H. M. DE GRAW.

BALANCING GEAR FOR AIRSHIPS.

APPLICATION FILED MAY 17, 1910.

987,439.

Patented Mar. 21, 1911.

5 SHEETS—SHEET 1.

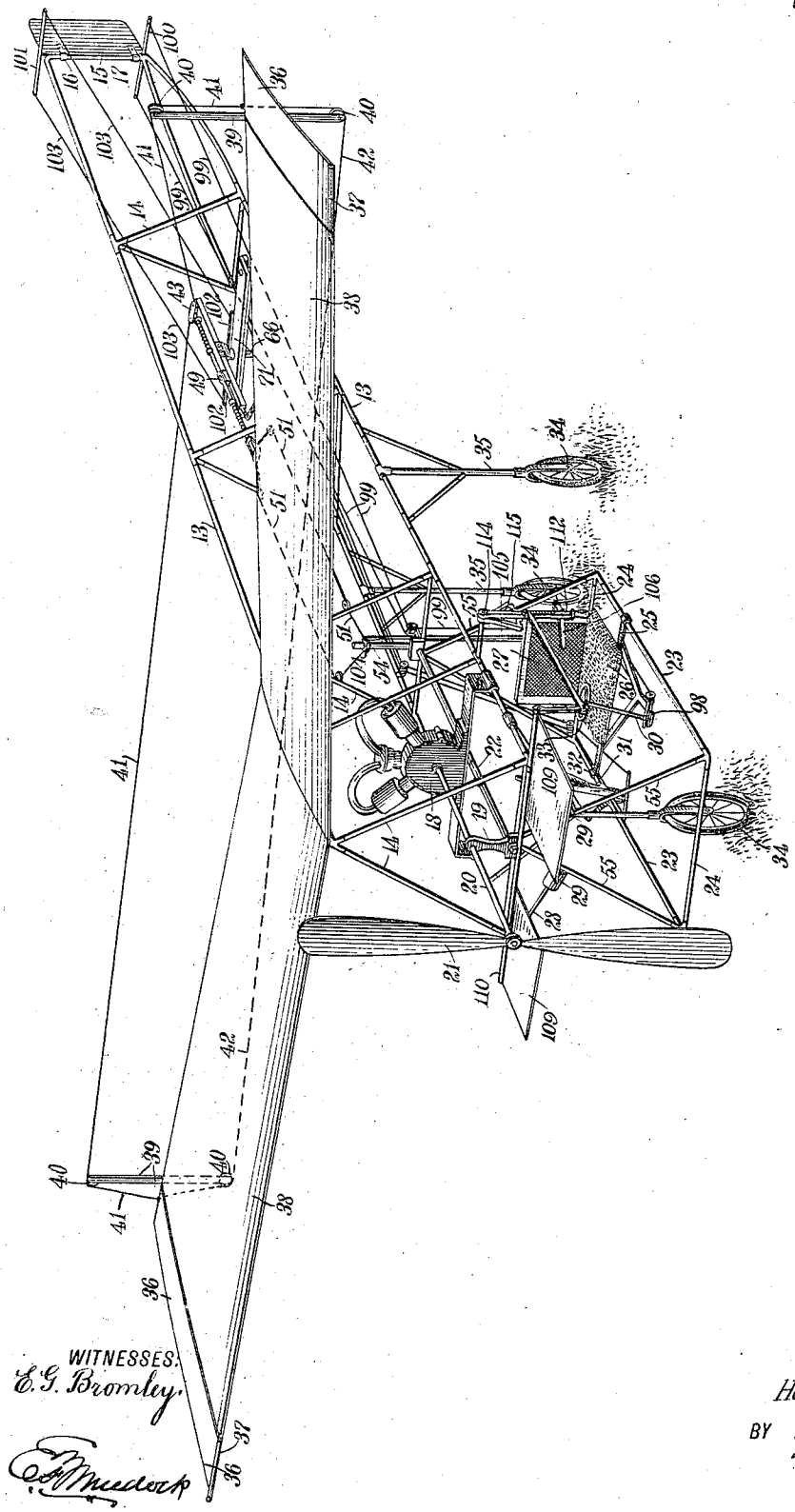

Fig. 1.

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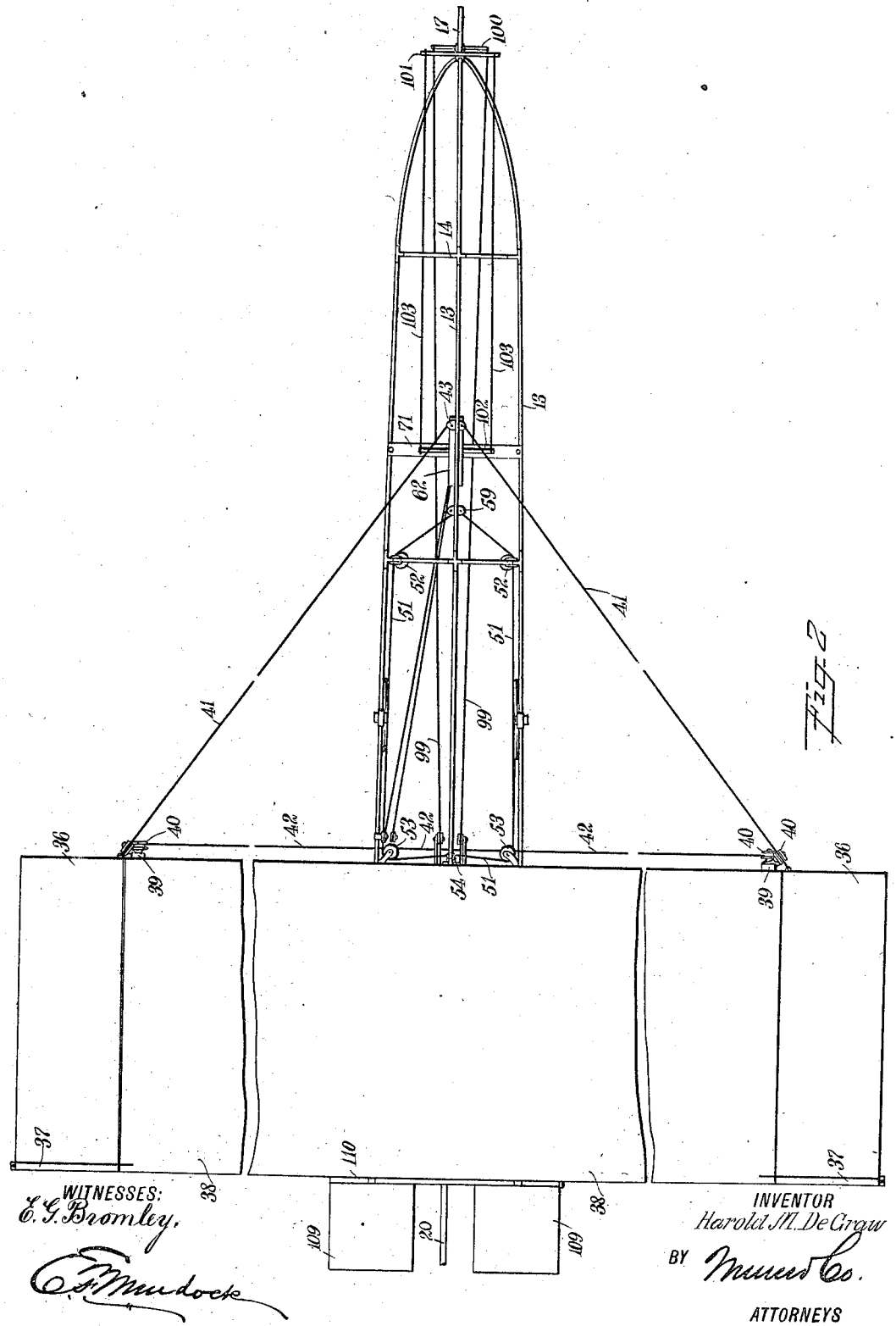

Fig. 2.

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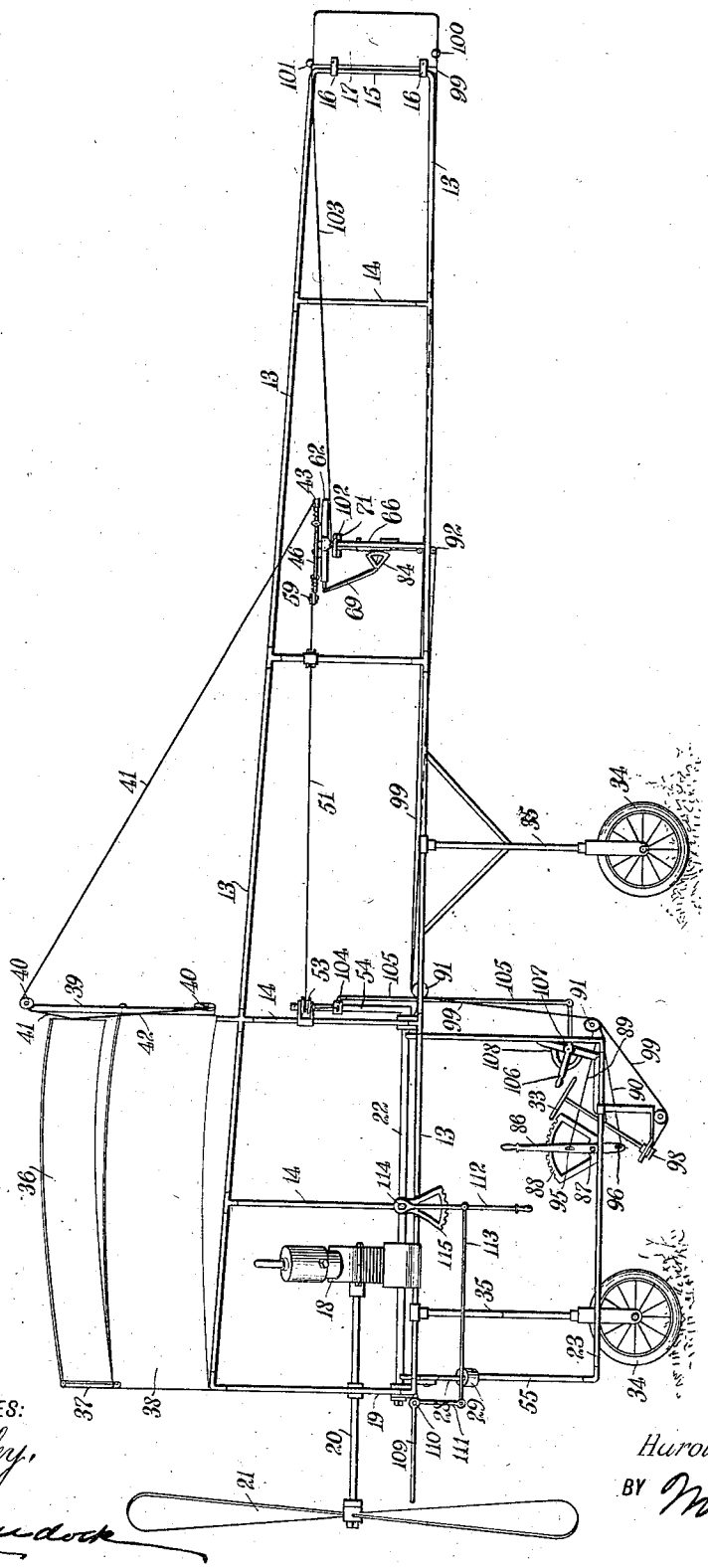

Fig. 3

WITNESSES:

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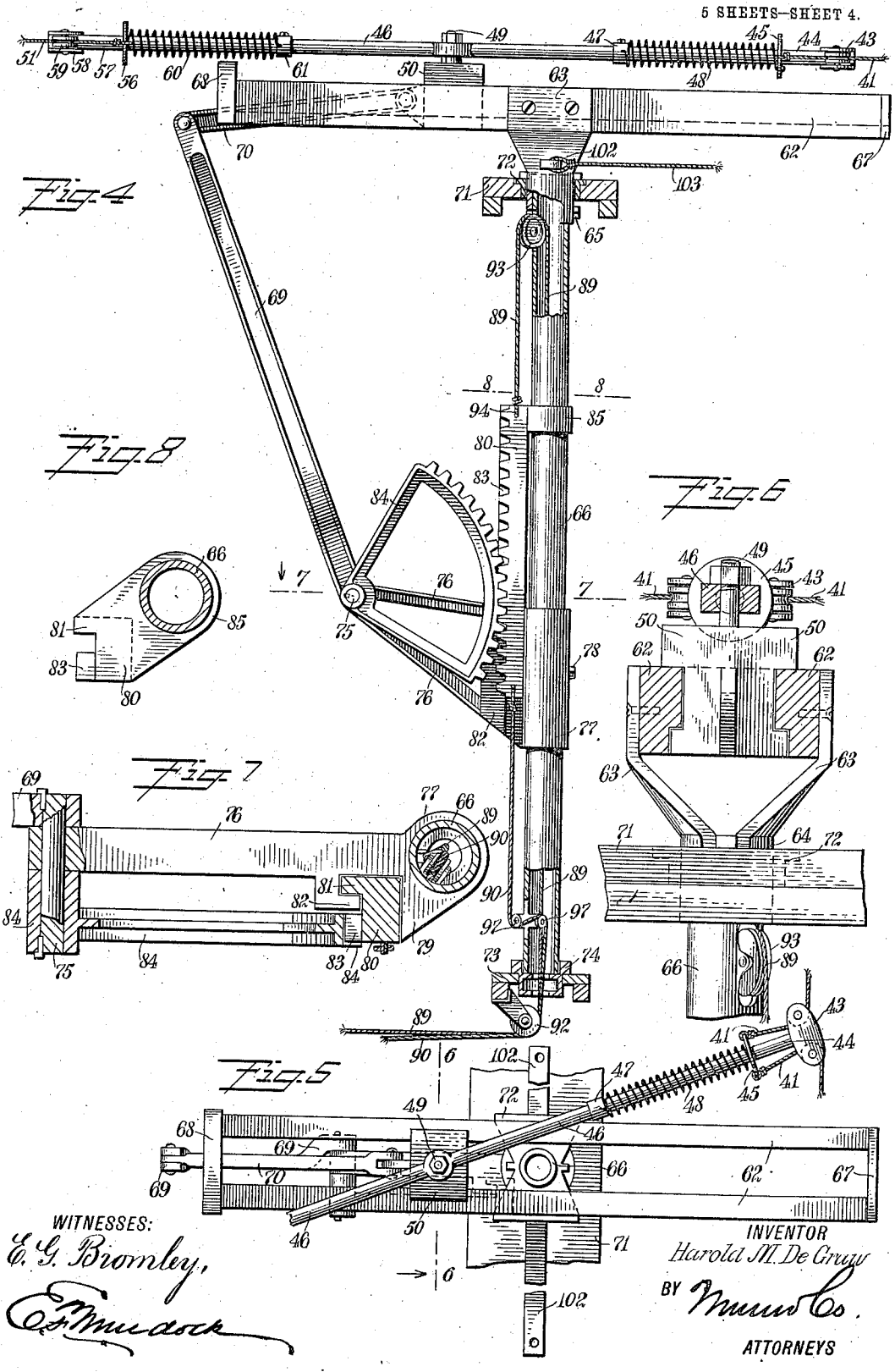

WITNESSES:

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5 SHEETS—SHEET 5.

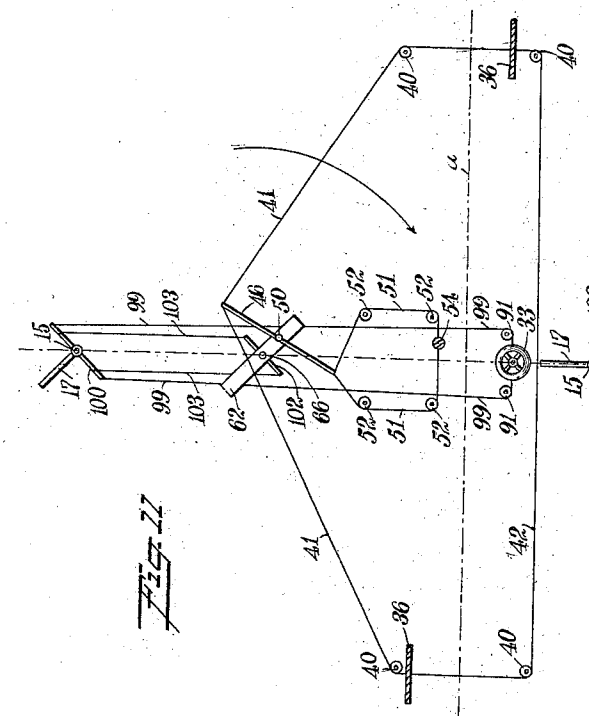

Fig. 11.

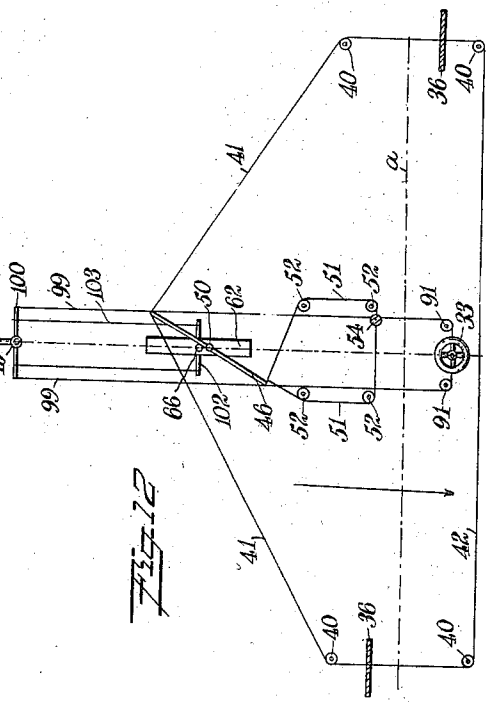

Fig. 12.

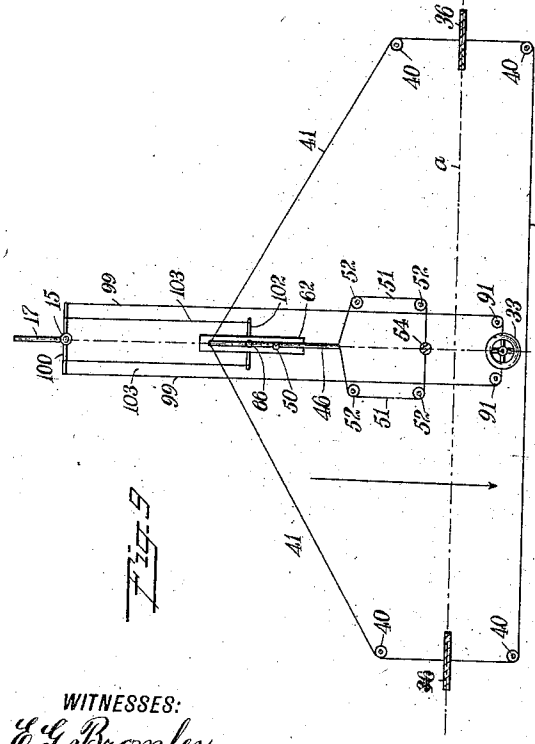

Fig. 9.

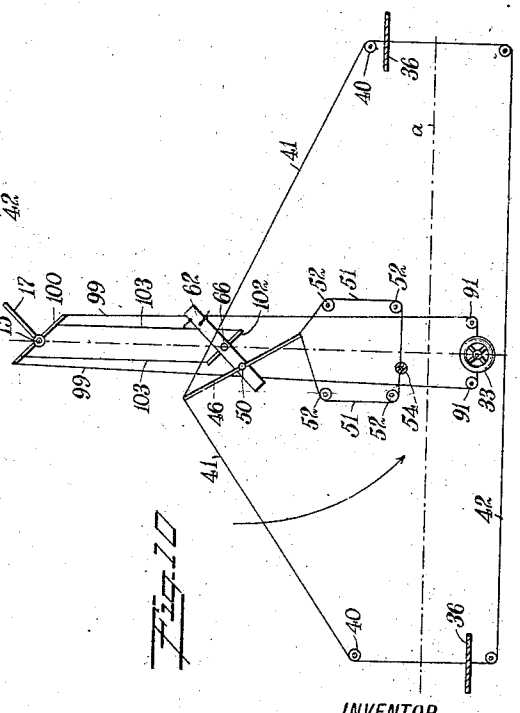

Fig. 10.

WITNESSES:

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UNITED STATES PATENT OFFICE.

HAROLD MASON DE GRAW, OF CAMDEN, NEW JERSEY.

BALANCING-GEAR FOR AIRSHIPS.

987,439. Specification of Letters Patent. Patented Mar. 21, 1911.

Application filed May 17, 1910. Serial No. 561,828.

To all whom it may concern:

Be it known that I, HAROLD M. DE GRAW, a citizen of the United States, and a resident of Camden, in the county of Camden and State of New Jersey, have invented a new and Improved Balancing-Gear for Airships, of which the following is a full, clear, and exact description.

Among the principal objects which the present invention has in view are: To provide means operable by the aviator for varying the wing flexure of aeroplanes; to provide means for varying the extent of the flexure and for connecting the same with the tiller device; to provide means for adapting the wing warping flexure or ailerons to the operation of the steering rudder; and to construct and arrange the mechanism for accomplishing the above stated purposes in a simple, efficient and workmanlike manner.

One embodiment of the present invention is disclosed in the structure illustrated in the accompanying drawings, in which like characters of reference denote corresponding parts in all the views, and in which—

Figure 1 is a perspective view of an aeroplane of the monoplane type, constructed and arranged in accordance with the present invention; Fig. 2 is a top plan view of the same, the plane being broken and contracted to show the ailerons mounted on the ends thereof; Fig. 3 is a side elevation of the same; Fig. 4 is a detail view on an enlarged scale and in side elevation, showing the steering mast and aileron adjusting devices connected therewith; Fig. 5 is a top plan view of the detail illustrated in Fig. 4; Fig. 6 is a detail view on an enlarged scale, and in vertical section taken on the line 6—6 in Fig. 5, showing the construction and arrangement of the adjusting devices for regulating the ailerons or plane warping; Fig. 7 is a detail view in horizontal section taken on the line 7—7 in Fig. 4, showing on an enlarged scale the construction and arrangement of the operating mechanism for shifting the floating pivot for regulating the adjustment of the pivots; Fig. 8 is a detail view on an enlarged scale, and in horizontal section taken on the line 8—8 in Fig. 4, showing in plan the upper end of the vertical rack forming part of the shifting mechanism for the floating pivot; Fig. 9 is a fragmentary view in plan, showing the rudder and balancing mechanism parallel with the line of flight, and the ailerons evenly disposed; Fig. 10 illustrates the disposition of the said parts in making a turn to the left, with the adjustment set as in Fig. 9; Fig. 11 illustrates the disposition of the same parts when making a turn to the right, the parts being adjusted as in the former two figures; and Fig. 12 illustrates the disposition of the parts mentioned when the rudder is held parallel with the straight line of flight and the ailerons are raised by the automatic balancing action of the machine, and when the floating and stationary pivots are more closely related than in the three former figures.

The present embodiment of the invention employs a car body, the main structure whereof is triangular in cross section, longitudinal braces 13, 13 being cross braced by rods 14, 14, as in the usual aeroplane construction. The preferred form of the frame is that wherein the base of the triangle is disposed in lowest position, and the braces 13, 13 thereof are converged at the rear upon a tiller post 15. The tiller post 15 is vertical in arrangement, as shown, and has pivotally connected therewith by loops 16 a rudder 17. The main body of the machine is elongated, as shown in the drawings, and supports in suitable arrangement a motor 18, and a bearing standard 19 for the shaft 20 of the propeller 21. Any suitable construction for the parts mentioned may be adopted.

Suspended from a central shaft 22 is the aviator's carriage or basket. This is triangular in shape, and of open construction similar to that of the main body. Longitudinal braces 23, 23 of the said carriage are connected at the ends by cross braces 24, 24, and by a middle brace 25. Between the middle brace and the rear brace 24 is placed the aviator's seat 26, having a vertical back 27. The carriage is pivotally mounted upon the upper structure, and is controlled in the swing therefrom by piston rods 28, 28 and dashpots 29, 29, the former being pivotally connected to the upper frame, and the latter carried fixedly on the lower frame. The dashpots 29, 29 and piston rods 28, 28 are of usual construction, adapted to check and modify the thrust or throw of the lower frame from its natural or normal position relative to the upper frame, thereby gradually regulating and adjusting the planes of the machine to the exigencies of aerial navigation.

On the aviator's carriage, and in conven-

ient position for the aviator's control, are placed a wheel post 30 for varying the rudder to steer the machine, and a lever 31 for varying the adjustment of the ailerons or extent of the warp of wing flexure, if planes permitting the warp or flexure control be used. The lever 31 is maintained in set position by a quadrant 32, secured in position upon one of the braces 23 forming the structure of the lower frame. It is by the operation of a steering wheel 33 and the lever 31 that the aviator controls the flight of the machine. The starting or stopping of the motor 18 is by means of the employment of any suitable and well known contrivance.

The machine is provided with ground traction wheels 34, 34. These are mounted on the ends of vertical legs 35, 35, as shown in Fig. 1 of the drawings. The wheels 34, 34 serve the same purpose and in substantially the same manner, as the wheel carriers of all accepted types of aeroplanes.

The present invention consists primarily in the method of control, and mechanism for effecting the same, whereby the aeroplanes or ends of the main planes, are disposed to produce lifting or depressing effects. The mechanism herein shown is best adapted to the use of ailerons 36, 36. These consist in the somewhat narrow elongated strips having an independent structure, and pivoted at 37, 37 to the main lateral brace forming the forward edge of the levitation planes 38, 38. The planes 38, 38 are slightly uptilted from their connection with the central brace 13 of the body structure of the machine, and extended laterally therefrom. The lateral extension and the longitudinal dimension of the planes are formed according to the design of the constructor. Likewise the bracing whereby the structure is prevented from collapsing varies according to the design of the architect constructing the same, and this, to prevent confusion, has been omitted in the present illustration and description. Suffice it at this time to say that the planes 38, 38 are of sufficient area to carry the load for which the machine is calculated, and are properly placed to prevent collapsing or flexing from the plane of operation for which they are designed. At the outer and rear end of the planes 38 are fixedly secured vertical rods 39, 39. The rods 39, 39 have mounted on the upper and lower ends thereof pulleys 40, 40, over which are passed operating cables 41, 41 and 42. The cables 41, 41 are each secured to an anchor block 43, and to the rear end of each of the ailerons 36. The cable 42 is passed around the lower pulleys 40, 40 and connected to the rear end of the ailerons 36, 36 at the same point. The cable 42 is stretched directly between the lower pulleys 40, 40 and the ailerons, serving merely as a balancing or return cable. The anchor block 43 is rigidly mounted on a bar 46. A sleeve 44 is provided with a flange 45 to form fastening holds for the ends of the cables 41, 41. The sleeve 44 is slidably mounted upon the pivoted bar 46. Between a collar 47 fixedly mounted on the said bar 46, and the sleeve 44, there is interposed a spiral spring 48, the operation of which is to extend the sleeve 44 carrying the block 43, and thereby automatically take up any slack in either or both of the cables 41, 41.

The bar 46 is pivoted upon a bolt 49 extended from a slide block 50. The bar 46 is extended forward from the pivot bolt 49, and is engaged by operating cables 51, 51. The cables 51, 51 are reeved over pulleys 52, 52 and 53, and anchored at the upper end of a rocking arm 54. The rocking arm 54 is securely mounted upon the shaft 22 and at the inner end thereof. The shaft 22 is fixedly attached to the aviator's carriage by triangularly disposed braces 55, 55.

With the construction and arrangement of the ailerons 36, 36, the cables 41, 41, the bar 46, the cables 51, 51 the rocking arm 54, and the aviator's carriage, it will be observed that as the carriage swings on the shaft 22 to change the angular relation of the said carriage with the planes 38, 38, the rocking arm 54 is moved to and from the one or the other of the pulleys 53, 53, to move, through the transmission cables 51, 51, the end of the bar 46 to which the said cables are attached in a direction opposite to that followed by the upper end of the said rocking arm 54. As the bar 46 is swung around the pivot bolt 49, the rear end thereof, to which are connected the cables 41, 41, is shifted, drawing on the one of said cables 41 and relieving the strain on the other. The result of this action is to elevate the rear end of the one aileron 36 on the one plane 38, while depressing in equal degree the rear end of the aileron 36 on the opposite plane 38.

When the machine is in flight, the operation of the ailerons is proportioned in their angularity to the plane of flight of the machine. The base of the angular plane of the ailerons is the pivot 37, and the peak of the said ailerons is the rear end thereof. The mechanism is constructed and arranged so that when the planes 38, 38, for any reason, be uptilted on one side to change the angle relative to the aviator's carriage, the aileron on the highest side is lifted at the rear end to form a downward inclination to produce a top or diving pressure. Simultaneously, the aileron on the lowered plane 38 is shifted to lower the rear end of said aileron, forming thereby an inclined plane to produce under the same a levitating pressure. The two pressures operate to right the planes 38, bringing them to a position hori-

zontal with the direction of gravity as represented by the hang of the aviator's carriage. As the planes are thus corrected, the arm 54 resumes the vertical position, bringing the bar 46 to a central position, where the cables 41, 41 move the ailerons 36, 36 into a parallel position with the planes 38, 38. It will be observed that the action is automatic and proportioned in extent to the shift of the planes 38, 38 from the horizontal position. It will also be observed that the operation of the aviator's carriage in thus swinging is made smooth and deliberate by reason of the piston rods 28, 28 operating in the dashpots 29, 29.

The cables 51, 51 are anchored upon a flange 56 of the sleeve 57, at the end whereof is a block 58, having mounted therein pulleys 59, 59. The construction of the sleeve 57, and parts connected therewith, is in all respects similar to the construction of the sleeve 44 and the parts connected therewith. The sleeve 57, at the forward end of the bar 46, is connected to a spiral spring 60, which in turn is anchored to a collar 61. By reason of the springs 48 and 60, the adjustment of the cables 41, 41 and 51, 51 is effected; and any slack or tension due to a motion of translation of the bar 46, is compensated in either cable and thus taken up.

Ailerons, plane sections and tips have heretofore been operated by connections with a swinging aviator's carriage. These connections have heretofore been automatic and set. A serious disadvantage in the operation of flying machines has resulted from the fact that the ailerons, being thus set, the control exercised thereby has not been proportioned to variation in wing pressures due to head winds, or to variation in speed of flight. This disadvantage may easily be appreciated when, by way of illustration, it is seen that a deflection which would operate with sufficient speed when a machine is traveling at twenty miles an hour would prove excessive for a machine traveling at the rate of sixty miles an hour. By means of the present construction the extent of the deflection of the ailerons is regulated and controlled by the aviator to meet the varying needs of the condition of flight.

The above mentioned control is needed for both the banking of the ailerons in correspondence with the steering action of the rudder, and in the balancing of straight line flight. To govern the latter the rocking arm 54 has mounted thereon a sliding block 104, to which the cables 51, 51 are securely fastened. By means of a cable 105 the block 104 is connected to a lever 106. The lever 106 is pivoted on the aviator's carriage at 107, and extended to the rear thereof to receive the cable 105. A quadrant 108 is provided to hold the lever 106 in set position. By the construction and arrangement of the lever 106, and the cable 105 connected therewith, the sliding block 104 is moved down on the arm 54, thereby proportionately shortening the length of the arc over which the block 104 is carried. As the block 104 is moved toward the pivotal center of the arm 54 a shorter path for the said block is furnished for any given swing of the aviator's carriage. The length of the path of the block 104 controls the amount of movement of the cables 51, 51, and the bar 46 connected therewith. Thus, if in a high wind, or flying at a high rate of speed, the aviator desires to shorten the movements of the ailerons in their vertical displacement, by lifting the lever 106 he depresses the block 104, and thereby limits the movement of the bar 46 and the rise and fall of the ailerons 36, 36. It will be seen that by the operation of this mechanism the aviator has perfect control of the deflection of the ailerons when in direct flight, accommodating the same to the speed of flight, and to variable or high wind pressures.

When the aviator desires to increase the deflection of the ailerons, he releases the lever 106. The block 104 is raised from its depressed position on the arm 54 by the spiral spring 60, which spring has been extended by the downward pull on the block 104 exerted by the lever 106. When the lever 106, therefore, is released, the spring 60 expands to draw upon the cables 51, 51, which lift the block 104 to the top of the arm 54.

The block 50, carrying the pivot bolt 49 and the bar 46, is slidably mounted in a runway formed by tracks 62, 62. The tracks 62, 62 are formed in cross section substantially as shown in Fig. 6, and are suspended in bracket arms 63, 63 of a head 64. The head 64 is bolted at 65 to a controlling mast 66. The tracks 62 are united by framing headers 67 and 68, the latter being arched to permit the passage therethrough of a lever arm 69. The arm 69 is connected by means of a link 70 to the block 50, and is utilized for shifting the said block 50. The link 70 is formed of a length adapted to extend the block 50 to the rear of the tracks 62, when the said arm 69 is stopped against the cross framing 71 of the machine. The framing 71 is provided with a bushing bearing 72 in which the mast 66 is rotated. A cross framing 73 is provided at the bottom to carry a foot casting 74 in which the said mast 66 is stepped. The frames 71 and 73 are suitably secured to the braces of the upper body frame.

The mechanism by which the block 50 is shifted lengthwise of the tracks 62, 62 consists of the link 70, the lever 69 and the means for rocking the said lever on a pivot shaft 75. The pivot shaft 75 is mounted in

the end of a bracket 76, which is provided with a tubular extension 77, provided to pass the mast 66 for adjustment thereon. The bracket 76 is fixed in position on the mast 66 by a set screw 78. Set out from the extension 77 is a shoulder 79, which forms a guide for the operation of a rack bar 80. The rack bar 80 is provided with a flange 81, which extends behind, and is held in guided relation with a guide flange 82 formed on the bracket 76 opposite the shoulder 79. The flanges 81 and 82 are sufficiently lengthened and closely nested to prevent the separation of the bracket structure and the rack structure. The rack 80 is provided with a series of gear teeth 83, which are normally engaged by the gear teeth of a sector 84. The sector 84 is fixedly mounted on the end of the shaft 75, as seen in Fig. 7 of the drawings. At the upper end of the rack bar 80 it is provided with a collar 85, which encompasses the mast 66, as shown in Fig. 8 of the drawings. The rack 80 is reciprocated vertically on the mast 66, and is guided in its reciprocation by the interlocking of the flanges 81 and 82 on the bracket 76, and by the collar 85 at the top of the said rack.

When the rack 80 is reciprocated, and by reason of the toothed engagement between the said rack and the sector 84, the shaft 75 is rocked, and the lever arm 69 is moved. The reciprocation of the rack 80 is controlled from a lever 86 mounted on the frame of the aviator's carriage at 87, and convenient to the hand of the aviator when seated in the seat 26. Erected upon the frame, and constructed and arranged concentrically with the pivot 87, is a quadrant 88, whereby the lever 86 is held in set position. The rack 80 and lever 86 are connected by means of cables 89 and 90, both of which are reeved over pulleys 91, 91, 92 and 93, and the former of which is connected with the upper end of the rack 80 at 94. The cable 89 is anchored to the lever 86 at 95, while the cable 90 is anchored to the said lever 86 at 96. The points of attachment of the said cables to the lever 86 are thus disposed on opposite sides of the pivot 87 of the lever 86. The cable 90 is connected with the lower end of the rack 80, being guided from within the mast 66 by twisted pulleys 97, 97. Both of the cables 89 and 90 are converged below the mast 66, and extended upward therethrough, the former passing to the top where it is reeved over the pulley 93, while the latter is carried but a short distance within the mast and led therefrom over the pulleys 97, 97.

It will be seen that with a construction arranged as shown and described, the aviator may, from the seat 26, by moving the lever 86, operate the cables 89 and 90 to lift the rack 80. The rack 80, in rising, rotates upward the sector 84, and through the connection thereby, the lever arm 69 is moved forward, carrying the link 70 and block 50 connected therewith, changing the relative disposition of the bolt 49 with the center of the mast 66.

The machine is steered by the aviator from the seat 26 by means of the steering wheel 33, and a winding block 98 on the end of the wheel post 30. Wound upon the said block 98 are tiller ropes 99, 99. These are led back and properly supported upon the tiller bar 100, made fast to the rudder 17. As stated, the rudder 17 is hinged at 16, 16 on the tiller post 15. A second tiller bar 101 is secured to the rudder at the top thereof. The tiller bar 101 is secured to a cross bar 102, fixedly mounted on the mast 66 by connecting ropes 103, 103. By this arrangement it will be seen that the rudder 17 is deflected from side to side to change the horizontal flight of the machine at the will of the aviator, steering by means of the wheel 33 and tiller ropes connected therewith. It will also be seen that by reason of the connection between the rudder and the mast 66 that the said mast is rotated in unison with the said rudder, and that the tracks 62, 62 are shifted in parallel disposition with the rudder 17.

The arrangement of the mechanism whereby the block 50 is shifted to and from the pivotal center of the mast 66 is provided to lessen or increase the automatic shift of the ailerons. It will be readily perceived that the disposition of the ailerons, when the machine is in flight at the rate of sixty miles an hour would require a different arrangement than when traveling at the rate of twenty miles an hour. The bank needed for the swing at the rate of twenty miles an hour would overturn the machine if traveling at the rate of sixty miles an hour.

The variation of the deflection of the ailerons, when operating in conjunction with the rudder, and when employed for making what is termed a bank, is controlled by the mechanism hereinafter described.

When the aviator finds that by reason of increased flight, or by reason of head winds, that his bank of the ailerons is too sensitive, he may, by shifting the lever 86, lower the rack 80, and thereby shift the pivot block 50 closer toward the rear end of the tracks 62. In doing this he has shortened the arc of the swing of the block 43 and the cables 41, 41 connected therewith.

In explanation of the operation of the bar 46 and the floating pivot block 50, attention is called to the fact that the end of the bar to which the cables 51, 51 are attached is the fixed point about which the said bar is rotated, and that the pivotal connection on the block 50 forms the shifting medium for the said bar 46. This is best seen by reference

to Figs. 9 to 12 inclusive of the drawings. Thus, it will be seen that when the pivotal center of the bar 46 and the mast 66 coincide, the deflection of the tracks 62 from the longitudinal straight line does not affect the disposition of the bar 46. When, however, as is illustrated in said figures of the drawings, the block 50 is removed from the pivotal center of the mast 66, then the arc of movement of the rear end of the bar 46 is increased in proportion as the block 50 is advanced from the center of the said mast. In this manner the aviator exerts perfect control over the ailerons when operating in conjunction with the rudder 17.

In explanation of the diagrams shown in Figs. 9 to 12 inclusive, the disposition of the ailerons 36, 36 and rudder 17 shown in Fig. 9 is that wherein the machine is pursuing an even straight flight. In Fig. 10, the disposition of the ailerons and rudder is that wherein the machine is being turned in a horizontal direction, and as indicated by the arrow therein. It will be noted that the pivot block 50 has been advanced toward the forward end of the tracks 62, thereby effecting a wide displacement from the horizontal, indicated by the broken line *a* in said diagram. In Fig. 11 the disposition of the ailerons and rudder is opposite to that shown in Fig. 10, illustrating the arrangement of the same when making a turn to the left, or as indicated by the arrow in said figure. In Fig. 12 is shown the disposition of the ailerons and rudder when the machine is in straight line flight, and the ailerons are operating to balance the machine. It will be noted in this connection that the arm 54 illustrates the extent of the inclination of the planes in each of said figures.

When in flight the machine is controlled or guided to change its vertical disposition by the diving planes 109, 109. These planes are horizontally extended in frames suitably rigid to preserve the shape of the said planes. The planes are fixedly mounted upon a shaft 110. The shaft 110 is pivotally mounted upon the frame, at the forward end thereof. Fixedly connected to the shaft 110 is a depended arm 11, as seen best in Fig. 3 of the drawings. The free end of the arm 111 is operatively connected with a lever 112 by a connecting rod 113. The lever 112 is pivotally mounted at 114 and is extended in parallel relation to a quadrant 115. The quadrant 115 is serrated as shown in Fig. 3 of the drawings, and the lever 112 is provided with a spring-actuated detent to engage in holding relation the serrations formed on the said quadrant 115. By means of this arrangement it is obvious that the aviator may, by shifting the lever 112, vary the horizontal angle of the planes 109, 109. It is equally obvious that the planes 109, by means of the quadrant 115, will be at all times held at the angle at which the aviator has elected to place the said planes.

While I herein describe the plane members as ailerons, it will be understood that wing flexure devices may be substituted therefor, and are intended to be comprehended within the term "aileron" as herein used.

The action of the centrifugal component in banking has been taken into consideration in this invention. The gravity component and the centrifugal component will have a resultant oblique to the vertical. The gearing will utilize this force as the controlling power for balancing when the machine is taking a bank, this resultant acting in the same manner as the gravity vertical force in the above description.

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

1. In an air ship embodying a body frame, levitating means, and a steering gear having a rudder for varying the path of flight and means for shifting said rudder; a balancing gear, comprising wing flexure members mounted on said levitating means; a gravity controlled pendant member pivotally mounted on said body frame; a transmission mechanism connecting said pendant member and said wing flexure members to change the angle of inclination of said flexure members in consonance with the transverse deflection of said body frame; and manually operated means for varying at will the ratio of transmission.

2. In an airship, embodying a body frame, levitating means, and a steering gear having a rudder for varying the path of flight and means for shifting said rudder, a balancing gear, comprising wing flexure members mounted on said levitating means; a gravity controlled pendant member pivotally mounted on said body frame; means for controlling the swing of said pendant member; a transmission mechanism connecting said pendant member and said wing flexure members to change the angle of inclination of said flexure members in consonance with the transverse deflection of said body frame; and manually operated means for varying at will the ratio of the transmission.

3. In an airship, embodying a body frame, levitating means, and a steering gear having a rudder for varying the path of flight and means for shifting said rudder, a balancing gear, comprising wing flexure members mounted on said levitating means; a gravity controlled pendant member pivotally mounted on said body frame; dash-pots mounted on said pendant member and provided with perforated pistons pivotally secured upon the said body frame and adapted to regulate the speed of oscillation of said

pendant member; a transmisison mechanism connecting said pendant member and said wing flexure members to change the angle of inclination of said flexure members in consonance with the transverse deflection of said body frame; and manually operated means for varying at will the ratio of the transmission.

4. In an airship, embodying a body frame, levitating means, and a steering gear having a rudder for varying the path of flight and means for shifting said rudder, a balancing gear, comprising wing flexure members mounted on said levitating means; a gravity controlled pendant member pivotally mounted on said body frame; a transmission mechanism connecting said pendant member and said wing flexure members to change the angle of inclination of said flexure members in consonance with the transverse deflection of said body frame; a movable connector for said transmission mechanism and the said pendant member; and a hand operated lever connected with said movable connector the operation whereof disposes the said connector to and from the pivotal center of said pendant member to vary the arc of travel of said connector.

5. In an airship, embodying a body frame, levitating means, and a steering gear having a rudder for varying the path of flight and means for shifting said rudder, a balancing gear, comprising wing flexure members mounted on said levitating means; a gravity controlled pendant member pivotally mounted on said body frame; a rocking lever pivotally mounted on said frame; flexible connectors attached to the end of said rocking lever to operate from opposite sides thereof; an anchoring device for said connectors slidably mounted on said pendant member; a lever mounted on said pendant member adapted to be manually operated; and means connecting said lever and sliding device for regulating the position of said sliding device relative to the pivotal center of said pendant member.

6. In an airship, embodying a body frame, levitating means, and a steering gear having a rudder for varying the path of flight and means for shifting said rudder, a balancing gear, comprising wing flexure members mounted on said levitating means; a gravity controlled pendant aviator's car; a rocking lever pivotally mounted on said body frame and extended longitudinally therewith; a plurality of vertical rods mounted on said frame adjacent to the movable ends of said flexure members and extended to the extremes of the movement thereof; flexible connectors attached to the end of said rocking lever and to the said flexure members, being guided over said vertical rods to deflect the said flexure members simultaneously and in opposite vertical directions in consonance with the movement of said lever; an arm mounted on said aviator's car radially extended from the pivot thereof; a sliding device mounted on said arm; and transmission means connected with said sliding device and the end of said rocking lever opposite that attached to said flexible connectors adapted to move the said lever proportionately to the movement of said arm; and operating means manually controlled from the aviator's car, connected with said sliding device for varying the disposition of said device on said arm.

7. In an airship, embodying a body frame, levitating means, a steering gear having a rudder for varying the path of flight, and means for shifting said rudder; a balancing gear, comprising wing flexure members mounted on said levitating means; a gravity controlled pendant aviator's car; an arm fixedly mounted on said aviator's car and extended radially from the pivot thereof; a rocking lever pivotally mounted on said body frame and extended longitudinally thereon; a sliding block mounted on said arm; means operable from the aviator's car for sliding said block to and from the pivot of said car; flexible resilient means connecting said sliding block and the one end of said lever; and means connecting the opposite end of said rocking lever with said flexure members to vary the pitch of said flexure members in consonance with the movement of said lever.

8. In an airship, embodying a body frame, levitating planes, a steering gear having a rudder for varying the path of flight, and means for shifting said rudder, a balancing gear, comprising a plurality of ailerons mounted on said planes and at the lateral extremes thereof; a gravity controlled aviator's car; a rocking lever mounted on said body frame and extended longitudinally therewith to rock horizontally; vertical members fixedly mounted on the outer and rear edge of said planes; a cable connecting one end of said rocking lever and the free ends of said ailerons, said cable being supported on said vertical members; a second cable connected to the free ends of said ailerons and guided by said vertical members; cables attached to the end of said rocking lever and guided on said body frame to turn the said lever on its pivot; an arm fixedly mounted on said aviator's car and extended in line with and radially from the pivotal center of said car; a sliding block mounted on said arm attached to the latter of said cables; a hand lever mounted on said car within reach of the aviator; a cable connecting said hand lever and said sliding block to depress the said block toward the pivotal center of said car; and resilient means connected with the cable attached to said block to lift said block from said pivotal center.

9. In an airship, embodying a carrying frame, an aviator's car suspended from said frame, and a rudder arranged to vary the horizontal path of flight, a balancing gear, comprising an auxiliary pivot mast having an elongated head and a cross arm fixedly mounted thereon; means for connecting the said cross arm and the tiller arm of the rudder in parallel relation; a rocking lever pivotally mounted on said elongated head to slide therein to and from the pivotal center of said mast; flexure members mounted on said frame; vertical members fixed on said frame in position adjacent to said flexure members; flexible connectors attached to said flexure members and one end of said rocking lever for transmitting the motion of said rocking lever to said flexure members; and means for sliding the said rocking lever in said elongated head.

10. In an airship, embodying a carrying frame, an aviator's car suspended from said frame, and a rudder arranged to vary the horizontal path of flight, a balancing gear, comprising an auxiliary pivot mast having an elongated head and a cross arm fixedly mounted thereon; means for connecting the said cross arm and the tiller arm of the rudder in parallel relation; a rocking lever pivotally mounted on said elongated head to slide therein to and from the pivotal center of said mast; flexure members mounted on said frame; vertical members fixed on said frame in position adjacent to said flexure members; flexible connectors attached to said flexure members and one end of said rocking lever for transmitting the motion of said rocking lever to said flexure members; a hand lever pivotally mounted on said aviator's car; and cables connecting said hand lever and said rocking lever to slide the same in said elongated head.

11. In an airship, embodying a carrying frame, levitating planes attached to said frame, a plurality of flexure members mounted on said planes at the extremes thereof, and an aviator's car supported on said frame, a balancing gear, comprising a rudder pivotally mounted on said frame to vary the horizontal path of flight; a mechanism for shifting said rudder; and a transmission mechanism interposed between said rudder and said flexure members embodying a floating pivot disposed in a track parallel to the rudder extension and movable to vary the arc of travel of said floating pivot.

12. A balancing gear for airships, comprising a rudder vertically mounted on said ship; an elongated track member pivotally mounted on said ship in parallel relation to said rudder; means connecting said track member and said rudder for maintaining the parallelism of the said rudder and said track member; ailerons pivotally mounted on the frame of the ship at the lateral extremes thereof; a slidable member mounted on said track member; flexible connections attached to said ailerons and said slidable member to vary the inclination of said ailerons; and means operable from the aviator's car for shifting said slidable member in said track member to and from the pivotal center thereof.

13. A balancing gear for airships, comprising a vertical pivot mounted on the frame of said airship and having a lateral extension; means connecting said lateral extension with the rudder of said ship to preserve the said rudder and said lateral extension in parallel relation; a plurality of ailerons mounted on said ship and at the lateral extremes thereof; vertical members disposed adjacent to the free ends of said ailerons; a rocking lever pivotally connected upon said lateral extension and in sliding relation thereto; connecting cables attached to said ailerons and to one end of said rocking lever; and means for shifting said lever on said extension, operable from the aviator's car.

14. A balancing gear for airships, comprising a mast pivotally mounted upon the frame of the ship and having a lateral extension; a rudder pivotally mounted upon the said frame of the ship to vary the horizontal flight thereof; means connecting said rudder and said mast to preserve the parallel arrangement of said lateral extension and said rudder; a rocking lever pivoted in sliding relation upon said lateral extension of said mast; an aviator's car pivotally mounted upon and pendant from the body frame of said ship, and having a member vertically extended from the pivot of said car; a plurality of elongated ailerons pivotally mounted on the levitating frame of said ship and at the extremes thereof; vertical members fixedly mounted on the said levitating frame at the outer and rear ends thereof in adjacent relation to the free ends of said ailerons; a plurality of cables attached to said ailerons and to the one end of said rocking lever to lift the same in consonance with the movement of said lever; a plurality of cables connecting the opposite end of said lever with said vertical member of the aviator's car; means for maintaining the median position of said ailerons; and means operable from the aviator's car for shifting the said rocking lever on said extension to and from said mast, to augment and decrease the path of movement of the end of said lever connected with the said ailerons.

15. A balancing gear for airships, comprising a mast pivotally mounted upon the frame of the ship and having a lateral extension; a rudder pivotally mounted upon said frame of the ship to vary the horizontal flight thereof; means connecting said rud-

der and said mast to preserve the parallel arrangement of said lateral extension and said rudder; a rocking lever pivoted in sliding relation upon said lateral extension of said mast; an aviator's car pivotally mounted upon and pendant from the body frame of said ship, and having a member vertically extended from the pivot of said car; a plurality of elongated ailerons pivotally mounted on the levitating frame of said ship and at the extremes thereof; vertical members fixedly mounted on the said levitating frame at the outer and rear end thereof in adjacent relation to the free ends of said ailerons; a plurality of cables attached to said ailerons and to the one end of said rocking lever to lift the same in consonance with the movement of said lever; a plurality of cables connecting the opposite end of said lever with said vertical member of the aviator's car; means for maintaining the median position of said ailerons; means operable from the aviator's car, for shifting the said rocking lever on said extension to and from said mast to augment and decrease the path of movement of the end of said lever connected with the said ailerons; and means operable from the aviator's car, for shifting the connection of the cable and the vertical member extended from said car to vary the length of the movement of said connection.

16. A balancing gear for airships, comprising a mast pivotally mounted on the frame of said ship; a T-shaped track mounted on said mast; a sliding block supported in said track; a rocking lever pivotally mounted on said block; a lever pivoted on said mast, movable in line with said track; reciprocating means slidably mounted on said mast, connected with said lever to rock the same; and means operable from the aviator's car, for adjusting said reciprocating means.

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

HAROLD MASON DE GRAW.

Witnesses:
GEORGE N. WATKINS,
THOMAS L. GASKILL.