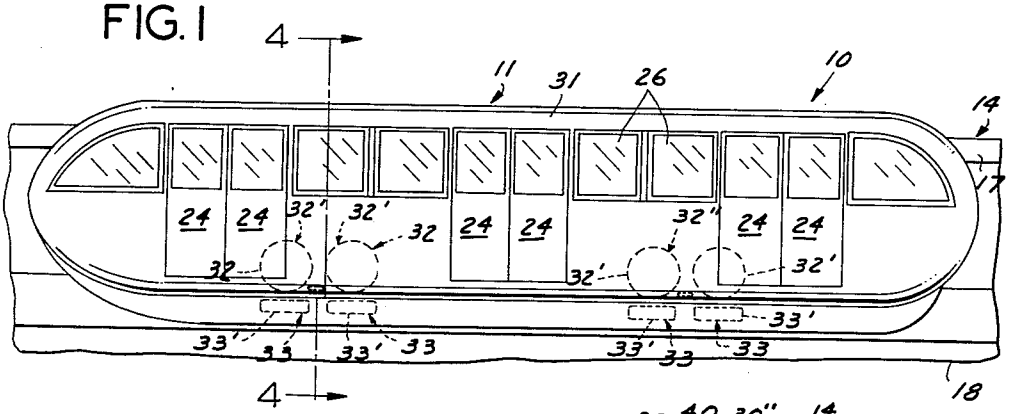
Feb. 25, 1964 L. G. SCHERER 3,122,105

MONORAIL SYSTEM

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FIG. 1



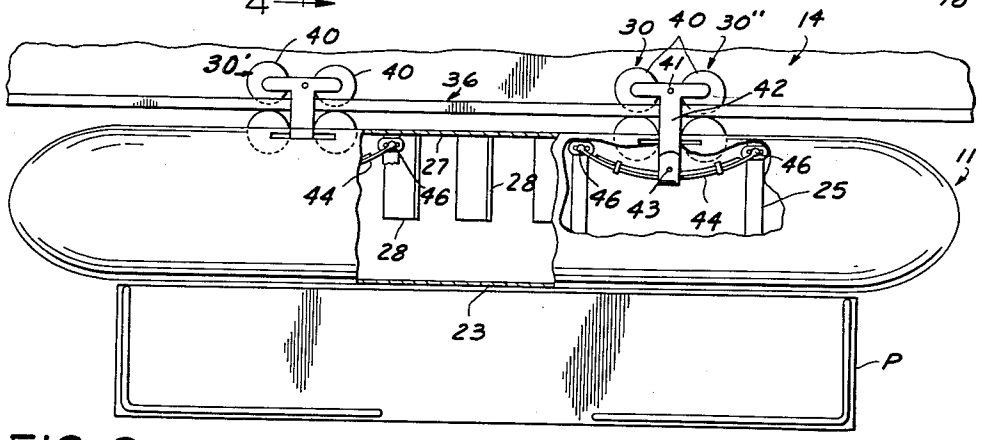


FIG. 2

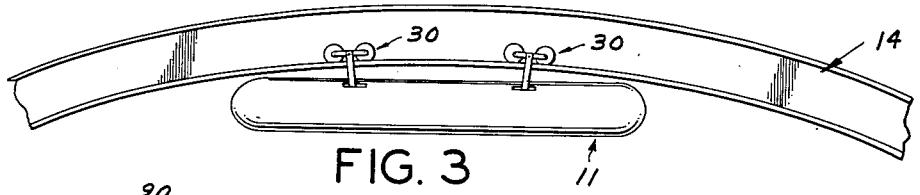


FIG. 3

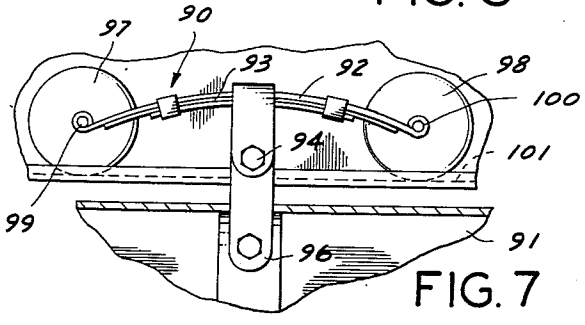


FIG. 7

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MONORAIL SYSTEM

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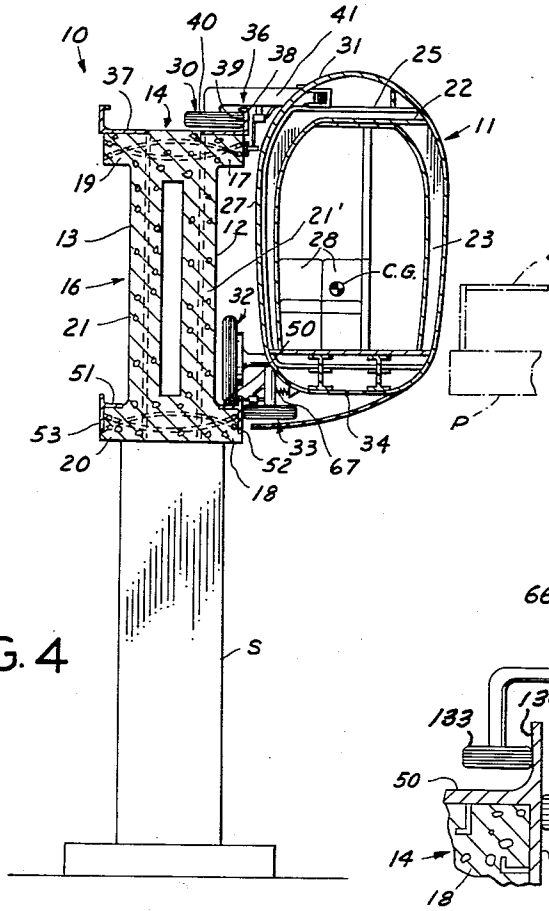


FIG. 4

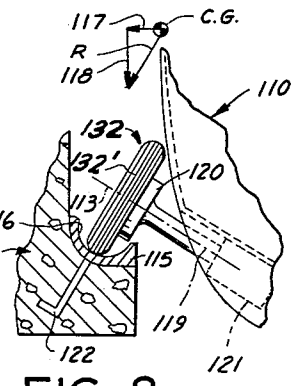


FIG. 8

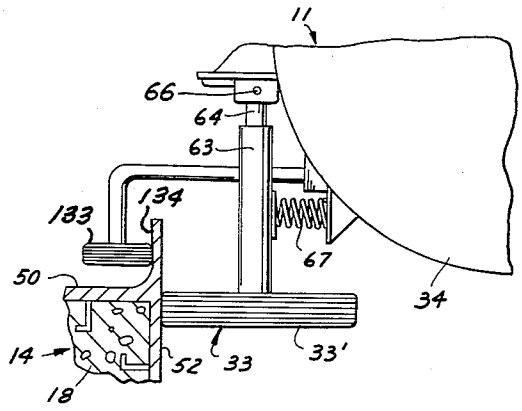


FIG. 5

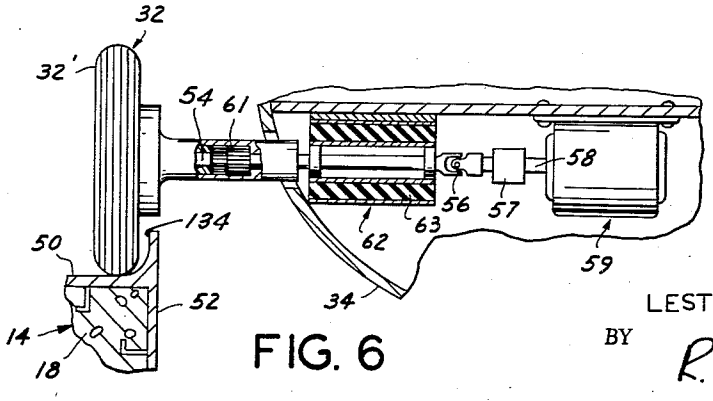


FIG. 6

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MONORAIL SYSTEM

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Filed May 28, 1962, Ser. No. 202,639
9 Claims. (Cl. 105—147)

This invention relates to a monorail system of the type in which the cars are supported on a monobeam track structure comprising a relatively-rigid monobeam anchored on a plurality of upstanding standards supported in spaced relationship in the ground whereby the cars are adapted to travel along the track beam in elevated relationship to the ground, or, optionally directly adjacent the ground.

More specifically, this invention relates to a monorail system in which the cars are supported for linear travel along opposite sides of a track beam which generally has an I-shaped cross-section positioned with its web vertical and its flanges horizontal and having a plurality of vertically spaced rail means on each side of the track beam upon which wheel means, rotatably mounted on the car, ride for supporting the car on the monobeam.

In the past, many such vehicles have been designed so as to be supported by a chassis unit including the load carrying or supporting wheels adapted to ride over the top surface of the supporting beam and lateral stabilizing guide wheels adapted to ride along the side beam surfaces. Optionally, such vehicles have been supoprted so as to straddle the beam with the support wheels engaging the top and side edges of the beam or to be suspended from tracks arranged to support a car depending from the beam and movable linearly thereon.

In most such structures, the cars are required to pass each other along one or more monobeams, one car being in full view of another during the passing stage and both being subject to substantial aerodynamic forces to rock or vibrate each other as they pass which frequently results in a disturbing psychological influence on passengers of the cars and often a violent rocking movement as a result of the aerodynamic forces.

Furthermore, many of the monorail systems designed for the same purpose actually include a pair of discrete, parallel rails physically separated and each having individual standards whereby the supports themselves entail considerable cost and clutter the supporting landscape with an unnecessary plurality of standards.

It is therefore an object of this invention to provide a new and improved monorail system including a symmetrical track monobeam of general I-shaped cross-section having a vertically positioned imperforate web and pairs of vertically-spaced horizontal flanges projected from opposite sides of the web for supporting one or more cars and in which cars supported on the single beam travel linearly along opposite sides of the beam and unseen by each other during travel.

Another object of this invention is to provide a new improved monorail system operable on a single beam which is prestressed so as to require fewer standards and thereby avoid cluttering of the roadway with an unncessary plurality of upstanding standards when the monobeam is supported in elevated position, and so as to reduce the size of a subway bore in the event the system is operated underground.

Another object of this invention is to provide a new and improved monorail system which incorporates improved and discrete track means on each side of the single beam for supporting the cars in improved stabilized relationship during its travel.

A further object of this invention is to provide a new and improved monorail system which includes improved drive means capable of being energized by an electrical, or other system incorporated within selective of the rails and readily accessible for energizing the drive means during the linear travel of the car.

Still another object of this invention is to provide a new and improved asymmetrical monorail system comprising a symmetrical track beam wherein the cars are linearly movable along opposite sides of the track beam in spaced parallel relationship thereto and wherein the center of gravity of each of the cars is arranged so as to be carried directly by load bearing wheel means provided therefor.

Yet another object of this invention is to provide a new and improved monorail system wherein selective wheel means supporting the car are resiliently mounted relative to the track beam.

Still another object of this invention is to provide new and improved means for mounting the wheel means of the car wherein the car is enabled to turn relatively short curves with the greatest of ease and whereby the cars can be run relative to the beam with the greatest freedom from jar and vibration and with the least possible noise.

Further objects of this invention are to provide improved and simplified construction of the cars supported by the monobeam whereby they may be more easily and readily loaded from one common side, may be narrower in width to eliminate passenger congestion, and may afford increased efficiency due to lighter car design. The construction further provides a better lit interior of the cars and less light loss to streets underlying the system.

It is among the objects of this invention to provide a new and improved transportation system in which the monobeam may also be designed to carry cars on one side only for one way traffic and in which a greater portion of the load is carried on the bottom flange of a composite beam. Therefore, in accordance with this invention a beam may be provided with horizontal flanges on one side only of the vertical portion of the monobeam, as in a general U-shaped beam.

A general object of this invention is to provide a new and improved monorail system of the character described which overcomes disadvantages of prior means and methods heretofore intended to accomplish generally similar purposes.

These and other objects of this invention will become more apparent from the following drawings, detailed description and appended claims.

In the drawings:

FIGURE 1 is a side view, in elevation, of fragmentary section of the monorail system of this invention;

FIGURE 2 is a fragmentary top plan view, in elevation, with portions broken away for greater clarity;

FIGURE 3 is a plan view, in reduced scale, illustrating a curved section of beam as associated with the monorail system of this invention;

FIGURE 4 is a vertical, cross-sectional view as taken

substantially along the line 4—4 of FIGURE 1 and illustrating a support standard therewith;

FIGURE 5 is a fragmentary and enlarged, vertical, cross-sectional view illustrating one of the lowermost of the wheel means of FIGURE 4 in greater detail;

FIGURE 6 is a fragmentary, vertical, cross-sectional view, illustrating another lower wheel means of FIGURE 4 in greater detail;

FIGURE 7 is a fragmentary, plan view, in elevation, showing a modified embodiment of an upper wheel means of this invention with parts thereof shown broken away for greater clarity; and

FIGURE 8 is a fragmentary, vertical, cross-sectional view schematically showing a third embodiment of this invention.

Referring in detail to the drawings, and more particularly to FIGURES 1–6, inclusive, there is shown by way of illustration, but not of limitation, a preferred embodiment of the monorail car system designed and constructed in accordance with this invention and generally designated by the numeral **10**. In general, the monorail system **10** includes elongated cars **11** mounted for linear movement on opposite sides **12** and **13** of a supporting monobeam generally designated by the numeral **14**.

The beam **14**, as illustrated herein, comprises a generally I-shaped cross-sectional configuration and preferably constructed of a relatively-rigid, non-electrical-conductive material, such as structurally reinforced concrete having a vertically positioned web **16** and a pair of vertically-spaced horizontal flanges projecting from opposite sides of the web, the flanges being designated as upper and lower flanges **17** and **18** projecting laterally from the side **12** and flanges **19** and **20** projecting from the opposite side **13**. The vertical web **16** is illustrated herein as comprising a pair of laterally spaced vertical sections **21** and **21'** which, for the purpose of this disclosure, can be considered as a single, imperforate web separating the opposed sides **12** and **13** of the beam. The discrete web sections **21** and **21'** provide a substantially strong construction which is relatively light in weight.

The car **11**, as illustrated herein, comprises frame member **22** including a plurality of longitudinally spaced transverse reinforcing frames **25** and having an outer wall **23** having a plurality of doors **24** and windows **26** extending therethrough. The other side of the car is preferably an imperforate inner wall **27** so that vision of the passengers seated in seats, as indicated at **28** located along the inner wall **27**, is restricted to vision through the windows **26** so as to avoid any psychological effect which might be adverse to the passengers when a car on one side passes a car supported on the other side of the monobeam **14**. For this purpose, any loading platform P. one being indicated by the broken lines in FIGURE 4 and by solid lines in FIGURE 2, is positioned outwardly of the monobeam **14** and spaced therefrom sufficiently to clear the car **11**. Steps or stairways (not shown) may be provided for access of the passengers to the loading platform, if desired. Further, such access may be provided by escalators or elevators, if desired, and the platform provided with rails **29** for the safety of passengers on the platform. Optionally, the platform P may be supported by suitable structure forming a part of the standards S, if desired.

The cars, such as car **11**, are adapted to be supported on the monobeam by wheel means extending laterally from the frame of the car and engageable with selective track means of the track beam **14** for linear movement of the car body along one of the sides **12** and **13** of the track beam **14**. A first wheel means **30** is provided adjacent to the upper portion **31** of the car **11** whereas second and third wheel means **32** and **33** are supported adjacent to a lower portion **34** of the car. The wheel means **30**, **32** and **33** are adapted to ride on vertically spaced track means **36** and **37** secured to the upper and lower flanges **19—17** and **20—18**, respectively.

As best seen in FIGURES 2 and 4, the uppermost track means **36** includes a laterally disposed L-shaped track of relatively-rigid material, such as steel, or the like, having a horizontal leg **37** overlying the upper surface of the flanges **17** and **19** and a vertical leg **38** extending upwardly therefrom and adjacent to the outer edges of flanges **17** and **19**, there being a track means **36** on each horizontal flange portion **17** and **19**. The horizontal leg of track means **36** is useable for securement of the track to the flange **17** or **19**. The extending leg **38** includes an inwardly facing vertical surface **39** for engagement by the upper wheel means **30**. The upper wheel means **30** includes a wheel assembly adjacent the fore and aft ends of the car **11**, the fore assembly being designated by the numeral **30'** and the aft by the numeral **30''** and each including two or more longitudinally-spaced wheels **40**, each rotatable about an axis substantially parallel to the plane of the movement of the car and to the vertical surface **39** of the rail **36** so that the periphery of the wheels **40** ride on the surface **39**. The wheels **40** are preferably resiliently mounted relative to the frame of the car **11**. Such a resilient mount is best illustrated in FIGURE 2 as a T-shaped member **41** supporting a wheel **40** at each of the outer ends of the cross-member and having an intermediate arm **42** pivoted as at its outer end **43** to a resilient spring member **44** which, in turn, has a pair of outer ends **46** tied in suitable manner to the frame **22** of the car whereby the T-shaped member **41** may flex transversely relative to the car body to provide resilient mounting means for the wheels so as to adapt the wheels to more effectively follow the track means **36** even at its curves such as the curve illustrated in FIGURE 3. Inasmuch as the monobeam is substantially symmetrical about its vertical center, the car wheel means **30**, **32** and **33** are adapted to engage either side of the monobeam.

On each side of the monobeam **14**, the lower flanges **18** and **20** provide horizontal track surfaces **50** and **51** secured to the upper edges of the flanges and vertical track surfaces **52** and **53** secured so as to face the outer edges of the flanges. The horizontal surfaces **50** and **51** are engageable by the wheel means **32** for the main support of the center of gravity of the car **11** whereas the side surfaces **52** and **53** are each engageable by the wheel means **33** for transmitting inwardly-extending side thrusts of the weight of the car against the flanges **18** and **20**.

The wheel means **32** includes a fore and aft wheel assembly each having at least two wheels **32'** mounted for rotation in a plane substantially parallel to the monobeam **14** and about an axis substantially normal to the monobeam. The wheel means **33** includes a fore and aft wheel assembly each assembly including two or more wheels **33'** resiliently mounted for pivotal movement in a plane substantially normal to the vertical surfaces **52** and **53** of the flanges **18** and **20**, respectively. The wheel means **32**, as best seen in FIGURE 6, has its individual wheels **32'** rotatable about individual axles **54** extending transversely from the car body **11** which is preferably connected as by a universal joint **56** and through a coupler **57** to a driven shaft **58** of a drive means in the form of an electrical, or other motor generally designated by the numeral **59**. Each shaft **54** preferably includes a spline connection **61** whereby its axle **54** has limited movement along the axis of rotation to adjust placement of wheels **32** on curves and is resiliently mounted as indicated generally by the numeral **62** so that the universal joint **56** has limited universal movement relative to the driven shaft **58** of the motor **59**. The resilient mount **62** may include any suitable resilient means such as a sleeve constructed of a compressible solid, such as Silastics, or the like, and indicated by the numeral **63**.

In this manner, by means of the resilient mount **62**, the axially movable joint or spline **61** and the joint **56**, the wheel means **32** is relatively flexible to provide relatively free movement of wheel means **32** relative to the

car frame to take up movement of the wheels relative to its track, particularly on curves.

The individual wheels 33' of the wheel means 33, as best seen in FIGURE 5, are mounted about an axis 63 for rotation in a horizontal plane substantially normal to its adjacent track surface 52. The wheels 33' are each rotatable on a shaft 64 having a pivotal connection 66 to the frame of the body 11 so as to have pivotal movement towards and away from the surface 52. The wheels 33' are biased towards the surface 52 by resilient means such as the spring means 67 illustrated in FIGURE 5, the spring 67 being yieldable to compress in response to pivotal movement of the shaft 64 in a direction towards the body 11.

For added stability, particularly on outside curves of the monobeam, stabilizing wheel means, generally indicated by the numeral 133 in FIGURE 5, are preferably provided resiliently secured to the car frame and engageable with an upwardly extending vertical portion 134 of the track 52, the wheel means 133 riding on the inner surface thereof to take side loads.

Referring in detail to FIGURE 7, a modification of the upper wheel means is more clearly illustrated and designated by the numeral 90. The wheel means 90 is secured to the upper portion of the car, herein generally designated by the numeral 91' and comprises a resilient mounting member 92 in the form of a multiple leafed spring 93, or the like, pivotally secured as at 94 by a shackle bolt to a transverse supporting frame 96 of the car body 91. The horizontal wheels of the instant embodiment, indicated by the numerals 97 and 98 are, as illustrated herein, secured for rotation about axes 99 and 100, respectively, to outer ends of the spring means 93 so as to be resiliently mounted in a horizontal attitude. The wheels 99 and 98 are rotatable on the inwardly facing vertical surface 101, similar to surface 38 of the first embodiment, and are biased by the spring means 93 into contact with the surface. The wheel means 90 preferably includes another pair of wheels like the wheels 97 and 98 adjacent to an opposite end of the car. The wheels in this manner, are flexibly and resiliently mounted so as to more readily yield and conform to any curved portions of the rail surface 101.

FIGURE 8 illustrates a further modification wherein a car body, a portion of which is designated by the numeral 110, is shown as being provided with a singular lower wheel means 132 to replace the vertical and horizontal lower wheel means 32 and 33 provided in the first embodiment. In accordance with the instant embodiment, the singular wheel means 132, including fore and aft wheel assemblies provides means whereby each individual wheel 132' of the pairs of fore and aft wheels is rotatable about an axis substantially normal to the resultant of the forces directed by the car body 110 on the track beam designated in the instant embodiment of the numeral 114. In such event, each individual wheel 132' rotates about the axis 113 of the wheel and the axis of rotation is substantially normal to the resultant of the forces of the body directed towards the track thereby eliminating any side forces tending to cause the wheel 132' to skid laterally relative to its track 115. Further, in the instant embodiment, the track 115 is preferably arcuate, forming a trough-like surface 116 in which the wheels, like 132', ride linearly along the lower projecting flange of the track beam 114. The lateral force of the car may be supported partially by upper wheel means, similar to the wheel means 30' and indicated by the force line 117 of the force diagram associated with FIGURE 8 wherein the resultant R is in a plane parallel to the plane of rotation of the wheels. In some embodiments, the lateral force 117 extending from the center of gravity (C.G.) of the diagram represent approximately thirty-five percent of the load whereas the vertical, downward force 118 represents approximately sixty-five percent of the load, the resultant of the forces being designated by R. The wheels 132' are provided with axles 119 coincident with the axis 113 of rotation of the wheels and preferably provided with brake drums 120 selectively controllable within the car body 110 and further, preferably include bearings 121 which are laterally yieldable, constructed similarly to the bearing 62 of the first embodiment.

The track 115 is preferably secured to the track means by lag bolts, as indicated by the numeral 122, and may be adapted to carry an electrical circuit for providing electrical power to a drive means similar to the motor 59 of the first embodiment for selectively driving the wheels like 132'.

Therefore, in accordance with this invention, a new and improved monorail is provided which comprises a symmetrical track beam 14 of generally I-shaped cross-section positioned with its web 16 vertical and its flanges 17, 18, 19 and 20 horizontal, a first vertical track rail 38 on each of opposite sides of the beam, secured to the uppermost flanges 17 and 19 of the beam and each including an inwardly-facing track surface 39; a second vertical rail means 52 and 53 on opposite sides of the track beam 14 and secured to the outer surface of the lowermost flanges, 18 and 20, and including outwardly facing track surfaces 52 and 53; and a horizontal rail means on each of the lowermost of the flanges, the horizontal rail having an upwardly facing track surface 50 and 51, respectively, in combination with an elongated car frame adapted to travel linearly along one of the sides of the multiple tracks of the monobeam in spaced, parallel relationship thereto. Means are provided for suspending the car for linear movement relative to the track beam and the cars are adapted to ride on opposite surfaces of the beam which is imperforate so as to prevent viewing of one car from another car during passing of the cars on opposite sides of the rail beam.

It is to be understood, that, although the tracks are described as being capable of carrying an electrical circuit for energizing the drive means, other means may be provided, well known in the art, such as discrete buss bars of high electrical conductive material, such as copper or the like, and engaged by a trolley, or the like, secured to the car, or, optionally, the drive means may be in the form of an internal combustion engine, or the like.

While there is herein shown and described what is conceived to be the most practical and preferred embodiments of this invention, it is recognized that departures may be made therefrom within the scope of this invention which is not limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

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

1. In a monorail car system comprising:
- a track beam having a vertical web and upper and lower flanges;
- first rail means mounted on said upper flange and extending upward therefrom to provide a surface facing inwardly toward said web;
- second rail means carried by said lower flange and located on the exterior surface thereof; the combination with:
- an elongated car frame adapted to travel along one side of said track beam;
- first wheel means mounted substantially perpendicular to said surface of said first rail means for engagement therewith and being connected with the upper portion of said car frame in order to hold the upper portion of said car frame adjacent said upper flange;
- second wheel means secured to the lower portion of said car frame; and
- axes means extending from said car frame for mounting said second wheel means substantially perpendicular to said second rail means for engagement therewith to hold the lower portion of the car away from

said lower flange and support the major portion of the weight of the car frame.

2. In a monorail car system as defined in claim 1 wherein said second rail means comprises:

a first vertical rail on the end of said lower flange and a second horizontal rail on the upper surface of said lower flange, said second wheel means comprising a plurality of first and second wheels located substantially perpendicular to said first and second rails, respectively;

said axes means comprising first substantially horizontal axes for said first wheels and second substantially vertical axes for said second wheels.

3. In a monorail car system as defined in claim 2 wherein said second rail means comprises:

a rail mounted on the upper surface of said lower flange;

said second wheel means comprising a plurality of wheels mounted for rotation, said axes means comprising separate axes for said wheels, said axes being positioned substantially normal to the resultant of the load forces acting at the center of gravity of the sections of said car frame opposite said wheels so that no substantial sidewise forces are exerted on said wheels, said rail on said upper surface of said lower flange being substantially normal to said wheels at the point of engagement with said rail.

4. In a monorail car system as defined in claim 2 wherein said first wheel means includes a pair of fore and aft assemblies of wheels adapted to ride on said first rail means, each assembly including a plurality of substantially horizontal wheels attached on a common mounting means to said car frame for rotation of said wheels about axes substantially vertical and parallel to said first rail means, each mounting means being pivotally mounted on said car frame for pivotal movement on a substantially vertical axis.

5. An asymmetrical monorail system comprising:

a track beam of general I-shaped cross section having a vertically positioned web and upper and lower horizontal flanges projecting from opposite sides of said web;

rail means on each side of said track beam, said rail means comprising a first rail on the upper flange and having a first substantially vertical surface facing inwardly toward said web and a second rail on said lower flange having a second surface facing outwardly away from said web, the combination with;

an elongated car frame adapted to travel along one of the sides of said track beam, said car frame having a plurality of wheel means on a side of said frame adjacent said track beam and arranged so as to support said frame for linear movement on one of said sides of said track beam, said wheel means comprising a plurality of first wheels rolling on said first surface substantially perpendicular thereto and secured to the upper portion of said car frame; and

second wheels rolling on said second surface substantially perpendicular thereto, each of said second wheels being mounted on the lower portion of said car frame for rotation about an axis substantially normal to the resultant of load forces at the center of gravity of the section of said car frame opposite each of said second wheels.

6. An asymmetrical monorail system comprising:

a symmetrical track beam of general I-shaped cross section having a vertically-positioned web and upper and lower horizontal flanges projecting from opposite sides of said web;

a first vertical rail on each of opposite sides of said track beam and secured to the uppermost of said horizontal flanges;

a second vertical rail on each of opposite sides of said track beam and secured to the outer surface of the lowermost of said horizontal flanges; and

a horizontal rail on each of said opposite sides of said beam and secured on said lowermost flange, the combination with:

an elongated car frame adapted to travel along one of said sides of said track beam, said car frame including:

first wheel means mounted on said car frame for rotation in a substantially horizontal plane and engageable with the vertical surface of said first vertical rail of an adjacent side of said beam; said engaged surface of said first rail facing inwardly toward said web;

second wheel means mounted on said car frame for rotation in a substantially vertical plane and engageable with the upper surface of said horizontal rail of said adjacent side of said track beam; and

third wheel means mounted on said car frame for rotation in a substantially horizontal plane and engageable with the vertical surface of said second vertical rail of said adjacent side of said beam; said engaged surface of said second rail facing outwardly away from said web.

7. A monorail car system as defined in claim 6 comprising drive means having a drive shaft for connection to said second wheel means, said second wheel means includ- a wheel resiliently mounted and rotatable about a shaft axially connected to said drive shaft, said drive shaft including a universal joint intermediate of said wheel and said drive means whereby said wheel is axially and laterally yieldable relative to said drive means.

8. A monorail car system as defined in claim 6 where said third wheel means includes a plurality of wheels mounted for rotation in a horizontal plane on separate shafts substantially parallel with the plane of said web, one end of each shaft being pivoted to said frame to permit some movement of said wheels transverse to the direction of travel of said car frame.

9. In a monorail car system comprising:

track supporting means having an upper portion and a lower portion;

first rail means mounted on said upper portion of said track supporting means and extending upward therefrom to provide a surface facing inwardly toward a vertical plane passing through said track supporting means;

second rail means carried by said lower portion of said track supporting means and located on the exterior surface thereof,

the combination with:

an elongated car frame adapted to travel along one side of said track supporting means;

first wheel means mounted substantially perpendicular to said surface of the said first rail means for engagement therewith and being connected with the upper portion of said car frame in order to hold the upper portion of said car frame adjacent said upper portion of said track supporting means;

second wheel means secured to the lower portion of said car frame, said second wheel means comprising a plurality of wheels mounted for rotation; and

axis means extending from said car frame for mounting said second wheel means substantially perpendicular to said second rail means for engagement therewith to hold the lower portion of said car frame away from said lower portion of said track supporting means and support the major portion of the weight of the car frame, said axis means comprising separate axes for said wheels, said axes being positioned substantially normal to the resultant of the load forces acting at the center of gravity of the sections of said car frame opposite said wheels so that no substantial sidewise forces are exerted on said wheels, said second rail means being substantially normal to said wheels at the point of engagement therewith.

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