Feb. 17, 1925. 1,526,657

H. BEA

FLYING MACHINE

Filed Aug. 24, 1923 7 Sheets-Sheet 1

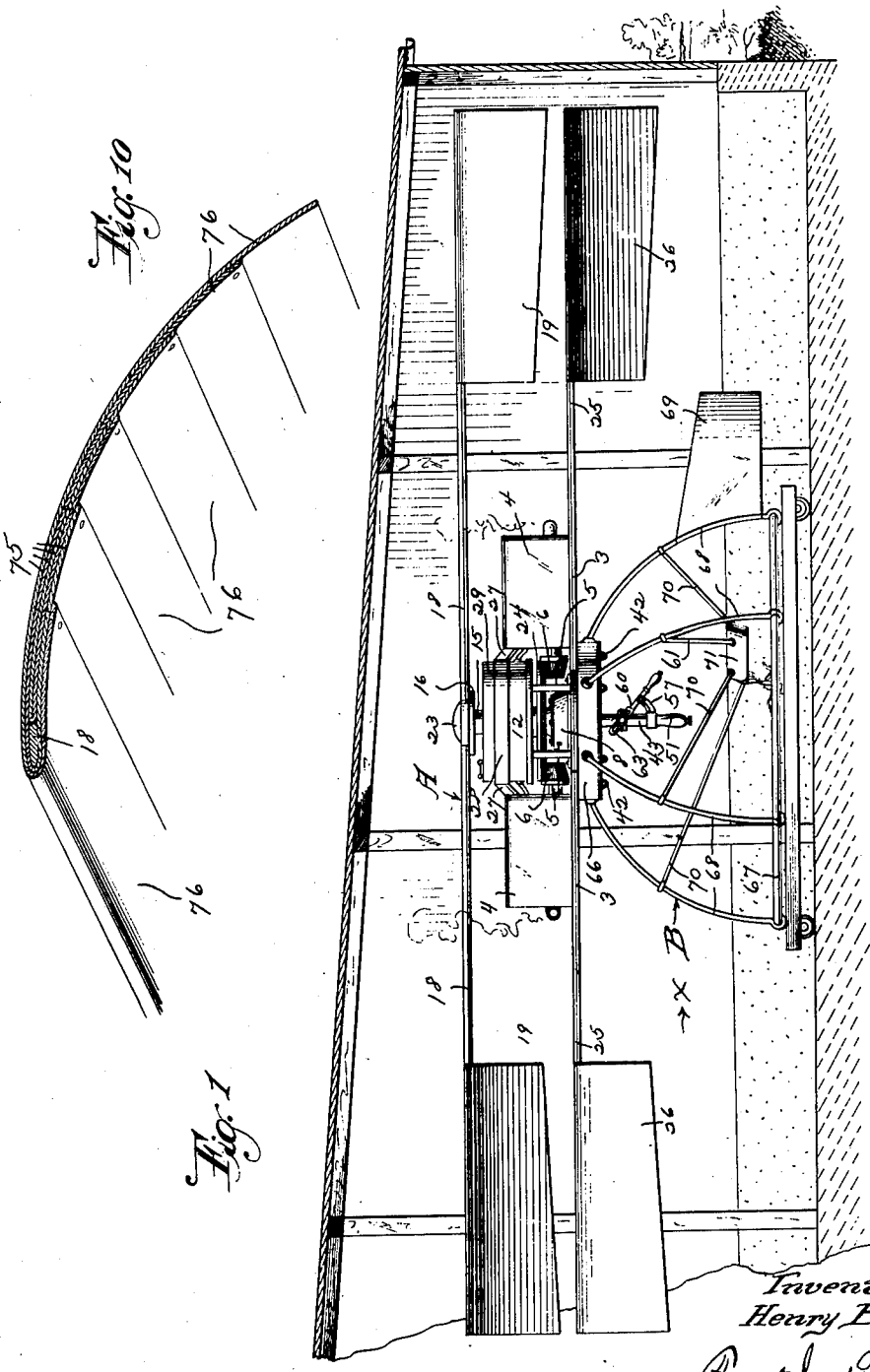

Fig. 10

Fig. 1

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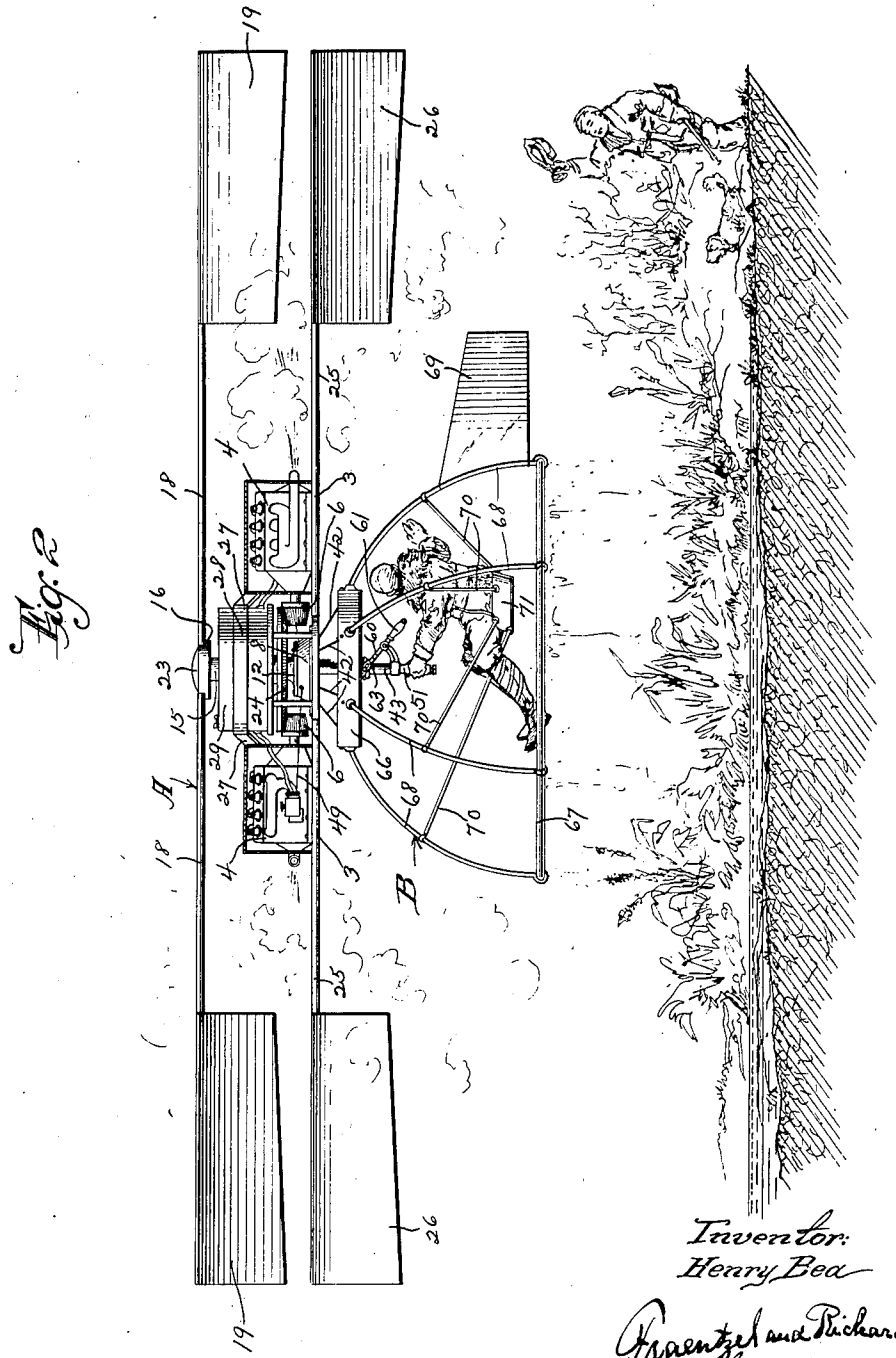

Fig. 2

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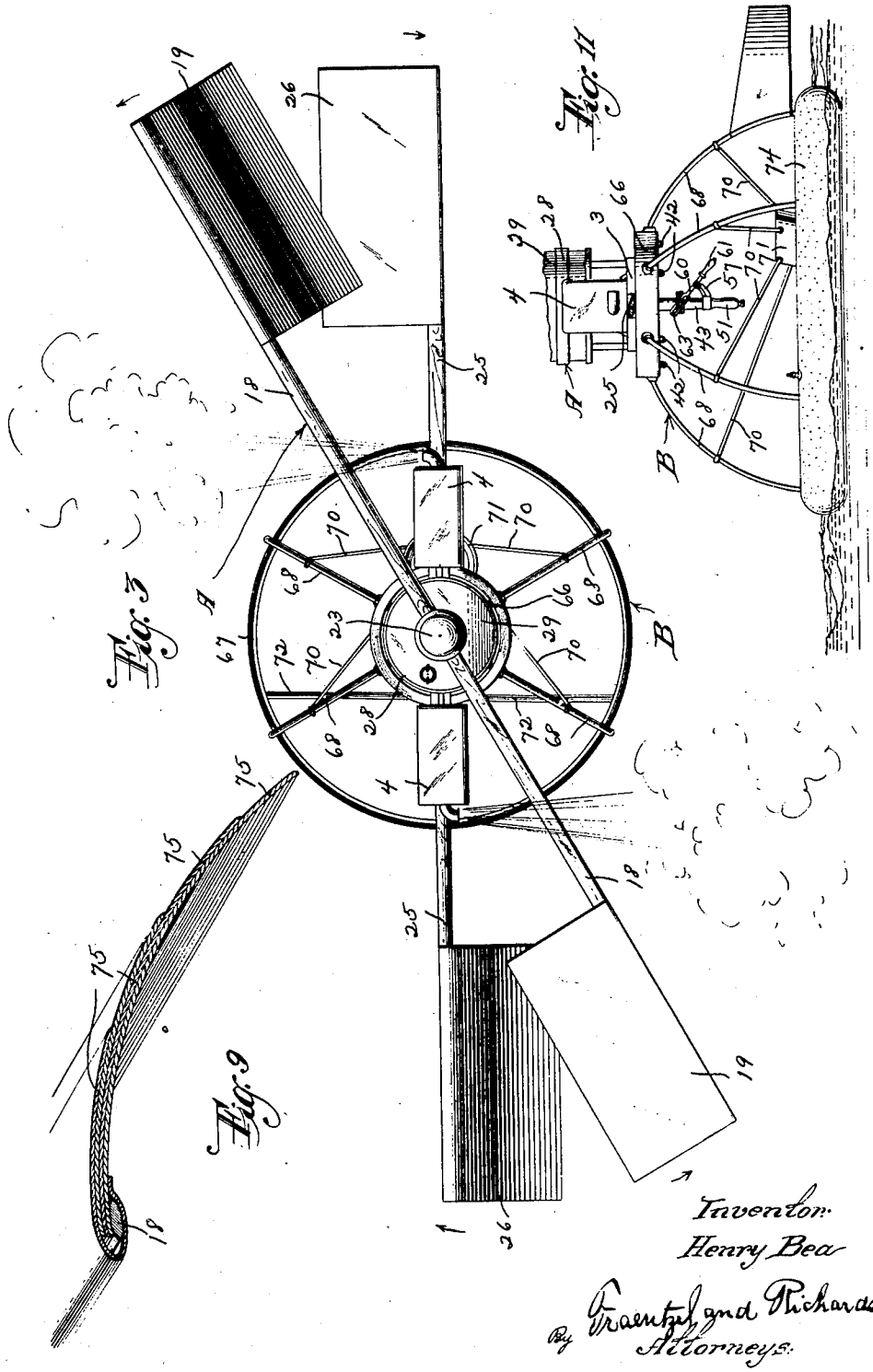

Fig. 3

Fig. 9

Fig. 11

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Fig. 4

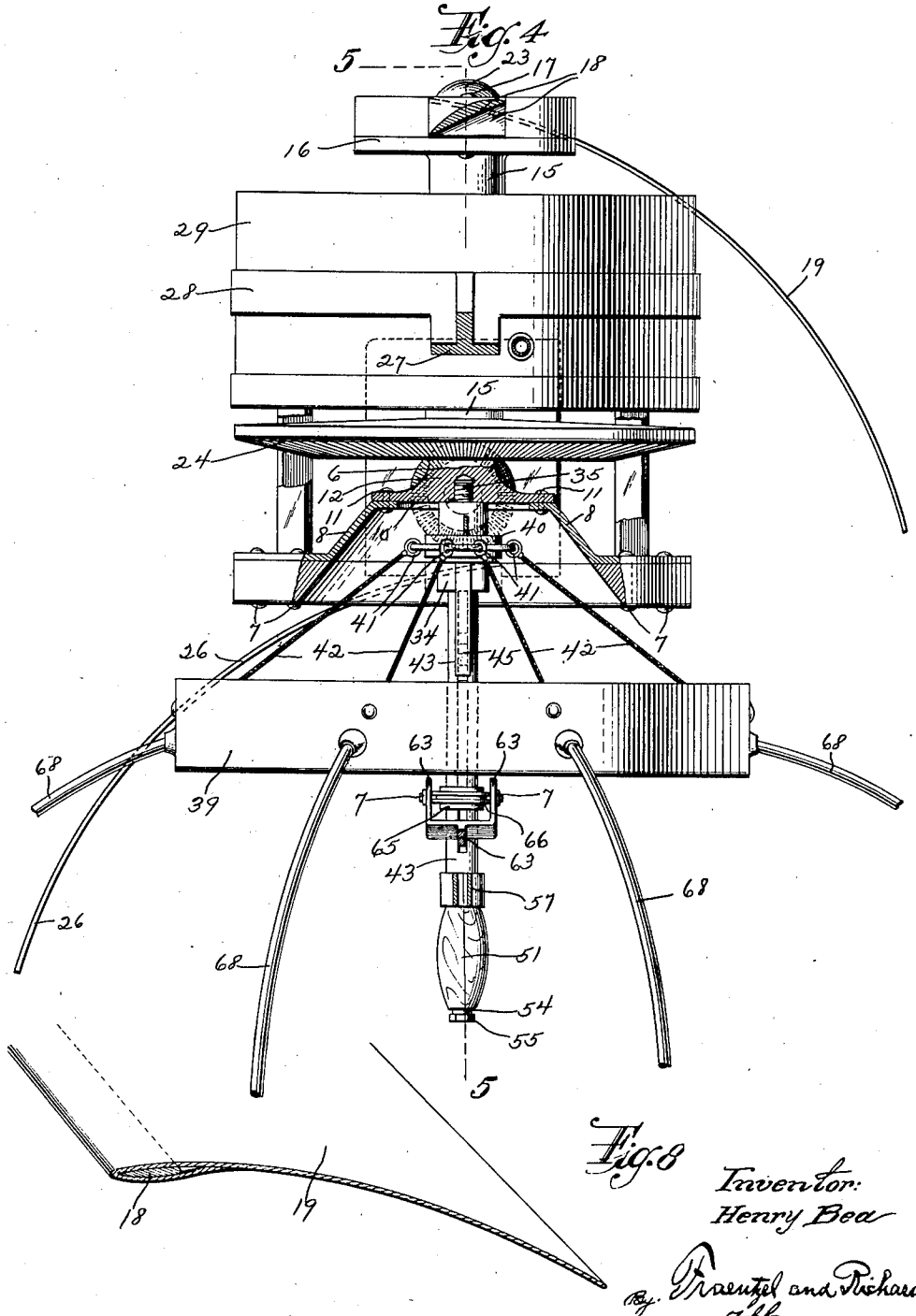

Fig. 8

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FLYING MACHINE

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Fig. 5

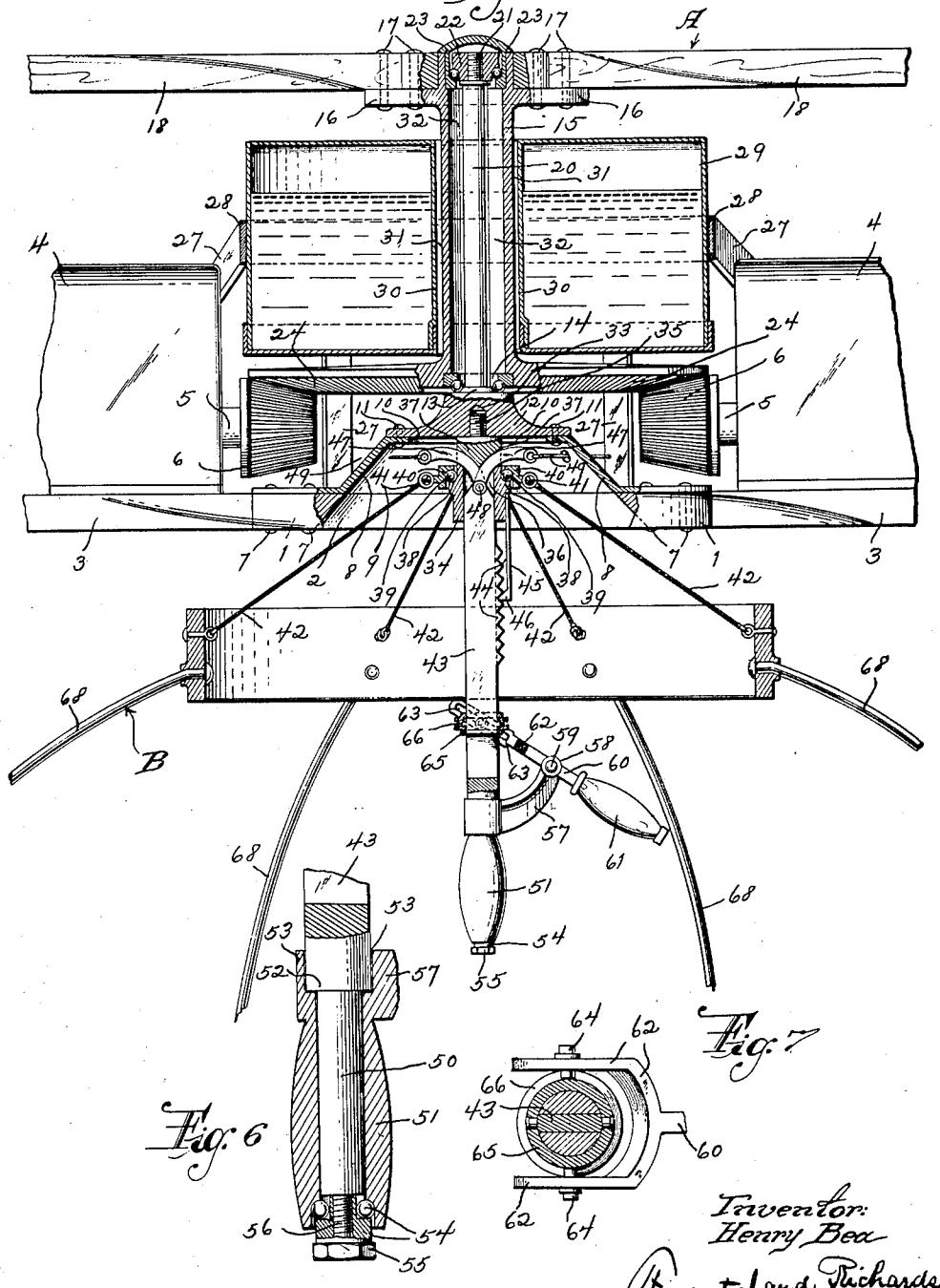

Fig. 6

Fig. 7

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FLYING MACHINE

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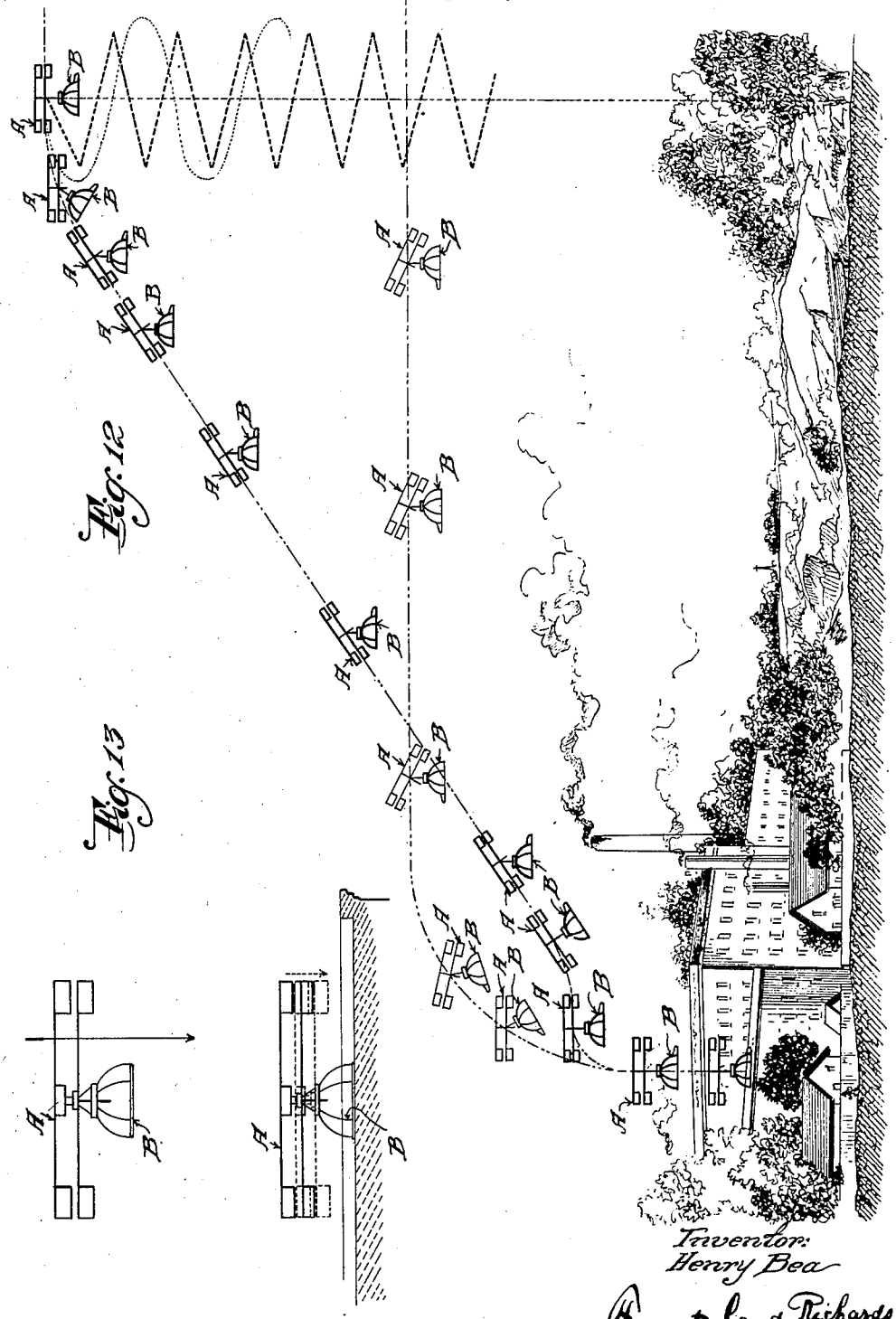

Fig. 12

Fig. 13

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FLYING MACHINE

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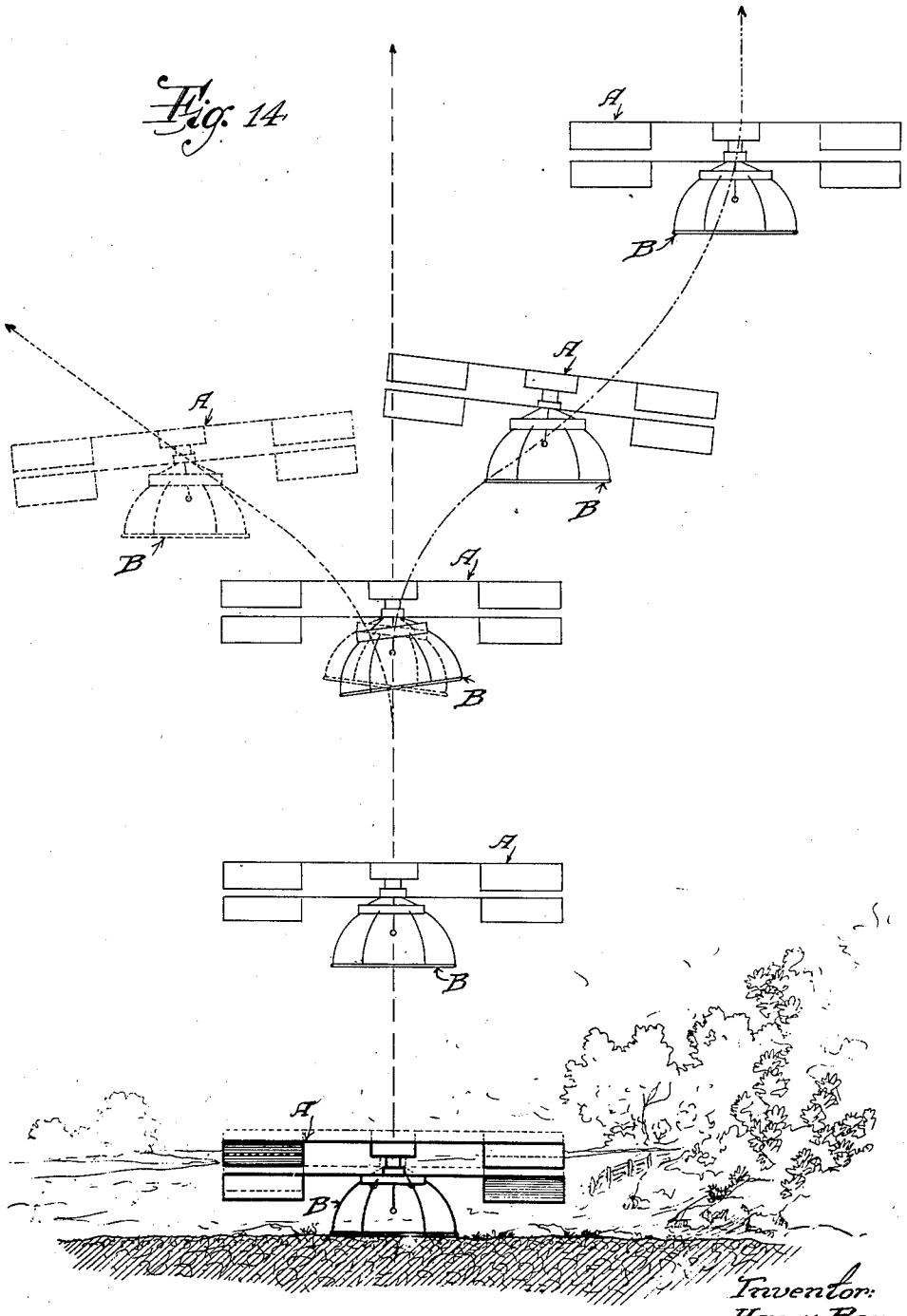
Fig. 14.



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UNITED STATES PATENT OFFICE.

HENRY BEA, OF HILLSIDE, NEW JERSEY.

FLYING MACHINE.

Application filed August 24, 1923. Serial No. 659,079.

To all whom it may concern:

Be it known that I, HENRY BEA, a citizen of the United States, residing at Hillside, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Flying Machines; and I do hereby 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 characters of reference marked thereon, which form a part of this specification.

This invention relates, generally, to improvements in flying machines; and, the present invention has reference, more particularly to a novel construction of flying machine of the heavier-than-air type, with a view, primarily, of permitting the operator, in a manner to be presently more fully set forth, to control the working parts for raising and lowering, and for properly guiding the machine in the desired directions, and for maintaining it in equilibrium and allowing easy landing without shock or jar.

The invention consists, primarily, in the novel flying machine of helicopter type hereinafter more fully set forth; and the invention consists, furthermore, in the general arrangements and combinations of the various devices and parts, as well as in the details of the construction of the said parts, all of which will be described in the following specification, and then finally embodied in the clauses of the claims, which are appended to and form an essential part of the said specification.

A practical embodiment of the invention is represented in the accompanying drawings, in the several figures of which similar characters of reference are employed, to indicate corresponding parts.

From a general inspection of the several figures of the accompanying drawings, it will be noted that the flying machine which embodies the principles of the present invention, is constructed out of what to all intents and purposes may be two single or separate units which have a disconnected relation to each other, except that the lower unit, as will be seen from the drawings, consists of a hemispherical or other suitably formed basket-like construction in which the aviator is adapted to be seated, and which is attached to the upper unit by means of flexible strands of aeroplane wire, or the like, so as to be properly suspended beneath and from said upper unit, and that it will have a swinging relation to said upper unit. Heretofore all flying machines of the helicopter type have been made as a single construction and have been found to be so gyroscopic as to be non-steerable. It will be evident, and it will necessarily be understood, that in order to steer a gyroscopic helicopter it is necessary to shift the axis of rotation, and this has been heretofore impossible, as there has been nothing to act upon, as might be stated, as a fulcrum. With the general arrangements and constructions the several devices and parts comprising the novel flying machine of the present invention, this objection has been overcome by the simple expedient of using the weight of the aviator as a fulcrum in a manner as will hereinafter be more fully described.

The various details of the construction, outside of those directly connected with the above stated operation, consists, generally, in an arrangement of two aeroplane-motors, preferably of V-shape type, which are mounted upon a rotating arm, and above which is another arm, suitably geared up to the motors, and each arm having at its opposite ends suitable lifting blades, all being arranged so as to rotate in opposite directions about a common central axis. Furthermore, the usual difficulty encountered by having to locate the gasoline tank to one side or off center is also eliminated by constructing the tank in such a manner that it will encircle the central and vertically disposed shaft of the mechanism, sufficient space being left between the encircling portion of the tank and the shaft in order to insure safety from friction.

In order that the method of steering may be more readily understood, attention is called to the picture, Figure 2 of the drawings, showing the machine in flight out of a marsh. From this picture it will be seen

that the swinging basket-part or element of the machine is hanging substantially plumb, and that the other part of the machine is also plumb, with respect to the ground. If the aviator should pull upon the central shaft, that he is pictured holding onto, he will momentarily throw himself out of plumb, which will also throw all the basket-like element out of plumb. The amount of a pull or push upon the said central shaft by the aviator, will determine the extent he will be out of plumb at the end of said pull or push, and should he let go, immediately because of his weight, he will swing plumb again; but, should he retain his position, or in other words for the time being automatically making the two units of the machine one by means of his rigidity, he will nevertheless be acted upon by gravity, and will therefore resame, a plumb position with respect to the earth while the upper unit of the machine will assume an angle of rotation out of the perpendicular, as much as he, the aviator, desired. If he wishes to bring the axis of rotation back to the perpendicular, all that is necessary is for the aviator to force himself over toward what would be to him the side of the angle, whereby as will be evident, the upper and lower units of the machine will again resume their vertically plumb relation.

Other novel features of the present invention which are especially noteworthy are as follows:—

Upon starting or alighting, the flexible connections between the two units permit a gradual settling down of the upper unit when making a landing, and a gradual pulling up of the lower unit upon starting.

Another important feature is the fact that the aviator always faces the direction in which he is flying, and instead of a tail, as employed on aeroplanes, the device functions more in the manner of a weather-vane tail, with the feet of the aviator acting, so to speak, as the head of the vane-arrow.

Another interesting feature is the ability to control the motor and the gasoline, by running the controls through the central shaft.

It will also be noted that the flying machine will have the ability to hover, not exactly becoming stationary, but to become practically motionless or stationary in the air, except for the horizontal rotation of the blade-carrying arms and their blades.

The principal object of the present invention therefore is to provide a flying machine of the general character hereinafter more particularly described, and in which the several purposes hereinbefore mentioned are carried out.

Other objects of the present invention not at this time more particularly enumerated will be evident from the following description of the said invention.

In the said drawings, Figure 1 represents a front elevation of a flying machine embodying the principles of the present invention, showing the machine at rest within a hangar, the latter being represented in section; Figure 2 is a view of the machine in its upward flight from a swamp; and Figure 3 is a plan view of the flying machine in flight.

Figure 4 is a view, partly in elevation and partly in section, looking in the direction of the arrow x in said Figure 1, said view being made on an enlarged scale; and Figure 5 is a vertical sectional representation of the units and their parts represented in Figure 4, said section being taken on line 5—5 in said Figure 4.

Figure 6 is a detail sectional representation of a handle for actuating the motor-control; and Figure 7 is a detail horizontal sectional representation, taken on line 7—7 in Figure 4.

Figure 8 is a detail sectional representation of one of the flying blades, said view also showing in perspective fragmentary portions of the said blade; and Figures 9 and 10 are similar views of modified forms of flying blades.

Figure 11 is an elevation of the lower basket-like unit provided with a pneumatic casing, for landing purposes upon the water.

Figures 12, 13 and 14 are picture-representations, showing diagrammatically, a series of the various flying operations of which the flying machine is capable.

Similar characters of reference are employed in all of the said above described views, to indicate corresponding parts.

Referring now to the several figures of the drawings, the reference characters A and B indicate in general an arrangement of an upper lifting and flying unit, and a cage or basket-like lower unit flexibly suspended from said upper unit, all showing one embodiment of the principles of the present invention.

The said upper unit, as will be seen more particularly from an inspection of Figures 1, 2, 3, 4 and 5 of the drawings, comprises a suitably constructed frame-work, as 1, which is formed with a centrally disposed open part, as 2, said frame-work being further provided with oppositely extending extensions or platforms 3, upon which are suitably mounted aeroplane motors 4 of any desired and suitable type. The said motors are provided with the usual driving shafts 5, each shaft carrying a suitable bevel-gear or toothed pinion, as 6.

Suitably secured over the open part 2 of the frame-work 1, by means of bolts or rivets 7, or in any other suitable manner, is a carrier-element, as 8, which is preferably made of metal, and is in the form of a hollow frustrated cone, provided with a lower open part 9 and an upper open part

10. Suitably secured upon the said upper open portion 10 of the carrier-element 8, by means of bolts or rivets 11, or in any other suitable manner, is a hub-shaped bearing element 12 formed with a suitable seat, as 13, upon which is suitably mounted a ball-bearing race, as 14.

Suitably and rotatably connected with the said ball-race 14, and extending in an upward direction therefrom is a tubular element 15 provided at or near its upper end-portion with an annular flange 16, or similar means, to which are suitably secured by means of bolts or rivets 17, or in any other suitable manner, oppositely extending arms or carrier-members 18 to the free end-portions of which are suitably secured, angularly disposed flying blades 19. Suitably connected with and extending upwardly from the said bearing-element 12 and into and through the said tubular element 15, so as to be concentric therewith, is a vertical stem 20 having an upper screw-threaded end-portion 21 upon which are suitably mounted the members 22 and 23 of a ball-bearing, as clearly indicated in Figure 5 of the drawings. At its lower end-portion, the said tubular element 15 is provided with a suitably formed bevel or ring-gear 24, the teeth of which are in operative mesh with the previously mentioned pinions 6, so as to produce the desired rotary movements of the tubular member 15 and the arms 18 and flying blades 19 connected therewith, as will be fully evident. As shown, the platforms 3 are provided with extensions, as 25, each extension carrying a blade 26. From an inspection of the devices and parts, as more particularly illustrated in Figures 4 and 5 of the drawings, it will be seen that while the arms or carrier-members 18 and their blades 19 are adapted to rotate about the stem 20 as a center, the plate-frame 3, with their extensions 25 and blades 26 at all times have a fixed stationary relation with said non-rotatable stem 20. Also suitably mounted upon said platforms 3 are brackets 27, or other suitable supports, which carry a ring-shaped member 28, or the like, in which is mounted a suitably constructed tank 29, providing a reservoir for supplying in any suitable and usual manner, gasoline to the engines 4.

This tank 29, as will be seen from said Figure 5, is made with a centrally disposed tubular member 30 which encircles the rotatable tubular stem or element 15, leaving a sufficient space 31 between said members 30 and 15, a similar space 32 being also provided between the rotatable member 15 and the stem 20, in order to insure safety against friction between the parts, and to thereby avoid dangerous overheating and sparks between the parts, which might cause an explosion of the fuel-mixture as it is being conducted to the cylinders of the engines.

The previously mentioned hub-shaped bearing-element 12 in its lower side is made with an internally screw-threaded receiving socket 33 into which is screwed a screw-threaded stud 35 extending from an end of a member or element 34. This member or element 34 which is usually in the form of a casting, which extends downwardly through the previously mentioned opening 10 into the chambered or hollow portion of the cone-shaped member 8, is formed with a socketed receiving portion, as 36, and a pair of arc-shaped guiding ducts 37, which lead from said socketed receiving portion 36 to the opposite sides of the said member or element 34, substantially as shown in said Figure 5 of the drawings. The said member or element 34 is also made with an annular seat, as 38, upon which are maintained by means of a ball-race providing ring 40 suitable anti-friction balls 39. Extending in outward directions from the said ring 40 are suitably disposed rings or eyes, as 41, for the attachment thereto of the ends of suitable cables 42, or other flexible means of connection, for the proper suspension of the cage or basket-like lower unit B to the upper unit A, for the purposes to be presently more fully described. Reciprocally disposed within the receiving portion 36 of the member or element 34 is the upper end-portion of a control lever or bar, as 43, provided along one of the edges with a rack, as 44, with which is adapted to be brought into retaining engagement the rack-engaging member 46 of a spring-arm 45 which is suitably secured to and extends in a downward direction from the said member or element 34. Arc-shaped links, as 47, are pivotally connected with said upper end-portion of the control-lever or bar 43, as at 48, said links being movably disposed in the previously mentioned arc-shaped guiding ducts 37 and having attached to their ends which project upon the said ducts 37, suitable control-connections in the form of rods, as 49 or the like, for starting and stopping, and otherwise controlling the operations of the engines 4. Upon its lower end-portion 50, the said lever or bar 43 has rotatably mounted thereon a handle 51 for grasping purposes, the said handle being suitably held in its operative position upon the end-portion of the lever or bar 43, by means of the off-set 52 and socketed portion 53, and the ball-bearing 54 and nut 55 screwed upon the screw-threaded stud 56 of the said lower end-portion 50, substantially as shown in Figure 6 of the drawings. Extending from the handle or grasping member 51 is a sector 57 having an eye-portion 58 for the reception of a pivot-pin 59. Pivotally connected

with said pin is an arm or lever 60 provided at one end with a handle 61 and at its other end with a fork 62, the embracing members of which are provided with elongated slots, as 63, for the reception of suitable pins or studs 64 which extend into and are movably disposed in an annular groove 66 of a sleeve or collar 65 mounted upon the previously mentioned control-lever or bar 43.

From an inspection of Figure 5 it will be evident, that as the handle 61 is raised, the fork 62 is moved in a downward direction, thus correspondingly moving the control-lever or bar 43, and with it the links 47 in a downward direction. This movement, by means of the said links, is communicated to the rods 49, so as to open the throttles of the engines, as will be evident. A movement of the handle 61 in the opposite direction will cause a reverse movement of the several members, so that the rods 49 are moved in opposite directions, to entirely close the engine-throttles, or to otherwise control the movement of the said throttles, in order to accordingly regulate the fuel-supply to the engine or engines 4, as will be fully understood.

The lower unit B hereinafter mentioned, as will be seen from an inspection of the several figures of the drawings, in the present instance comprises an arrangement of ring-shaped members, as 66 and 67, which are suitably connected by means of stay-rods 68, or other suitable frame-like construction, and to one of which rods 68, is suitably secured in a fixed position a vane 69. Suitably connected with the several rods 68 are guy-rods 70 which carry a seat 71 for the seating thereon of the pilot or operator of the flying machine. Suitably attached to the said ring-shaped member 66 are the previously mentioned flexible connections 42, in the form of chains or the like, which are also attached to the previously mentioned eyes 41 of the ring 40 of the upper unit A. Thus it will be seen that a basket-like element or cage for the pilot has been produced, which is flexibly suspended from the upper unit A, and in which the vane 69, while flying, will act in the manner of the usual weather-vane, so that the operator will always be properly seated and will face in the flying direction of the machine. Extending across the ring-shaped member 67, in proper location, is a tie-rod 72, adapted to serve as a foot-rest for the pilot, and as a brace for the pilot when pulling or pushing upon the control-lever or bar 43, when it is desired that the flying machine shall move in various directions, such as are indicated in Figures 12 and 14 of the drawings.

For alighting and floating upon a body of water, the basket or cage just described, may be provided with a pneumatic and preferably ring-shaped float 74 of any desired construction, as will be evident from an inspection of Figure 11 of the drawings.

Referring now to Figure 8 of the drawings, there is shown therein the simplest and preferred form of construction of one of the flying wings to be used with the upper unit A. However, in lieu of this construction of wing, each wing may consist of laminated layers 75, see Figure 9, or each wing may consist of laminated layers 76, see Figure 10, these layers being arranged and connected with the carrier-member in a manner, substantially as illustrated in said Figures 9 and 10.

The manner of operating the flying machine, so as to cause it to be propelled in the various directions is shown diagrammatically in Figures 12, 13 and 14, and having been described in the foregoing description, and being fully understood from an inspection of Figure 2 of the drawings, any further description of the same is, therefore, deemed unnecessary.

It will be understood, that when the engine or engines have been set in operation, the arms or carrier-members 18, with their blades 19 will rotate rapidly, so as to cause the flying machine to rise. At the same time, owing to the rotary speed of said members 18 and the blades 19, due to the ball-bearing connections between the several elements, and owing to centrifugal force, the extensions 3, with the engines or motors 4, and blades 26, will also rotate, but at a slower speed, thus serving as an auxiliary rotor to the rotor composed of the elements 18 and 19. Of course I am fully aware that changes may be made in the general arrangements and combinations of the various devices and parts, as well as in the details of the construction of the said parts, without departing from the scope of the present invention as set forth in the foregoing specification, and as defined in the clauses of the claims which are appended thereto. Hence, I do not limit my present invention to the exact arrangements and combinations of the several devices and parts as described in the said specification, nor do I confine myself to the exact details of the construction of the said parts, as illustrated in the accompanying drawings.

I claim:—

1. A flying machine of the helicopter type comprising an upper unit and a lower unit, said upper unit comprising a frame-work provided with laterally extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a vertically disposed shaft rotatably mounted upon said carrier-element, carrier-arms connected with and extending laterally from said shaft, a flying blade mounted upon each carrier-arm, and

motor-driven mechanism for rotating said shaft, and means extending in a downward direction from said upper unit to a point within the lower unit for shifting the axis of rotation of said vertically disposed shaft.

2. A flying machine of the helicopter type comprising an upper unit and a lower unit, said upper unit comprising a frame-work provided with laterally extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a vertically disposed shaft rotatably mounted upon said carrier-element, carrier-arms connected with and extending laterally from said shaft, a flying blade mounted upon each carrier-arm, and motor-driven mechanism for rotating said shaft, a means of flexible connection between said upper and lower units for flexibly suspending the lower unit from said upper unit, and means extending in a downward direction from said upper unit to a point within the lower unit for shifting the axis of rotation of said vertically disposed shaft.

3. A flying machine of the helicopter type comprising an upper and a lower unit, said upper unit comprising a frame-work provided with laterally extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a hub-shaped bearing-element upon said carrier-element, a vertically disposed shaft rotatably mounted upon said bearing-element, carrier-arms connected with and extending laterally from said shaft, a flying blade mounted upon each arm, and motor-driven means for rotating said shaft, a means of flexible connection between said upper and lower units for flexibly suspending the lower unit from said upper unit, and means connected with and extending downwardly from said bearing-element to a point within the lower unit for shifting the axis of rotation of said vertically disposed shaft.

4. A flying machine of the helicopter type comprising an upper and a lower unit, said upper unit comprising a frame-work provided with laterally extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a hub-shaped bearing-element upon said carrier-element, a vertically disposed shaft rotatably mounted upon said bearing-element, carrier-arms connected with and extending laterally from said shaft, a flying blade mounted upon each arm, and motor-driven means for rotating said shaft, a means of flexible connection between said upper and lower units for flexibly suspending the lower unit from said upper unit, and means for shifting the axis of rotation of said vertically disposed shaft, consisting of a control-bar, means at one end of said bar for attaching the same to said bearing-element, and a grasping member at the other end of said bar.

5. A flying machine of the helicopter type comprising an upper and a lower unit, said upper unit comprising a frame-work provided with laterally extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a hub-shaped bearing-element upon said carrier-element, a stem connected with and extending in an upward direction from said bearing-element, a tubular shaft surrounding said stem and having a rotatable relation with respect to said stem, carrier-arms connected with and extending laterally from said shaft, a flying-blade mounted upon each arm, motor-driven mechanism for rotating said shaft, a means of flexible connection between said upper and lower units for flexibly suspending the lower unit from said upper unit, and means connected with and extending downwardly from said bearing element to a point within the lower unit for shifting the axis of rotation of said vertically disposed shaft.

6. A flying machine of the helicopter type comprising an upper and a lower unit, said upper unit comprising a frame-work provided with laterally extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a hub-shaped bearing-element upon said carrier-element, a stem connected with and extending in an upward direction from said bearing-element, a tubular shaft surrounding said stem and having a rotatable relation with respect to said stem, carrier-arms connected with and extending laterally from said shaft, a flying-blade mounted upon each arm, motor-driven mechanism for rotating said shaft, a means of flexible connection between said upper and lower units for flexibly suspending the lower unit from said upper unit, and means for shifting the axis of rotation of said vertically disposed shaft, consisting of a control-bar, means at one end of said bar for attaching the same to said bearing-element, and a grasping member at the other end of said bar.

7. A flying machine of the helicopter type comprising an upper unit and a lower unit, said upper unit comprising a frame-work provided with laterally extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a vertically disposed shaft rotatably mounted upon said carrier-element, carrier-arms connected with and extending laterally from said shaft, a flying

blade mounted upon each carrier-arm, and motor-driven mechanism for rotating said shaft, and means extending in a downward direction from said upper unit to a point within the lower unit for shifting the axis of rotation of said vertically disposed shaft, combined with an engine or motor-controlling mechanism connected with and co-operating with said axis-shifting means for controlling the action of the motors.

8. A flying machine of the helicopter type comprising an upper unit and a lower unit, said upper unit comprising a frame-work provided with laterally extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a vertically disposed shaft rotatably mounted upon said carrier-element, carrier-arms connected with and extending laterally from said shaft, a flying blade mounted upon each carrier-arm, and motor-driven mechanism for rotating said shaft, a means of flexible connection between said upper and lower units for flexibly suspending the lower unit from said upper unit, and means extending in a downward direction from said upper unit to a point within the lower unit for shifting the axis of rotation of said vertically disposed shaft, combined with an engine or motor-controlling mechanism connected with and co-operating with said axis-shifting means for controlling the action of the motors.

9. A flying machine of the helicopter type comprising an upper and a lower unit, said upper unit comprising a frame-work provided with laterally extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a hub-shaped bearing-element upon said carrier-element, a vertically disposed shaft rotatably mounted upon said bearing-element, carrier-arms connected with and extending laterally from said shaft, a flying blade mounted upon each arm, and motor-driven means for rotating said shaft, a means of flexible connection between said upper and lower units for flexibly suspending the lower unit from said upper unit, and means connected with and extending downwardly from said bearing-element to a point within the lower unit for shifting the axis of rotation of said vertically disposed shaft, combined with an engine or motor-controlling mechanism connected with and co-operating with said axis-shifting means for controlling the action of the motors.

10. A flying machine of the helicopter type comprising an upper and a lower unit, said upper unit comprising a frame-work provided with laterally extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a hub-shaped bearing-element upon said carrier-element, a vertically disposed shaft rotatably mounted upon said bearing-element, carrier-arms connected with and extending laterally from said shaft, a flying blade mounted upon each arm, and motor-driven means for rotating said shaft, a means of flexible connection between said upper and lower units for flexibly suspending the lower unit from said upper unit, and means for shifting the axis of rotation of said vertically disposed shaft, consisting of a control-bar, means at one end of said bar for attaching the same to said bearing-element, and a grasping member at the other end of said bar, combined with an engine or motor-controlling mechanism connected with and co-operating with said axis-shifting means for controlling the action of the motors.

11. A flying machine of the helicopter type comprising an upper and a lower unit, said upper unit comprising a frame-work provided with laterally extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a hub-shaped bearing-element upon said carrier-element, a stem connected with and extending in an upward direction from said bearing-element, a tubular shaft surrounding said stem and having a rotatable relation with respect to said stem, carrier-arms connected with and extending laterally from said shaft, a flying-blade mounted upon each arm, motor-driven mechanism for rotating said shaft, a means of flexible connection between said upper and lower units for flexibly suspending the lower unit from said upper unit, and means connected with and extending downwardly from said bearing element to a point within the lower unit for shifting the axis of rotation of said vertically disposed shaft, combined with an engine or motor-controlling mechanism connected with and co-operating with said axis-shifting means for controlling the action of the motors.

12. A flying machine of the helicopter type comprising an upper and a lower unit, said upper unit comprising a frame-work provided with laterally extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a hub-shaped bearing-element upon said carrier-element, a stem connected with and extending in an upward direction from said bearing-element, a tubular shaft surrounding said stem and having a rotatable relation with respect to said stem, carrier-arms connected with and extending laterally from said

shaft, a flying-blade mounted upon each arm, motor-driven mechanism for rotating said shaft, a means of flexible connection between said upper and lower units for flexibly suspending the lower unit from said upper unit, and means for shifting the axis of rotation of said vertically disposed shaft, consisting of a control-bar, means at one end of said bar for attaching the same to said bearing-element, and a grasping member at the other end of said bar, combined with an engine or motor-controlling mechanism connected with and co-operating with said axis-shifting means for controlling the action of the motors.

13. A flying machine of the helicopter type comprising an upper and a lower unit, said upper unit comprising a frame-work provided with laterally extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a hub-shaped bearing-element upon said carrier-element, a vertically disposed shaft rotatably mounted upon said bearing-element, carrier-arms connected with and extending laterally from said shaft, a flying blade mounted upon each arm, motor-driven means for rotating said shaft, a socket-member secured to and extending downwardly from said bearing-element, a ring rotatably mounted upon said socket-member, cable-receiving eyes extending from said ring, flexible cables attached to said eyes and said lower unit, and means extending downwardly from said socket-member to a point within the lower unit for shifting the axis of rotation of said shaft.

14. A flying machine of the helicopter type comprising an upper and a lower unit, said upper unit comprising a frame-work provided with laterally extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a hub-shaped bearing-element upon said carrier-element, a vertically disposed shaft rotatably mounted upon said bearing-element, carrier-arms connected with and extending laterally from said shaft, a flying blade mounted upon each arm, motor-driven means for rotating said shaft, a socket-member secured to and extending downwardly from said bearing-element, a ring rotatably mounted upon said socket-member, cable-receiving eyes extending from said ring, flexible cables attached to said eyes and said lower unit, and means for shifting the axis of rotation of said vertically disposed shaft, consisting of a controlling bar, means at one end of said bar for attaching the same to said socket-member, and a grasping member at the other end of said bar.

15. A flying machine of the helicopter type comprising an upper and a lower unit, said upper unit comprising a frame-work provided with laterally extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a hub-shaped bearing-element upon said carrier-element, a vertically disposed shaft rotatably mounted upon said bearing-element, carrier-arms connected with and extending laterally from said shaft, a flying blade mounted upon each arm, motor-driven means for rotating said shaft, a socket-member secured to and extending downwardly from said bearing-element, a ring rotatably mounted upon said socket-member, cable-receiving eyes extending from said ring, flexible cables attached to said eyes and said lower unit, and means for shifting the axis of rotation of said shaft, consisting of a controlling bar, means at one end of said bar for attaching the same to said socket-member, and a grasping member at the other end of said bar, combined with an engine or motor-controlling mechanism connected with and co-operating with said axis-shifting means for controlling the action of the motors.

16. A flying machine of the helicopter type comprising an upper and a lower unit, said upper unit comprising a frame-work provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a hub-shaped bearing-element upon said carrier-element, a stem connected with and extending in an upward direction from said bearing-element, a tubular shaft encircling said stem and rotatably mounted with relation to said stem, carrier-arms connected with and extending laterally from said shaft, a flying blade mounted upon each arm, motor-driven means for rotating said shaft, a socket-member secured to and extending downwardly from said bearing-element, a ring rotatably mounted upon said socket-member, cable-receiving eyes extending from said ring, flexible cables attached to said eyes and said lower unit, and means extending downwardly from said socket-member to a point within the lower unit for shifting the axis of rotation of said shaft.

17. A flying machine of the helicopter type comprising an upper and a lower unit, said upper unit comprising a frame-work provided with latterly extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a hub-shaped bearing-element upon said carrier-element, a stem connected with and extending in an upward direction from said bearing-element, a tubular shaft encircling said stem and ro-

tatably mounted with relation to said stem, carrier-arms connected with and extending laterally from said shaft, a flying blade mounted upon each arm, motor-driven means for rotating said shaft, a socket-member secured to and extending downwardly from said bearing-element, a ring rotatably mounted upon said socket-member, cable-receiving eyes extending from said ring, flexible cables attached to said eyes and said lower unit, and means for shifting the axis of rotation of said vertically disposed shaft, consisting of a controlling bar, means at one end of said bar for attaching the same to said socket-member, and a grasping member at the other end of said bar.

18. A flying machine of the helicopter type comprising an upper and a lower unit, said upper unit comprising a frame-work provided with laterally extending motor-carrying elements, each element being provided with an extension, a blade carried by each extension, a carrier-element mounted upon said frame-work, a hub-shaped bearing-element upon said carrier-element, a stem connected with and extending in an upward direction from said bearing-element, a tubular shaft encircling said stem and rotatably mounted with relation to said stem, carrier-arms connected with and extending laterally from said shaft, a flying blade mounted upon each arm, motor-driven means for rotating said shaft, a socket-member secured to and extending downwardly from said bearing-element, a ring rotatably mounted upon said socket-member, cable-receiving eyes extending from said ring, flexible cables attached to said eyes and said lower unit, and means for shifting the axis of rotation of said vertically disposed shaft, consisting of a controlling bar, means at one end of said bar for attaching the same to said socket-member, and a grasping member at the other end of said bar, combined with an engine or motor-controlling mechanism connected with and co-operating with said axis-shifting means for controlling the action of the motors.

19. A flying machine of the helicopter type comprising an upper motor-driven flying unit, and a lower pilot-carrying unit, comprising a pair of ring-shaped members, stay-rods connecting said members so as to provide a cage, a seat, guy-rods connected with said stay-rods and said seat, and a means of flexible connection between one of said ring-shaped members and the upper motor-driven flying unit.

20. A flying machine of the helicopter type comprising an upper motor-driven flying unit, a bearing-member carried by said upper unit, a socket-member connected with and extending downwardly from said bearing-member, a ring rotatably mounted upon said socket-member, cable-receiving eyes extending from said ring, a lower pilot-carrying unit, comprising a pair of ring-shaped members, stay-rods connecting said members so as to provide a cage, a seat, guy-rods connected with said stay-rods and said seat, and flexible suspension cables connected with one of said ring-shaped members and with said cable-receiving eyes.

21. In a flying machine, in combination with a rotatable shaft, a fuel-carrying tank provided with a central tubular member, said tubular member encompassing said shaft, said tubular member and said shaft being arranged so as to provide an air-space between them.

In testimony that I claim the invention set forth above I have hereunto set my hand this 9th day of August, 1923.

HENRY BEA.

Witnesses:
FREDK. C. FRAENTZEL,
EVA E. DESCH.