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Blemly et al.

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[45] Apr. 17, 1973

[54] **VEHICLE PROPULSION AND GUIDE TRUCK SYSTEM**

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[21] Appl. No.: **96,476**

[52] **U.S. Cl.** ....**104/147 R,** 104/247, 105/30, 105/133, 105/215, 180/79

[51] **Int. Cl.** **B61c 11/00,** B61d 15/12, B61f 9/00

[58] **Field of Search**......................104/108, 119, 120, 104/121, 94, 95, 148, 172 BT, 242, 243, 244, 245, 147, 247; 105/30, 141, 144, 145, 148, 150, 153, 154, 155, 215, 133, 215 R; 180/79

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[57] **ABSTRACT**

A transportation system in which wheeled carriers are guided by and driven along a plate-like rail member, mounted on edge on a supporting surface for the wheels of the carriers. Each carrier has a pair of pinch rolls engaging opposite vertical sides of the rail, one of the rolls being driven by a motor obtaining power from a conductor bar or bars secured to the sides of the rail above the normal elevation of the pinch rolls to prevent the carrier from jumping the rail. An improved pivotal mounting of the motor and pinch rolls aids in maintaining driving engagement of the pinch rolls with the rail on horizontal and vertical curves.

16 Claims, 12 Drawing Figures

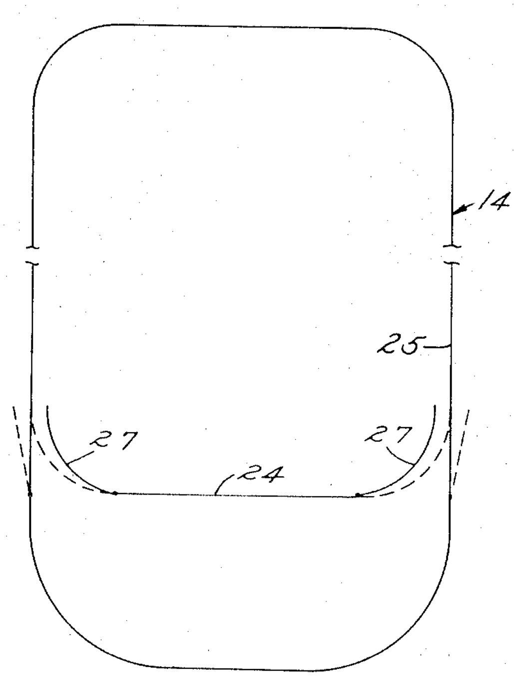

FIG. 1

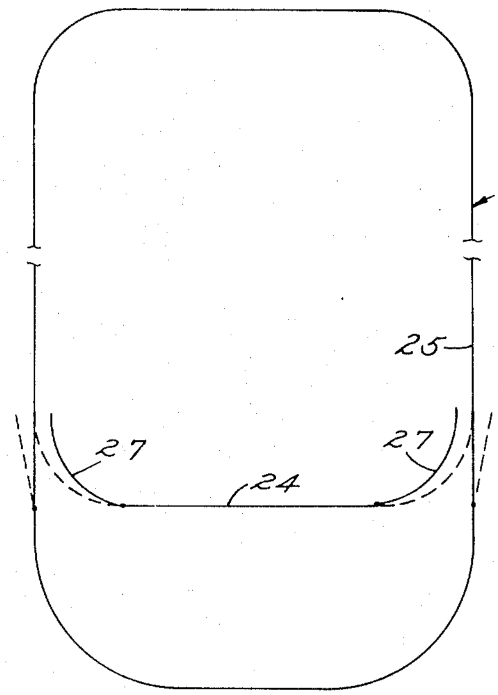

FIG. 5

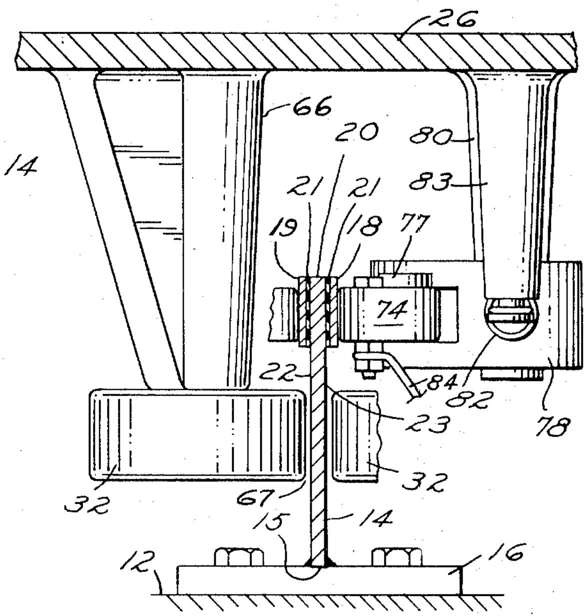

FIG. 2

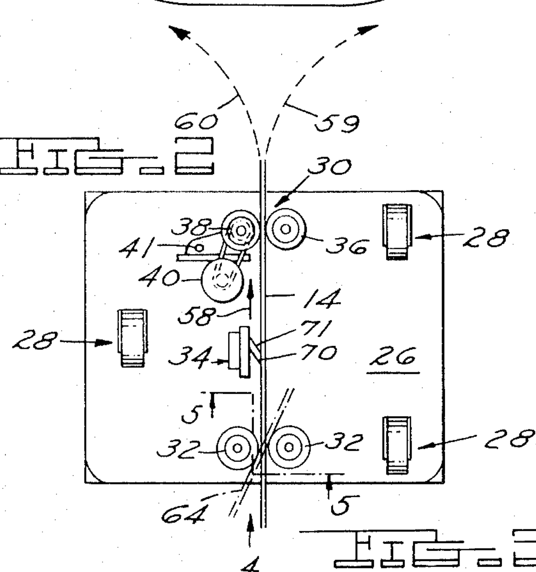

FIG. 4

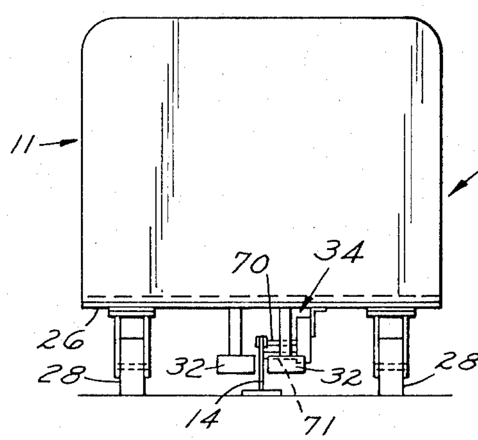

FIG. 3

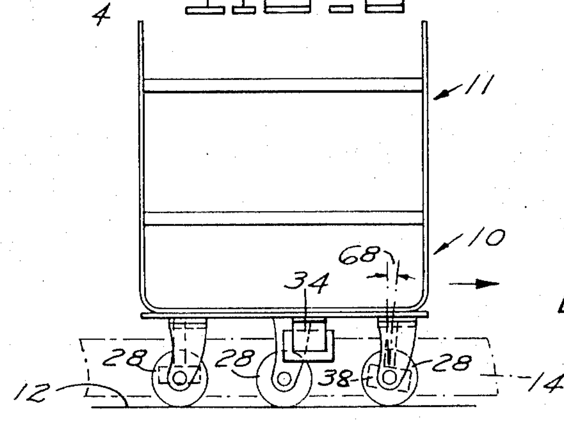

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FIG. 6

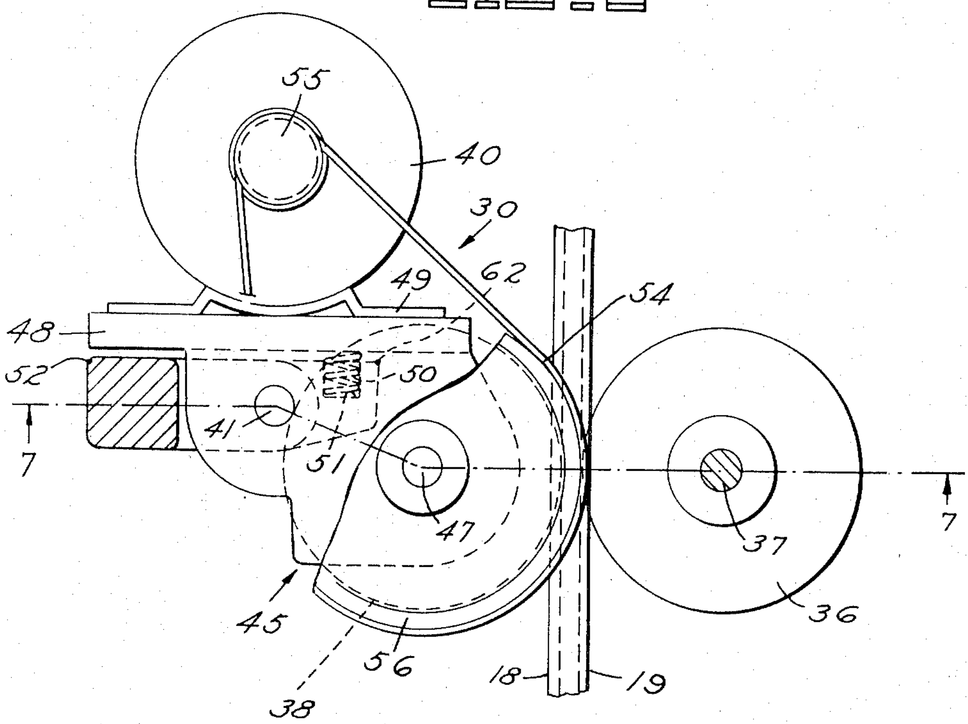

FIG. 7

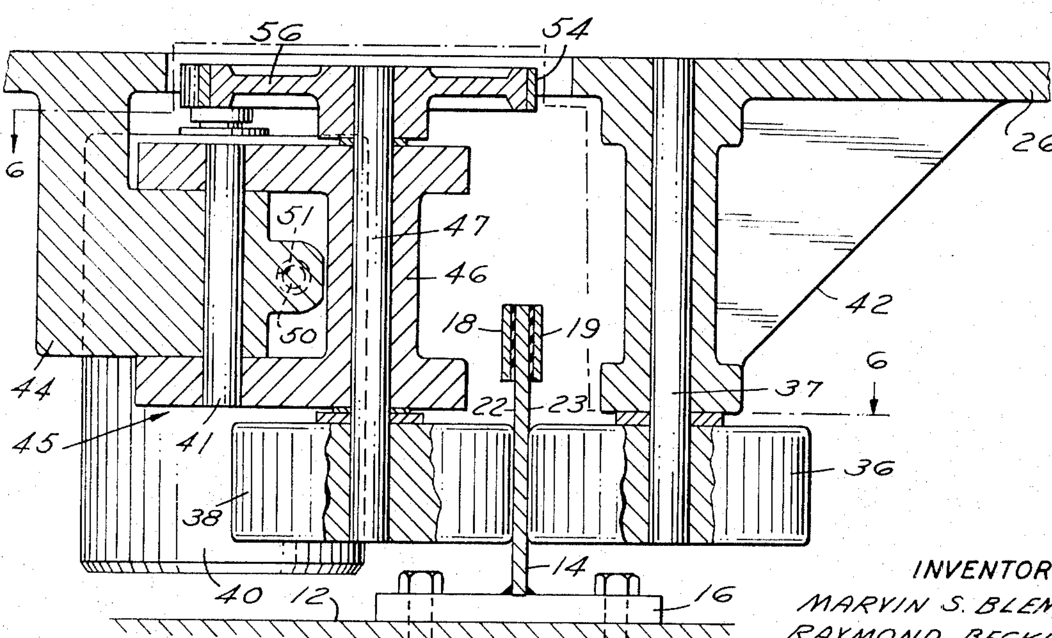

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FIG. 8

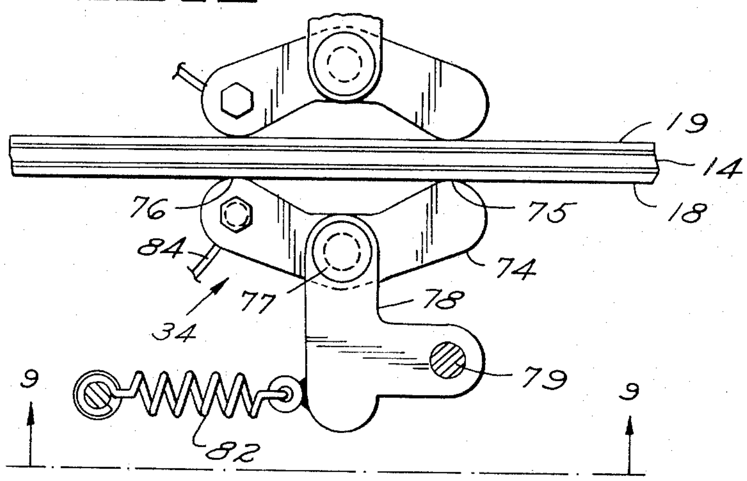

FIG. 9

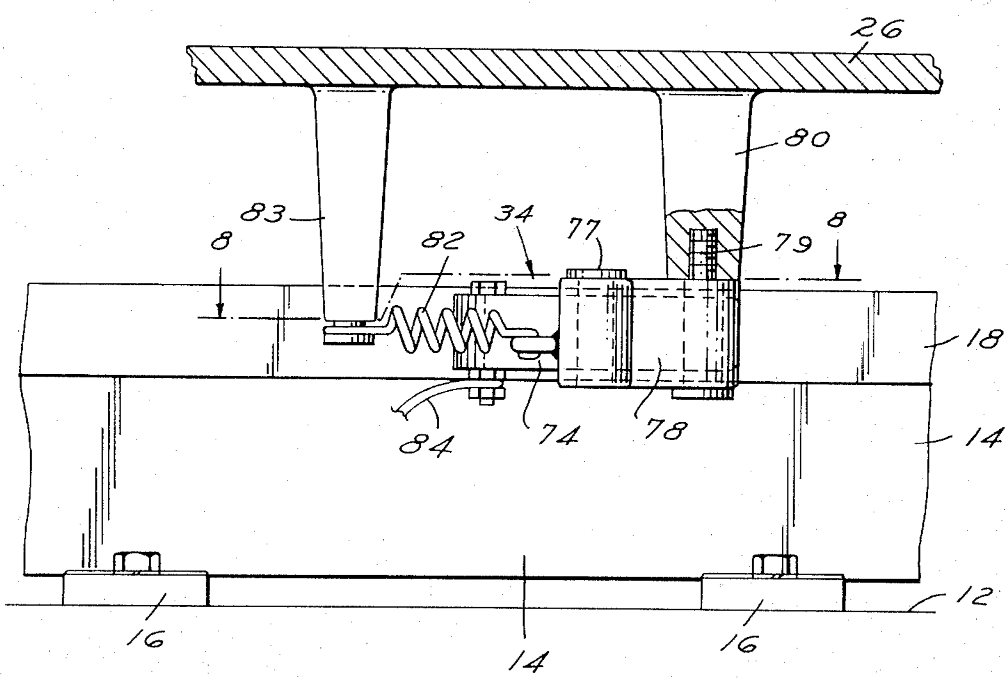

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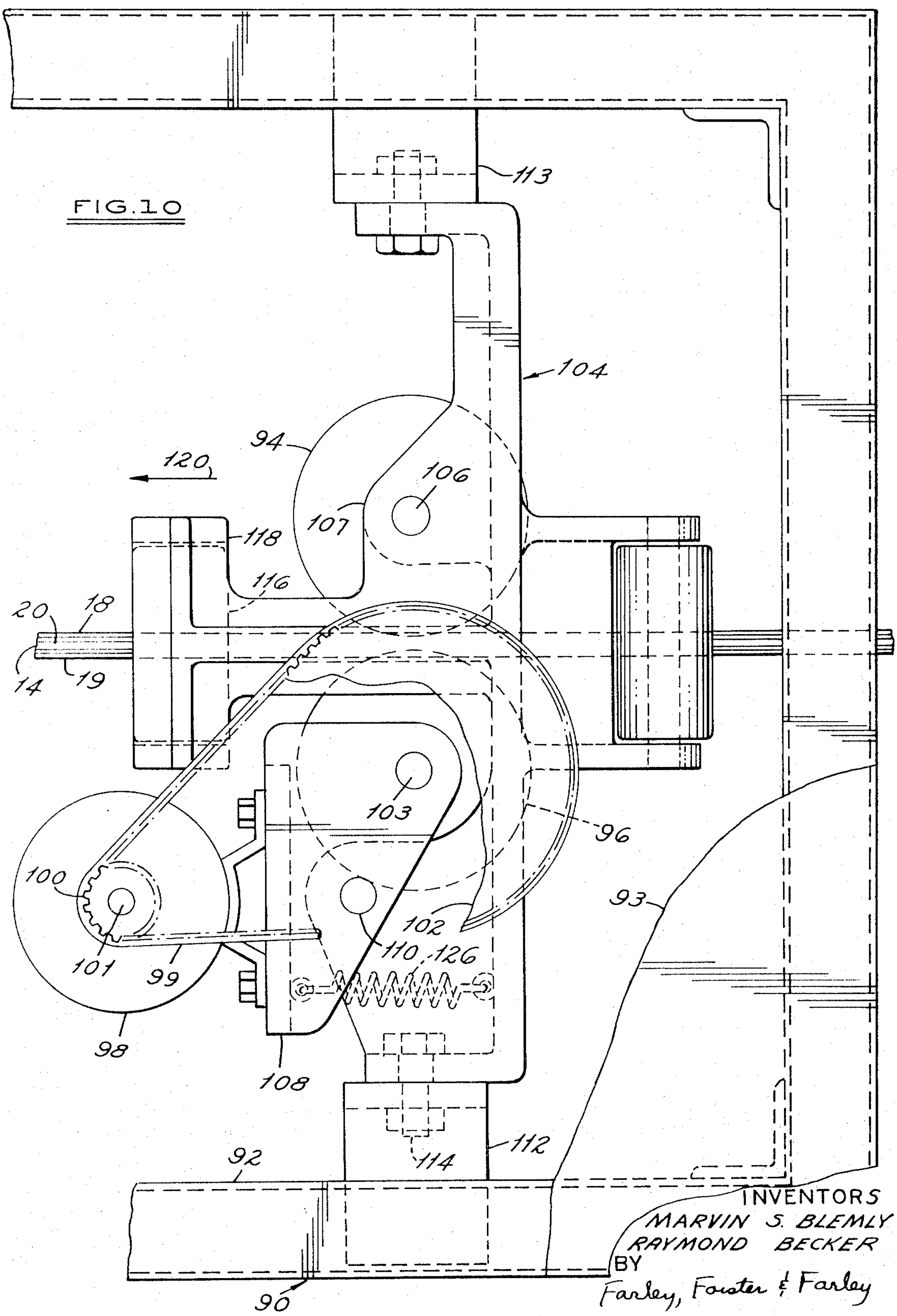
FIG.10



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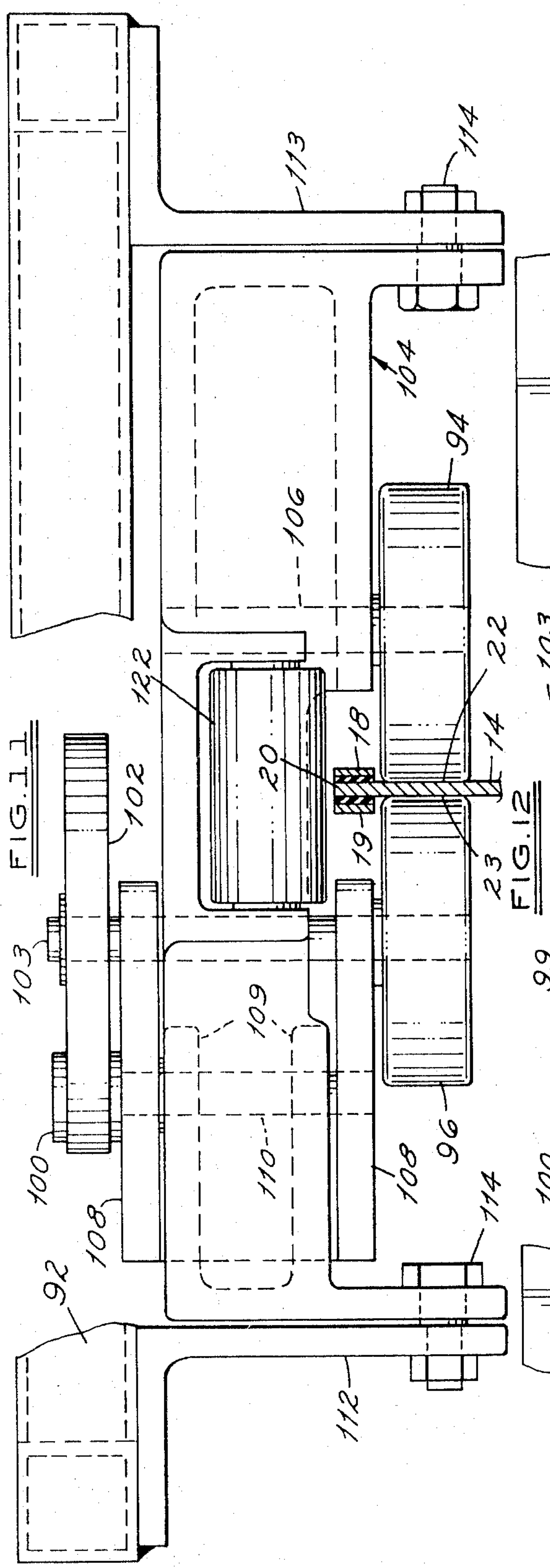

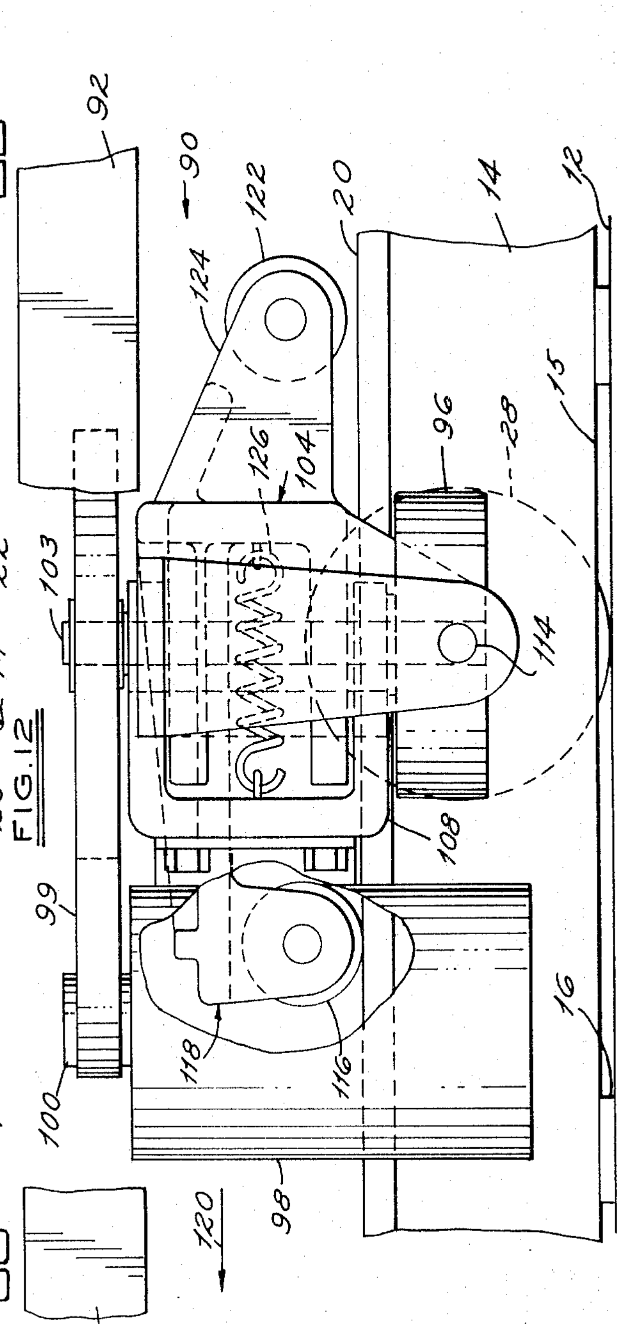

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VEHICLE PROPULSION AND GUIDE TRUCK SYSTEM

RELATED APPLICATION

This application is a continuation-in-part of co-pending application, Ser. No. 789,229, filed Jan. 6, 1969, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to improvements in monorail transportation systems employing a pinch roll type of drive for propelling a carrier vehicle along the monorail.

2. Description of the Prior Art

A "pinch roll" type of drive is one in which oppositely facing surfaces of a rail member are engaged between a pair of driving rolls or wheels of the vehicle. Various forms of railways, both single and multiple rail, have been proposed employing this drive, examples being shown in U.S. Pat. No. 549,522; 627,565; 1,600,767 and others.

6. A railway accordintt claim**1** further comprsing mans iimiting pivotal movement of the frame.**8c 003352 7.**

The main object of the present invention is to provide an improved and simplified monorail system utilizing the pinch roll type of vehicle drive which will fulfill an existing need in the material handling field for a remotely operable, relatively inexpensive form of conveyance capable of safely travelling at speeds far above the maximum that can be attained with conventional belt conveyors and with chain propelled carriers. The maximum speed of the fastest of such conventional conveyors is about 300 feet per minute, whereas the need is for speeds on the order of 1,500 feet per minute.

SUMMARY OF THE INVENTION

A transportation system or railway of the invention comprises a planar support such as a floor, a carrier vehicle having wheels engaging the support, and a plate-like rail having a pair of oppositely facing track surfaces mounted with these track surfaces extending substantially perpendicular to the plane of the support. Driving means are provided on the vehicle, including an idler roller engaging one of the track surfaces, a driving roller engaging the opposite track surface, and a driving motor for rotating the driving roller, the driving motor being energized by power obtained from a conductor bar mounted on the rail by an electrical pickup unit on the vehicle.

The preferred form of rail construction is simple, inexpensive and easy to install in any desired path including horizontal and vertical curves. Strips of sheet metal plate are used for the rail, with mounting brackets being secured at intervals to one edge thereof and a pair of conductor bars mounted on the sides or track surfaces of the plate adjacent the other edge thereof so as to project outwardly of the track surfaces and form a headed portion which serves to prevent the vehicle driving and idler rollers from jumping the rail. The rail provides a tractive surface, a guide, and source of power for the vehicle.

Traction between the driving roller and rail is maintained, with automatic compensation for the variations encountered, particularly in traversing curved rail sections, by mounting the driving roller, idler roller and motor on a frame which is connected to the vehicle on a pivotal axis extending transversely to the track surfaces of the rail and perpendicular to the axes of rotation of the driving and idler rollers. Means are provided for positioning this frame so that the axes of the driving and idler rollers extend substantially perpendicular to the support on which the vehicle travels, and so that when the vehicle encounters a vertical curve the frame is positioned so that the axes of the driving and idler rollers extend substantially along radial lines of the vertical curve. The positioning means preferably consists of a roller carried by the frame and engaging the upper edge of the rail which thereby forms a guide or reference surface, and the pivotal axis of the frame is located below the centerline of the periphery of the driving roller so that the driving action of the driving roller produces a turning moment on the frame which normally urges the positioning roller into engagement with the upper edge of the rail.

Traction between the driving roller and rail is also improved by mounting the driving roller and driving motor on a bracket connected to the frame by a pivot located so that the driving action of the driving roller produces a turning moment on the bracket tending to urge the driving roller into firm engagement with the track surface contacted thereby.

Positive tracking of the vehicle on the rail is provided by a pair of guide rolls spaced longitudinally on the vehicle from the driving and idler rollers.

Preferably, low voltage power is used in the system for safety, simplicity and the ability to remotely control the vehicles by methods similar to those used on model railroads.

Other features and advantages of the invention will appear from the description to follow of the representative construction illustrated in the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic plan view of a representative track layout;

FIG. **2** is a plan view of the underside of a carrier vehicle;

FIG. **3** is a side elevation of the vehicle;

FIG. **4** is an end elevation thereof taken in the direction of the arrow **4** of FIG. **2**;

FIG. **5** is an enlarged sectional elevation on the line **5—5** of FIG. **2** showing the rail construction, conductor bar and pickup, and guide roll mounting;

FIG. **6** is an enlarged sectional plan view of the pinch roll drive construction taken as indicated by the line **6—6** of FIG. **7**;

FIG. **7** is a sectional elevation taken as indicated by the line **7—7** of FIG. **6**;

FIG. **8** is an enlarged sectional plan view of the conductor bar and pickup construction taken on the line **8—8** of FIG. **9**;

FIG. **9** is a side elevation of the rail, conductor bar and pickup construction taken as indicated by the line **9—9** of FIG. **8**;

FIG. 10 is an enlarged plan view of one end of the vehicle showing a frame connected thereto on a transverse axis and carrying an idler roller, driving roller and driving motor;

FIG. 11 is a transverse elevation of the construction shown in FIG. 10; and,

FIG. 12 is a side elevation of the construction shown in FIG. 10.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The transportation system illustrated and to be described is intended for high-speed handling of articles such as baggage at a rail or air passenger terminal or articles in a large warehouse. A relatively small carrier vehicle **10** is shown, having a U-shaped, open-sided load compartment **11** with a width greater than its length.

The track is designed to be installed on a suitable supporting surface **12** including an existing floor, and as shown in FIGS. **1**, **3** and **5**, consists of a single rail **14** which may be made of lengths of steel plate — for example, ¼ in. × 4 in. in section — one edge **15** of which is welded at suitable intervals to mounting plates **16** which are secured to the supporting surface **12** as shown in FIG. **5** so that the rail **14** projects above the surface **12** substantially perpendicular to the plane thereof. A pair of conductor bars **18** and **19** are secured to the rail **14** adjacent the upper edge **20** thereof, the conductor bars being spaced from the rail **14** by insulating strips **21** and projecting outwardly of the opposite side faces **22** and **23** of the rail which form the track surfaces. This track construction is relatively inexpensive, flexible, and may easily be shaped to any configuration desired for horizontal or vertical curves. FIG. **1** illustrates a representative loop-type of track layout, including a branch line **24** connected to a main line **25** by switches **27**.

Each vehicle **10** includes a base or frame **26**, best shown in FIG. **2**, on which are mounted three supporting wheels **28**, a pinch roll drive assembly **30**, a pair of guide rolls **32** and an electrical pickup assembly **34**. The supporting wheels **28** may be fixed or castering, or a combination thereof, and for vehicles with a longer wheel base, a four rather than a three wheel suspension would ordinarily be employed. Where a caster type of wheel is used, the castering action should preferably be dampened in order to minimize flutter at high speeds.

The pinch roll drive assembly **30** includes a reaction or idler roll **36** mounted on an axis fixed to the vehicle frame **26**, and a driving roll **38** and motor **40** mounted as a unit for limited rotation about a pivot **41** on the vehicle frame.

The motor **40** is preferably a type operable by a relatively low voltage so that no insulation is required for the conductor bars **18** and **19**. For example, a series type 24-volt DC torque-rated motor of 7,000 RPM, developing about one-third horsepower, can propel the relatively small vehicle **10** along the rail **14** at speeds up to 15 miles per hour. One form of this pinch roll drive assembly is further illustrated in FIGS. **6** and **7**, to which reference should now be made.

A boss **42** depending from the vehicle frame **26** supports the idler roll **36** and idler roll shaft **37** in fixed relation to the frame, the idler roll **36** engaging one track surface **23** of the rail **14**.

A boss **44** on the vehicle frame **26** supports the pivot pin **41** to which is connected a mounting bracket **45** for the drive roll **38** and motor **40**. The mounting bracket **45** includes a portion **46** (FIG. **7**), forming a bearing for a drive roll shaft **47**, and a vertical plate portion **48** to which the motor base **49** is secured. A spring **50**, mounted in a recess **51** in the boss **44**, bears against the plate portion **48** of the bracket and normally biases the bracket in a counter-clockwise direction about the pivot, as viewed in FIG. **6**, urging the drive roll **38** against the track surface **22**. This spring biased movement of the bracket **45** is limited by engagement between the bracket and boss in the area **52**. The axis defined by the pivot pin **41** is located between the drive roll shaft **47** and the center of the motor **40**.

A driving belt **54** connects the motor output pulley **55** with a pulley **56** secured to the drive roll shaft **47**.

Proper engagement between the idler and drive rolls **36**, **38** and the track surfaces **23**, **22** for traction is maintained as the vehicle traverses curved sections of the rail by the pivotal mounting of the motor and drive roll. Referring to FIG. **2**, if the vehicle is proceeding along the rail **14** in the direction of the arrow **58** and encounters a rail section curving to the right or to the idler roll side of the vehicle as indicated by the arrow **59**, centrifugal force acting on the vehicle tends to force the idler roll **36** into the curved rail **14** and displace the drive roll **38** away from the rail. This centrifugal force, however, acts on the motor **40**, and the mass of the motor together with the force of the spring **50** tends to pivot the bracket **45** and drive roll **38** into engagement with the rail. On a curve **60** in the other direction, or toward the drive roll side of the vehicle, the bracket **45** can pivot in the opposite direction to relieve excessive pinching between the drive roll **38** and rail surface **22** which would tend to stall the motor. Pivotal movement in this direction collapses the spring **50**, and is limited by engagement between the plate portion **48** of the bracket **45** and the boss **44** at the portion **62** of the latter.

Clearance between the idler roll **36** and drive roll **38** and the rail **14** varies between straight and curved rail sections, as illustrated by the curved rail section **64** shown in phantom at the guide rolls **32** in FIG. **2**. The pivotal mounting of the drive roll **38** and motor **40** automatically compensates for this change in clearance as well as for the effect of centrifugal force upon the drive roll and rail engagement in traversing curves. Without this automatic compensation for these factors, it would be necessary to allow the rear of the vehicle to swing violently, and even then there would be a tendency to lose traction in negotiating a curve to the idler roll side of the vehicle.

The guide rolls **32** provide positive tracking. Each of these rolls **32** is mounted as shown in FIG. **5** on a boss **66** depending from the vehicle frame **26**, and clearance is provided between the rolls **32** and rail surfaces **22** and **23**, as indicated at **67**, sufficient to prevent binding on curves. However, the guide rolls **32** are preferably overlapped by the conductor bars **18** and **19**, as are the idler and drive rolls **36**, **38** to prevent the vehicle from jumping the rail **14**.

Any tendency of the vehicle to leave the rail at high speeds may also be minimized by mounting the drive roll **38** at a slight angle **68** to the vertical, as illustrated in FIG. **3**. This crab angle may be on the order of one and a half - two degrees so that there is little scuffing action on the drive roll **38** but at the same time a positive force component is obtained tending to keep the vehicle on the surface **12**.

The pickup assembly **34** as schematically illustrated in FIGS. **2** and **4**, may consist of a pair of resilient wipers **70** and **71**, the wiper **70** engaging one of the conductor bars **18** or **19** to obtain current for the motor **40**, and the wiper **71** contacting a side surface **22** or **23** of the rail to complete a circuit to ground. With this type of pickup circuit, from conductor bar to rail, the other conductor bar **18** or **19** may be used for control purposes. Alternately, the motor circuit may be completed across the bus bars **18** and **19**, a pickup assembly engaging each.

A preferred form of pickup assembly is illustrated in FIGS. **5**, **8** and **9**. A carbon shoe **74**, having two longitudinally spaced conductor bar engaging portions **75** and **76**, is connected by a pivot **77** to a bracket **78** of insulating material which in turn is secured by a pivot pin **79** to a boss **80** on the vehicle frame **26**. A spring **82** is connected to the bracket **78** and to a second boss **83** on the vehicle frame. A lead wire **84** is secured to the shoe **74** as shown in FIG. **9**.

FIGS. **10–12** illustrate a preferred form of construction of the vehicle for a railway which incorporates vertical curves in the track system. Parts of this construction which correspond to those previously described are identified by the same reference numerals.

The vehicle **90** of FIGS. **10–12** has a rectangular tubular framework **92** supporting a load carrying platform **93** which is broken away in FIG. **10**. Means for driving the vehicle along the rail **14** include an idler roller **94** engaging the track surface **22**, a driving roller **96** engaging the track surface **23** and a driving motor **98** operatively connected with the driving roller **96** by a belt **99** engaging a sprocket **100** on the motor shaft **101** and a sprocket **102** which is mounted on a shaft **103** with the drive roller **96**, as best shown in FIG. **11**, the sprocket **102** being broken away in FIG. **10**. All these driving components are mounted on a frame **104**, the idler roller **94** being secured to a shaft **106** carried by a portion **107** (FIG. **10**) of the frame **104**; and, the driving roller **96**, the driving motor **98** and the drive elements **99–103** being carried by a bracket **108** secured to portions **109** of the frame by a pivot pin **110**. The bracket **108** is U-shaped when viewed in elevation as in FIG. **12** and the portions **109** of the frame are vertically spaced, as best seen in FIG. **11**.

The frame **104** is mounted between a pair of brackets **112** and **113**, which depend from the frame work **92**, by pivot bolts **114** which define a pivotal axis extending transversely to the rail member **14** and perpendicular to the axes **103** and **106** of the drive and idler rollers, and the frame **104** is free to rock about this pivotal axis.

This rocking movement is constrained by positioning means which locate the frame **104** so that the axes of the idler and driving roller shafts **106** and **103** extend substantially perpendicular to the supporting surface **12** (FIG. **12**) over which the vehicle **90** travels. In the construction shown, the positioning means includes a sensing roller **116** mounted on a U-shaped bracket portion **118** of the frame **104** and engaging a guide surface formed by the upper edge **20** of the rail **14**. The sensing roller **116** is located forwardly of the pivotal axis of the frame **104**, defined by the pivot bolts **114**, with relation to the forward direction **120** of movement of the vehicle; and, as best shown in FIGS. **11** and **12**, this pivotal axis of the frame **104** is spaced vertically below the centerline of the periphery of the driving roller **96**. As a result of this placement of the pivotal axis of the frame **104**, the driving action of the driving roller **96** in propelling the vehicle in the forward direction **120**, produces a turning moment on the frame **104** which tends to maintain the sensing roller **116** in engagement with the guide surface **20**. The sensing roller **116** is thus able to detect any vertical change in the contour of the track **14** and cause the frame **104** to rock so that the axes of the idler and driving rollers **94** and **96** are maintained in substantially perpendicular relation to the supporting surface **12** and in substantially radial relation to a vertical curve in the track. The vehicle is thereby able to follow vertical curves in the track without any tendency to drive into the supporting surface and stall in negotiating the transition into an ascending vertical curve, and without any tendency to climb off the rail in negotiating the transition into a descending curve.

Pivotal movement of the frame **104** is limited by suitable means such as the trailing roller **122** carried by a bracket portion **124** of the frame **104** and engageable with the upper rail surface **20**.

As previously mentioned, and as best shown in FIG. **10**, the driving motor **98** and driving roller **96** are mounted on the bracket **108** connected to the frame **104** by the pivot pin **110**. This pivot pin **110** is located forwardly of the shaft **103** of the driving roller **96** with relation to the forward direction **120** of vehicle travel, and outwardly of the shaft **103** with relation to the track surface **23** engaged by the driving roller **96**. As a result of this placement of the pin **110**, the driving action of the driving motor produces a turning moment on the bracket **108** which urges the periphery of the driving roller into engagement with the track surface **23**, pinching the track surfaces between the driving and idler roller and resulting in improved traction. A spring **126** mounted between the frame **104** and bracket **108** normally urges the periphery of the driving roller **96** into contact with the track surface **23**. Once in contact with the track surface, the driving roller produces the turning moment on the bracket **108** and pinching action described above, and the force of the spring **126** is not relied upon to improve traction.

As in the construction of FIGS. **1–9**, the pin **110** is located between the driving roller shaft **103** and the center of mass of the driving motor.

The foregoing description is illustrative in the sense that the requirements of transportation systems utilizing the present invention for handling of particular types of articles, or of personnel, will require forms of vehicles other than that described above to which the principles and features of the present invention may readily be applied by those skilled in the art. The automatic compensation provided for traction enables the vehicle speed to be accurately controlled as a function of conductor bar voltage, while the positive tracking enables the vehicle to be equipped with an escort type of magnetic or probe signalling device for selective dispatching.

We claim:

1. In a railway having a supporting surface for a wheeled vehicle and a rail having a pair of oppositely facing track surfaces mounted on the supporting surface with the track surfaces extending substantially perpendicular to the supporting surface, the improvement comprising:

a vehicle having wheels engaging the supporting surface;

driving means on the vehicle including a roller engaging one of the track surfaces, a driving roller engaging the opposite track surface, and a driving motor operatively connected with the driving roller;

a frame on which the driving means are mounted, and pivot means connecting the frame to the vehicle for movement on a pivotal axis extending transversely to the rail and parallel to the supporting surface;

and means for positioning the frame about said pivotal axis so that the axes of said rollers extend substantially perpendicular to the supporting surface.

2. A railway according to claim 1 wherein the positioning means includes a sensing roller carried by the frame, and a guide surface extending along the path of vehicle travel for engagement by the sensing roller.

3. A railway according to claim 2 wherein the pivotal axis defined by the pivot means connecting the frame to the vehicle is spaced vertically from the center line of the periphery of the driving roller whereby the driving action of the driving roller produces a turning moment on the frame tending to maintain the sensing roller in engagement with the guide surface.

4. A railway according to claim 2 wherein the rail has an upper surface extending substantially parallel to the supporting surface, said upper surface forming the guide surface.

5. A railway according to claim 4 wherein the sensing roller is mounted forwardly of the pivotal axis of the frame with relation to the forward direction of vehicle travel, and the pivotal axis of the frame is spaced below the centerline of the periphery of the driving roller whereby the driving action of the driving roller produces a turning moment on the frame which urges the sensing roller into engagement with said upper rail surface.

6. A railway according to claim 1 further comprising means limiting pivotal movement of the frame.

&. A railway according to claim 6 wherein the means limiting pivotal movement of the frame comprises a motion limiting member carried thereby and a guide surface extending along the path of vehicle travel engageable by said motion limiting member.

8. A railway according to claim 1 further comprising a bracket to which the driving roller and driving motor are secured, and a pivot connecting the bracket to the frame, the pivot extending parallel to the axis of rotation of the drive roller.

9. A railway according to claim 8 wherein the pivot connecting the bracket to the frame is located between the axis of the driving roller and the center of mass of the driving motor.

10. A railway according to claim 8 wherein the pivot connecting the bracket to the frame is located forwardly of the axis of the driving roller with relation to the forward direction of vehicle travel and outwardly of the axis of the driving roller with relation to the track surface engaged thereby, whereby the driving action of the driving roller on said track surface produces a turning moment on the bracket which urges the driving roller into engagement with said track surface.

11. A railway according to claim 10 further comprising resilient means acting on the bracket to urge the driving roller into contact with said track surface.

12. In a railway having a supporting surface for a wheeled vehicle and a rail having a pair of oppositely facing track surfaces mounted on the supporting surface with the track surfaces extending substantially perpendicular to the supporting surface, the improvement comprising:

a vehicle having wheels engaging the supporting surface at least some of which wheels are self-steering;

driving means on the vehicle including an idler roller engaging one of the track surfaces, a driving roller engaging the opposite track surface, a driving motor operatively connected with the driving roller, a bracket to which the driving motor is secured and on which the driving roller is mounted on a rotational axis, the driving motor having a center of mass displaced from the rotational axis of the driving roller in a direction longitudinally of the rail, and pivot means connecting the bracket to the vehicle on a pivotal axis extending generally perpendicular to the supporting surface and located on the bracket in said longitudinal direction between the rotational axis of the driving roller and the center of mass of the motor.

13. A railway according to claim 12 wherein the vehicle is provided with a pair of guide rolls mounted thereon in longituinally spaced relation to the idler and driving rollers, the guide rolls being engageable with the track surfaces.

14. A railway according to claim 12 further including means for limiting pivotal movement of the motor and driving roller.

15. A railway vehicle having frame structure;

supporting wheels carried by the frame structure;

driving means including a frame, a pair of pinch rolls mounted on the frame on axes spaced transversely of the vehicle, a driving motor operatively connected with one of the pinch rolls, and means connecting the frame to the frame structure for movement on a pivotal axis extending in a direction normal to the direction of the axes of the pinch rolls;

and means for positioning the frame about said pivotal axis to establish the driving position of the axes of the pinch rolls.

16. A vehicle according to claim 15 wherein the driving means includes a bracket pivotally secured to the frame, the bracket having means for supporting the driving motor and the one pinch roll operatively connected thereto.

* * * * *