March 5, 1940. H. A. DROITCOUR 2,192,300

AERIAL NAVIGATING MACHINE

Filed Aug. 26, 1937 4 Sheets-Sheet 1

Fig. 1.

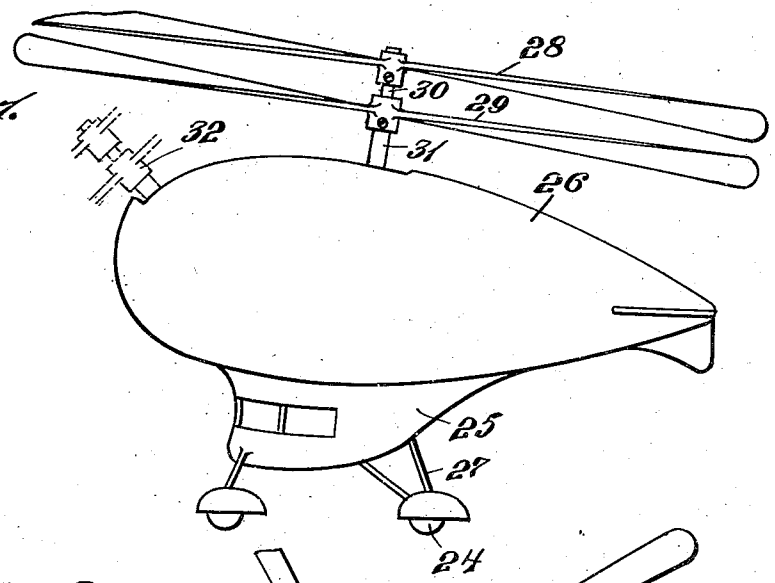
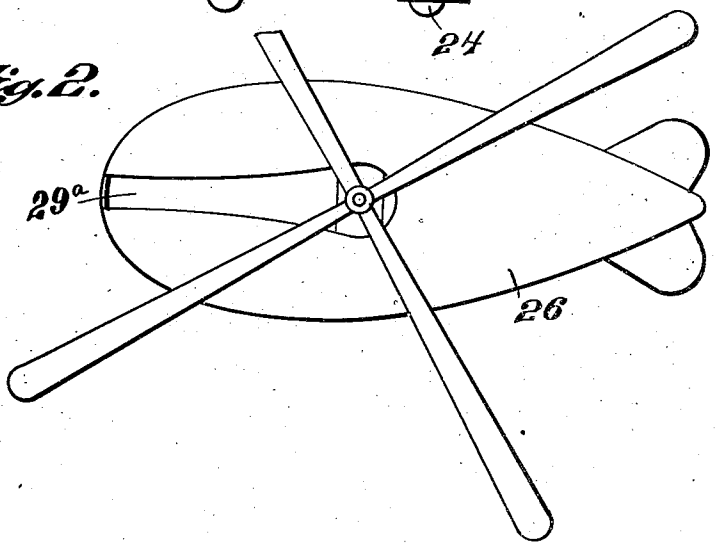


Fig. 2.



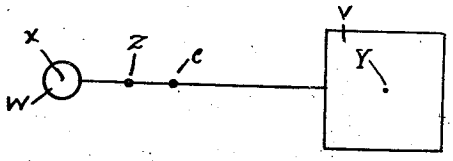


Fig. 24.

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AERIAL NAVIGATING MACHINE

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Fig. 3.

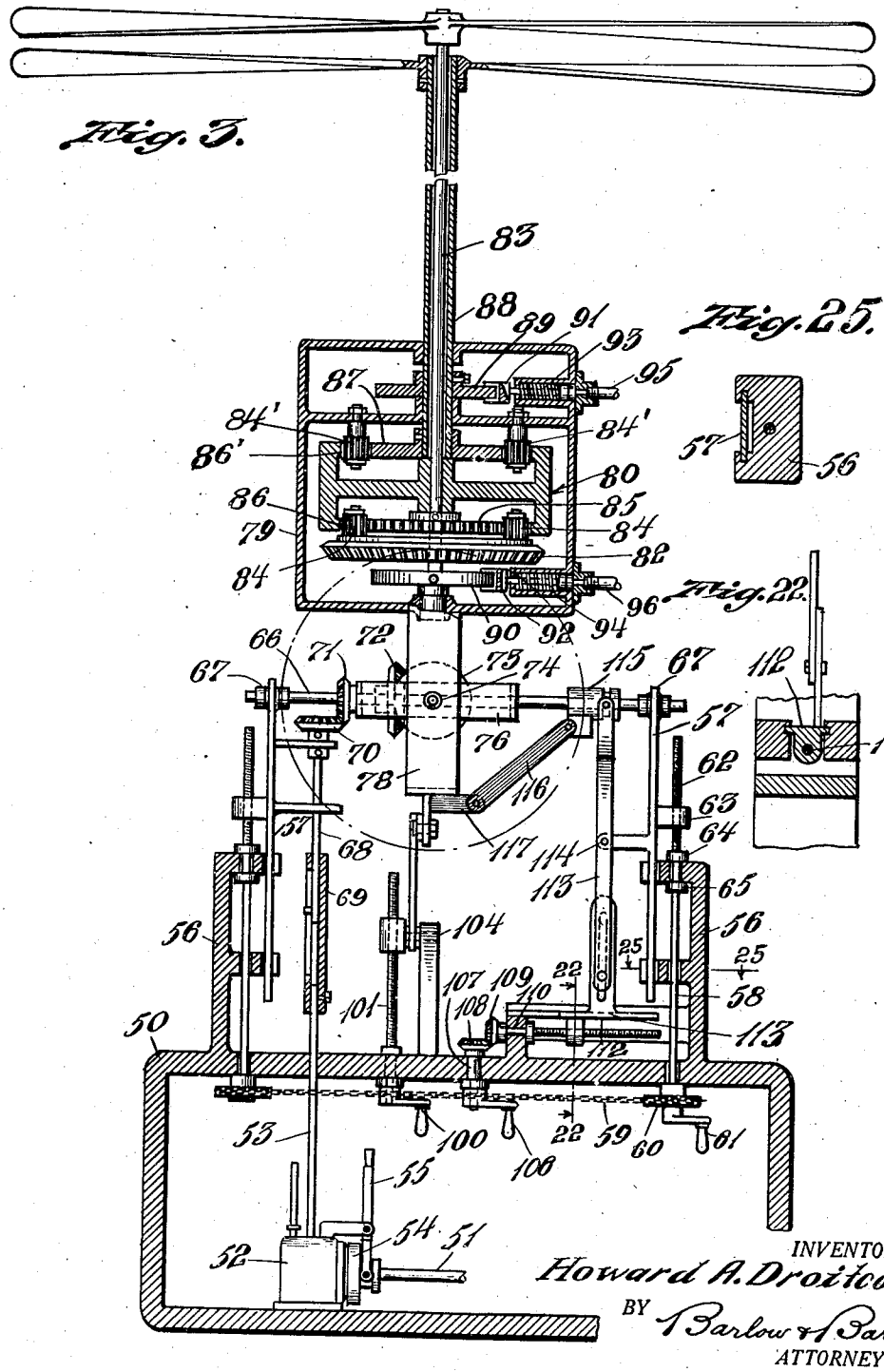


Fig. 25.

Fig. 22.

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AERIAL NAVIGATING MACHINE

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Fig. 4.

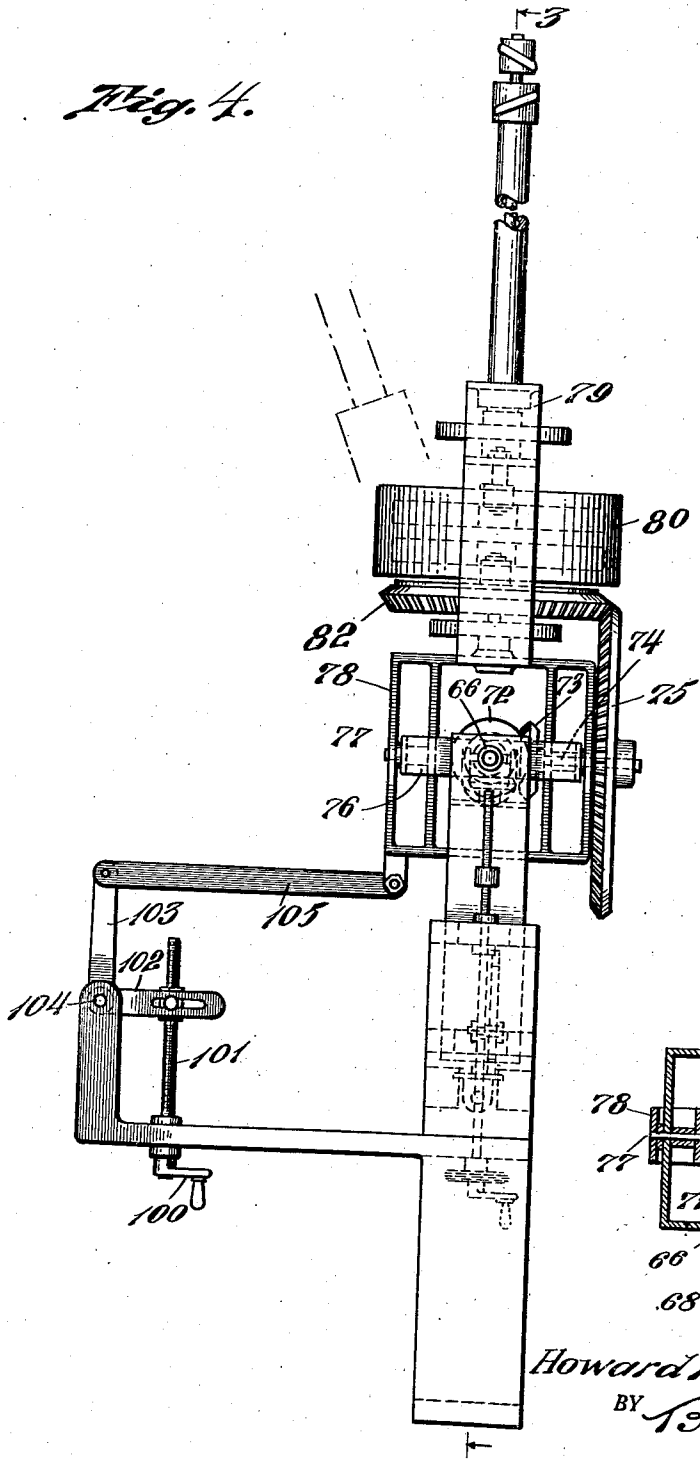
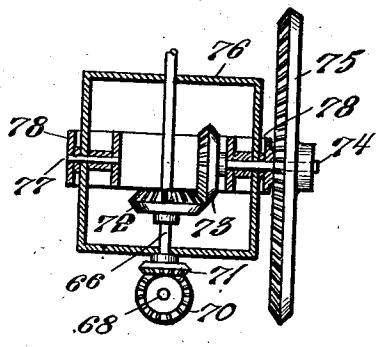


Fig. 2.



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Fig. 5.

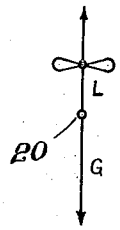


Fig. 6.

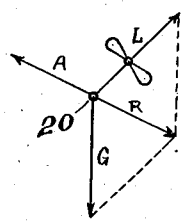


Fig. 7.

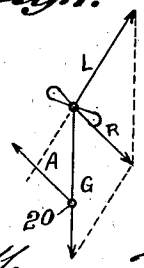


Fig. 8.

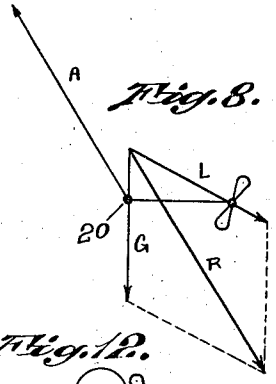


Fig. 9.

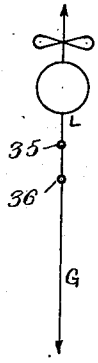


Fig. 10.

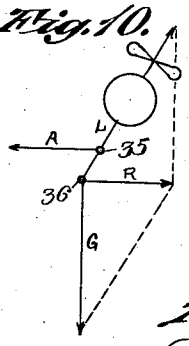


Fig. 11.

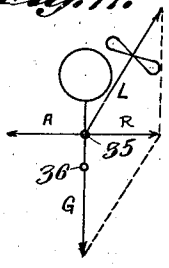


Fig. 12.

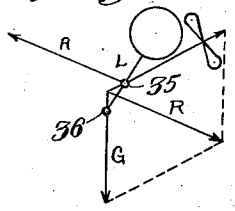


Fig. 13.

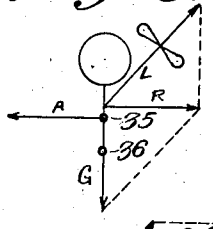


Fig. 14.

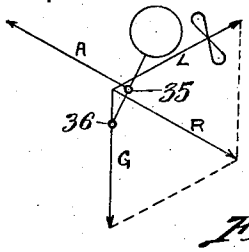


Fig. 15.

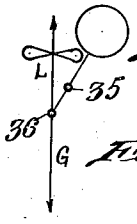


Fig. 16.

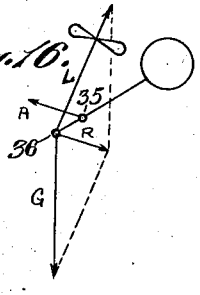


Fig. 17.

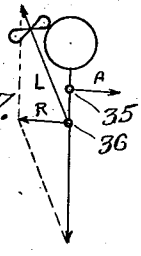


Fig. 18.

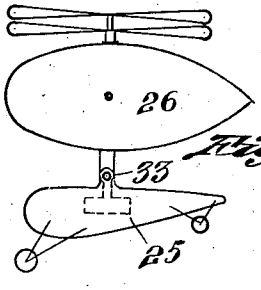


Fig. 19.

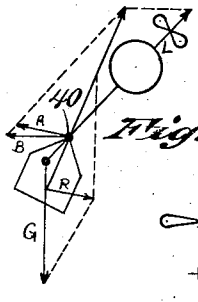


Fig. 20.

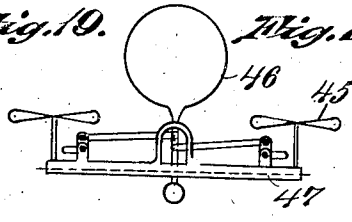
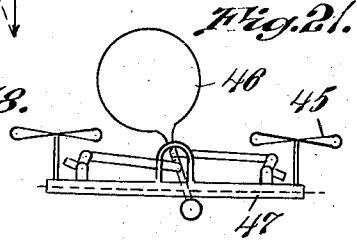


Fig. 21.



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Patented Mar. 5, 1940 2,192,300

UNITED STATES PATENT OFFICE

2,192,300

AERIAL NAVIGATING MACHINE

Howard A. Droitcour, Cranston, R. I.

Application August 26, 1937, Serial No. 161,008

11 Claims. (Cl. 244—17)

This invention relates to an aerial navigating machine of the helicopter type; and has for one of its objects the provision of greater stability of this type of machine.

Another object of the invention is the provision of inherent stability in a helicopter type of aerial machine so that the machine will return from an inclined position to a normal upright position without the manual manipulation of controls and thus provide a construction which will not require any action of an operator to correct the inclination of the machine.

Another object of the invention is the provision of an air displacement member which will have a stabilizing effect upon the body of the machine by changing the apparent center of gravity in air to a point spaced from the actual center or mass, thus causing two points about which forces act and with a directing of the acting forces so as to form a couple to stabilize the machine and cause it to move to upright vertical position rather than to maintain or increase an inclination which might result were it not for such displacement member.

With these and other objects in view, the invention consists of certain novel features of construction, as will be more fully described, and particularly pointed out in the appended claims.

In the accompanying drawings:

Fig. 1 is an elevational view largely diagrammatic of a helicopter type of navigating machine incorporating my invention;

Fig. 2 is a top plan view thereof with one of the propellers broken away;

Fig. 3 is a sectional view largely diagrammatic of the driving means for the propellers;

Fig. 4 is an elevational view of the driving means shown in Fig. 3;

Figs. 5 through 21 are diagrammatic views indicating various forces which have an effect upon the machine;

Fig. 22 is a sectional view on line 22—22 of Fig. 3;

Fig. 23 is a sectional view on line 23—23 of Fig 4;

Fig. 24 is a diagrammatic view for certain illustrative purposes;

Fig. 25 is a sectional view on line 25—25 of Fig. 3.

It is quite generally recognized that the helicopter type of machine has little inherent stability and attempts have been made to provide forces which will act at various locations tending to stabilize and prevent helicopters assuming an inclined position, all of which devices require the control by an operator who must be highly skilled if the devices are to be effective; and as a general rule such arrangements have been found impractical because too great a skill is required of the operator for manipulating them. Conditions change rather quickly in the air, making a constant manipulating of the control devices necessary; and in order to avoid this undesirable condition I have so arranged a helicopter navigating machine that it will have an inherent tendency to stabilize itself or return to upright vertical position without requiring the action of any operator, all by the arrangement and control of the buoyant, sustaining and gravity acting forces and without the necessity of manual control by any operator; and the following is a more detailed description of the present embodiment of this invention, illustrating the preferred means by which these advantageous results may be accomplished.

In order that this invention may be best understood I will first refer to the force diagrams indicated in Figs. 5, 6, 7 and 8 showing the old or generally known type of heliocopter with no inherent stability. Fig. 5 shows the center of mass which is also the actual center of gravity in air in the usual helicopter at 20, the forces tending to lift the machine are indicated at L and the force of gravity is indicated at G. These forces L and G are in the same line, equal and opposite and accordingly the machine would have no tendency to move in any direction, and so long as this condition remains undisturbed by wind or some other outside force the machine will remain stationary. In Fig. 6 the lift force L is inclined and the force of gravity is equal to the lift force and both act through the center of gravity in air or center of mass, as in Fig. 5. When such condition exists the resultant force R of L and G tends to accelerate the machine in its direction and will have no tendency to turn the machine back to its vertical position or away from its vertical position. In the condition shown in Fig. 7 the forces L and G are equal but the force L does not act through the center of mass and center of gravity in air 20, as shown by the diagrams. The machine, however, is vertical. The resultant of the lift and gravity forces R does not pass through the center of gravity of the machine, and as the center of gravity 20 offers a resistance to the acceleration with an equal and opposite force through the center of gravity, which force is indicated A, the forces A and R form a couple which tends to turn the machine away from the vertical posi-

tion, clockwise. When this condition of Fig. 7 exists the condition of Fig. 8 will quickly result and the resultant R will tend to accelerate the machine in its direction but will have no tendency to turn the machine back to its vertical position from the 90° angle through which it is turned, as shown in Fig. 8.

It will be readily apparent that the various forces which may act upon the conventional type of machine with its center of mass and center of gravity in air at the same point 20 will have little or no affect upon righting the machine should it be inclined from its vertical position; and it will also be readily apparent that where manual controls must be utilized for obtaining stability that the operator must anticipate and stop the machine in true vertical position, otherwise an incline from the vertical in the other direction will be had.

All aerial navigation machines of the mixed type (part displacement lift and part propeller or wing lift) have depended upon a lift from the gas filled member to support part of the rest of the machine. The additional expense of a gas unit is so great, and the additional resistance to motion so large that all machines employing a displacement lifting member in conjunction with other sustaining means depend upon it to deliver a total lifting force sufficient not only to lift its own weight (the combined weight of the gas and its containing and controlling means) but also to lift a substantial part of the weight of the rest of the machine. A buoyant member has been used for a stabilizing effect, but the gas filled envelope always had a resultant force which was a substantial lift. There has been no previous suggestion of a buoyant member, used for control, so heavy it could not sustain substantially more than its own weight.

It is the disclosure of this invention to use a displacement member, whose resultant force is a comparatively insignificant lift or a downward force, as a means of control to stabilize an aerial navigation machine.

The principle of the present invention is that by providing a large bulbous member connected to the main weight of the machine, there will be caused a sufficient buoyancy so that the heavy part of the machine will tend to right itself with reference to the larger bulbous member under the influence of the force of gravity or any sustaining force which may be applied; and this I accomplish by securing to the main body of the heliocopter a bulbous member which will displace a sufficient volume of air to provide the desired conditions, and this bulbous body may be either such as to itself sustain a part of the lift such as being made lighter than air, or it may be itself heavier than air and sufficiently open so as to permit some little circulation of air into and out of it. In this latter case it will be plain that the bulbous member on the upper part of the body is not for the purpose of lift but is for the purpose of control and stabilization, and while lift may be had, it is merely incidental to the principle of this invention.

In Fig. 1 I have indicated the body of the helicopter at 25 which is provided with the usual landing wheels 24 supported by struts 27. This body portion of the machine houses the engines and all heavy parts of the device. The bulbous member is designated 26 and consists of a large envelope which will contain air and need not be sealed with a lighter than air content, although it may be sealed when a combination machine which has some lighter than air sustaining qualities, is desired. This bulbous member 26 is slotted as at 27*a* and a pair of propeller shafts 30 and 31 are located one within the other in this slot to drive propellers 28 and 29 in opposite directions, the slot 27*a* in the envelope 26 being sufficient to permit of some movement of the shafts 30 and 31 in the slot to different positions, such for instance as that indicated at 32 in dotted lines in Fig. 1, and also the slot is sufficiently wide to permit some little tilting from side to side of the propeller shafts. The drive of the propeller shafts and their tilting will be more fully hereinafter described. By the relation of this large bulbous envelope secured to the body the machine will tend to right itself or stabilize with the heavier part of the machine lowermost and the bulbous member uppermost no matter in what direction the forces are acting so long as they act close to or through lines close to the center of mass and center of gravity in air. By center of mass I mean the absolute center of mass of the entire machine including the mass of any air or gas contained within the machine. The center of mass would be identical with the center of gravity in a vacuum of the entire machine including the gases normally contained within the machine.

By the apparent center of gravity in air I mean that point through which the resultant force of the absolute force of gravity and the total buoyant force, passes. The absolute force of gravity is the total weight of the entire machine including the weight of all gases (including air) enclosed in the bulbous member. The total buoyant force is the resultant force of the static air pressure upon the entire outermost surface of the machine. This total buoyant force equals the weight of air that would be displaced by a solid member whose outermost surfaces were identical with that of the entire machine.

When the large bulbous member 26 is attached to the body 25 the center of mass will be as indicated at 35 in Fig. 9. However, due to the fact that the member 26 is large and relatively light it will have a certain buoyant effect when placed in any liquid medium, such for instance as air, and will have a much more buoyant effect than the body of the device which is comparatively small and heavy. The relation of the bulbous member 26 and the relatively heavy body 25 may perhaps best be illustrated by reference to Fig. 24 showing diagrammatically a small solid concentrated weight W with its center of gravity at X and a large bulbous box-like member V whose center of gravity is at Y. These two are connected by a rigid member whose weight is negligible for the purposes of illustration. For the purposes of illustration it may be assumed that the connecting member is of sufficient length to position the points X and Y 100 inches apart. The weight W is 100 pounds, and the weight of of the box V is 10 pounds, and it has in it 12 pounds of air. Thus, the total weight of the entire system will be 122 pounds. Taking the moments about X, the center of gravity of the system will be located at 18.05 inches to the right of the point X which I designate C, which is the absolute center of gravity or center of mass of the system. The volume of the box V would be about 160 cubic feet while the volume of the concentrated weight W would be about .2 cubic foot so that the center of buoyancy of the system would be between the center of gravity Y of the

box V and the center of buoyancy X of the concentrated weight W. However, its distance from the point Y is so small that it is here neglected. There is then a buoyant force of 12 pounds acting upwardly at Y. This makes the resultant downward force 110 pounds. Taking moments about the point X the point Z through which this resultant downward force acts may be determined. The resultant downward force is here referred to as the apparent weight in air and the point Z through which this force acts as the apparent center of gravity in air which is 9.09 inches to the right of X. Thus, the distance between the points Z and C is 8.96 inches. This will give a definite illustration of the different points which are of dominant importance in connection with this invention. The important thing to note is that the apparent center of gravity in air is not at the same point as the center of mass C but a point an appreciable distance from it. This illustration will also show that it is unnecessary to have a lighter than air member to separate the center of mass and the apparent center of gavity in air. A lighter than air member has a similar effect upon the separation of the center of mass and apparent center of gravity in air as may be similarly determined. Accordingly, the center of mass will be low in the machine, while the center of aerostatic lift will be high. Under these conditions the center of mass and the apparent center of gravity in air will be separated. This apparent center of gravity in air is designated 36 in Fig. 9, while the point 35 is the center of mass, and I hereinafter refer to these points in this manner.

Should the lift force L, as shown in Fig. 9, and the force of gravity be equal and opposite, the same condition will occur as in Fig. 5 heretofore mentioned. If, however, the force L is shifted to the position shown in Fig. 10 and is slightly larger than the force G shown therein, the forces L and G will form the resultant force R which will tend to accelerate the machine in its direction. The inertia of the mass resists this acceleration with a force equal and opposite to the force R which is designated as A, which force will act through the center of mass 35. The forces A and R form a couple which tend to turn the machine from its inclined position counter-clockwise and tend to place the machine in an upright position. As G is the only component of R having a moment about 35, its moment about 35 equals the moment of R about 35. No matter what the value or direction of L, as long as it is through 35, it does not affect the stabilizing moment. Even if L were zero, as when the propellers were stopped, the stabilizing moment would be undiminished.

In Fig. 11 I have illustrated the lifting force L as inclined and passing through the center of mass 35, but not through the apparent center of gravity in air 36, the force L being slightly greater than the force G and the resultant R of the forces L and G moves through the center of mass 35 and accelerates the machine in its direction. The force A resisting the acceleration passes through the center of mass and in this case is equal and in an opposite direction in the same line to the force R and therefore produces no turning moment. Thus, should the forces act in this manner while the machine is vertical there is no tendency to turn it from its vertical position.

Assuming the conditions, shown in Fig. 12, the machine is inclined with the force L greater than G, as heretofore. The force L passes through the center of mass but not through the apparent center of gravity. The resultant R of the forces L and G accelerate the machine in its direction, the force A resisting the acceleration passes through the center of mass and the forces A and R form a couple which tends to turn the machine counter-clockwise as viewed in Fig. 12, from its inclined position to an upright position so that the position of Fig. 11 will be re-assumed.

In Fig. 13 the force L does not pass through the center of mass or the apparent center of gravity in air, and while the machine is vertical the resultant R forms a couple with the resisting force A to produce a clockwise moment which will turn the machine from vertical. Thus, it would appear that should this condition occur the machine will tend to tilt, which will occur until the conditions of Fig. 14 are reached, which shows the machine is inclined. The resultant force R causes a counter-clockwise moment with the resisting force A passing through the center of mass, and thus the machine would stabilize itself at the position where the clockwise moment of the force L about the center of mass would just be equaled by the counter-clockwise moment of the force G about the center of mass, and thus the machine would stabilize at a slight inclination which would be within tolerable limits of use, the general rule being that as long as the value of the moment of the force L about the center of mass is less than the product of the weight in air and the distance between the center of mass and the apparent center of gravity in air the machine will stabilize at some angle.

In the conditions assumed in Fig. 15 the lift force L passes through the apparent center of gravity in air but not through the center of mass, and the machine is inclined so that the lift is vertical. It is here assumed that the lift force L is equal to gravity force G. There is no resultant force of L and G and the machine would remain in the same position so long as these conditions continue.

In the conditions assumed in Fig. 16 the lift force L passes through the apparent center of gravity in air 36 but not through the center of mass 35. The machine is inclined and also the force L is acting in an inclined direction. The resultant R will accelerate the machine in its direction and the force A offers a resistance, which force acts through the center of mass 35. The couple of the forces A and R will tend to turn the machine counter-clockwise until the condition in Fig. 15 is reached.

In the conditions assumed in Fig. 17 the force L passes through the apparent center of gravity in air 36 but not through the center of mass 35. The machine is vertical, the two forces L and R are equal, and the resultant R will accelerate the machine in its direction, and as the force A resisting this acceleration acts through the center of mass the couple of A and R will tend to turn the machine in a clockwise direction until the condition in Fig. 15 is reached. The inclination of Fig. 15, as heretofore noted, is within the range of a tolerable inclination which may be had.

The machine may shift somewhat from the stabilized condition back and forth from the conditions of Fig. 15 between Figs. 16 and 17, but natural resistances will stabilize the machine in the condition of Fig. 15 rather quickly.

It is of course appreciated that the change in the values of forces will change the conditions, but in most of those figures heretofore mentioned the forces L and G are substantially equal, in some cases the force L being a little greater than the force G. It will be apparent from these force diagrams that the machine will stabilize itself at a reasonable angle so long as the operator keeps the force L in a line near the center of mass 35 and at a reasonable angle with the machine.

This lift force L is provided through the propellers 28 and 29 and the shafts are so arranged that they are close to the line passing through the center of mass. As the lift force L is the resultant force of all the component air forces, except buoyancy, upon all the machine, it is necessary to consider the effect of a relative wind upon the force L. At low relative wind velocities L is substantially the resultant of the force produced by the sustaining and propelling means, and the action of the slip stream upon the machine. Assuming no change in the controls, this force will remain constant, and in a fixed relation to the machine whatever the machine's inclination, as long as the relative wind is negligible.

At higher relative wind velocities a component of the force L will be added of sufficient size to materially affect the position and direction of the force L. The effect of this resistance force upon stabilization is helpful due to the fact that the resistance is higher than the center of mass which is purposely kept comparatively low.

It will be apparent that by inclining the propeller shafts as desired a propelling force forward as well as a sustaining lift may be had and yet the machine may be kept in stability by reason of the buoyant member above the body.

If it is desired that the stabilizing effect be increased the body 25 may be articulated to the bulbous buoyant member 26 which is the gas containing and sustaining means, by means of a gimbal arrangement 33 enabling the body to rock in any direction with reference to the bulbous member 26, as shown in Fig. 18. A force diagram is shown in Fig. 19 of the condition of the body being articulated to the bulbous envelope so that it may hang like a pendulum therefrom. The articulation point is designated 40 and is at the center of mass of the bulbous body 26. The articulation point is at the center of mass of body 26. The body 25 imparts a force B to the member 26. The lift force L and gravity G also act upon member 26. These forces B, L and G form a resultant R of the forces acting upon body 26. The force R accelerates the body 26 in its direction, and the force A resists this acceleration. The couple A and R tends to return the body 26 to its proper vertical. As G is the only component force of R having a moment about the center of mass of body 26, its moment equals the moment of R about the center of mass of body 26. The stabilizing moment is therefore unchanged by the action of 25 upon 26, and no matter what the value or direction of the force B, the body 26 will have the stability described in Figs. 9 to 17. The articulation point may be separated from the center of mass of the member 26 if the moments which are present of the force B about the center of mass of the member 26 opposite to the stabilizing moment have not a constantly greater value than the stabilizing moment.

The advantage of having the stabilizing effect act upon only a member instead of the whole machine, is that the member has a less moment of inertia about its center of mass than the whole machine. The stabilizing moment will, therefore, be able to stabilize the member more quickly with the same size envelope, or a smaller envelope will be necessary to obtain an equal stabilizing time.

It will of course be readily apparent that the point of articulation of the bulbous member 26 may be either above or below or between the center of mass and the apparent center of gravity, and various force diagrams may be readily worked out illustrating these various conditions which I will not here attempt to show, as these will be apparent from the force diagrams already provided.

It will also be apparent that the bulbous member may be either lighter or heavier than air and its various points of connection will also provide various force diagrams, but in all cases the stabilizing influence will be effected according to the theory and arrangement heretofore indicated above.

In some cases, it is desirable to provide this principle in a control unit and I have illustrated in Figs. 20 and 21 a plurality of propellers 45 with a bulbous member 46 which may be rocked with reference to the frame support 47 so as to cause an inclination of the blades of propellers to change their pitch through a suitable control mechanism, thus change their effective values. The member 46 is articulated to the body near the center of mass of the member, and preferably between the center of mass and apparent center of gravity in air of the member. When the body becomes inclined with respect to the member 46, the propellers are so controlled that the sustaining force offers an increased moment in the direction of stabilization. With this arrangement, the member 46 acts merely as a control for the applying of stabilizing forces rather than acting directly to stabilize the machine as a whole, all of which is within the preview of this invention.

Referring now more particularly to the mechanism for mounting and driving the propellers, I have shown a suitable framework 50 in which there is mounted a drive shaft 51 driven from some suitable engine, not shown, and which drives through a suitable reduction gearing 52, a shaft 53, there being a control clutch 54 with operating handle 55 for disconnection of the gearing. Standards 56 slidably mount a frame 57 which may be raised and lowered by means of shafts 58 operated in unison through the sprocket chain 59 and sprocket 60 by a handle 61 rotating the threaded shafts 62 in threaded boss 63 fixed on frame 57, the shafts 58 being rotatably mounted in bearings in the standards 56 but axially held between collars 64 and 65 fixed on the shafts 58. Cross shaft 66 is mounted in bearings 67 on the frame 57 and is driven through the telescoping portion 68, 69 of the shaft 53 by bevel gears 70 and 71. The shaft 66 in turn drives the bevel gear 72 meshing with bevel gear 73 on shaft 74 on the end of which there is a large bevel gear 75.

A rectangular yoke 76 is rockably supported upon the shaft 66 and in turn rockably supports the frame 78 by means of shaft 77 and shaft 74 which has gear 75 mounted thereon. Upon this frame 78 there extends upwardly supports 79 which mounts a differential unit 80. Gear 75 drives the gear 82 which rotates about shaft 83 as a center and carries with it pinions 84 which in turn engage the gear 85 fixed on the shaft 83

while also engaging internal gear teeth 86 of the differential unit 80 so that pinion 84 also drives this unit, and in turn the gear 87 through the pinions 84' which are rotated by engaging teeth 86' of the unit 80. Gear 87 is fixed on tube 88 to drive this tube in the opposite direction to rotate the two propellers in opposite directions. Disks 89 and 90 are provided with brake shoes 91 and 92 which are operated by the plungers 93 and 94 through suitable air brake conduits 95 and 96 so that one propeller may be retarded while the other will be correspondingly increased due to the differential connection of the mechanism, the control being from some suitable location in the body of the machine.

In order to rock the propellers about the axis of the shaft 66 as a center I may manipulate the handle 100 which through screw shaft 101 rocks the arms 102 and 103 of the bell crank lever pivoted at 104 to move the link 105 connected to the frame 78 to rock this frame and the propellers and shafts carried thereby about the axis of the shaft 66 as a center. To rock the propeller shafts about the shafts 74, 77 as a center I manipulate the handle 106 which through shaft 107 bevel gears 108, 109, shaft 110, slide 112, rocks lever 113, pivoted at 114 and connected to the collar 115 by a yoke which permits rotation of the collar while maintaining connection thereto to move the link 116 and its connection 117 to the frame 78 whereby to rock this frame about the shafts 74, 77 which are at right angles to the shaft 66. Thus, the handles 100 and 106 serve to manipulate the propellers both about a lateral axis and also a longitudinal axis to dispose them in various positions in the slot 27.

The above mechanism is merely one example of a means to drive the propeller shafts and other equivalent means may be provided by which lifting and propelling force may be applied to the machine.

The foregoing description is directed towards the method and construction illustrated, but I desire it to be understood that I reserve the privilege of resorting to all the equivalent changes to which the construction and method are susceptible, the invention being defined and limited only by the terms of the appended claims.

I claim:

1. An aerial navigating machine comprising a body, means providing a sustaining force, and a bulbous member above said body providing a total buoyant force of sufficient value to cause the points of actual center of mass and apparent center of gravity in air of the member to be substantially spaced, said bulbous member being fixed to the sustaining means but articulated to said body to move with reference thereto in any direction to change the angular relation.

2. An aerial navigating machine comprising a body, means providing a sustaining force, and a bulbous member providing a buoyant force of sufficient value to cause the points of actual center of mass and apparent center of gravity in air of the member to be substantially spaced, said bulbous member being articulated to said body to move with reference thereto, and means governed by the movement of the bulbous member with respect to the body to control the sustaining force of said body.

3. An aerial navigating machine comprising a body, means providing a sustaining force for said body, a bulbous member above the body providing a resultant downward force but of a size having a total buoyant force of sufficient value to cause the points of the actual center of mass and apparent center of gravity in air to be substantially spaced, said means including a shaft extending through said bulbous member.

4. An aerial navigating machine comprising a body, means providing a sustaining force for said body, a bulbous member above the body providing a resultant downward force but of a size having a total buoyant force of sufficient value to cause the points of the actual center of mass and apparent center of gravity in air to be substantially spaced, said means including a shaft extending through said bulbous member and movable with reference thereto.

5. An aerial navigating machine comprising a body, means providing a sustaining force for said body, a bulbous member above the body providing a resultant downward force but of a size having a total buoyant force of sufficient value to cause the points of the actual center of mass and apparent center of gravity in air to be substantially spaced, said means including oppositely rotatable shafts extending through said bulbous member.

6. An aerial navigating machine comprising a body, means providing a sustaining force for said body, a bulbous member above the body providing a resultant downward force but of a size having a total buoyant force of sufficient value to cause the points of the actual center of mass and apparent center of gravity in air to be substantially spaced, said means including oppositely rotatable shafts extending through said bulbous member and movable with reference thereto.

7. An aerial navigating machine comprising a body, means providing a sustaining force for said body, a member above the body providing a resultant downward force but of a size having a total buoyant force of sufficient value to cause the points of the actual center of mass and apparent center of gravity in air to be substantially spaced and having a slot therein, said sustaining means extending through and being movable in said slot.

8. An aerial navigating machine comprising a body, means providing a sustaining force for said body, a bulbous member above the body providing a resultant downward force but of a size having a total buoyant force of sufficient value to cause the points of the actual center of mass and apparent center of gravity in the air of the whole machine to be substantially spaced, said sustaining means including two propellers and shafts, and means for driving said propellers and shafts in opposite directions through a differential gearing.

9. An aerial navigating machine comprising a body, means providing a sustaining force for said body, a bulbous member above the body providing a resultant downward force but of a size having a total buoyant force of sufficient value to cause the points of the actual center of mass and apparent center of gravity in the air of the whole machine to be substantially spaced, said sustaining means including two propellers and shafts, with the propellers being disposed above the center of mass of the machine.

10. An aerial navigating machine comprising a body, means providing a sustaining force for said body, a bulbous member above the body providing a resultant downward force but of a size having a total buoyant force of sufficient value to cause the points of the actual center of mass and apparent center of gravity in the air of the whole machine to be substantially spaced, said sustaining means including two propellers

and shafts with the propellers being disposed above the center of volume of the machine.

11. An aerial navigating machine comprising a body, means providing a sustaining force for said body, a bulbous member above the body providin a resultant downward force but of a size having a total buoyant force of sufficient value to cause the points of the actual center of mass and apparent center of gravity in the air of the whole machine to be substantially spaced, said sustaining means including two propellers and shafts, with the propellers being disposed above the bulbous member.

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