March 28, 1961 E. SCHAAR 2,976,820

MONO-RAIL RAILROAD

Filed May 12, 1955 3 Sheets-Sheet 1

FIG. 1.

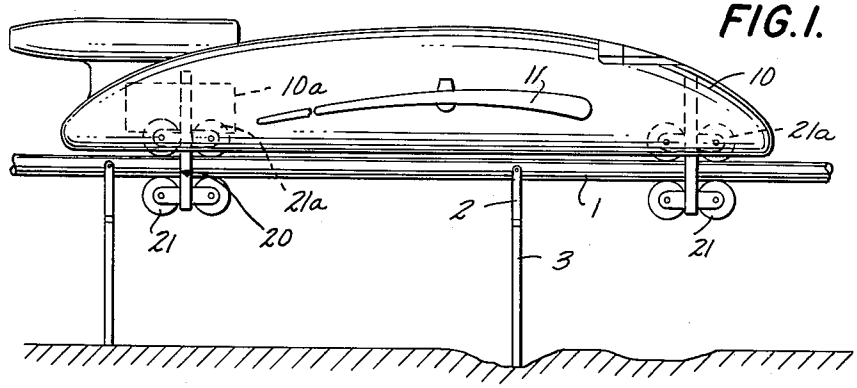
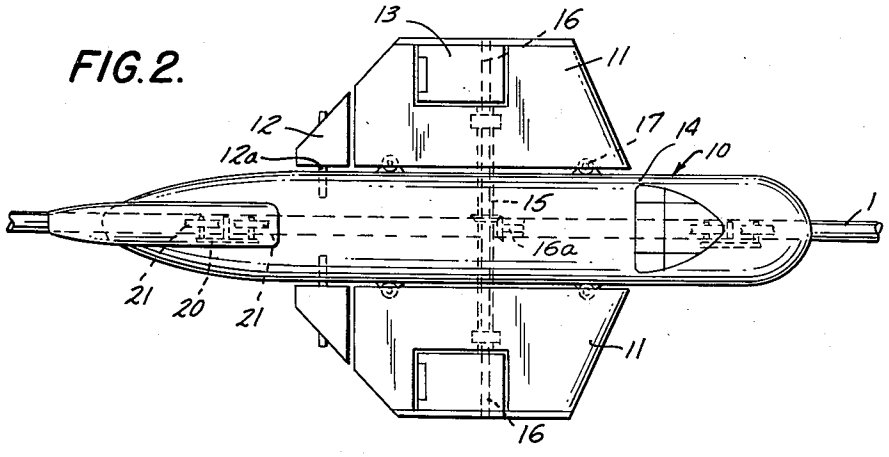


FIG. 2.



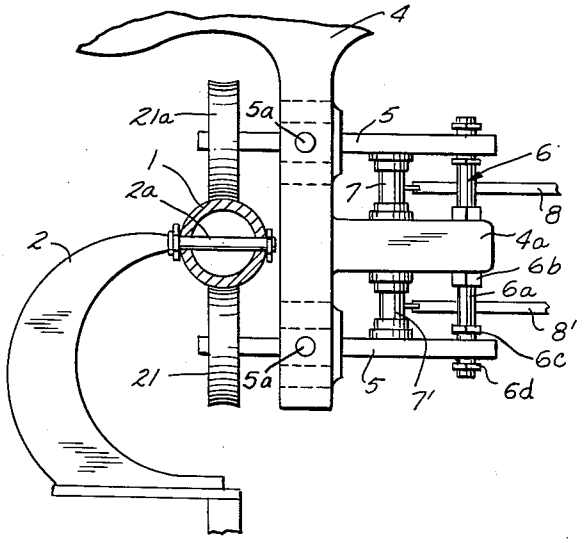


FIG. 4.

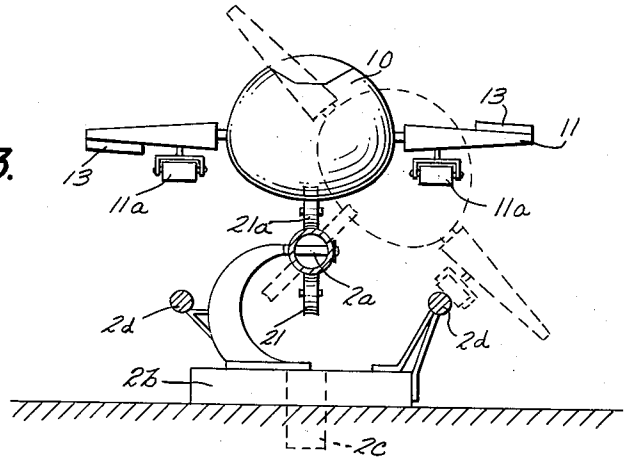
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March 28, 1961 E. SCHAAR 2,976,820

MONO-RAIL RAILROAD

Filed May 12, 1955 3 Sheets-Sheet 2

FIG. 3.



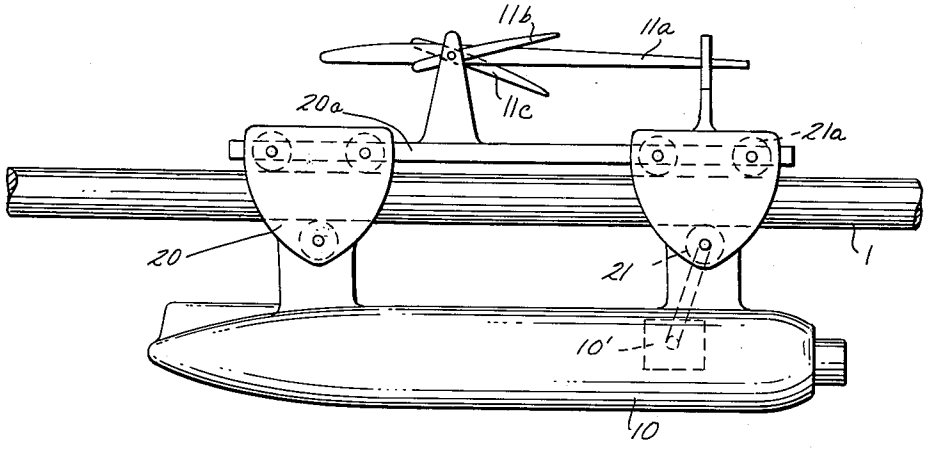


FIG. 6.

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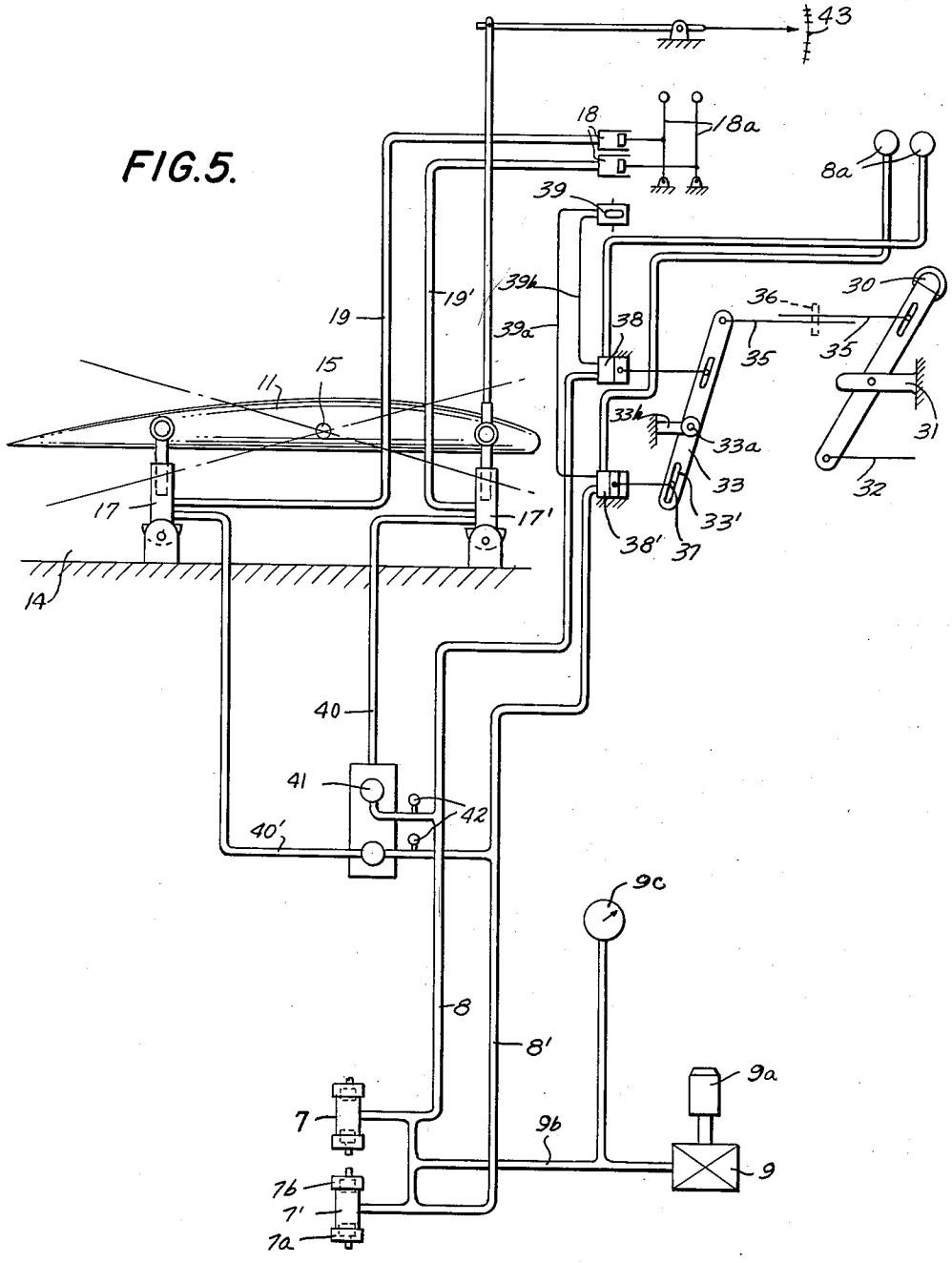
March 28, 1961 E. SCHAAR 2,976,820

MONO-RAIL RAILROAD

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3 Sheets-Sheet 3

FIG.5.



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MONO-RAIL RAILROAD

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Claims priority, application Germany May 13, 1954

18 Claims. (Cl. 105—141)

The present invention relates to a mono-rail railroad, and more particularly to a railroad in which a car is supported on a single rail for turning movement in transverse planes.

Arrangements are known in which cars are guided by roller means along a single rail, the single rail, however, being of such shape that a tilting of the car in a curve is not possible. Railroads of this type are incapable of being operated at high speeds.

It is one object of the present invention to overcome the disadvantages of the known railroad constructions, and to provide a railroad which can be operated at very high speeds while the cars are safely supported on a single rail even when moving along a curve of the track.

It is another object of the present invention to provide a mono-rail railroad in which the rail is subjected to a comparatively small load which is less than the weight of the car.

It is a further object of the present invention to provide a mono-rail railroad in which the car is supported on a single rail in such a manner as to be tiltable in curves in a transverse plane to compensate for the action of the centrifugal force.

It is a still further object of the present invention to provide a rail having a circular cross section for supporting the car traveling thereon for tilting movement in a transverse plane.

It is yet an object of the present invention to provide airfoils on the car for producing a lifting force compensating the force of gravity and the centrifugal force acting on the traveling car.

It is an important object of the present invention to provide a carriage means on the car including pairs of opposite rollers having a grooved peripheral rim whose radius of curvature corresponds to the radius of the rails so that tilting movement of the car is possible while the rollers roll on the rail and are held on the same.

Another object of the present invention is to provide means for pressing the rollers against the rail, and to limit movement of the rollers away from the rail so that the grooved rims of the rollers are reliably held on the rail.

It is a further object of the present invention to provide means for determining the difference between the weight of the car and the lifting aerodynamic force produced by the airfoils so that the angle of attack of the airfoils and the speed of the car may be manually or automatically adjusted to adjust the lifting force.

With these objects in view, the present invention mainly consists in a railroad which comprises, in combination, an elongated single rail, a car mounted on the rail movable in longitudinal direction thereof and turnable in a transverse plane about the rail for movement between a normal upright position and opposite tilted positions for compensating the centrifugal force acting on the car in a curve, propulsion means on the car for propelling the car along the rail, and airfoil means on the car for producing a lifting force to compensate the weight of the car acting on the rail.

The rail has a circular cross section, and carriage means are provided which support roller means embracing the rail by means of a grooved peripheral rim. Opposite rollers are movably supported and pressed against the rail by a suitable means, such as hydraulic and cylinder piston means, or springs.

The airfoil means are preferably turnable and can be manually or automatically adjusted by operating means to vary the angle of attack for adjusting the lifting force to compensate the force of gravity and the centrifugal force acting on the car in a curve. Ailerons are provided on the airfoils which are operated to balance the car at low speeds, or whenever required.

The rail is preferably supported on arcuate supports permitting the car to assume a tilted position in a curve without interfering with the supports. The arcuate supports may be mounted on high upright supports so that the rail is elevated and the railroad passes above regular traffic. This is particularly advantageous when the car is propelled by a jet engine.

Auxiliary rails may be provided on both sides, or on one side of the main rail for supporting the car in a station or when moving at low speed. According to a preferred embodiment, the airfoil means are laterally projecting wings provided with retractable wheel means. In a station, the wheel means are advanced to engage the auxiliary rails so that the car cannot tilt about the main rail. Auxiliary rails may also be used in a curve so that the retracted wheel means engage an auxiliary rail when the greatest permissible angle of inclination of the car is reached.

The main rail, and the auxiliary rails, are preferably made of seamless steel tubes, a number of steel tubes being welded together end on end.

Due to the fact that the lifting force acting on the airfoils relieves the rail of the weight of the car, and of the centrifugal force, a very high speed of about 300 miles per hour may be safely obtained on the railroad according to the present invention.

During movement of the car through a curve a transverse turning movement is exerted on the car by the centrifugal force. In the event that pairs of opposite rollers are provided for holding the car on the rail, an axial pair of shearing forces acts on the axes of the opposite rollers. The difference between these forces can be determined by suitable measuring instruments which are connected to movable supports of the rollers. The shearing force acts transverse to the rail, and its direction is determined by the position of the car in a curve, which may be too much or too little inclined with respect to a vertical plane, taking into consideration the speed of the car and the radius of the curve. The speed of the car is automatically or manually adjusted until the transverse force is zero which corresponds to a desirable relationship between the force of gravity and the centrifugal force. Inclination responsive means may be provided preventing actuation of the automatic control means before a predetermined angle of inclination is exceeded.

Pairs of rollers engaging the main rail are mounted on movable supporting means, which are preferably pivoted levers, prevented by stop means to move to a position in which the rollers would release the rail. Mechanical or hydraulic means are preferably provided for pressing the rollers against the rail. Corresponding to the ratio between the lifting force and the gravity, different pressures may act on the rollers, and the pressure at which each roller engages the rail is preferably determined by a mechanical, electrical or hydraulic pressure measuring instrument. The speed of the car, or the angle of attack of the airfoils can then be adjusted by a suitable manually operated or automatic means until the forces are in equilibrium, and a desired pressure is exerted

on the rail by the rollers. It will be understood that due to this arrangement the rail has to be constructed for a comparatively small load.

Preferably, the car is provided with a brake including two semi-circular brake shoes embracing the rail so that the car can be braked whenever required, and held at a standstill in upright position with the brake shoes firmly clamping the rail.

The cars according to the present invention may be provided with an auxiliary motor connected to the rollers of the carriage so that the car may be driven even if the jet engine or gas turbine fails which normally drives the car. When the car is driven by the auxiliary motor through the rollers, the pressure on the supporting means of the rollers is increased to produce sufficient friction.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is a side view of an arrangement according to the present invention;

Fig. 2 is a plan view of an arrangement according to the present invention;

Fig. 3 is an end view of an arrangement according to the present invention;

Fig. 4 is an end view of an under-carriage according to the present invention;

Fig. 5 is a schematic diagram illustrating the operating means according to the present invention; and

Fig. 6 is a side elevation of a modified arrangement according to the present invention.

Referring now to the drawing, Figs. 1, 2 and 3 illustrate the arrangement of a railroad according to the present invention. The single rail **1** is of circular cross section, and preferably consists of connected steel tubes. The rail **1** is supported on arcuate supports **2** to which the rail is secured by steel bolts **2***a*. The supports **2** may be further supported on supporting means **3** or directly secured to the road bed by means of ties **2***b* which are anchored to the ground by suitable means **2***c*. According to the embodiment of the invention illustrated in Figs. 1, 2 and 3 the car **10** is arranged above the rail and is provided with a supporting under-carriage which is generally indicated by reference numeral **20**.

The carriage **20** will be described in greater detail hereinafter, and includes pairs of cooperating rollers **21**, **21***a* which roll along the rail **1** when the car **10** is driven by a suitable motor, such as a jet engine.

The car **10** is provided with wings or airfoils **11**, which include ailerons **12** at the trailing edges thereof and additional ailerons **13** arranged in the wing tips. The wings **11** are turnably mounted on the fuselage **14** by means of hollow shafts **15** which envelop the shafts **16** serving for adjusting the position of the ailerons **13** when turned by bevel gears **16***a*. The wings **11** can be turned about the axis of shaft **15** by servo-motors **17** which are actuated by means which will be described hereinafter. The ailerons **12** are mounted on the fuselage **14** turnable about the shafts **12***a*. It will be understood that, as the car **10** rolls along the single rail **1**, the air passing along the wings **11** will tend to hold the craft in upright position when the same moves at sufficient speed.

The wings or airfoil means **11** are provided with retractable wheel means **11***a*. When the car slows down and stops, the airfoils are ineffective to hold it in upright position. Consequently, auxiliary rails **2***d* are provided at stations, and wherever required, and extend parallel to the rail **1** spaced apart corresponding to the space of the wheel means **11***a* so that the car rolls with its wheel means **11***a* on the auxiliary rails and is supported at three points, when the wheel means **11***a* are advanced into a projecting position.

While the car moves along the rail, it is held in equilibrium by operation of the ailerons **13**. In a curve in which the centrifugal force acts on the rapidly moving car, the car assumes an inclined position as indicated in broken lines in Fig. 3. In order to prevent excessive turning of the car about the rail **1** in curves, the auxiliary rails **2***d* are engaged by the wheel means **11***a* when the car reaches the maximum permissible inclination in the position shown in broken lines. The maximum inclination is limited by the shape of the arcuate supports **2** since the lower portion of the carriage **20** and the rollers **21** must not interfere with the supports **2**. It will be understood that along straight portions of the track, almost straight supports **2** can be provided, while in curves the arcuate supports **2** have a smaller radius of curvature so as to permit movement of the rollers **21** into the inclined position illustrated in broken lines in Fig. 3.

During travel of the car along a straight rail portion, the gravity of the car and the lifting force exerted on the wings by the air have to compensate each other to obtain the optimal conditions in which the car rolls almost frictionless on the rail. In a curve corresponding conditions can be obtained when the action of the additional centrifugal force is compensated by inclining the car. The proper angle can be easily maintained by the operator when certain maximum speeds are maintained when traveling along a curve. Each curve is designed for a particular speed, and such speeds are preferably indicated by signs along the track so that an operator may maintain in a curve the speed for which the track is designed. The exact adjustment is carried out by adjustment of the wings **11** and the ailerons **12** and **13**. Since the maximum permissible angle assumed by the car in a curve is known, it is possible to design the rail supports accordingly to permit tilting of the car and of the roller carriage **20** about the axis of the rail **1**.

The under-carriage **20** will now be described in greater detail with reference to Fig. 4. From the preceding description of the operation of the railroad according to the present invention, it will be appreciated that the under-carriage **20** must support the car for a tilting movement about the axis of the rail **1** while safely holding the car on the rail. The support **4** is rigidly connected to the fuselage **14** of the car **10**. The support **4** includes a projecting portion **4***a*. A pair of levers **5** is pivotally mounted on pivot pins **5***a* and supported on support **4**. The levers **5** include axles supporting the rollers **21**, **21***a* which roll on the rail **1**. The peripheral rims of the rollers **21**, **21***a* have grooves of curved cross-section having a radius of curvature corresponding to the circular cross-section of the rail **1**, and consequently, the rollers **21**, **21***a* can roll on the rail **1** even in the inclined position shown in broken lines in Fig. 3, and the car is free to tilt about the axis of the rail **1** without producing any change in the engagement between the semi-circular grooves of rollers **21** and **21***a* and the rail **1**. The movement of the levers **5** permits an adjustment of the spacing of the rollers **21** and **21***a* to compensate for slight inaccuracies in the structure of the rail **1**. However, since the car must be reliably held on the rail **1**, a stop device **6** is provided, which is illustrated to be a bolt **6***a* secured by nuts **6***b* to the projecting portion **4***a* of the support **4**, and having at the ends thereof nuts **6***c* and **6***d* which are adjustable on threaded portions of the bolt **6***a*. The ends of levers **5** move between the nuts **6***c* and **6***d* so that the movement of the levers **5** is limited whereby an extreme spacing of the rollers **21**, **21***a* is prevented. The nuts **6***c* and **6***d* constitute stop means limiting movement of the rollers **21**, **21***a* away from each other beyond a spaced position in which the peripheral grooves of the rollers **21**, **21***a* still embrace the rail and hold the car on the rail.

In order to obtain a reliable engagement between the rollers 21 and 21*a* and the rail 1, it is necessary that the rollers 21, 21*a* be pressed against the rail 1. As illustrated in Fig. 4 and in the diagram of Fig. 5, pressure means 7, 7′ are provided which are arranged between the projecting portion 4*a* and the levers 5, respectively. Each hydraulic pressure means 7, 7′ includes a cylinder and a pair of pistons 7*a* and 7*b* which are connected to one of the levers 5 and to the projecting portion 4*a*, respectively. The cylinder of each hydraulic means 7, 7′ communicates with one of the conduits 8, 8′ which are connected to manometers 8*a*. Consequently, the pressure prevailing in each of the hydraulic means 7, 7′ can be determined by the operator of the car. In the event that the lifting force of the airfoils exceeds the weight of the car, the car will tend to move upwardly so that the pressure between the rail 1 and the rollers 21 exceeds the pressure between the rail 1 and the rollers 21*a*. If this is the case, the manometer 8*a*, associated with the hydraulic means 7′ will have an indication different from the indication of the manometer 8*a* associated with the hydraulic means 7, and the necessary adjustment can be made. Either the speed is reduced, or the angle of attack of the wings is suitably adjusted, such adjustment may be carried out manually by the operator, or automatically. It will be understood that if the uplift is insufficient to overcome the weight of the car, the condition will be reversed, and it will be necessary to accelerate the car, or to change the angle of attack of the wings to produce a greater lifting force. The pressure in the hydraulic means 7, 7′ is produced by a pump 9 driven from a motor 9*a* and communicating with the hydraulic means 7, 7′ and with the conduits 8, 8′ through a conduit 9*b*. A manometer 9*c* is provided for indicating the pressure in the conduit system and the absolute pressure between the rollers 21, 21*a* and the rail.

When the operator determines from the manometer 8*a* a pressure difference, he either accelerates or decelerates the car by adjusting the fuel supply to the engine of the car, or he operates the manually-operated pumps 18 by means of levers 18*a*. The pumps 18 are respectively connected through conduits 19, 19′ to servo-motors 17, 17′ which turn the wing 11 about the shaft 15 for varying the lifting force acting on the wings.

The wings 11 can be also automatically adjusted. Conduits 40, 40′ connect the conduits 8, 8′, respectively to the servo-motors 17, 17′. A control mechanism 41 is provided in the conduits 40, 40′ which adjusts the pressure prevailing in the conduits 8, 8′ in accordance with the pressure required for adjusting the servo-motor 17, 17′. This is necessary since the lifting force is a parabolic function, while the pressure varies in accordance with a linear function. When automatic control of the wings is not desired, the valves 42 are closed. Indicating means 43 are provided for indicating the angle of attack of the wings 11 and the lifting forces acting thereon.

Since the lifting force also depends on the speed of the car, the operator may also adjust the fuel supply by the manually-operated control lever 30 which is pivotally mounted on a bracket 31 and connected by a pivoted link 32 to the fuel supply control means of the engine. The operating lever 30 is connected to a double-arm lever 33 by a coupling linkage comprising two rods 35 which are connected by a pin 36 passing through bores in the rods 35. When the pin 36 is removed only the manually-operated means 30 act on the fuel supply controls means, but when the pin 36 is inserted into the bores of the rods 35, the fuel control means are connected to the double-arm lever 33 so that turning of the same about a pivot pin 33*a* on a bracket 33*b* results in control of the fuel supply control means of the engine.

The fuel supply control lever 30 can be also automatically controlled by operation of the double-arm lever 33. Slots 33′ are provided in lever 33 in which slide members 37 are slidably mounted. The pistons of two hydraulic servo-motors 38 and 38′ are connected by piston rods to the slide members 37. A control mechanism 39 which is responsive to a pressure differential is connected by conduits 39*a* and 39*b* to the servo-motors 38 and 38′. The arrangement is such that a pressure differential in the conduits 8 and 8′ which are also connected to the servo-motors 38 and 38′, results in actuation of the levers 33*a* and 30 and in adjustment of the fuel control of the propelling engine until the control mechanism 39 responds to a desired pressure differential in which a desired slight pressure is exerted by the rollers 21, 21*a* on the rail 1. When the pin 36 is removed, the connection between the double-arm lever 33 and the gas control lever 30 is interrupted, and the automatic control eliminated so that the operator controls the fuel supply and thereby the speed of the car in accordance with the conditions present in a particular curve. The slotted levers 33, 30 constitute a differential transmission which is necessary since the lifting force is a parabolic function while the hydraulic pressure is changed according to a linear function.

During operation the car is driven by the engine 10*a*, preferably a jet engine or a gas turbine. The lifting force is manually or automatically controlled by adjusting the angle of attack of the wings 11 until the weight of the car is substantially balanced. The proper position of the car can be controlled by the ailerons 13 and 12. In a curve, the additional action of the centrifugal force has to be compensated by turning the car into a tilted position comparable to the banking of an airplane, and again the forces acting on the car are made to balance each other so that the rail is subjected only to a very small load. The uplifting force and the centrifugal force depend on the speed of the car, and consequently an adjustment to a desired tilted position can be carried out by controlling the fuel supply of the engine.

In the modified embodiment shown in Fig. 6, the car 10 is suspended on the rail 1 by means of carriages 20 provided with rollers 21*a* and 21 which are controlled in the manner described with reference to Fig. 5 to exert a desired pressure on the rail 1. The carriages 20 are connected by a frame member 20*a* on which an airfoil 11*a* is mounted. At the lateral tips of the airfoil 11*a*, ailerons 11*b* and 11*c* are arranged which are turnable independently of the airfoil 11*a*. The operation of the suspended car illustrated in Fig. 6 corresponds to the operation of the embodiment described with reference to Figs. 1–5, and it will be understood that the uplifting force can be produced by adjusting the position of airfoil 11*a*, while the ailerons 11*b* and 11*c* provide for proper banking in curves. An auxiliary motor 10′ may be provided which is connected to the rollers 21, 21*a* for driving the car along the rail in the event that the jet engine fails or that it is undesirable to use the jet engine.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of monorail railroads differing from the types described above.

While the invention has been illustrated and described as embodied in a car provided with airfoils and guided along a rail having a circular cross-section, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are

intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In a railroad, in combination, an elongated single rail having a circular cross section; carriage means including pairs of opposite rollers located in a plane passing through the axis of said rail, each of said rollers having a peripheral rim engaging said rail and formed with a peripheral groove having a curved cross section whose radius of curvature corresponds substantially to the radius of the cross section of said rail so that said carriage means is supported for lateral turning movement in a transverse plane about the axis of said rail, said carriage means including movable supporting means supporting the rollers of each pair of opposite rollers for movement towards and away from said rail, stop means on said carriage means engaging and blocking said supporting means in a position in which said rollers are spaced a predetermined distance in which said peripheral grooves in the same at least partly embrace said rail for holding said carriage means on said rail, hydraulic pressure means engaging said movable supporting means and urging said opposite rollers into engagement with said rail; a car fixedly connected to the carriage means and laterally turnable with the same in said transverse plane for movement between a normal upright position and opposite tilted positions; airfoil means mounted on said car for turning movement about an axis transverse to said rail and adapted to produce at high speed a lifting force; and operating means located in said car for turning said airfoil means in opposite directions about said transverse axis.

2. In a railroad, in combination, an elongated single rail having a circular cross section; carriage means including pairs of opposite rollers located in a plane passing through the axis of said rail, each of said rollers having a peripheral rim engaging said rail and formed with a peripheral groove having a curved cross section whose radius of curvature corresponds substantially to the radius of the cross section of said rail so that said carriage means is supported for lateral turning movement in a transverse plane about the axis of said rail, said carriage means including movable supporting means supporting the rollers of each pair of opposite rollers for movement towards and away from said rail, stop means on said carriage means engaging and blocking said supporting means in a position in which said rollers are spaced a predetermined distance in which said peripheral grooves in the same at least partly embrace said rail for holding said carriage means on said rail, a carriage support movably supporting said supporting means, and a pair of hydraulic cylinder and piston means mounted on said carriage support associated with each of said pairs of opposite rollers and connected to said supporting means for urging opposite rollers of each pair of opposite rollers into engagement with said rail; pump means communicating with said hydraulic cylinder means for producing pressure in the same; a pair of conduit means, each conduit means connected to one of said hydraulic cylinder means; manometer means connected to each of said conduit means for determining the pressure between each of said opposite rollers and said rail; a car supporting said pump means, conduit means and manometer means and being fixedly connected to said carriage support of said carriage means and laterally turnable with the same in said transverse plane for movement between a normal upright position and opposite tilted positions; control means in said car connected to said conduit means for adjusting the pressures in said cylinders; airfoil means mounted on said car for turning movement about an axis transverse to said rail adapted to produce at high speed a lifting force; and operating means located in said car for turning said air foil means in opposite directions about said transverse axis.

3. In a railroad, in combination, an elongated single rail having a circular cross section; carriage means including pairs of opposite rollers located in a plane passing through the axis of said rail, each of said rollers located in a plane passing through the axis of said rail, each of said rollers having a peripheral rim engaging said rail and formed with a peripheral groove having a curved cross section whose radius of curvature corresponds substantially to the radius of the cross section of said rail so that said carriage means is supported for lateral turning movement in a transverse plane about the axis of said rail, said carriage means including movable supporting means supporting the rollers of each pair of opposite rollers for movement towards and away from said rail, stop means on said carriage means engaging and blocking said supporting means in a position in which said rollers are spaced a predetermined distance in which said peripheral grooves in the same at least partly embrace said rail for holding said carriage means on said rail, a carriage support movably supporting said supporting means, and a pair of hydraulic cylinder and piston means mounted on said carriage support, associated with each of said pairs of opposite rollers for urging opposite rollers of each pair of opposite rollers into engagement with said rail; pump means communicating with said hydraulic cylinder means for producing pressure in the same; a pair of conduit means, each conduit means connected to one of said hydraulic cylinder means; manometer means connected to each of said conduit means for determining the pressure between each of said opposite rollers and said rail; a car supporting said pump means, conduit means and manometer means and being fixedly connected to said carriage support of said carriage means and laterally turnable with the same in said transverse plane for movement between a normal upright position and opposite tilted positions; control means in said car connected to said conduit means for adjusting the pressures in said cylinders; airfoil means mounted on said car for turning movement aobut an axis transverse to said rail adapted to produce at high speed a lifting force; operating means located in said car for turning said airfoil means in opposite directions about said transverse axis; and a pressure differential responsive hydraulic control mechanism communicating with said conduit means of said pair of conduit means, said control mechanism being connected to the operating means for controlling the angle of attack of said airfoil means and thereby the lifting force acting on said airfoil means.

4. In a railroad, in combination, an elongated single rail having a circular cross section; carriage means including pairs of opposite rollers located in a plane passing through the axis of said rail, each of said rollers having a peripheral rim engaging said rail and formed with a peripheral groove having a curved cross section whose radius of curvature corersponds substantially to the radius of the cross section of said rail so that said carriage means is supported for lateral turning movement in a transverse plane about the axis of said rail; a car fixedly connected to the carriage means and laterally turnable with the same in said transverse plane for movement between a normal upright position and opposite tilted position; airfoil means mounted on said car for turning movement about an axis transverse to said rail and adapted to produce at high speed a lifting force; and operating means located in said car for turning said airfoil means in opposite directions about said transverse axis, said operating means including hydraulic servo-motors engaging said airfoil means; and manually operated pump means connected to said servo-motors for operating the same.

5. An arrangement as set forth in claim 4 and including indicating means connected to said airfoil means for indicating the angular displacement of the same and thereby the aerodynamic lifting force acting on said airfoil means.

6. In a railroad, in combination, an elongated single rail having a circular cross section; carriage means including pairs of opposite rollers located in a plane passing through the axis of said rail, each of said rollers having a peripheral rim engaging said rail and formed with a peripheral groove having a curved cross section whose radius of curvature corresponds substantially to the radius of the cross section of said rail so that said carriage means is supported for lateral turning movement in a transverse plane about the axis of said rail; a car located above said rail and said carriage means and being fixedly connected to the carriage means and laterally turnable with the same in said transverse plane for movement between a normal upright position and opposite tilted positions; airfoil means mounted on said car for turning movement about an axis transverse to said rail adapted to produce at high speed a lifting force; operating means located in said car for turning said airfoil means in opposite directions about said transverse axis; wheel means mounted on said airfoil means; and auxiliary rail sections located at points spaced along said rail and being transversely spaced from the same and cooperating with said wheel means for supporting said car at stations and in extremely tilted positions.

7. In a railroad, in combination, an elongated single rail; a car including means at least partly embracing said rail and being movable in longitudinal direction of the same and turnable laterally about the same between a normal upright position and opposite tilted positions; air foil means mounted on said car for turning movement about an axis transverse to said rail adapted to produce at high speed a variable lifting force, said airfoil means including means for turning said car about said rail into tilted banking positions in which the force of gravity and the centrifugal force produce a resultant force passing through the axis of said rail so that said resultant force can be compensated by turning said airfoil means; and operating means located in said car for operating said airfoil means.

8. In a railroad, in combination, an elongated single rail having a circular cross section; a car including roller means at least partly embracing said rail so that said car is movable in longitudinal direction of the same and turnable laterally about the same between a normal upright position and opposite tilted positions; airfoil means mounted on said car for turning movement about an axis transverse to said rail and adapted to produce a variable lifting force, said air foil means including means for turning said car about said rail into tilted banking positions in which the force of gravity and the centrifugal force produce at high speed a resultant force passing through the axis of said rail so that said resultant force can be compensated by turning said airfoil means; and operating means located in said car for operating said airfoil means.

9. In a railroad, in combination, an elongated single rail having a circular cross section; carriage means including pairs of opposite rollers located in a plane passing through the axis of said rail, each of said rollers having a peripheral rim engaging said rail and formed with a peripheral groove having a curved cross section whose radius of curvature corresponds substantially to the radius of said rails so that said carriage means is supported for lateral turning movement about the axis of said rail and is movable along said rail; a car fixedly connected to said carriage means and laterally turnable with the same about said rail for movement between a normal upright position and opposite tilted positions; airfoil means mounted on said car for turning movement about an axis transverse to said rail adapted to produce at high speed a variable lifting force, said airfoil means including means for turning said car about said rail into tilted banking positions in which the force of gravity and the centrifugal force produce a resultant force passing through the axis of said rail so that said resultant force can be compensated by turning said airfoil means; and operating means located in said car for operating said airfoil means.

10. In a railroad, in combination, an elongated single rail having a circular cross section; carriage means including pairs of opposite rollers located in a plane passing through the axis of said rail, each of said rollers having a peripheral rim engaging said rail and formed with a peripheral groove having a curved cross section whose radius of curvature corresponds substantially to the radius of said rail so that said carriage means is supported for lateral turning movement about the axis of said rail and is movable along said rail; a car fixedly connected to said carriage means and laterally turnable with the same about said rail for movement between a normal upright position and opposite tilted positions; propulsion means on said car for propelling said car along said rail; airfoil means mounted on said car for turning movement about an axis transverse to said rail adapted to produce at high speed a variable lifting force; operating means located in said car for turning said airfoil means about said transverse axis for varying the lifting force to compensate the force of gravity and the centrifugal force acting on said car in a curve of said rail; ailerons mounted on said car for independent turning movement about transverse axes; and means in said car for turning said ailerons about said axes for turning said carriage means and said car about said rail into banking positions in which the force of gravity and the centrifugal force produce a resultant force passing through the axis of said rail so that said resultant force can be compensated by turning said airfoil means by said operating means.

11. In a railroad, in combination, an elongated single rail having a circular cross section; carriage means including pairs of opposite rollers located in a plane passing through the axis of said rail, each of said rollers having a peripheral rim engaging said rail and formed with a peripheral groove having a curved cross section whose radius of curvature corresponds substantially to the radius of said rail so that said carriage means is supported for lateral turning movement about the axis of said rail and is movable along said rail; a car fixedly connected to said carriage means and laterally turnable with the same about said rail for movement between a normal upright position and opposite tilted positions; airfoil means mounted on said car for turning movement about an axis transverse to said rail and adapted to produce at high speed a variable lifting force, said airfoil means including means for turning said car about said rail into tilted banking positions in which the force of gravity and the centrifugal force produce a resultant force passing through the axis of said rail so that said resultant force can be compensated by turning said airfoil means; operating means located in said car for operating said airfoil means; pressure responsive means mounted in said car for determining the pressure differential between opposite rollers of a pair of rollers; and means connecting said pressure responsive means to said operating means for adjusting the position of said airfoil means until there is no pressure differential between said opposite rollers.

12. In a railroad, in combination, an elongated single rail having a circular cross section; carriage means including pairs of opposite rollers located in a plane passing through the axis of said rail, each of said rollers having a peripheral rim engaging said rail and formed with a peripheral groove having a curved cross section whose radius of curvature corresponds substantially to the radius of said rail so that said carriage means is supported for lateral turning movement about the axis of said rail and is movable along said rail; a car fixedly connected to said carriage means and laterally turnable with the same about said rail for movement between a normal upright

position and opposite tilted positions; air-foil means mounted on said car for turning movement about an axis transverse to said rail adapted to produce at high speed a variable lifting force, said airfoil means including means for turning said car about said rail into tilted banking positions in which the force of gravity and the centrifugal force produce a resultant force passing through the axis of said rail so that said resultant force can be compensated by turning said airfoil means; operating means located in said car for operating said airfoil means; pressure responsive means mounted in said car for determining the pressure differential between opposite rollers of a pair of rollers; and means connected to and controlled by said pressure responsive means to vary the speed of movement of said car until there is no pressure differential between said opposite rollers.

13. In a railroad, in combination, an elongated single rail having a circular cross section; carriage means including pairs of opposite rollers located in a plane passing through the axis of said rail, each of said rollers having a peripheral rim engaging said rail and formed with a peripheral groove having a curved cross section whose radius of curvature corresponds substantially to the radius of the cross section of said rail so that said carriage means is supported for lateral turning movement in a transverse plane about the axis of said rail; a car located below said rail and said carriage means and being fixedly connected to the carriage means and laterally turnable with the same in said transverse plane for movement between a normal upright position and opposite titled positions; airfoil means mounted on said car for turning movement about an axis transverse to said rail and adapted to produce at high speed a lifting force, and including means for turning said car and said carriage means about said rail for banking in a curve; and operating means located in said car for turning said airfoil means in opposite directions about said transverse axis.

14. In a railroad, in combination, an elongated single rail having a circular cross section; spaced supports for supporting said rail; carriage means including a pair of holding means engaging said rail from opposite sides for holding said carriage means on said rail movable along said rail and turnable in a transverse plane about the longitudinal axis of said rail, and pressure means on said carriage means for urging each of said holding means against said rail; pressure responsive means connected to said pressure means for determining the pressure of each of said holding means; a car fixedly connected to said carriage means and turnable with the same in said transverse plane for movement between a normal upright position and opposite tilted positions; air foil means mounted on said car for turning movement about a transverse axis and adapted to produce a lifting force; aileron means on said air foil means for balancing said car in said upright position and for turning said car and said carriage means about said rail for banking in a curve of said rail; means in said car for controlling said aileron means; operating means located on said car for turning said air foil means in opposite directions about said transverse axis and control means in said car connected to said pressure means for adjusting the pressure at which each roller of each pair of rollers is pressed against said rails.

15. In a railroad, in combination, an elongated single rail having a circular cross-section; spaced supports for supporting said rail; carriage means including pairs of rollers located in a plane passing through the axis of said rail and located on opposite sides of said rail, each of said rollers having a peripheral rim engaging said rail and formed with a peripheral groove having a curved cross-section whose radius of curvature corresponds to the radius of the cross-section of said rail so that said carriage means is supported for turning movement in a transverse plane about the axis of said rail, said carriage means including movable supporting means supporting the rollers of each pair of rollers for movement toward and away from said rail, stop means on said carriage means engaging and blocking said support means in a position of said supporting means in which the rollers of the respective pair of rollers are spaced a predetermined distance from each other in which said peripheral grooves in the same embrace said rail for holding said carriage means on said rail, a carriage support movable supporting said supporting means, and pressure means mounted on said carriage support end engaging said movable supporting means and urging said opposite rollers of each pair of opposite rollers into engagement with said rail; pressure responsive means connected to said pressure means for determining the pressure of each of said rollers on said rail; a car fixedly connected to said carriage support of said carriage means and turnable with the same in said transverse plane for movement between a normal upright position and opposite tilted positions; air foil means mounted on said car for turning movement about a transverse axis and adapted to produce a lifting force; aileron means on said air foil means for balancing said car in said upright position and for turning said car and said carriage means about said rail for banking in a curve of said rail; means in said car for controlling said aileron means; first operating means located on said car for turning said air foil means in opposite directions about said transverse axis for varying the lifting force to compensate the force of gravity and the centrifugal force acting on the tilted car in a curve; and control means in said car connected to said pressure means for adjusting the pressure at which each roller of each pair of rollers is pressed against said rail.

16. In a railroad, in combination, an elongated single rail having a circular cross section; spaced supports for supporting said rail; carriage means including a pair of holding means engaging said rail from opposite dies for holding said carriage means on said rail movable along said rail and turnable in a transverse plane about the longitudinal axis of said rail, and pressure means on said carriage means for urging each of said holding means against said rail; pressure responsive means connected to said pressure means for determining the pressure of each of said holding means; a car fixedly connected to said carriage means and turnable with the same in said transverse plane for movement between a normal upright position and opposite tilted positions; propulsion means on said car including fuel supply control means; air foil means mounted on said car for turning movement about a transverse axis and adapted to produce a lifting force; aileron means on said air foil means for balancing said car in said upright position and for turning said car and said carriage means about said rail for banking in a curve of said rail; means in said car for controlling said aileron means; first operating means located on said car for turning said air foil means in opposite directions about said transverse axis; control means in said car connected to said pressure means for adjusting the pressure at which each roller of each pair of rollers is pressed against said rails, said control means being connected to said pressure responsive means and being controlled by the pressure differential between the pressure means acting on opposite rollers of each pair of rollers; and second operating means in said car and connected to said fuel supply control means for controlling the same, said first and second operating means being connected to said pressure responsive means and controlled by the pressure differential between the pressure means acting on opposite rollers of each pair of rollers.

17. An apparatus as claimed in claim 16 and including manually operated means for independently controlling said first and second operating means and said control means.

18. In a railroad, in combination, an elongated single

rail having a circular cross section; carriage means including holding means engaging said rail for holding said carriage means on said rail movable along said rail and turnable in a transverse plane about the longitudinal axis of said rail, and pressure means for urging said holding means against said rail; a car fixedly connected to said carriage means and turnable with the same in said transverse plane for movement between a normal upright position and opposite tilted positions; air foil means mounted on said car for turning movement about a transverse axis and adapted to produce a lifting force and including means for turning said carriage means and said car about said rail; operating means located on said car for turning said air foil means in opposite directions about said transverse axis; and control means in said car connected to said pressure means for adjusting the pressure of said holding means.

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