with an automatic equilibrium device for maintaining the same on an even keel, and this device may be applied or positioned on any part of the craft, at the bow, stern or amidships, for the purpose of creating downward and upward pressure so as to force the craft into a position opposed to that naturally produced by the air or by improper loading. In my aeroplane, said equilibrium device is adapted to operate the wings or vanes.

The embodiment of the equilibrium mechanism shown in Figs. 18 and 19 embraces means for operating certain vanes or wings at the sides of the craft when said craft has a tendency to tilt sidewise, or transversely to the longitudinal axis of the craft, and,

furthermore, automatic means are provided for operation by a longitudinal upward or downward tilt of the craft so as to throw rear vanes or rudders to a position which will automatically counteract the longitudinal tilting motion. As shown, certain vanes or wings, C^2, C^3, are carried by horizontal shafts, c^4, and the inner ends of these shafts are provided with bevel gears, c^5, the latter having intermeshing engagement with a bevel gear, c^6, on a shaft, C^4. This shaft runs longitudinally with regard to the keel, F, for a suitable distance, and on said shaft is a gravity pendulum, C^5, said pendulum being adapted to swing in a direction transversely with respect to the longitudinal axis of the craft or its keel, F. As the pendulum swings in one direction, the shaft, C^4, is rocked so as to turn gears, c^5, thereby moving one vane or wing in an upward direction, and the other vane or wing in a downward direction simultaneously; but a reverse movement of the pendulum, C^5, so operates the shaft, C^4, and the gear as to simultaneously reverse the direction of movement of vanes or wings, C^2, C^3. This mechanism acts automatically to keep the craft on an even keel against side pressure of the wind, and in a measure it counteracts unequal distribution in the load of the craft. Said Figs. 18 and 19 of the drawings illustrate, furthermore, an equilibrium device which operates automatically to counteract any excessive forward or rearward dipping of the craft in a longitudinal direction. In the embodiment shown, a horizontal rock shaft 13′ is at the stern of the deck, preferably in the plane of the deck thereof. This shaft carries a plurality of horizontal vanes or rudders, J^2, J^3, J^4, and from the shaft extends an arm, j^4, to which is connected the rear part of a link, j^5. The forward end of the link is pivoted to an arm, j^6, of the rock shaft, j^7, and on this rock shaft is mounted a gravity pendulum, J^5, the latter being adapted to swing in a forward and rearward direction, or in the direction of the longitudinal axis of the keel. Normally, the pendulum, J^5, is restrained from operation by an automatic lock, J^6, herein shown as a counterpoised lever having a latch end, j^8, which is adapted for engagement with the nose, j^9, of the pendulum, but this lock, J^6, is adapted to be released from the pendulum by the endwise movement of a rod, J^7, which extends forwardly to the station of the operator. It will be seen that on an upward and forward movement of the craft in the direction of its length the pendulum, J^5, will swing rearwardly, thereby throwing the vanes or rudders, J^2, J^3, J^4, in a downward direction, but a reverse movement of the craft and the pendulum will operate to throw the vanes or wings in an upward direction, whereby the rear vanes or wings are operated automatically to maintain the craft in a proper longitudinal position.

The operation of the pendulum, C^5, is shown by an indicator device, X, the spindle of which is turned by a belt connection, x, with a pulley, x', on the longitudinal shaft, C^4. Similarly, the operation of the pendulum, J^5, is shown by an indicator, Y, the spindle of which is operated by a belt, y, running over guide sheaves, y', and operated from a pulley, y^2, on shaft, j^7.

The indicators, X, Y, may be variously constructed, substantially as shown in Figs. 22 to 29 inclusive, but these indicators are positioned at, or close to, the operator's station so as to inform him of the condition of the craft when in flight.

I will now proceed to describe various forms of indicators which may be employed.

The indicator shown in Figs. 22 and 23 embodies a stationary casing 35 for a dial 36, over which is adapted to travel a pointer 37, the latter being carried by a shaft 38 which is mounted for rotation in a bearing 39 of said casing 35. This indicator shaft is provided with a pulley 40 which is operated by the belt, x, of indicator, X, or the belt, y, of the indicator, Y. The casing 35 is supported in a stationary position by suitable frame or post 41, and secured to this casing is a transparent face 42, through which the dial and the pointer can be viewed. The dial is provided with two rows of numbers, as shown in Fig. 22, one running from right to left, and the other running from left to right, the numbers in said row indicating the list of the craft to port or starboard.

A modified form of indicator is shown in Figs. 24 and 25, wherein the casing is omitted, and a semi-circular dial plate 43 is supported in a fixed position on arms 44. At the base of this dial plate is mounted a pivotal shaft 45 which carriers a pointer 46, one end of which is weighted at 47. The dial plate is graduated with two rows of numbers running in the same order as in Fig. 22, and the pointer 46 is held automatically by the weight 47 at the zero position, whereby the list of the craft moves the dial plate 43 or 44 in a corresponding direction, so that the degree of the list will be indicated on the dial plate by the pointer 46.

A modification of the construction of Figs. 24 and 25 is shown in Figs. 26 and 27, wherein a pivoted dial plate 48 is used in conjunction with a stationary pointer 49, the latter being supported by arms 50 of a suitable frame. The movable dial plate 48 is supported by a pivotal shaft 51, and said dial plate is provided with a counterweight 52, the latter holding said plate for the zero indication to be in line with the stationary pointer 49.

It will be understood that either form of indicator shown in Figs. 22 to 27 inclusive,

may be used in connection with the pendulum, C^5, for indicating the list of the craft in one direction or the other, or either form of indicator may be associated with pendulum, J^5, for indicating the longitudinal dip fore and aft of the craft, thereby keeping said craft on an even keel, or substantially so.

In Figs. 28 and 29 I have shown a form of indicator which operates to denote both the fore and aft dip, or the transverse list of the craft. Said indicator comprises a semi-spherical chamber 53 which is provided with a closed bottom 54, the shell of said chamber being composed of glass or other transparent material. The surface of the chamber is graduated by radial and circumferential lines which read from 0 to 90 on each of the four quarters of the circle. Within the chamber is a suitable liquid which may fill the chamber to such an extent as to leave only an air bubble therein so that the indicator will operate on the principle of a spirit level, or said indicator may be equipped with a float 55, see Fig. 29, whereby the float is adapted to assume different positions relative to the graduated surface of the indicator, thus denoting the sidewise list of the craft, or the fore and aft dip thereof.

It will be understood, furthermore, that I may employ the equilibrium devices and their vanes, or either of them, at the bow of the craft or at the stern thereof, or amidships of the craft, the position of said equilibrium device and the vanes coöperating therewith being a matter for the designer or engineer.

Having thus fully described the invention, what I claim as new, and desire to secure by Letters Patent is:

1. In an apparatus of the class described, a substantially triangular deck and a keel depending therefrom and extending centrally and longitudinally thereof, said deck being composed of an open-work frame and two longitudinal series of transverse vanes pivoted within said frame and movable into open positions for air to flow through said deck, said vanes when closed presenting with the deck a substantially imperforate surface.

2. In an apparatus of the class described, a substantially triangular shaped deck, a chambered keel depending therefrom and extending centrally and longitudinally thereof, and means whereby the area of the keel exposed to wind or air pressure may be varied.

3. In an apparatus of the class described, a substantially triangular shaped deck, a keel depending therefrom and extending centrally and longitudinally thereof, and suitable propelling mechanism for said apparatus, the axis of rotation of said propelling mechanism being substantially in the plane of said deck.

4. In an apparatus of the class described, a substantially triangular shaped deck, a keel depending therefrom and extending centrally and longitudinally thereof, a propeller positioned forwardly of the bow of the deck, and another propeller rearwardly of the stern of the deck.

5. In an apparatus of the class described, an aeroplane deck, and a chambered keel depending therefrom, the walls of said keel being provided with movable vanes for the purpose of reducing air pressure on said keel.

6. In an apparatus of the class described, an aeroplane deck provided with vanes movable on horizontal axes, and a keel provided with vanes movable on vertical axes.

7. In an aerocraft, an aeroplane deck, a keel provided with a chamber and with transverse openings in a different part of said keel from said chamber, driving mechanism positioned within said chamber of the keel, vanes pivoted to said aeroplane, said vanes being movable on horizontal axes, and other vanes pivoted within the openings of the keel, said last mentioned vanes being movable on vertical axes.

8. In an apparatus of the class described, an aeroplane deck, a keel depending therefrom, propellers fore and aft of the craft, a steering rudder near the stern of said deck, another steering rudder at the bow of the deck, the second named rudder being rearwardly of the fore propeller, and a diving rudder rearwardly of the stern of the deck and forwardly of the aft propeller.

9. In an apparatus of the class described, an aeroplane deck, a keel depending therefrom, a steering rudder and a propeller near the bow of said deck, a steering rudder and a propeller near the stern of said deck, and a diving rudder mounted at the stern of the deck and forwardly of the rear propeller.

10. In an aerocraft, the combination of an aeroplane deck, a keel coöperating therewith, propellers positioned forwardly of the bow and rearwardly of the stern of said aeroplane deck, and means for shifting the bow propeller into different angular positions with respect to the deck and independently of the operation of the rearwardly positioned propeller.

11. In an aerocraft, the combination of an aeroplane deck composed of an open-work frame and two longitudinal series of transverse vanes pivoted within said frame, and a chambered keel depending from said deck, said keel being triangular in lateral cross section and positioned in a plane substantially between the planes of the two series of vanes.

12. In an aerocraft, the combination of an aeroplane deck equipped with vanes movable on horizontal axes and adapted to vary the area of said deck exposed to wind or air

pressure, a chambered keel depending from the deck, said keel being triangular in lateral longitudinal cross section, and other vanes pivoted to the keel for movement on vertical axes.

13. In an aerocraft, the combination of an aeroplane deck, two longitudinal series of transverse vanes adapted to lie substantially flush with said deck, means for operating said vanes, a keel depending from the deck and positioned in a plane substantially between the planes of the two series of movable vanes, propellers positioned forwardly of the bow and rearwardly of the stern of said deck, and steering mechanism.

14. In an apparatus of the class described, an aeroplane deck, a keel depending therefrom, said keel being substantially triangular in vertical, longitudinal and transverse section, two longitudinal series of transverse vanes movable relative to the deck, propellers positioned forwardly of the bow and rearwardly of the stern of the deck, and steering mechanism.

15. In an apparatus of the class described, an aeroplane deck, a keel depending from the deck and extending longitudinally and centrally with relation thereto, propellers at the bow and stern of the aeroplane deck, steering devices positioned intermediate the propellers, a motor for operating said bow and stern propellers, a wheeled running gear disposed below the keel, and means whereby the running gear may be operated from the motor.

16. In an apparatus of the class described, an aeroplane deck, a keel depending therefrom, and propellers forwardly of the bow and rearwardly of the stern of the aeroplane deck for driving the craft in the direction of its length, said keel being substantially triangular both in longitudinal and cross section.

17. In an aerial craft, an aeroplane deck, provided with a keel, vanes in the plane of the deck at the respective sides of the keel, a pendulum connected operatively with the vanes, other vanes at the stern of the deck and keel, and another pendulum connected to the stern vanes, said pendulums being movable on axes located substantially at right angles to each other.

18. In an aerial craft, an aeroplane deck, a pendulum movable fore and aft with respect to the craft, a vane positioned at the stern of the craft and controllable by the pendulum, and means for locking and releasing said pendulum.

19. An aeroplane having a swinging and gravity-influenced weight, in combination with means whereby the position of said weight in respect to the plane is caused to correct longitudinal dip of the latter, and means whereby, at will, said weight can be locked to or unlocked from the plane in respect to fore or aft movement.

20. In an aeroplane, the combination of a main plane, lateral-dip-correcting means comprising surfaces adjustable to different angles of incidence to the air flowing past the plane, longitudinal - dip - controlling means, a gravity-influenced weight for operating the lateral-dip-correcting means, and manually operated devices independent of the weight for actuating the longitudinal-dip-controlling means.

21. In a navigable air ship, a horizontal plane, balancing wings at opposite sides of the plane adjacent to the transverse ends thereof, a vertically tiltable blade at the end of the machine for directing the vertical angle of flight, separate hinged depending and swinging members having their axes disposed at substantially right angles to each other, connections between one of said swinging members and the wings for automatically controlling the lateral dip of the machine in either direction, and other connections between the other swinging member and blade for controlling the angle of flight or inclination of the machine in the direction of travel.

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

LUDOLF G. SCHROEDER.

Witnesses:
H. I. BERNHARD,
V. E. MARKMANN.