S. LAKE.

AIR SHIP.

APPLICATION FILED DEC. 10, 1908.

928,524.

Patented July 20, 1909.

7 SHEETS—SHEET 1.

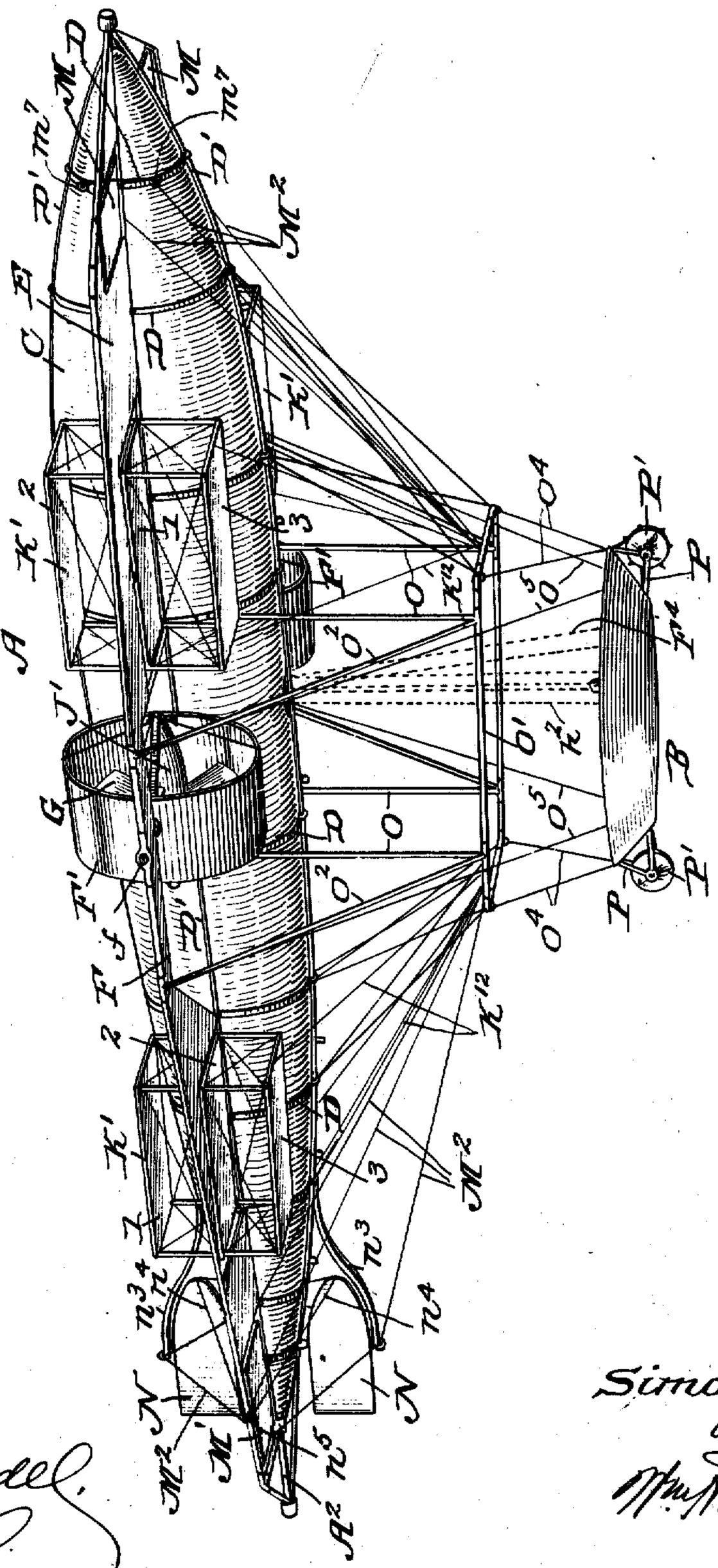

Fig. 1.

Witnesses

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7 SHEETS—SHEET 2.

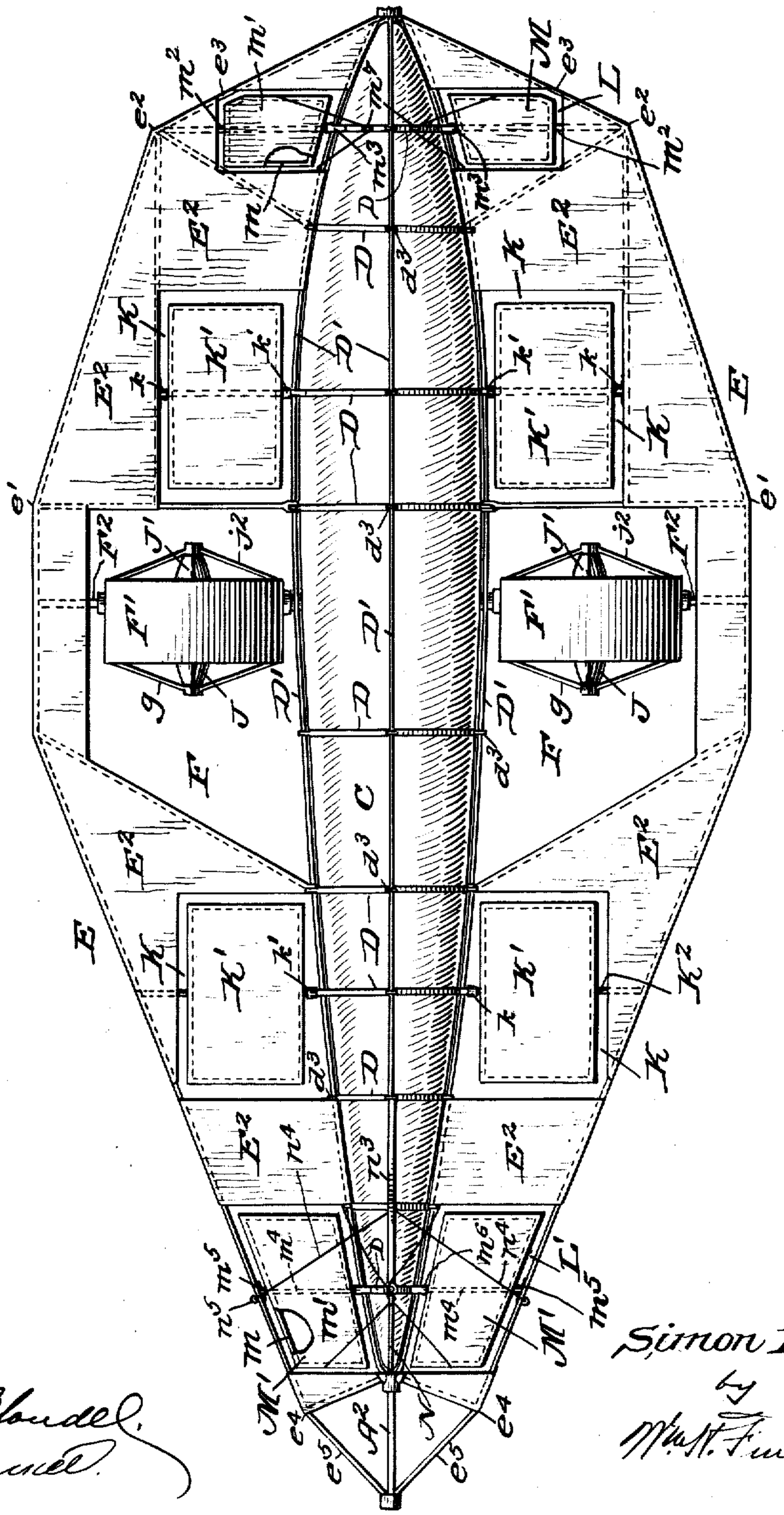

Fig. 2.

Witnesses

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7 SHEETS—SHEET 3

Fig. 3.

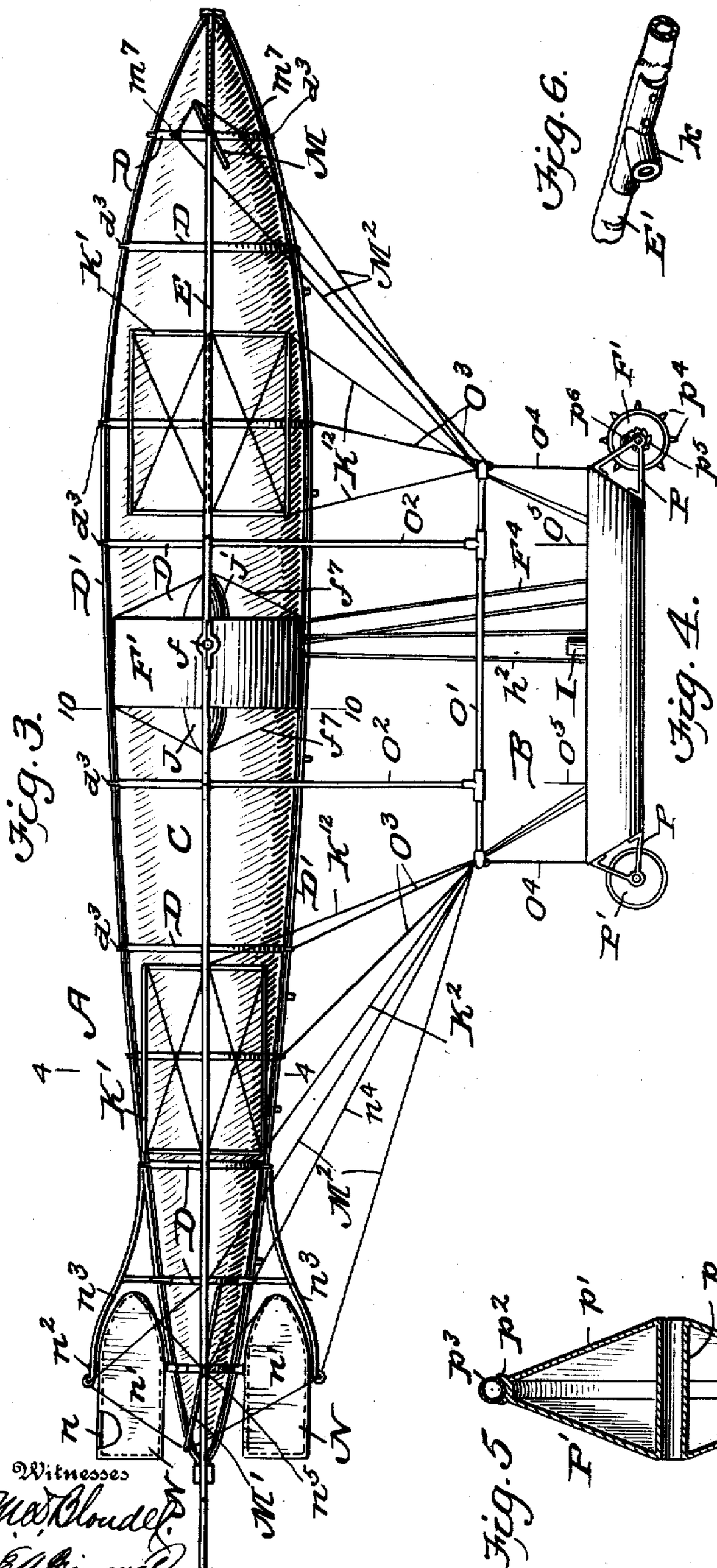

Fig. 6.

Fig. 4.

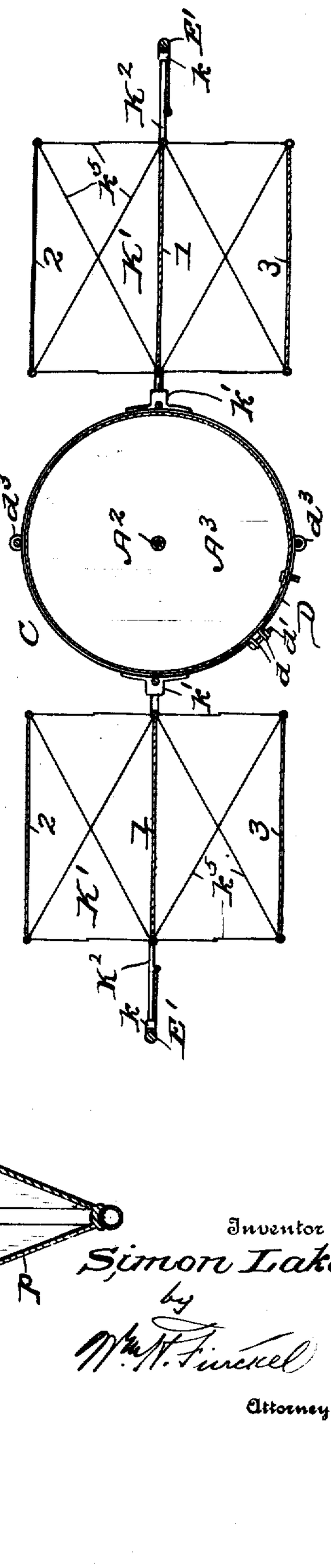

Fig. 5.

Witnesses

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7 SHEETS—SHEET 4.

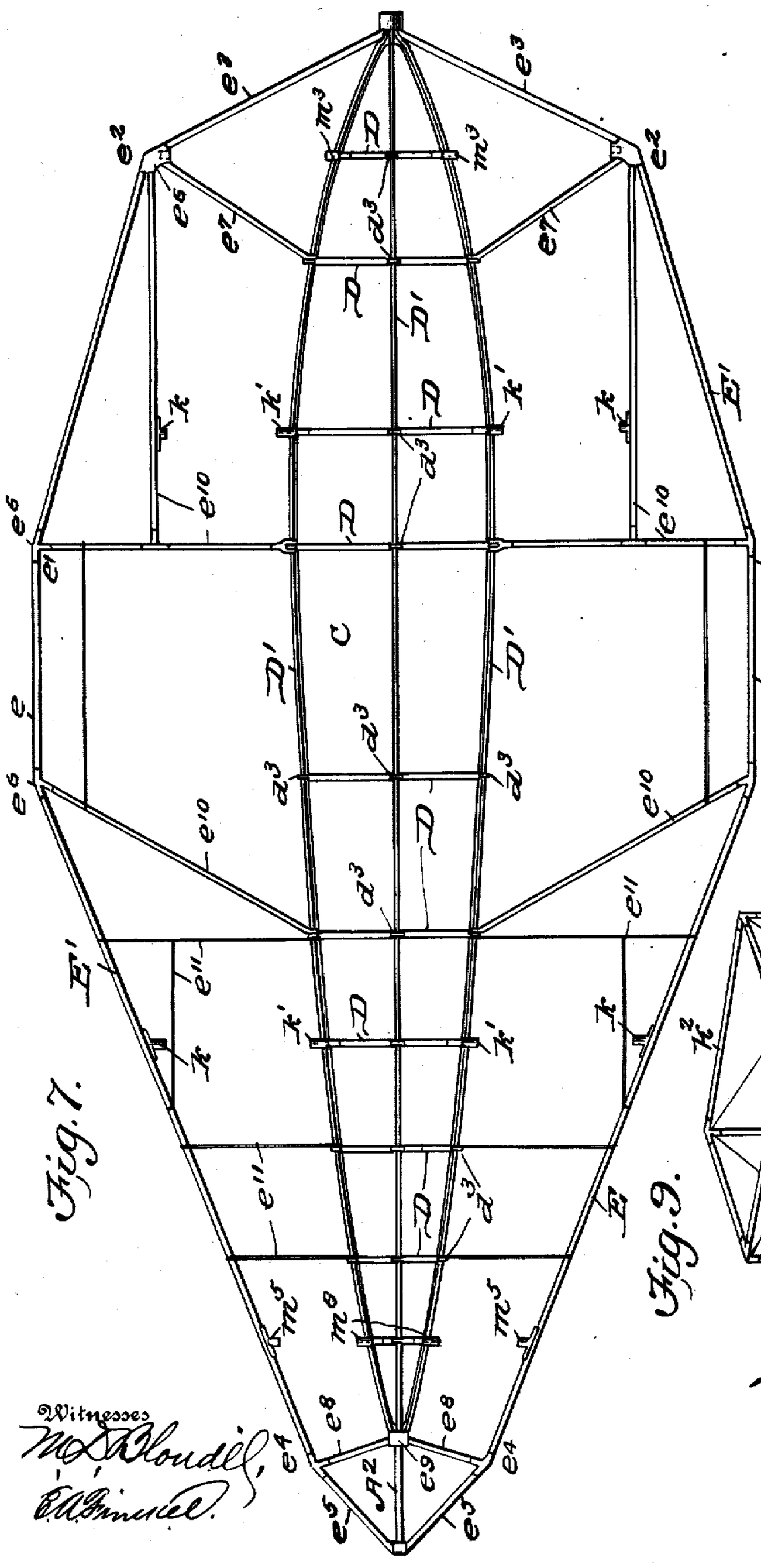

Fig. 7.

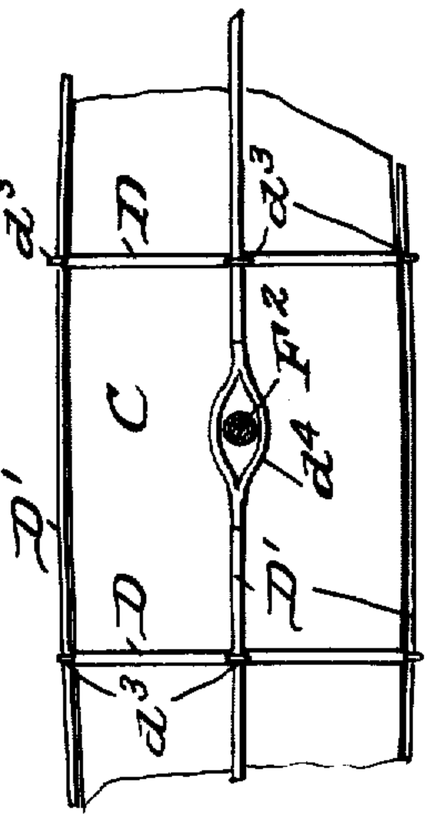

Fig. 8

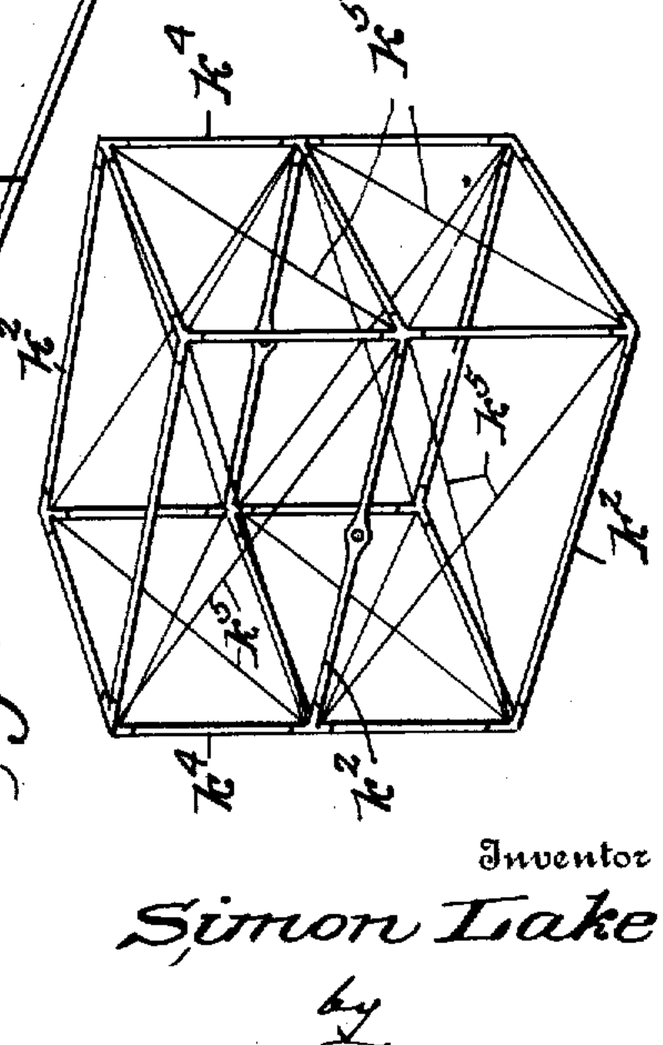

Fig. 9.

Witnesses

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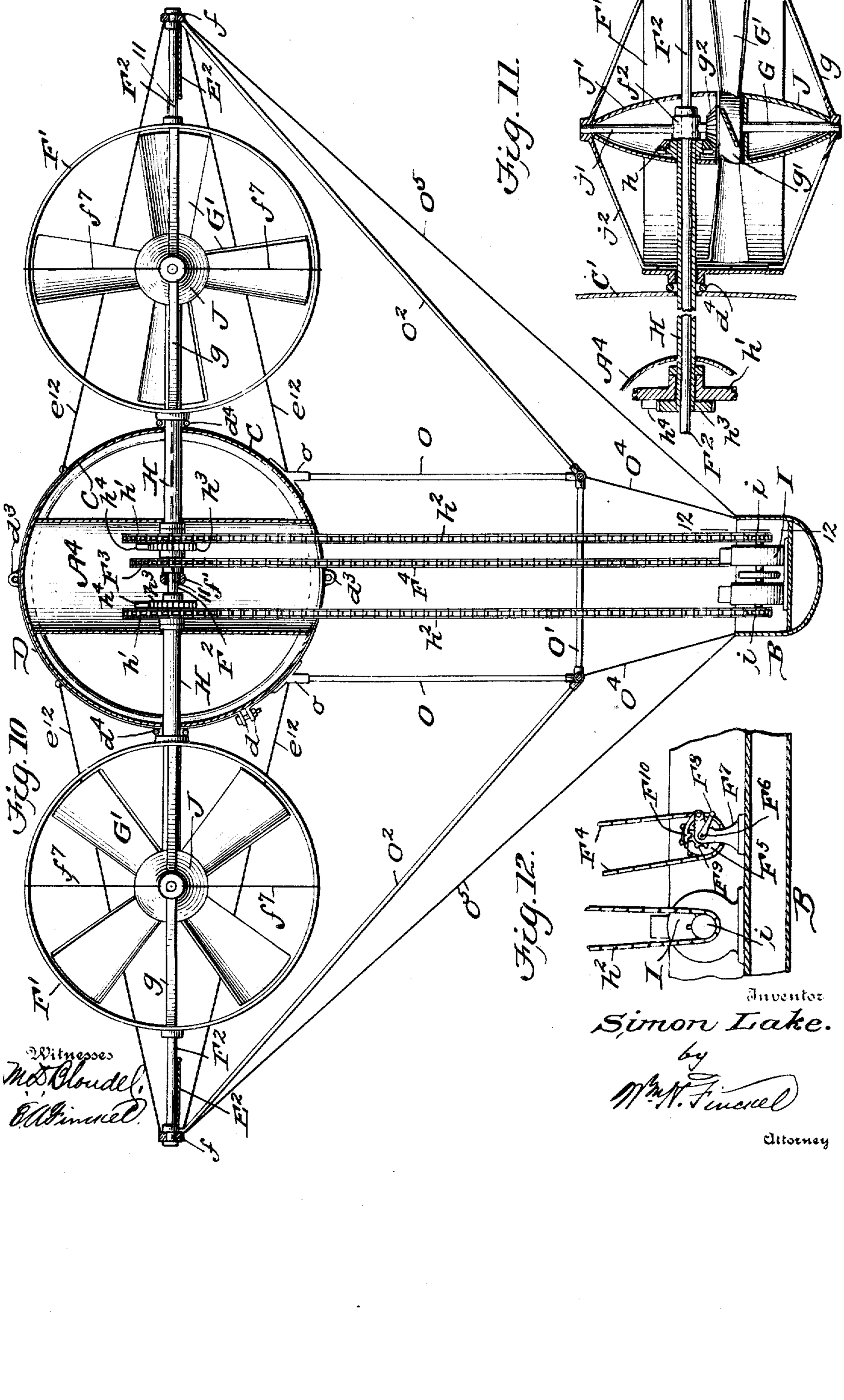
7 SHEETS—SHEET 5



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7 SHEETS—SHEET 6

Fig. 13.

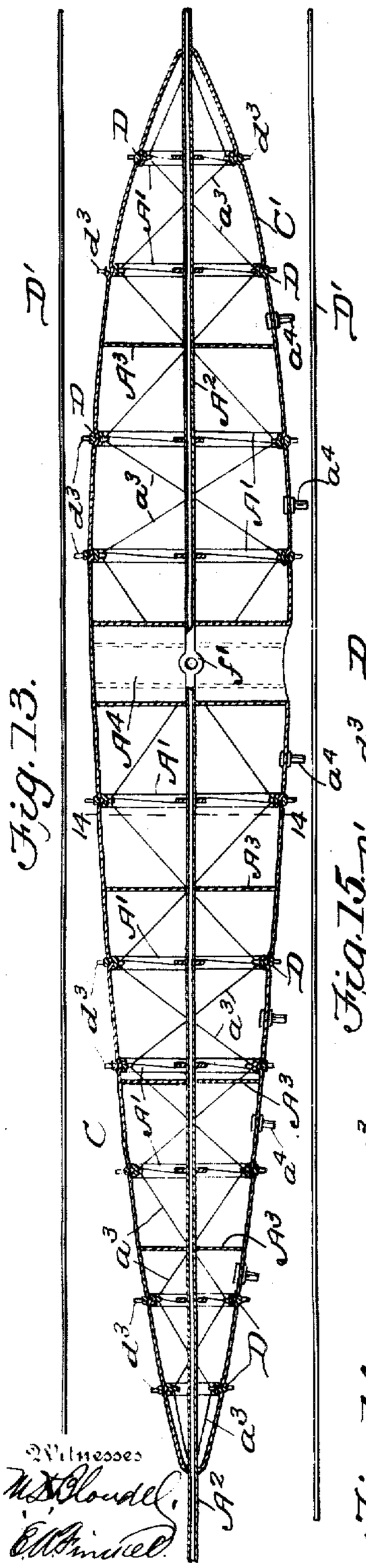

Fig. 16.

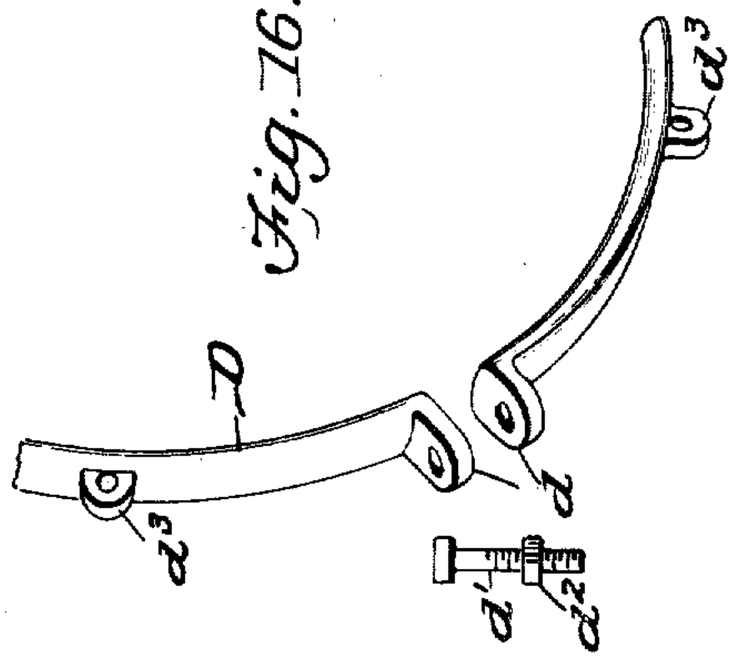

Fig. 15.

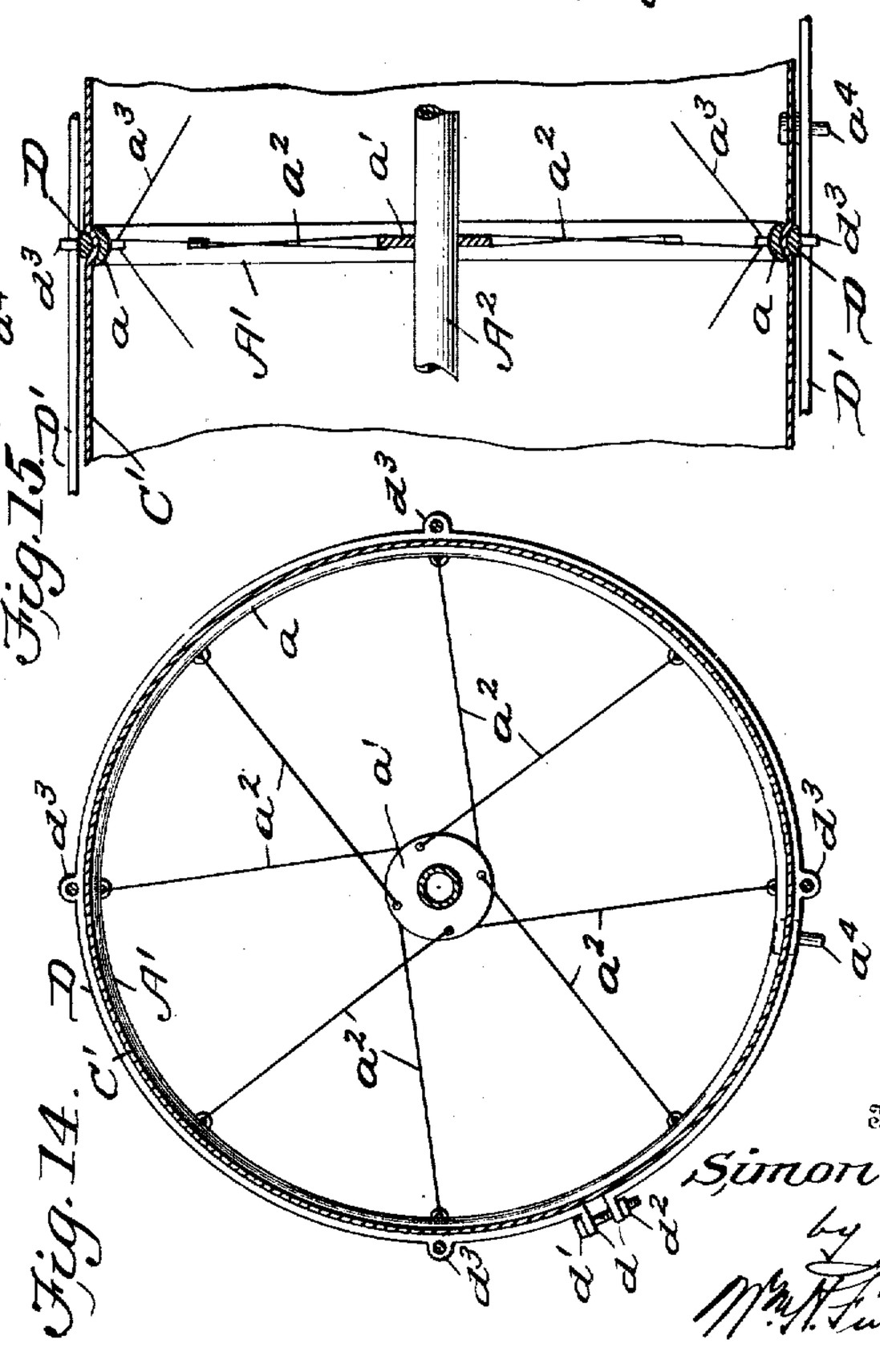

Fig. 14.

Witnesses

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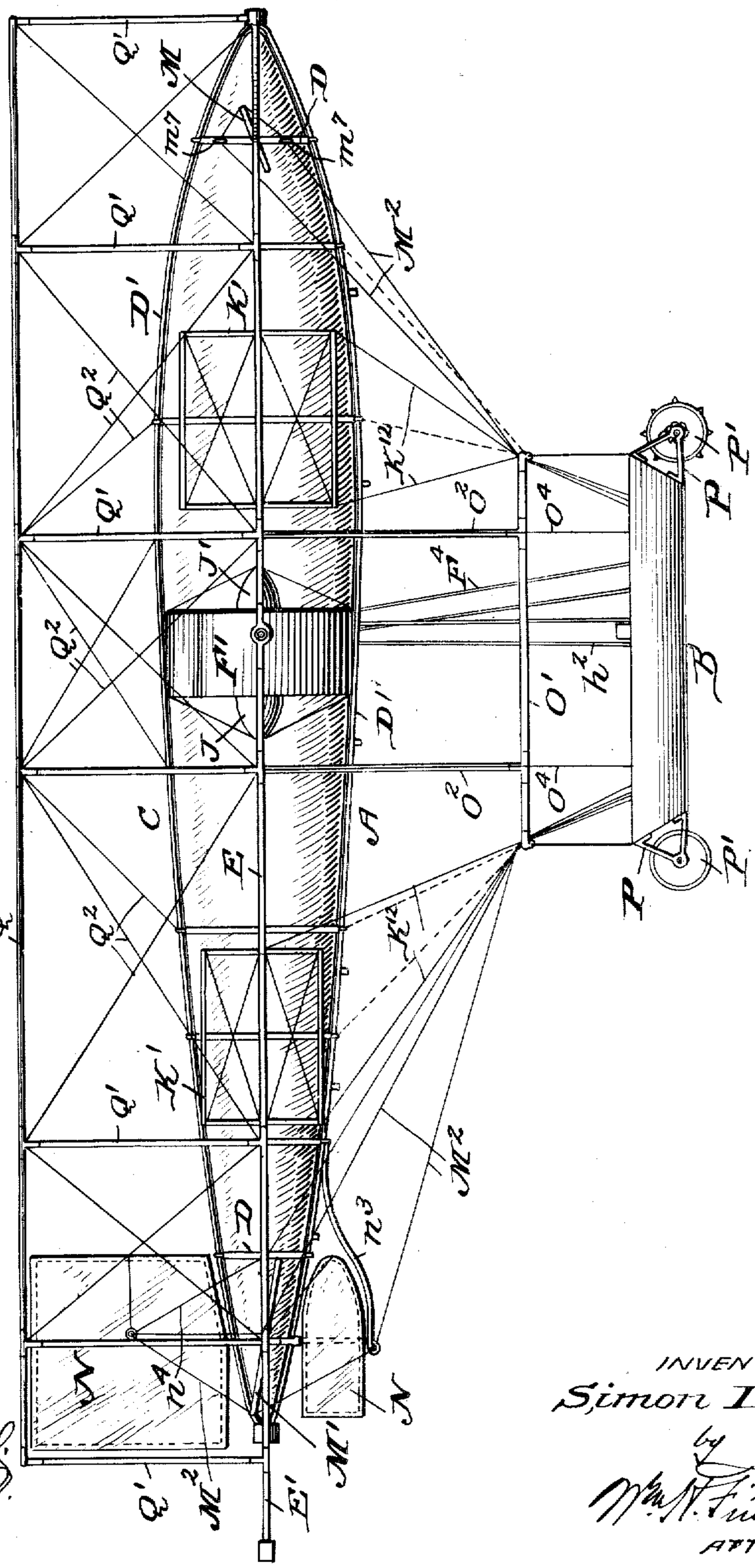
APPLICATION FILED DEC. 10, 1908.

928,524.

Patented July 20, 1909.

7 SHEETS—SHEET 7.

Fig. 17.



WITNESSES

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UNITED STATES PATENT OFFICE.

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AIR-SHIP.

No. 928,524. Specification of Letters Patent. Patented July 20, 1909.

Application filed December 10, 1908. Serial No. 466,851.

To all whom it may concern:

Be it known that I, SIMON LAKE, a citizen of the United States, and a resident of Bridgeport, in the county of Fairfield and State of Connecticut, have invented a certain new and useful Improvement in Air-Ships, of which the following is a specification.

The object of this invention is to provide an air-ship, particularly one of the class known as "heavier than air flying machines", with a thoroughly rigid construction, whose center of gravity is so disposed relatively to the center of its supporting surface and the center of falling resistance as to insure the ship retaining a true horizontal position under all conditions of flight, and not tilting should any of its operating parts be temporarily or permanently thrown out of operation, and whereby the entire air-resistance surfaces of the aeroplane or aeroplanes may be held both during flight and when making a descent, so that the occupants of the ship may retain complete control of the ship, direct its course, and effect a gradual gliding descent, without fear of injury to themselves or the ship.

Having thus stated the object and nature of the invention, I will proceed to describe its structural details, the arrangement of parts and the mode of operation, and then particularly point out and distinctly claim the part, improvement or combination which I claim as my invention.

In the accompanying drawings illustrating the invention, in the several figures of which like parts are similarly designated, Figure 1 is a perspective view of my air-ship. Fig. 2 is a top plan view of the same. Fig. 3 is a side view. Fig. 4 is a vertical cross section drawn on the line 4—4 of Fig. 3, on a larger scale. Fig. 5 is a vertical section drawn through one of the wheels carried by the car section of the ship. Fig. 6 is a detail perspective view of one of the bearings in which the outer ends of the elevating and trimming rudder shafts are journaled. Fig. 7 is a top plan view of the upper section of the air-ship illustrating the frame work of the aeroplanes. Fig. 8 is a detail side view of the central portion of the hollow body section of the air-ship illustrating the loops formed in the longitudinal brace rods extending along the sides of the said section. Fig. 9 is a perspective view of the frame work of one of the elevating rudders. Fig. 10 is a vertical cross section on a larger scale, drawn on the line 10—10 of Fig. 3. Fig. 11 is a detail horizontal section drawn on the line 11—11 of Fig. 10, Fig. 12 is a detail longitudinal section on a larger scale, drawn on the line 12—12 of Fig. 10. Fig. 13 is a central vertical longitudinal section drawn through the central hollow body section of the ship, illustrating the arrangement of the brace wires and bulk heads and showing two of the longitudinal brace rods detached. Fig. 14 is a vertical cross section on a larger scale, drawn on the line 14—14 of Fig. 13. Fig. 15 is a longitudinal section of a portion of the hollow body section. Fig. 16 is a perspective view of a portion of one of the clamping rings. Fig. 17 is a side elevation illustrating the construction of the ship with a superposed aeroplane.

A designates the upper section and B the lower or car section of my improved air-ship. The upper section A is constructed with a central, rigid, hollow body section C preferably of double-conoidal shape in longitudinal section and is constructed of a plurality of light weight circular-shape ribs A′ over which is arranged a skin or cover C′ of aluminium or any other strong light weight impervious material. The ribs A′ are so spaced apart and so diminish in size from the center toward the extreme ends of the body section, that a symmetrical structure is obtained, and these ribs are also arranged at such points as to faciliate the connections of the various supporting rods and braces for the lower section B of the ship, as will be described later on. Each rib A′ has a grooved rim *a*, a centrally disposed apertured disk a' and wire spokes or braces a^2 which latter connect the rim with the said disk. A light weight metal tube, or bamboo rod A^2 is arranged within the body member and is extended through the apertures in the several disks a' and has its ends projected beyond the ends of the cover C′. Truss wires a^3 connect the ribs throughout the length of the body section C and the ends of these wires are connected to the central tube or bamboo rod A^2 adjacent to the outer ends of the said rod, thus not only holding the ribs in an upright position but also providing a thoroughly rigid structure throughout.

D designates divided clamping rings one of which is positioned over the grooved rim of each rib and each divided ring has its ends bent outwardly as at *d* and perforated to receive a bolt d' upon which is threaded a clamping nut d^2 by which the ends of the ring

are drawn together and the said ring securely clamped in position upon the rib which also forces the cover C′ down into the groove of the rim *a* thereby holding the said cover tightly in position. The clamping rings D are provided with perforated ears d^3 which are arranged at diametrically opposite points in the vertical and horizontal planes of the center of the section C and through which are extended light weight brace rods D′ which extend throughout the length of the body section C and have their ends securely clamped to the projected ends of the central tube or bamboo rod A^2.

The hollow body section C is preferably constructed air and gas-tight so that it may be filled with a gas that is lighter than the atmosphere to make the said section buoyant if it should be desired to do so. The section C is divided throughout its length by a series of partitions or bulkheads A^3 which are joined air and gas-tight to the cover C′ and to the rods A^2, and valved inlet tubes a^4 are arranged in the cover by which the gas is led into the several compartments formed by the said bulkheads.

Upon each side of the central body section A is arranged an aeroplane E which extends horizontally from the said section in the horizontal plane of the center thereof. The aeroplanes are constructed of outer light weight frames E′ each of which comprises a short central portion *e* that is arranged parallel with the axis of said central section C, from the forward end *e′* of which the frame is extended forwardly and inwardly to a point e^2 from which it is continued at a sharper angle as at e^3 toward the extreme forward end of the central body section C and has its end connected to the forward end of the tube or bamboo rod A^2 that projects through the cover C′. From the rear end of the central portion *e* the frame is extended rearwardly and inwardly to a point e^4 from which it is continued inwardly at a sharper angle as shown at e^5 and has its extreme end connected to the rear end of the tube or rod A^2. Suitable brackets e^6 are arranged at the angles of the frame and connect the sections thereof. Brace rods e^7 extend from the brackets e^6 at the points e^2 of the frames and their inner ends are securely fastened to the clamping ring D next or near to the forward clamping ring, and similar rods e^8 extend from the points e^4 and have their inner ends fastened to a sleeve e^9 arranged upon the tube or rod A^2 adjacent to the rear end of the cover C′ of the central section C. Other brace rods e^{10} and wires e^{11} are arranged throughout the length of the aeroplanes to thoroughly brace the said aeroplanes to the section C and truss wires e^{12} connect the frames E′ to the upper and lower portions of the clamping rings D, thereby holding the aeroplanes in a true horizontal position.

The body portions of the aeroplanes are constructed of canvas or any other suitable material E′ and their outer longitudinal edges are connected to the frames E′ and their inner edges to the horizontal brace rods D′ and e^{10} and the brace wires e^{11} as shown most clearly in Fig. 2 of the drawings.

The aeroplanes are provided with central openings F in each of which is held a cylindrical sleeve F′ both of which are carried by and securely held to a common shaft F^2 that extends entirely across the upper section of the ship and through the hollow body portion thereof. The ends of the shaft F^2 are journaled in bearings *f* secured to the central portions *e* of the frames E′ and at its center in a bearing *f′* interposed in the central tube or rod A^2. At the points where the shaft passes through the cover C′ the longitudinal brace rods D′ are bowed or provided with a loop d^4 (Fig. 8) which encircle the shaft F^2 to permit of the shaft being passed through the body section in the horizontal plane of its center. Arranged upon the shaft F^2 and centrally within each cylindrical sleeve F′ is a short sleeve f^2. These sleeves f^2 form bearings for the inner ends of propeller shafts G, and the outer ends of these shafts have bearings in brackets *g* carried by the sleeves F′. A propeller G′ is mounted upon each shaft G and each has its hub *g′* provided with or keyed to a bevel pinion g^2 which is meshed by a bevel gear *h* carried by and at the outer end of a hollow shaft H surrounding the intermediate section of the shaft F^2. The inner end of each hollow shaft H extends into the hollow body section C and each has a sprocket wheel *h′* loosely mounted thereon over which operates a chain h^2 that passes around a drive sprocket *i* carried by the shaft of a suitable motor I which is mounted in the lower or car section B of the ship. To the extreme inner ends of the hollow shafts H are keyed ratchet wheels h^3 that are engaged by pawls h^4 carried by the adjacent sprocket wheels.

Surrounding each propeller shaft G is a conical sleeve J the base of each being arranged adjacent to and of the same diameter as the hub *g′* of the propeller and upon the opposite side of each hub is a conical sleeve J′ which incases the gears and is supported at its outer end upon a short shaft or rod *j′*. The forward ends of the shafts *j′* are held in brackets j^2 and their inner ends are held in the sleeves f^2. The inner ends of the sleeves J′ are provided with apertures through which the shafts F^2 and H pass and which form the supports for the inner ends of the sleeves. These cone-shape sleeves form practically elongations of the hubs *g′* although they are not designed to revolve with them, and they serve the purpose of providing a pointed cutting surface to offer the least possible resistance to the air on the

front side of the hubs of the propellers and of preventing a vacuum at the rear sides of the hubs which is caused by the rotation of the propeller blades. As is well known, the rapid rotation of the propeller of a marine vessel causes a vacuum at the rear side of the hub, the suction of which retards the speed of the ship and prevents the full force of the propeller being exerted. The percentage of loss of power of the propeller in a marine vessel from this cause is so slight, however, that changes in their construction have been thought unwarranted, but in the use of the propeller in flying machines, such a loss would be manifold for the reason that, unlike the marine vessel which is supported upon a denser fluid than the air, the flying machine is elevated and navigated entirely by the force derived from the propeller, and therefore it is essential that the flying machine propeller be constructed to exert its fullest force to successfully operate the machine. By arranging the extensions upon the hubs of the propellers, as described, the vacuum or back pull incidental to the ordinary construction of propellers is entirely avoided and the currents of air are driven back and away from the propellers in an unobstructed path and the full power therefrom obtained.

Brace wires or rods f^7 connect the central parts of the brackets with the edges of the rims of the sleeves F′ to firmly hold the brackets and likewise the shafts steady when the propellers are in motion.

The hollow body section is provided with a well A^4 which surrounds the sprocket wheels h' and the shafts adjacent thereto and is closed at its upper end but is left open at its lower end through which the sprocket chains h^2 pass and also for the purpose of permitting access to the said wheels and parts adjacent thereto to lubricate them. Access to the well may be had by a rope ladder (not shown). Keyed to the shaft F^2 is a sprocket wheel F^3 over which operates a sprocket chain F^4 that extends down into the lower or car section of the ship and which operates around a sprocket F^5 carried by a shaft F^6 mounted in a frame F^7 located in the boat within easy reach of the operator. The shaft F^6 is provided with a crank handle F^8 by which the sprocket F^5 is revolved to turn the shaft F^2 and the sleeves F′ so as to direct the thrust of the propellers in any desired direction. The shaft F^6 is provided with a ratchet wheel F^9 which is engaged by a pawl F^{10} to hold the parts in their adjusted position.

The aeroplanes are provided with openings K adjacent to the central openings F and in each opening K is a multi-plane elevating rudder K′ each of which is mounted upon a shaft K^2 and each shaft has its outer end mounted in a bearing k (Fig. 6) secured to the frame E′ and its inner end is mounted in a bearing k' (Fig. 4) secured to the side of one of the rings D. The rudders are preferably constructed of three planes 1, 2 and 3, the central planes 1 lie in the same plane as the body portions E^2 of the aeroplanes when adjusted to a horizontal position, and the upper and lower planes 2 and 3 are arranged equidistant from the central planes 1 and parallel therewith. Each plane is constructed of a rectangular shape frame k^2 and a body portion of canvas or other suitable material. The upper and lower frames of each plane are connected to the central frame by corner posts k^4 and diagonally arranged brace wires k^5 connect the frames of the planes 2 and 3 with the frame of the central plane 1 as shown most clearly in Fig. 9 of the drawings.

Cables K^{12} connect the forward and rear ends of each elevating plane and extend down into the lower section. By means of these cables the said planes may be adjusted to the proper angle for elevating the ship and for holding the planes in the position to which they may be adjusted when the ship is in flight.

Openings L and L′ are arranged respectively in the forward and rear ends of the aeroplanes, and in which are mounted fore and aft trimming rudders M and M′ respectively. Each rudder is constructed of a rectangular-shape frame m and a body portion of canvas or other suitable material m' and each rudder M is mounted upon a shaft m^2 which shafts are journaled at their outer ends in the brackets e^6 arranged at the angles e^2 of the frames E′ and at their inner ends in bearings m^3 secured to the sides of the forward clamping ring D. The rudders M′ are mounted upon shafts m^4 whose outer ends are journaled in brackets m^5 secured to the frames E′, and their inner ends in brackets m^6 secured to the rearmost clamping ring D. Tiller lines M^2 are connected to the trimming rudders M and M′. The lines controlling the rudders M extend through eyelets m^7 secured to the foremost clamping ring D and the lines controlling the rudders M′ extend through guides formed in brackets n^3 hereinafter described and all the lines extend to the lower or car section of the ship where they are secured to suitable cleats (not shown).

Vertical rudders N are arranged at the rear end of the central section C in the vertical plane of the center of the said section for steering the ship. These rudders are constructed of an outer light weight frame n and a body portion of canvas or other suitable material n'. Shafts n^2 are connected to the frame and have their inner ends journaled in bearings secured to the rearmost clamping ring D and their outer ends in the brackets n^3 carried by the central section C. Tiller lines n^4 are connected to the forward ends of the vertical rudders N and are extended over

pulleys or through eyelets n^5 connected to the frames E′ from which they are extended down into the lower or car section B of the ship and have their ends secured to cleats (not shown).

Depending from the central part of the central section C is a rigid skeleton frame consisting of four vertical light weight or bamboo rods O and a lower rectangular frame O′ also of light weight metal or bamboo. The upper ends of the rods O are connected to T-shape brackets *o* depending from the central clamping rings D. Brace rods O^2 connect the sides of the frame O′ and the central portion *e* of the aeroplane frames E′ and brace wires O^3 connect the forward and rear members of the frame O′ and the clamping rings at the forward and rear ends of the central portion of the section C.

Suspended below the frame O′ is the lower or car section B of the ship which is preferably of boat shape and of a size to support the crew and machinery in the event of the ship descending upon a body of water. The car is preferably suspended from the frame by rope or wire cables O^4 and is braced laterally by cables O^5 which extend from the sides of the car to the aeroplane frame E′ and its center of gravity is arranged directly below the center of gravity of the upper section A and at such distance as to insure the upper section retaining its equilibrium and thereby presenting the full supporting surface of the aeroplanes to the air to insure safety of flight and a safe and gradual descent when making a landing, especially in the event of the propellers or machinery becoming disabled during the course of navigation.

Projecting from the forward and rear ends of the car sections are brackets P in each of which is journaled a supporting wheel P′ which are preferably in the shape of hollow air-tight drums. Each wheel P′ comprises a tubular hub portion *p*, and side portions *p′* which converge toward the rim p^2 upon which latter is held a pneumatic tire p^3. The forward wheel P′ has its rim or tire provided with spurs p^4 and its hub is provided with a ratchet wheel p^5 that is engaged by a pawl p^6 carried by the front frame P and which permits of the rotation of the wheel in one direction only so that the ship will be anchored and its head turned around and held to the wind in the event of the ship making a landing with its broadside to the wind. The purpose of making the wheels P′ hollow and air tight is to increase the buoyancy of the car section should it alight upon a body of water.

From the foregoing it will be seen that I provide an air-ship or a heavier-than-air flying-machine of thoroughly rigid construction and by having the center of gravity of the ship as a whole, arranged considerably below the center of resistance of the aeroplanes, the ship will always remain in a horizontal position thereby insuring safety when making a descent, and especially in the event of the machinery or the propellers getting out of order. It may be desirable, however, to arrange the car section slightly forward of the center of gravity of the upper section and forward of the center of falling resistance to slightly lower the forward end of the ship which would thereby permit of a gradual descent in a forward and downward gliding motion which can be regulated by the elevating and trimming rudders, and at the same time the ship can be steered through any course by the vertical rudders so as to make a landing at any particular point.

The upper section C forms, as it were, the keel or backbone of the entire structure and while I have shown and described the said section as air and gas-tight and provided with inlet tubes so that it can be filled with a gas that is lighter than the atmosphere to make the said upper section of the ship buoyant and self-sustaining, I do not consider it essential to make the said section buoyant when making short flights, but for extended trips I do consider it an advantage as it will be readily appreciated that the conditions under which the ship would be operated would be entirely different. Therefore, when making short flights the said upper section is not intended to be made buoyant which thus brings the ship into the class of heavier-than-air flying-machines.

I may find it desirable to construct the ship with a superposed aeroplane Q, (Fig. 17) which is arranged at a suitable distance above the section C with its outer edges preferably of the same outline as the outer edges of the aeroplanes E, and which is supported above the section C by upright standards Q′ which extend vertically from the corners of the frames E′ and from such other points as may be found necessary to provide a rigid construction. Brace wires Q^2 connect the superposed aeroplane and the aeroplanes E and also the section C as shown.

When the ship is constructed with a superposed aeroplane the surface of the upper vertical rudder N may be increased by making it of a height to snugly fit between the said section C and the said superposed aeroplane Q. With this construction, it will be seen that I retain the central hollow body section which forms the support for the entire structure and from which the lower or car section is suspended thereby retaining the low center of gravity as in the construction of the ship with only the aeroplanes extending from the sides of the said section C.

In practice I may find it desirable to employ propellers instead of the multi-plane

elevating rudders, in which case the propellers would be of substantially the same construction and operation as the propellers G.

While I have shown and described the cover C′ of the section C as held in place by the clamping rings D and the said section strengthened by the externally arranged brace rods D′, I do not wish to be understood as limiting myself to this exact arrangement as the said cover may be held in place by means of cord or fine wire wrapped around the cover over the rims of the ribs A′. In this construction the longitudinal brace rods D′ may be arranged inside of the cover and connected to the rims of the said ribs and the inner edges of the body portions of aeroplanes E and the brace wires therefor would be connected to sides of the body section in any suitable manner.

What I claim is:—

1. In an air-ship, a hollow body section, aeroplanes supported thereby, propellers arranged upon each side of the hollow body section, elevating rudders arranged forwardly and rearwardly of the said propellers, vertical rudders arranged adjacent to the rear end of the hollow body section, a car section, means for operating the propellers, and independent means for controlling the positions of all of the said rudders.

2. In an air-ship, a hollow body section, aeroplanes supported thereby, propellers arranged at each side of the hollow body section and opposite the center of gravity of said section, elevating rudders arranged forwardly and rearwardly of said propellers, trimming rudders arranged adjacent to the ends of the aeroplanes, steering rudders arranged adjacent to the rear ends of the aeroplanes, a car section suspended below the said hollow body section, means for operating the propellers, and independent means for controlling the positions of all of the said rudders.

3. In an air-ship, a hollow body section, aeroplanes supported thereby, propellers arranged upon each side of the hollow body section, elevating rudders arranged forwardly and rearwardly of the said propellers, trimming rudders arranged adjacent to the ends of the said hollow body section, steering rudders arranged adjacent to the rear end of the said hollow body section, a car section, means for operating the propellers, and independent means for controlling the positions of all of the said rudders.

4. In an air-ship, a hollow body section, aeroplanes supported thereby, propellers arranged at each side of the hollow body section and opposite the center of gravity of said section, multi-plane elevating rudders arranged forwardly and rearwardly of said propellers, trimming rudders arranged adjacent to the ends of the aeroplanes, steering rudders arranged adjacent to the rear ends of the aeroplanes, a car section suspended below the said hollow body section, means for operating the propellers, and independent means for controlling the positions of all of the said rudders.

5. In an air-ship, a central hollow body section, aeroplanes extending laterally therefrom, a propeller arranged at each side of said hollow body section, elevating rudders arranged forwardly and rearwardly of the propellers, a car section suspended below the said central body, means for operating the propellers, and means for controlling the positions of the rudders.

6. In an air-ship, a central hollow body section, aeroplanes at the sides thereof and connected thereto, a propeller arranged at each side of the central body section, multiplane elevating rudders arranged forwardly and rearwardly of the propellers, a car section suspended below the said central body section, means for operating the propellers, means for changing the angles of their thrust, and independent means for controlling the positions of the rudders.

7. In an air-ship, a central hollow body section, aeroplanes extending from the sides thereof, a propeller arranged at each side of the central body section and opposite the center of gravity of said section, multi-plane elevating rudders arranged forwardly and rearwardly of the said propellers, trimming rudders adjacent to the ends of the aeroplanes, steering rudders at the rear end of the said central body section, means for operating the propellers, and independent means for controlling the positions of all of the said rudders.

8. In an air-ship, a central hollow body section, aeroplanes extending laterally therefrom, propellers adjustably supported at the sides of the central body section, elevating rudders arranged forwardly and rearwardly of the propellers, a car section suspended below the said central body section, trimming rudders adjacent to the ends of the aeroplanes, vertical steering rudders arranged at the rear end of the said central body section, means for operating the propellers, and means for operating all of the said rudders.

9. In an air-ship, an upper structure comprising a central body section, aeroplanes carried thereby, propellers arranged at the sides of the central body section, elevating rudders arranged adjacent to the propellers, trimming rudders arranged adjacent to the ends of the aeroplanes, steering rudders at the end of the said central section, a car section suspended below said central section and below the center of falling resistanes of the entire upper structure, means for operating the propellers, and independent means for operating all of the said rudders.

10. In an air-ship, a central body section, aeroplanes extending laterally therefrom, a propeller arranged at each side of said cen-

tral body section, elevating rudders arranged forwardly and rearwardly of the propellers, trimming rudders arranged adjacent to the ends of the aeroplanes, steering rudders carried by the said central section, a frame rigidly suspended below the said central section, a boat shaped car suspended from the frame and below the center of gravity of the said central section, means carried by the car section for operating the propellers, and means operable from the car section for controlling the positions of all of the said rudders.

11. In an air-ship, an upper structure, comprising a central hollow body section, aeroplanes extending laterally therefrom, a shaft journaled at its ends to the frames of said aeroplanes and extending through the said hollow body section, cylindrical sleeves carried by said shaft, a propeller mounted in each sleeve, elevating rudders arranged forwardly and rearwardly of the said propellers, a car section arranged below the central hollow body section and below the center of falling resistance of the said upper structure, means for adjusting the sleeve to direct the thrust of the propellers for the purpose specified, means for operating the said propellers, and means for operating all of the said rudders.

12. In an air-ship, an upper structure comprising a central hollow body section, aeroplanes extending laterally therefrom, a shaft journaled at its ends to the frames of said aeroplanes and extending through the said central hollow body section, cylindrical sleeves carried by said shaft, a propeller mounted in each sleeve, elevating rudders arranged forwardly and rearwardly of the said propellers, a car section arranged below the central hollow body section and below the center of falling resistance of the upper structure, means for adjusting the sleeves to direct the thrust of the propellers for the purpose specified, means for operating the said propellers, and independent means for operating the said rudders.

13. In an air-ship, an upper structure comprising a central hollow body section constructed with a plurality of gas-tight compartments throughout its length and having a well at its center of gravity which is open at its lower end, aeroplanes arranged upon each side of said central body section, a shaft journaled at its ends in the frames of said aeroplanes and extending through the hollow body section and through the said well, cylindrical sleeves secured to the shaft, propellers mounted in the sleeves and having their hubs provided with beveled pinions, hollow shafts surrounding the first mentioned shaft and having their outer ends extending into the sleeves and provided with beveled gears which mesh with the said bevel pinions and their inner ends projecting into the said well of the central section, sprocket wheels mounted upon the inner ends of the shafts, multi-plane rudders arranged forwardly and rearwardly of said propellers, trimming rudders arranged adjacent to the ends of said aeroplanes, a car section suspended below the center of falling resistance of the upper structure, a motor carried by the car section and having a shaft provided with sprocket wheels, sprocket chains operating around the said sprockets and over the sprockets of the said hollow shafts, means for rotating the first mentioned shaft to change the angle of thrust of the propellers, and means for controlling the positions of all of the said rudders.

14. In an air-ship, an upper structure, comprising a central hollow body section, aeroplanes extending laterally therefrom, a main shaft extending transversely through the said upper structure and having its ends journaled in bearings secured to the frames of the said aeroplanes, cylindrical sleeves secured to the shaft, a propeller mounted in each sleeve, conical sleeves extending from the hubs of the propellers, a bevel pinion fixed to each hub, hollow shafts surrounding the intermediate sections of the first mentioned shaft, each hollow shaft having one end extending through the side of one of the cylindrical sleeves and provided with a beveled gear which meshes the said pinion and having its opposite end extending into the central hollow body section, a sprocket wheel loosely mounted upon the inner end of each hollow shaft, a ratchet wheel keyed to each of said inner ends, a pawl carried by each sprocket wheel to engage its ratchet wheel, a car section suspended below the upper structure, a motor carried by said car section and having its shaft provided with drive sprocket wheels, sprocket chains operating around the said drive sprocket wheels and over the sprocket wheels carried by the said hollow shafts, and means for rotating the main shaft to change the angle of thrust of the said propellers.

15. In an air-ship, an upper structure, comprising a hollow central body section, which is constructed of a plurality of ribs having grooved rims, an impervious cover arranged over the ribs, clamping rings arranged over the cover and registering with the said ribs and having perforated ears projecting therefrom, a rod extending centrally through the said body section and projecting beyond the ends thereof, longitudinal rods extending throughout the length of the said body section and through the perforated ears of said clamping rings and having their ends connected to the ends of the said centrally arranged rod, aeroplanes extending laterally from the sides of the central section, each aeroplane comprising an outer frame whose ends are connected to the forward and rear-

ward ends of the said central rod and a body portion of cloth that forms the supporting surfaces of the aeroplanes, brace rods and brace wires arranged between the frame and the sides of the central body section, propellers arranged at the sides of the said central hollow body section, elevating rudders arranged adjacent to said propellers, trimming rudders arranged adjacent to the ends of the aeroplanes, steering rudders arranged at the rear end of the said central hollow body section, a car section suspended below the upper structure and below the center of gravity thereof, means for operating the said propellers, and independent means for operating all of the said rudders.

16. In an air-ship, a central hollow body section, aeroplanes extending laterally therefrom, a superposed aeroplane, propellers arranged adjacent to the sides of the said central hollow body section, vertical steering rudders arranged at the end of the said hollow body section, a car section arranged below the said central hollow body section, and means for operating the propellers.

17. In an air-ship, a central hollow body section, aeroplanes extending laterally therefrom, a superposed aeroplane arranged over said central hollow body section and over said first mentioned aeroplanes, propellers arranged at the sides of and opposite to the center of gravity of the said central hollow body section, multi-plane elevating rudders arranged adjacent to and forwardly and rearwardly of said propellers, one of the planes of each of said multi-plane rudders being adapted to lie in the same plane as the body of the said first mentioned aeroplanes when in a horizontal position, vertical steering rudders arranged at one end of said central hollow body section, a car section arranged below the center of gravity of said central hollow body section, means for operating the propellers, and independent means for operating all of the said rudders.

In testimony whereof I have hereunto set my hand this 7th day of December A. D. 1908.

SIMON LAKE.

Witnesses:
WM. H. SCHOLZ,
FRED B. WHITNEY.