E. E. JOHNSON.

MEANS FOR STABILIZING MOVING BODIES.

APPLICATION FILED NOV. 15, 1921.

1,437,183. Patented Nov. 28, 1922.

2 SHEETS—SHEET 1.

FIG. 1.

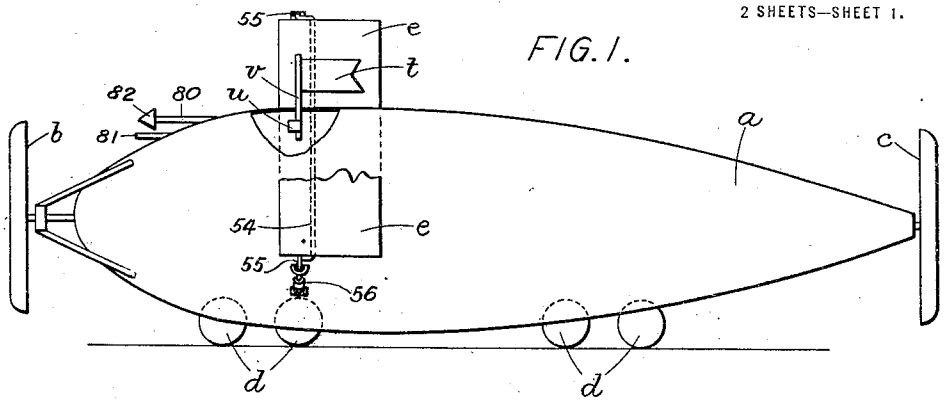


FIG. 2.

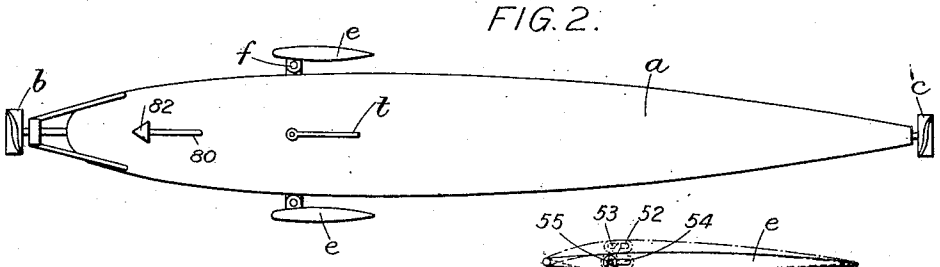
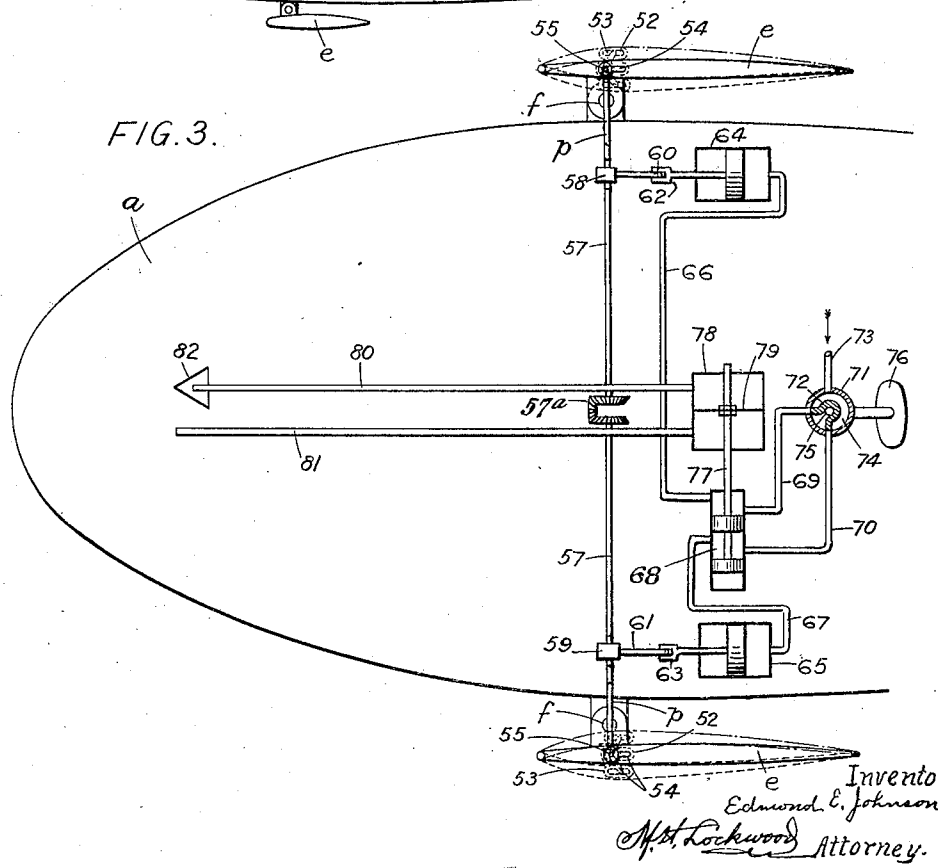


FIG. 3.



Inventor,
Edmund E. Johnson
by H. St. Lockwood Attorney.

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2 SHEETS—SHEET 2.

FIG. 4.

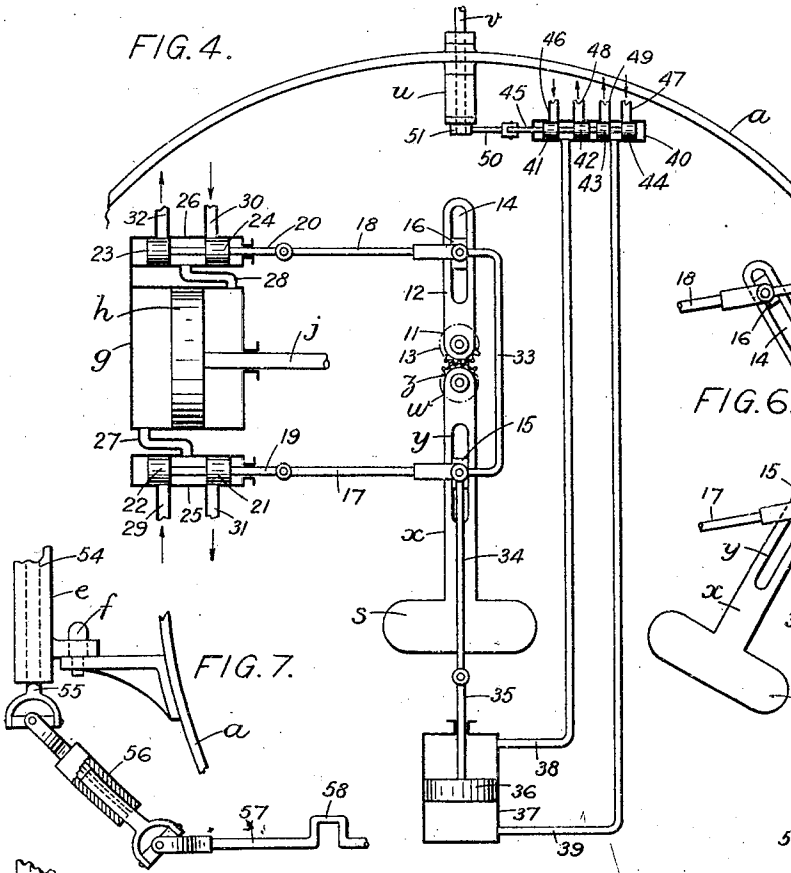
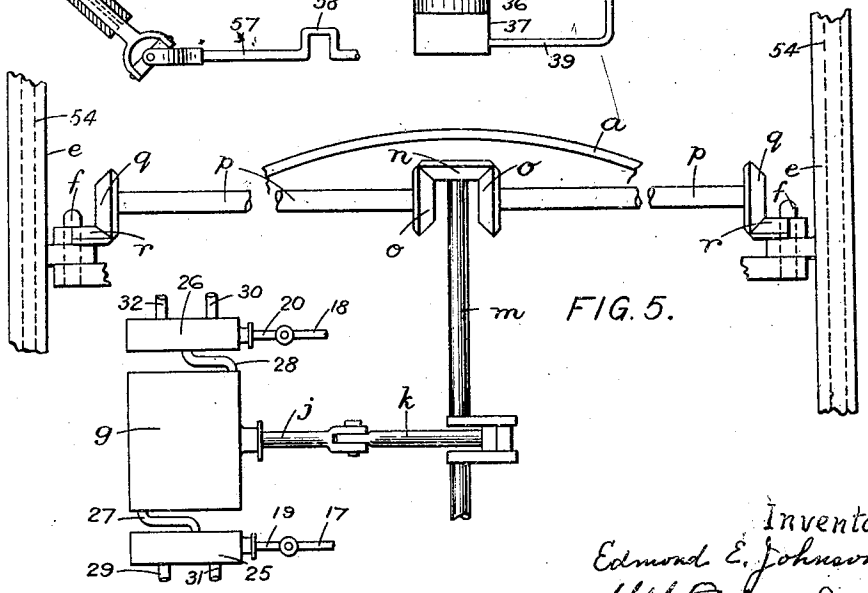


FIG. 6.

FIG. 7.

FIG. 5.



Inventor,
Edmund E. Johnson
M. A. Lockwood
Attorney.

Patented Nov. 28, 1922. 1,437,183

UNITED STATES PATENT OFFICE.

EDMOND ERNEST JOHNSON, OF MAIDENHEAD, ENGLAND.

MEANS FOR STABILIZING MOVING BODIES.

Application filed November 15, 1921. Serial No. 515,217.

To all whom it may concern:

Be it known that I, EDMOND ERNEST JOHNSON, of Maescourt, Maidenhead, in the county of Berks, England, a British subject, have invented certain new and useful Improved Means for Stabilizing Moving Bodies, of which the following is a specification.

This invention relates to means for neutralizing forces acting laterally in a horizontal plane such, for instance, as centrifugal force or the effects of side winds, on a moving monorail vehicle.

According to this invention a monorail vehicle body is provided on each side with an aerofoil or cambered vane mounted so that its angle of incidence may be varied about a vertical axis and constructed so that its camber may be varied towards either side of a neutral plane.

Each aerofoil is adapted to exert, when the monorail vehicle body is in motion through the air, a lateral force adapted to counteract a lateral force such as the centrifugal action set up when rounding a curve or the effect of a side wind, and for the purpose of conteracting such force as closely as possible each aerofoil may be set by hand, both with regard to its angle of incidence and with regard to its camber, but preferably automatically acting means would be provided to attain these ends. For instance, a servo-motor may be employed for varying the angle of incidence of the aerofoils, to the one side or the other, to counteract centrifugal force in rounding a curve the valve chests for permitting the servo-motor to operate, in the one direction or the other, being controlled by a pendulum and a correspondingly moving arm geared thereto, whilst a servo-motor controlled by a pennant may be employed, in conjunction with the pendulum-controlled servo-motor, for a like purpose to counteract the effect of a side wind, and a servo-motor controlled by an aero-static device may be employed for varying the camber of the aerofoils to maintain the latter at their most efficient configuration according to the speed at which the monorail vehicle body is moving. The aerofoils are operated simultaneously and in the same direction so that when their angle of incidence is varied the force acting on the one would tend to push, and the force acting on the other would tend to pull, the vehicle body towards the inner side of the curve.

The aerofoils should be mounted so that their centres of pressure lie in or near the transverse vertical and horizontal planes in which lie the centre of gravity of the vehicle and the means for varying their angle of incidence and camber may be of any known type as used on aeroplanes. By the use of aerofoils as set forth above a component of the resistance presented by each counteracts the laterally acting centrifugal or wind force.

If desired, and for the preservation of balance, when the vehicle body or bodies is or are moving at speed, one or more additional aerofoils may be provided and mounted on each body so that the angle of incidence of each aerofoil is variable about an axis passing through the centre of gravity of the respective body. When more than one additional aerofoil is employed on a body, they may be operated simultaneously but may act in conjunction with each other thereby displacing a volume of air, on each side of the moving vehicle body of sufficient mass to maintain lateral rolling equilibrium. Their controls may also be operated automatically through forces acting from the body at the point or points of contact with the supporting medium.

In addition to the stabilizing effects which may be obtained the aerofoils may also be actuated so as to operate as brakes.

The accompanying drawings illustrate diagrammatically one method of carrying out the invention; Fig. 1 being a side elevation of a monorail vehicle, parts being broken away, and Fig. 2 being a plan thereof. Fig. 3 is a plan on a larger scale of the means for varying automatically the camber of the aerofoils, Fig. 4 is a transverse sectional elevation on a still larger scale of means for varying the angle of incidence of the aerofoils. Fig. 5 is a similar view of another portion of the means shown in Fig. 4, which portion has been omitted from Fig. 4 for the sake of clearness whilst a servo-motor and its valve chests are shown in both Fig. 4 and Fig. 5 to

facilitate comprehension of the relationship of the different parts; Fig. 6 is a detail view showing the pendulum and its associated parts in positions different from those shown in Fig. 4, whilst Fig. 7 is a sectional elevation on a still larger scale showing a detail of the means illustrated by Fig. 3.

As shown in Figs. 1 and 2, a monorail vehicle has a semi-streamline body *a* and is provided with tractor and pusher propellers *b* and *c* and track wheels *d*. At each side of the body *a* an aerofoil *e* is mounted so that its angle of incidence may be varied about a vertical axis *f* situated near its leading edge, such variation being effected automatically by a servo-motor *g*, which is shown in both Figs. 4 and 5 and the piston *h* of which is connected by its piston rod *j* and a connecting rod *k* with a vertical crank shaft *m* at the top of which is a bevel wheel *n* meshing with bevel wheels *o. o.* each on a shaft *p* projecting through the body *a* near its top and at the opposite end of which is a bevel wheel *q* meshing with a bevel quandrant *r* secured to the frame of the aerofoil *e* so that movement of the piston *h* either way from the mid-position shown in Fig. 4 will vary the angle of incidence of the aerofoils *e. e.* in the one direction or the other.

The servo-motor *g* is controlled by a pendulum *s* within the body *a* which pendulum is subjected to centrifugal force, whilst the action of the pendulum may be modified by a pennant *t* situated outside and above the body *a*, in the vertical plane of the track wheel *d* . . . and above the widest part of the body *a* which pennant is subjected to the action of side winds and is balanced against centrifugal force by a bob weight *u* mounted on the opposite side of its spindle *v* and within the body *a* and of the requisite mass depending upon the distances of its centre of gravity from the axis of the spindle *v*. In Fig. 1 the upper portion of the nearer aerofoil and part of the body *a* are broken away showing the pennant *t*, its bob-weight *u* and its spindle *v* in full lines.

The pendulum *s* is pivoted at *w* as high as possible and vertically above and parallel with the longitudinal axis of the body *a* and its arm *x* is slotted as at *y* and formed at its upper end with a toothed quadrant *z* meshing with a corresponding toothed quadrant 11 formed at the lower end of an arm 12 pivoted at 13 and slotted as at 14. In the slots *y* and 14 are mounted slide blocks 15 and 16 united by connecting rods 17 and 18 with the piston rods 19 and 20 of piston valves 21, 22 and 23, 24 situated in valve chests 25 and 26 respectively. The valve chests 25 and 26 communicate from the middle of the length of each with opposite ends of the cylinder of the servo-motor *g* by pipes 27 and 28 and the piston valves 22 and 24 normally close the inlet pipes 29 and 30 to, whilst the piston valves 21 and 23 normally close the exhaust pipes 31 and 32 from, the valve chests 25 and 26, it being understood that the inlet pipes 29 and 30 are connected with a suitable supply of fluid under pressure (not shown) whilst the exhaust pipes 31 and 32 are led away to a convenient location.

As the pendulum *s* swings to the one side or the other the arm 12 is moved correspondingly and the connecting rods 17 and 18 and valve rods 19 and 20 are moved in the same direction, so that either the inlet pipe 29 and the outlet pipe 32 or the inlet pipe 30 and the outlet pipe 31 are uncovered and fluid under pressure is admitted to the one side, and exhausted from the other side, of the piston *h*, which is consequently moved in the one direction or the other to vary the angle of incidence of the aerofoils *e. e.* as hereinbefore set forth.

The slide blocks 15 and 16 are united by a yoke 33, which is in turn united by a connecting rod 34 with the piston rod 35 of the piston 36 of a servo-motor cylinder 37, the opposite ends of which communicate by pipes 38, 39, with a valve chest 40 in which are disposed four piston valves 41, 42, 43, 44, on a valve rod 45. The piston valves 41 and 44 normally close inlet pipes 46 and 47 to, and the piston valves 42 and 43 normally close exhaust pipes 48 and 49 from, the valve chest 40, and the valve rod 45 is united by a connecting rod 50 with a crank 51 (with which may be combined the bob-weight *u*) on the spindle *v* of the pennant *t*, so that as the spindle *v* turns in the one direction or the other as a result of the action of a side wind on the pennant *t* the valve rod 45 is acted upon to cause the inlet pipe 46 and outlet pipe 49 or the inlet pipe 47 and the outlet pipe 48, to be uncovered thus admitting fluid under pressure by way of the pipe 38 or the pipe 39 to one side of the piston 36 in the servo-motor cylinder 37 and exhausting fluid from the other side of said piston by way of the pipe 39 or the pipe 38, according as the wind acts upon the pennant from the one side or the other.

Movement of the piston 36 in the servo-motor cylinder 37 causes the blocks 15 and 16 to be slidden up or down in the slots *y* and 14 thus varying the leverage of the action of the pendulum *s* on the valve rods 19 and 20 as shown in Fig. 6 and modifying the valve opening to correspond with the algebraic sum of the pendulum and pennant movements, *i. e.* the valve opening which should result from a given amount of centrifugal action on the pendulum *s* may be augmented or decreased, as a result of wind action on the pennant *t*. That is to say if the monorail vehicle body *a* be rounding a curve to the right centrifugal action

will cause it to lean to the left and the pendulum *s* will consequently swing from its normal upright position to the left as shown in Fig. 6, this will cause the inlet pipe 29 and the outlet pipe 32 to be opened (to an extent corresponding with the extent of swing of the pendulum *s*), and the outlet pipe 31 and the inlet pipe 30 to be closed thus moving the piston *h* and its rod *j* to the right so as to turn the vertical crank shaft *m* and shafts *p*. *p* to incline the aerofoils *e*, *e* towards the right to the required extent, the angles of incidence thus imparted tending to restore the vehicle body *a* to its upright position. If at the same time as the pendulum *s* thus swings to the left the pennant *t* be acted upon by a wind from the left, this will to some extent counteract the effect of centrifugal action, and consequently the angles of incidence imparted to the aerofoils *e*, *e*, should be less. As a result of this wind action on the pennant *t* the inlet pipe 47 and outlet pipe 48 will be opened thus moving the piston 36 piston rod 35, connecting rod 34 yoke 33 and slide blocks 15 and 16 from their normal positions equidistant from the pivotal axes of the pendulum *s* and arm 12 upwards. The positions of the parts resulting from the combined action of a wind from the left and rounding a curve to the right is shown in Fig. 6. This reduces the leverage of the pendulum *s* on the connecting rod 17 and piston rod 19 thus causing the inlet pipe 29 to be opened to a smaller extent while the upward movement of the slide block 16 increases the leverage of the arm 12 on the connecting rod 18 and piston rod 20, thus causing the outlet pipe 32 to be opened to a great extent with the result that the angles of incidence imparted to the aerofoils *e*, *e* are less than would have been the case if there had been no side wind. Had the wind acting on the pennant *t* been from the right it would have augmented the effects of centrifugal action and to counteract this the inlet pipe 46 and outlet pipe 49 would have been opened with the result that the piston 36 and with it the slide blocks 15 and 16 would have been moved downwards from their normal positions equidistant from the pivotal axes of the pendulum *s* and arm 12, thus increasing the leverage of the pendulum *s* and decreasing the leverage of the arm 12 so that the inlet pipe 29 would have been opened to a greater extent and the outlet pipe 32 to a less extent than would have been the case if there had been no side wind, so that greater angles of incidence would be imparted to the aerofoils *e*, *e*. Similarly, if the vehicle be rounding a curve to the left the pendulum *s* would swing to the right and open the inlet pipe 30 and outlet pipe 31 to incline the aerofoils *e*, *e*, to the left; a wind from the left would to some extent augment the effect of centrifugal force and the opening of the inlet pipe 47 and outlet pipe 48 and the consequent upward movement of the slide blocks 16 and 15 from their normal positions equidistant from the pivotal axes of the pendulum *s* and arm 12 would increase the leverage of the arm 12 and decrease the leverage of the pendulum *s* so that the inlet pipe 30 would be opened to a greater extent and the outlet pipe 31 to a less extent than would be the case if there were no side wind thus causing greater angles of incidence to be imparted to the aerofoils *e*, *e*, whilst if the wind be from the right the opening of the inlet pipe 46 and outlet pipe 49 and the consequent lowering of the slide blocks 16 and 15 from their normal mid-positions would decrease the leverage of the arm 12 and increase the leverage of the pendulum *s* so that the inlet pipe 30 would not be opened to so great an extent and the outlet pipe 31 would be opened to a greater extent than would be the case if there were no side wind, thus causing the angles of incidence imparted to the aerofoils *e*, *e* to be decreased according to the strength of the side wind. It would appear that as the pennant *t* is the only controlling element on which side winds act directly and that as the effect of movement of said pennant is to cause an upward or downward movement of the slide blocks 15 and 16 from their normal mid-positions, such movement would be non-effective except when the pendulum *s* and arm 12 are displaced from their normal vertical positions as a result of the effect of centrifugal action on the vehicle body *a* when rounding a curve, but it must be borne in mind that a side wind of sufficient force to be taken into consideration would not only act upon the pennant *t* but would also tend to, and in fact, would, to some extent, cause the body *a* to lean over to one side or the other (to the right if the wind be from the left and vice versa) thus producing obliquity of the pendulum *s* and arm 12 and bringing about a corresponding setting of the aerofoils *e*, *e* to counteract the wind effect and right the body *a*.

It is to be understood that the mechanism shown in Figs. 4 and 5 lie in the same or nearly the same plane and that they are shown separately merely for the sake of clearness.

In order that the camber of the aerofoils *e e* may be adjusted so that their configuration is the most efficient according to the speed at which the vehicle is travelling, and according to centrifugal action on the body *a*, each aerofoil *e* is hollow and has fixedly mounted therein a block or blocks, such as 52 through a slot 53 in each of which passes the crank 54 of a vertical crank shaft 55 adapted to deform the walls of the aerofoil *e* and so adjust its camber. Each crank

shaft 55 is connected by an extensible camber shaft 56 (Fig. 7) with a crank shaft 57 (Figs. 3 and 7) and these crank shafts are disposed transversely of and near the bottom of the body *a* and are interconnected by suitable gearing as at 57ª so as to rotate in opposite directions. The cranks 58 and 59 of the crank shafts 57, 57 are united by connecting rods 60, 61 with the piston rods 62, 63 of servo-motors 64, 65, the cylinders of which are connected through pipes 66—67 with a valve chest 68 similar to the valve chests 25 and 26, except that the valve chest 68 has four ports instead of three. The valve chest 68 has two inlets 69, 70 for fluid under pressure connected with the casing 71 of a cock 72, said casing being connected by a pipe 73 with a source of fluid under pressure (not shown). The cock 72 has an admission port 74 extending through nearly 270° and a centrally escaping exhaust port 75 extending through nearly 90° and is operated by a pendulum 76. The valve rod 77 of the valve in the chest 68 passes slidably through the ends of a chamber 78 in which is centrally disposed a flexible diaphragm 79 to which said valve rod 77 is secured. Opening into the chamber 78 are two pipes 80 and 81, one at each side of the diaphragm 79, said pipes leading forwardly and projecting through the body *a*, the open end of the pipe 80 being covered by a cowl 82. As the vehicle moves forward the rush of air over the cowl 82 creates a partial vacuum in the pipe 80, whilst the air entering the open end of the pipe 81 sets up pressure therein with the result that the diaphragm 79 is deformed, the valve rod 77 is moved and the ends of both pipes 69 and 70 are covered, to an extent depending upon the speed of the vehicle, the greater the speed the more said ends are closed. The pipes 69 and 66 are thus normally in communication with one another, as are also the pipes 70 and 67, and the aerofoils *e e* occupy the mid-position shown in full lines in Fig. 3. The admission port 74 of the cock 72 is adapted, when said cock is turned in the one direction or the other, to establish communication between the pipe 73 and either the pipe 69 and therefore the pipe 66, or the pipe 70, and therefore the pipe 67, thus admitting fluid under pressure to the cylinder of the servo-motor 64 or of the servo-motor 65 whilst the exhaust port 75 communicates with either the pipe 70 and therefore with the pipe 67, or with the pipe 69, and therefore with the pipe 66 and exhausts the cylinder of the servo-motor 65 or of the servo-motor 64.

The pendulum 76 which actuates the cock 72 being subject to centrifugal action serves to determine to which of the servo-motors 64 and 65 fluid under pressure shall be admitted and from which fluid shall be exhausted, and thus determines which shall actuate the crank shafts 57, 57, and 55, 55, according as it becomes necessary to vary the camber of the aerofoils *e e* to, and adjust it on, the one side or the other of the central neutral chords, as indicated in Fig. 3. Normally the pendulum 76 occupies a vertical position so that the inlets to both the pipes 69 and 70 are closed, when, therefore, the diaphragm 79 is deformed (to an extent which depends upon the speed of the vehicle) as a result of the pressure set up in the pipe 81 and of the partial vacuum created in the pipe 80 the valve rod 77 is moved but neither servo-motor 64 nor 65 is operative and each aerofoil *e*, remains symmetrical about its central neutral chord, as shown in full lines in Fig. 3, no matter what may be the speed of the vehicle and the consequent extent of deformation of the diaphragm 79. When, however, the vehicle leans over to one side or the other under wind or centrifugal action, or both, either the inlet 69 or 70 is placed in communication with the pipe 73 according as the body *a* leans to the right or to the left and consequently either the servo-motor 64 or 65 is caused to actuate the crank shafts 57, 57, and 55, 55 so as to vary the camber of the aerofoils *e e* to, and adjust it on, the one side or the other of the central neutral chords, the extent to which such adjustment takes place depending on the extent of deformation of the diaphragm 79 and consequent closure of the pipes 69 and 70, as a result of the speed of the vehicle; the slower the speed the less the deformation of the diaphragm 79, consequently the less the closing of the pipes 69 and 70 and the more the movement of the pistons in the servo-motors 64 and 65, so that the camber of the aerofoils *e*, *e* is greater the less the speed. Thus assuming the cranks 58 and 59 to be in such an angular position in Fig. 3 (vertically upwards from their crank shafts 57, 57) that forward movement of the piston rod 62 will move the crank 58 forwardly and the crank 59 rearwardly, the crank shafts 55 of the aerofoils *e*, *e* will be moved clockwise and the variation of camber of the aerofoils *e*, *e* (and its adjustment) will be towards the left i. e. relatively to the direction of movement of the vehicle, as shown in dotted lines, whilst forward movement of the piston rod 63 will move the crank 59 forwardly and the crank 58 rearwardly and produce counter-clockwise movement of the crank shafts 55, so that the variation of camber of the aerofoils *e*, *e* (and its adjustment) will be towards the right, i. e. relatively to the direction of movement of the vehicle as shown in dot and dash lines.

It is to be understood that the valve mechanism of the various servo-motors may include any known form of hunting gear, where required, in order to cut off admis-

sion of fluid under pressure to the cylinders of the servo-motors in accordance with the effect to be produced.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In a monorail vehicle the combination with the body thereof of means for neutralizing lateral forces acting on either side of said body when in motion, said means being adapted to exert in a horizontal plane on either side of said body when in motion, forces opposed to said lateral forces, said means comprising two aerofoils or cambered vanes mounted on vertical axes and arranged on either side of said body with their centers of pressure lying in the transverse vertical and horizontal planes in which lies the center of gravity of said vehicle, and means adapted to vary the angle of incidence of each aerofoil or cambered vane.

2. In a monorail vehicle the combination with the body thereof of means for neutralizing lateral forces acting on either side of said body when in motion, said means being adapted to exert in a horizontal plane on either side of said body when in motion, forces opposed to said lateral forces, said means comprising two aerofoils or cambered vanes mounted on vertical axes and arranged on either side of said body with their centers of pressure lying near the transverse vertical and horizontal planes in which lies the center of gravity of said vehicle and means adapted to vary the angle of incidence of each aerofoil or cambered vane.

3. In a monorail vehicle the combination with the body thereof of means for neutralizing lateral forces acting on either side of said body when in motion, said means being adapted to exert in a horizontal plane on either side of said body when in motion, forces opposed to said lateral forces, said means comprising a plurality of aerofoils or cambered vanes mounted on vertical axes and arranged in pairs on either side of said body in such positions that the resultant center of pressure lies in the transverse vertical and horizontal planes in which lies the center of gravity of said vehicle, and means adapted to vary the angle of incidence of each aerofoil or cambered vane.

4. In a monorail vehicle the combination with the body thereof of means for neutralizing lateral forces acting on either side of said body when in motion, said means being adapted to exert in a horizontal plane on either side of said body when in motion, forces opposed to said lateral forces, said means comprising a plurality of aerofoils or cambered vanes mounted on vertical axes and arranged in pairs on either side of said body in such positions that the resultant center of pressure lies near the transverse vertical and horizontal planes in which lies the center of gravity of said vehicle, and means adapted to vary the angle of incidence of each areofoil or cambered vane.

5. In a monorail vehicle the combination with the body thereof of means for neutralizing lateral forces acting on either side of said body when in motion, said means being adapted to exert in a horizontal plane on either side of said body when in motion, forces opposed to said lateral forces, said means comprising two aerofoils or cambered vanes mounted on vertical axes and arranged on either side of said body with their centers of pressure lying in the transverse vertical and horizontal planes in which lies the center of gravity of said vehicle, and means controlled by said lateral forces and adapted to vary the angle of incidence of each aerofoil or cambered vane.

6. In a monorail vehicle the combination with the body thereof of means for neutralizing lateral forces acting on either side of said body when in motion, said means being adapted to exert in a horizontal plane on either side of said body when in motion, forces opposed to said lateral forces, said means comprising two aerofoils or cambered vanes mounted on vertical axes and arranged on either side of said body with their centers of pressure lying near the transverse vertical and horizontal planes in which lies the center of gravity of said vehicle, and means controlled by said lateral forces and adapted to vary the angle of incidence of each aerofoil or cambered vane.

7. In a monorail vehicle the combination with the body thereof of means for neutralizing lateral forces acting on either side of said body when in motion, said means being adapted to exert in a horizontal plane on either side of said body when in motion, forces opposed to said lateral forces, said means comprising a plurality of aerofoils or cambered vanes mounted on vertical axes and arranged in pairs on either side of said body in such positions that the resultant center of pressures lies in the transverse vertical and horizontal plane in which lies the center of gravity of said vehicle, and means controlled by said lateral forces and adapted to vary the angle of incidence of each aerofoil or cambered vane.

8. In a monorail vehicle the combination with the body thereof of means for neutralizing lateral forces acting on either side of said body when in motion, said means being adapted to exert in a horizontal plane on either side of said body when in motion, forces opposed to said lateral forces, said means comprising a plurality of aerofoils or cambered vanes mounted on vertical axes and arranged in pairs on either side of said body in such positions that the resultant center of pressure lies near the transverse

vertical and horizontal planes in which lies the center of gravity of said vehicle, and means controlled by said lateral forces and adapted to vary the angle of incidence of each aerofoil or cambered vane.

9. In a monorail vehicle the combination with the body thereof of aerofoils or cambered vanes pivotally mounted on said body in substantially vertical planes, and means for varying the degree of camber of said vanes according to the speed of the vehicle, said means being adapted to effect such variation on either side of a neutral plane.

10. In a monorail vehicle the combination with the body thereof of aerofoils or cambered vanes pivotally mounted on said body in substantially vertical planes, means controlled by the speed of the vehicle for varying the degree of the camber of said vanes, and means for determining on which side of a neutral plane the camber of each vane shall be varied, said second mentioned means being controlled by lateral forces.

11. In a monorail vehicle, the combination with the body thereof, of aerofoils or cambered vanes pivotally mounted on said body, the centers of pressure of said vanes lying in the transverse vertical and horizontal planes in which lies the center of gravity of the vehicle, a servo-motor connected with said aerofoils or vanes for effecting a change of incidence thereof, a pendulum adapted under the influence of centrifugal action to control said servo-motor, an auxiliary servo-motor, adapted when operated to modify the action of the first mentioned servo-motor, and a pennant operable under the influence of lateral wind pressure to control said auxiliary servo-motor.

12. In a monorail vehicle, the combination with the body thereof, of aerofoils or cambered vanes pivotally mounted on said body, the centers of pressure of said vanes lying near the transverse vertical and horizontal planes in which lies the center of gravity of the vehicle, a servo-motor connected with said aerofoils or vanes for effecting a change of incidence thereof, a pendulum adapted under the influence of centrifugal action to control said servo-motor, an auxiliary servo-motor, adapted when operated to modify the action of the first mentioned servo-motor, and a pennant operable under the influence of lateral wind pressure to control said auxiliary servo-motor.

13. In a monorail vehicle, the combination with the body thereof, of aerofoils or cambered vanes pivotally mounted thereon, said vanes being so constructed that the camber thereof may be varied to one side or the other of a neutral position, servo-motors for varying the camber of said vanes and a diaphragm chamber for automatically controlling the amount of camber according to the speed of the vehicle, the diaphragm in said chamber being controlled by air pressure exerted thereon, through tubes connected with said chamber on each side of the diaphragm, one of said tubes being provided with a cowl, substantially as described.

14. In a monorail vehicle, the combination with the body portion thereof, of a plurality of aerofoils or cambered vanes, mounted on vertical axes, servo-motors for simultaneously varying the angle of incidence of said vanes, servo-motors for simultaneously varying the camber of said vanes and means for automatically controlling the operation of said servo-motors in accordance with lateral pressures of wind or centrifugal action on said monorail body to counteract the effect thereof.

15. In a monorail vehicle, the combination with the body portion thereof, of a plurality of aerofoils or cambered vanes, means for mounting said vanes for varying the angle of incidence thereof, means for varying the camber of said vanes on either side of a neutral position, servo-motors for controlling the angle of incidence and camber respectively and means automatically controlled by lateral wind pressure and centrifugal action for controlling the action of said servo-motors, said servo-motor for varying the cambers of the vanes being also controlled by the speed of the vehicle.

EDMOND ERNEST JOHNSON.