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Howells et al.

[11] **3,831,526**

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[54] **VIADUCT FOR SMALL, POWERED, PASSENGER VEHICLES**

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[22] Filed: **Oct. 26, 1973**

[21] Appl. No.: **410,165**

[52] **U.S. Cl.** .... **104/121,** 104/88, 104/69, 104/113, 104/172 R, 105/147 R

[51] **Int. Cl.** **E01b 25/08**

[58] **Field of Search** .... 104/69, 70, 53 R, 88, 113, 104/118, 121, 147 R, 165, 172 R, 172 B, 172 C, 173; 105/147 R

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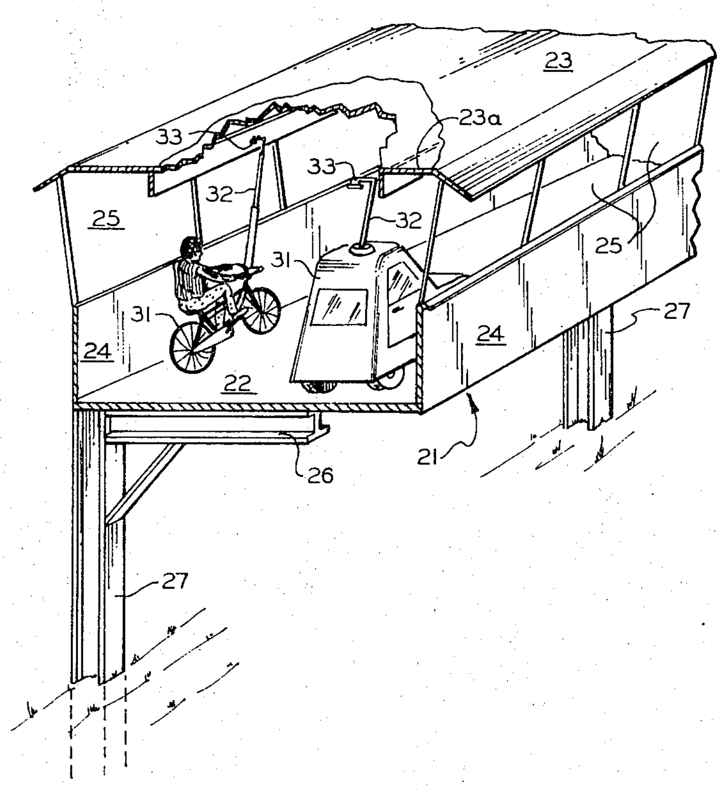
Primary Examiner—M. Henson Wood, Jr.
Assistant Examiner—D. W. Keen
Attorney, Agent, or Firm—Bruns & Jenney

[57] **ABSTRACT**

The viaduct comprises an enclosed and windowed way or flat road, wide enough for two vehicles abreast, the vehicles each having a forwardly and upwardly extending mast. The way is elevated and is arranged in successive portions comprised of comparatively long downwardly sloping portions followed by comparatively short upwardly sloping lift portions having overhead, endless belt means engageable by friction pad means at the upper ends of the vehicle masts for towing the vehicles up the lifts to another downward slope where the vehicle is released to coast or be driven by power furnished by the driver or by a battery powered electric motor. Entrance and exit ramps are provided for entering vehicles and for those leaving for street level. The lift belt is stainless steel supported on drive rollers and a low friction slider bed. The friction pad is offset from the mast and comprises a pad with a rubber working surface layer lying adjacent another body having a surface of low friction material, the pad being spring-biased downward against the belt by novel lever means to prevent excessive initial friction of the pad with the belt in the case of a low speed entry of a vehicle to the lift. Ceiling supported guide rails are provided at each side of the downslopes and similar converging rails are provided for guiding the mast tops to the lift belts.

10 Claims, 18 Drawing Figures



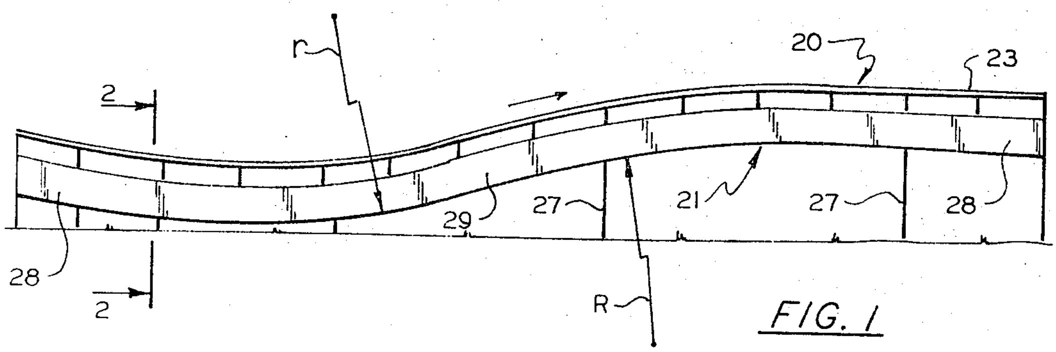


FIG. 1

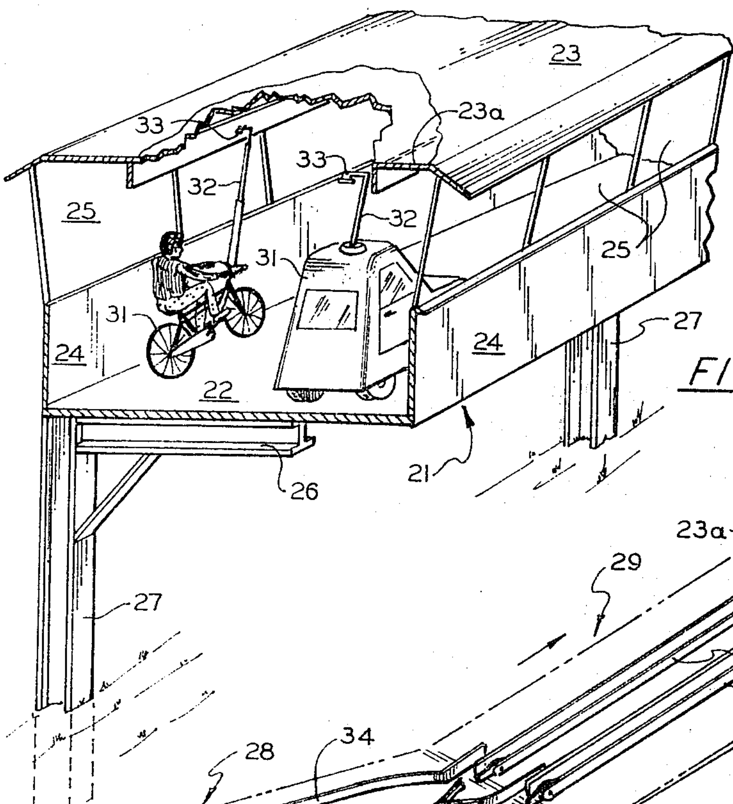


FIG. 2

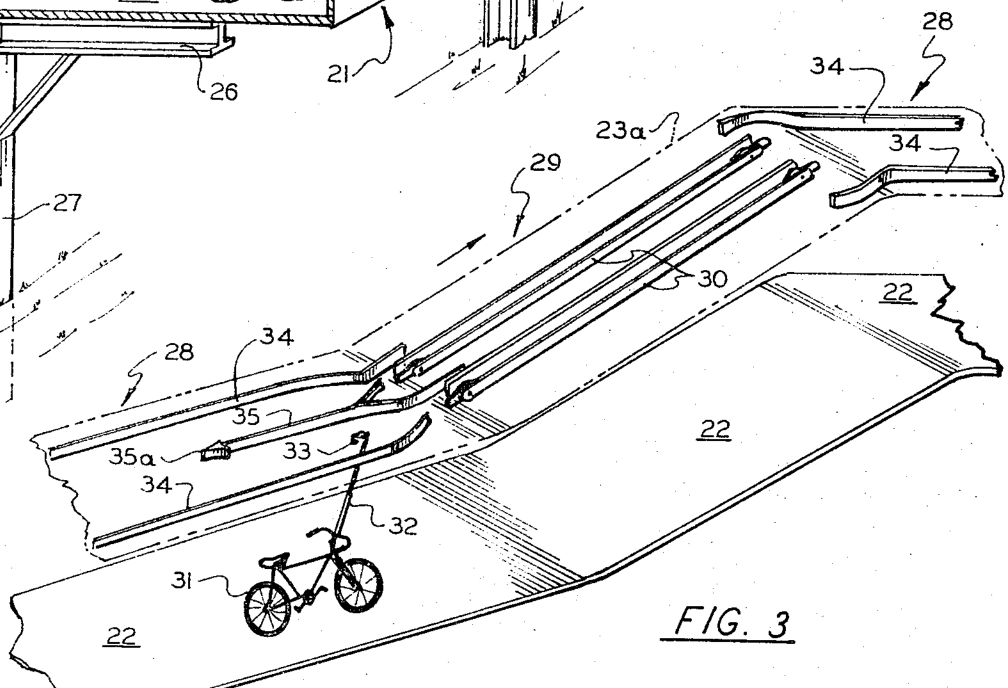


FIG. 3

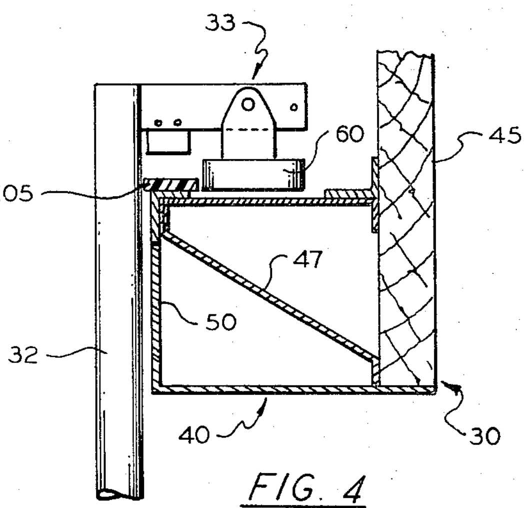


FIG. 4

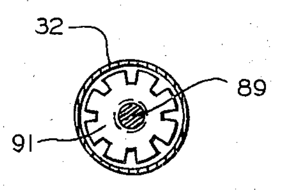


FIG. 12

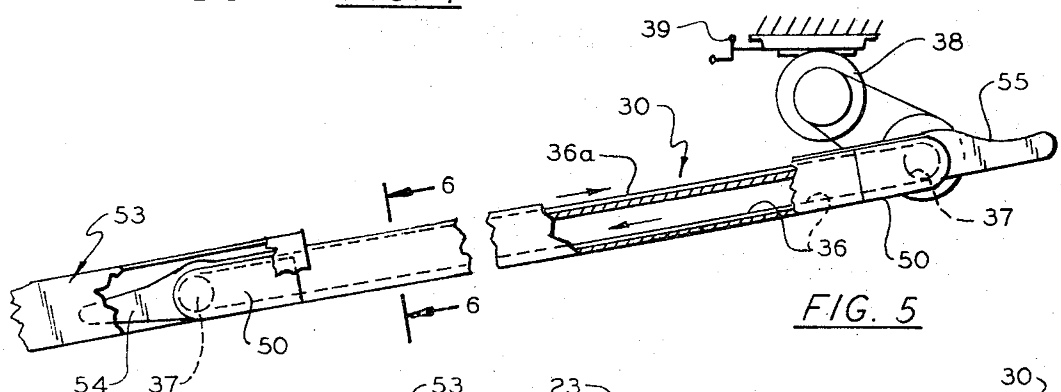


FIG. 5

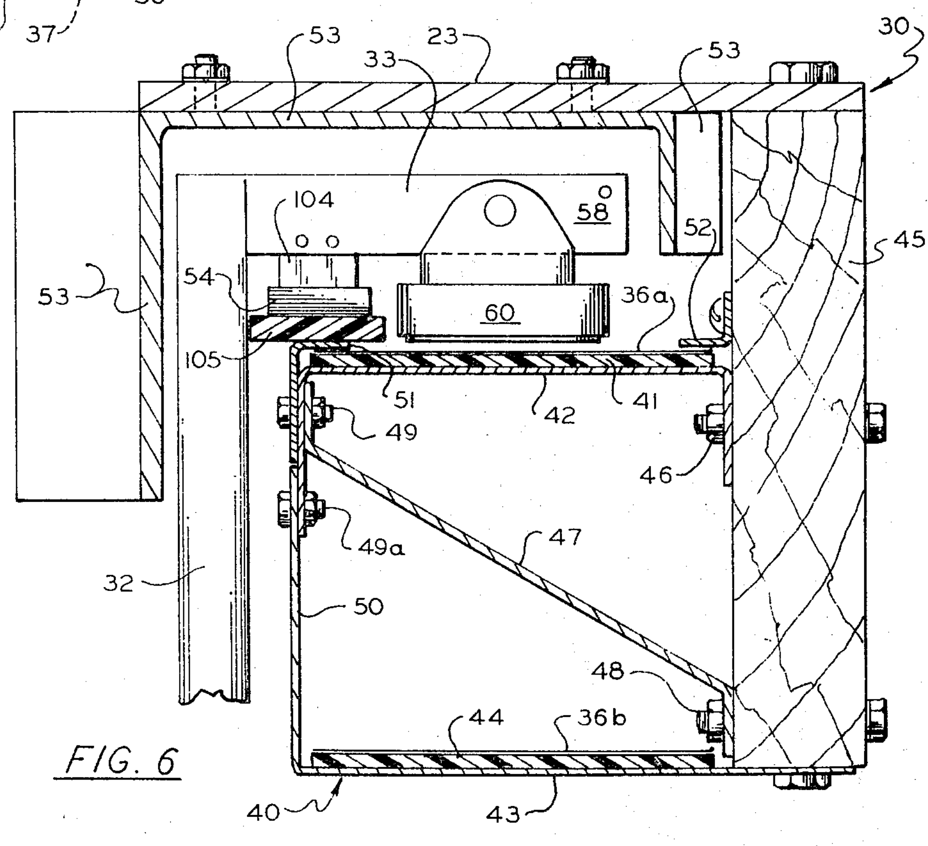


FIG. 6

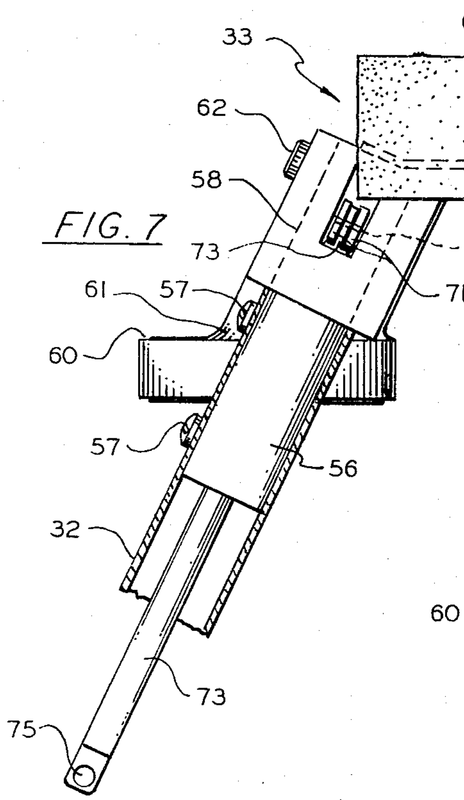


FIG. 7

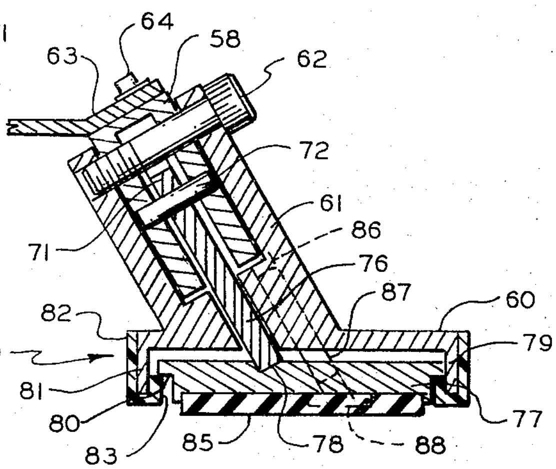


FIG. 9

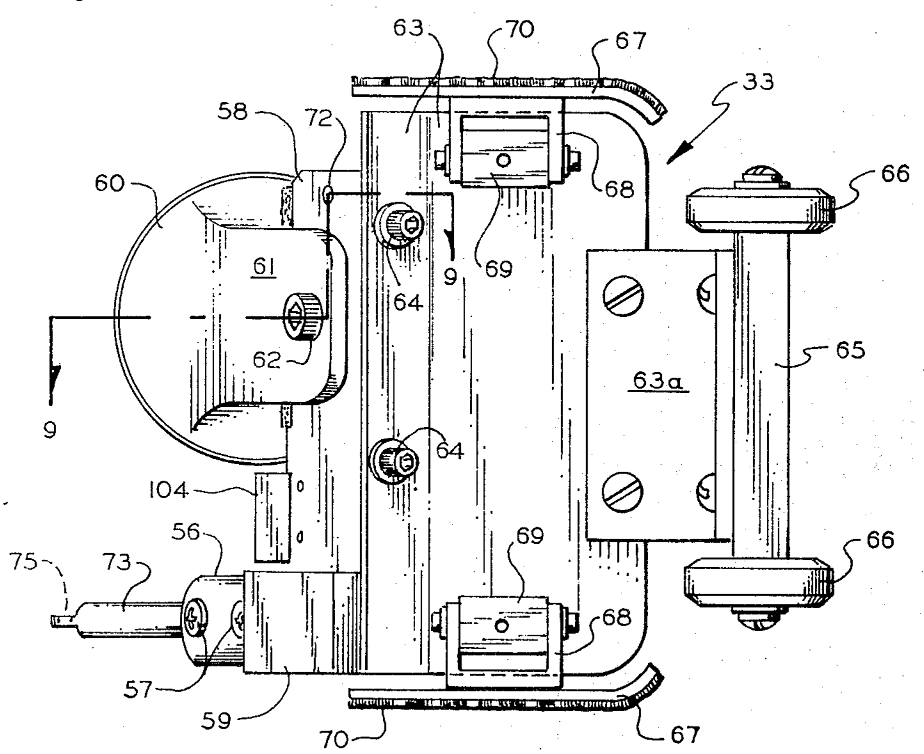


FIG. 8

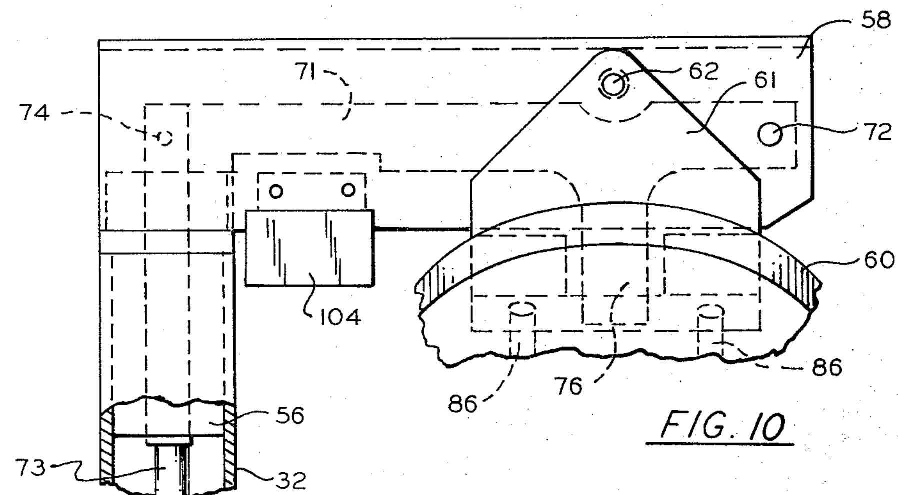


FIG. 10

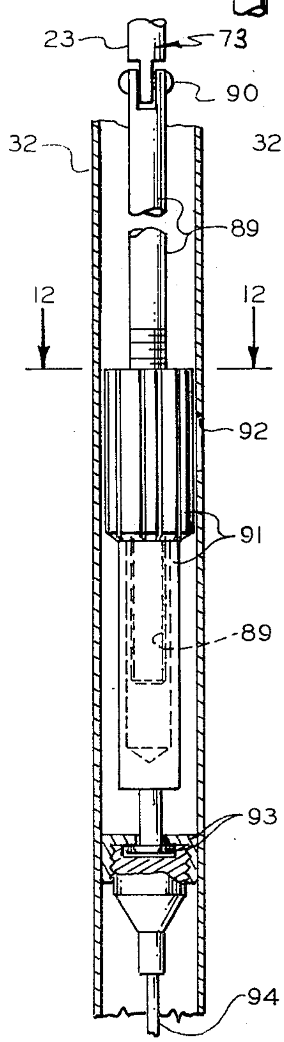


FIG. 11

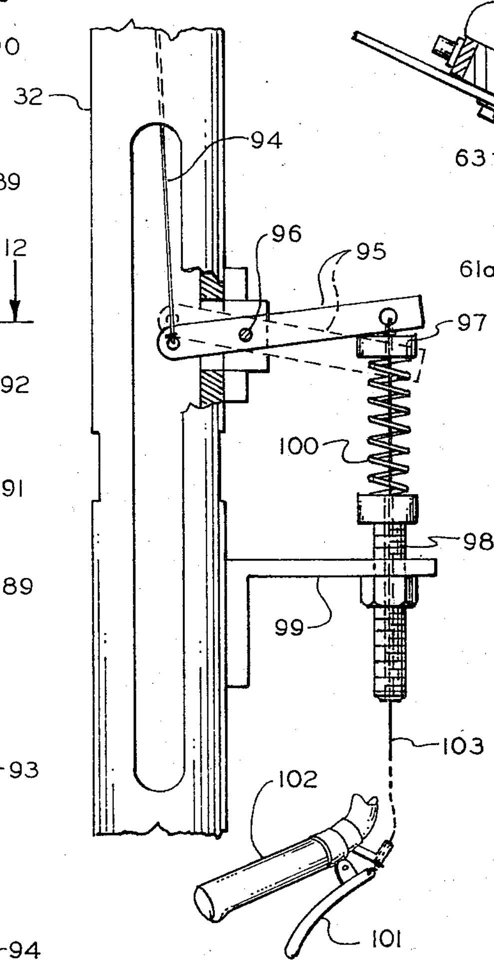


FIG. 13

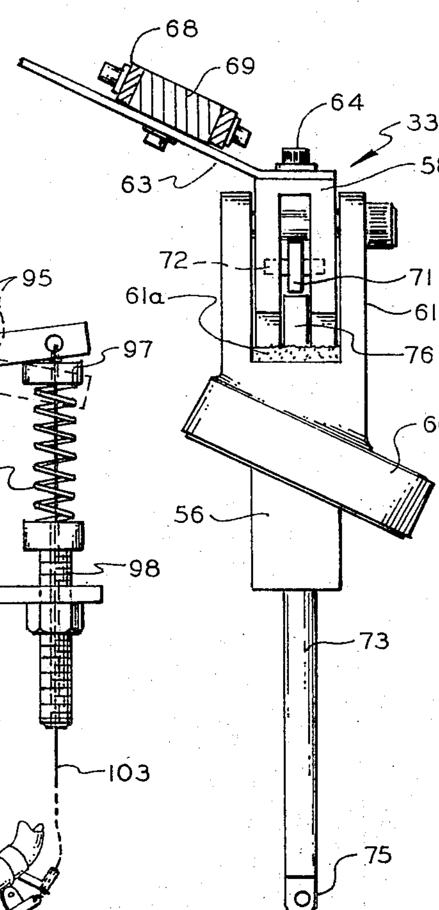


FIG. 14

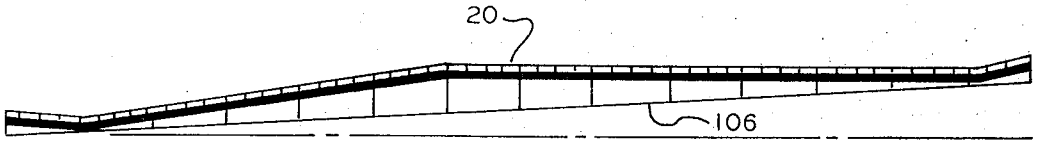


FIG. 15

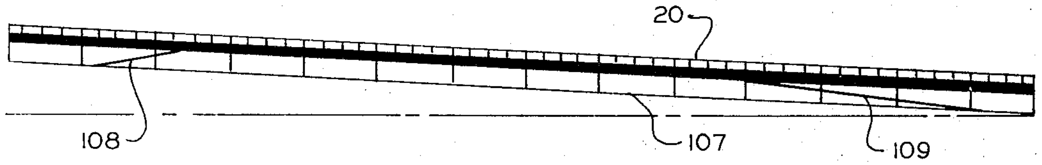


FIG. 16

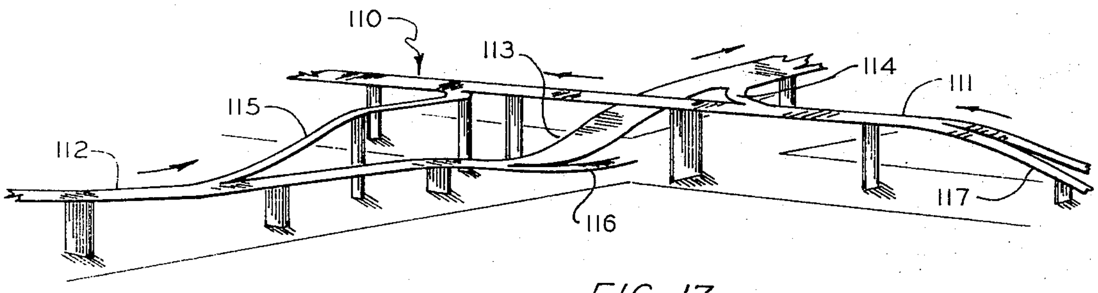


FIG. 17

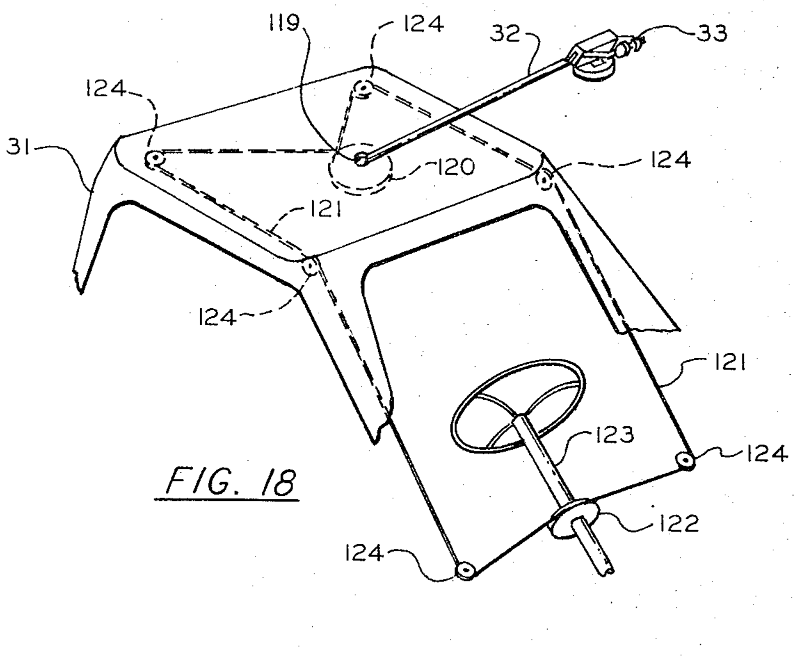


FIG. 18

VIADUCT FOR SMALL, POWERED, PASSENGER VEHICLES

BACKGROUND OF THE INVENTION

This invention relates in general to transportation systems and to wheeled vehicles for use therein and in particular to a low speed, passenger carrying system, wherein a way has downslopes followed by upslopes having overhead endless belt lifts for carrying the vehicles thereup and wherein the vehicles carry a mast terminating in a novel grabber-mechanism engageable by the lift, the vehicles being also powered for off-the-way travel.

Prior art transportation systems having downslopes followed by elevating means have employed cable or rail supported vehicles and have had complicated elevating means usually requiring a halt to the forward motion of the vehicles. Furthermore, because of the arrangement of the cable or the tracks, the vehicles are required to follow one another in single file.

Two wheel and four wheel vehicles with masts have heretofore been known but both overhead and wheel engaging guides have been required or, where the masts have been engageable by endless belt means, the vehicles must follow one another in single file because they have been track supported or because of the nature of the engagement of the mast with the endless belt means.

Other systems for mass transportation employ high-speed, train-type vehicles not practical for individual transportation, or require complicated computer-type traffic control, or expensive electronic guidance systems embedded in highway pavement.

SUMMARY OF THE INVENTION

The transportation system contemplated by the present system is for mass transportation using a plurality of vehicles which are usable on a covered way, either as a commuter-serving system with intercommunicating ways running in opposite directions on parallel streets in the urban section and with more widely spaced ways in the suburbs, or as transportation systems on large campuses, factory complexes or amusement parks. The vehicles are lightweight and adapted for powered movement either on the ways or on surface roads off the ways. Two, three or four wheel vehicles may be used, the vehicle to be owned by the passenger and used similarly to his automobile or to be owned by the system operators and supplied to thee public for rental or otherwise.

The unidirectional ways are wide enough for two or more vehicles abreast and are preferably covered, windowed and supported on pillars adapted to be installed along existing streets. The ways are in successive cascades off relatively long and moderately downwardly sloped sections on which the vehicles may coast or pass one another under power, interspersed with relatively short and steeply upwardly sloped sections each having a powered, overhead, endless-belt lift. It is only at the lifts that the vehicles must follow in single file and two or more lifts abreast are usually provided for the upwardly sloped sections. Suitable ramps, down for exits and up for entrances, are provided at intervals and interchange ramps, with or without a lift, are provided for change in direction of travel.

Each of the vehicles is provided with a forwardly and upwardly projecting mast. These masts are somewhat flexible tension masts rather than the heretofore known rigid cantilever masts. Each mast carries a novel, friction type grabber mechanism or clutch laterally offset at the mast end for engagement with the top run of a thin flexible, polished stainless steel endless belt. Means are provided, at the lower end of the lift, for automatically receiving the grabber and, at the top of the lift, for automatically releasing the grabber with minimum change in speed.

Each downslope is provided with an overhead guide rail at each side of the way to prevent the vehicle from hitting the way side. Just before each lift section, similar converging rails are provided for guiding the vehicle to one or the other lift. Due to the nature of the vehicle, the masts of bicycles and some types of three wheeled vehicles may be attached to the frame but for other tricycles and four wheel vehicles the mast is connected to the steering mechanism for turning the vehicle in one direction or the other when the grabber sides come in contact with one or the other of the guide rails.

Each lift belt is enclosed except for an entrance and exit and travel path for the mast and grabber. The upper run is supported by a slider bed of sheet material having a low friction upper surface and the lower run is similarly supported by sheet material having a low friction working surface. A guide for the grabber assembly and mast top is provided along one side of each belt.

The novel grabber assembly comprises a disk-like pad having a working surface of a high density rubber, the pad being loosely surrounded by a ring of low friction material and being movable up and down to a limited extent within the ring. The ring and pad are angularly offset with respect to the clutch or grabber body so as to be adapted to have the pad andd ring working surfaces flat on the lift belt.

The ring is connected by a bracket to the grabber body angularly projecting from the body. The pad has one end of a downwardly projecting portion of a lever engaged therewith.

The lever is a lever of the second class extending across the hollow interior of the grabber body. The fulcrum end of this lever is pivotally connected to the grabber body and the other longer end is pivotally connected by elongated linear elements down the hollow mast to spring means which bias the pad downward in the ring.

Two pins secured in the pad ring bracket are telescopically received in holes in the pad itself guiding the movement of the pad in relation to the ring along a line of movement parallel to the angular direction the bracket projects from the grabber body. When the pressure of the pad on the belt is too great, so as to cause a too sudden increase in the forward velocity of a slowly entering vehicle, the pad is forced up into the ring, by reason of its spring bias, and the ring of low friction material is forced, to a greater extent, to bear on the belt. This changes the total friction exerted by the pad-and-ring combination. Both pad and ring normally engage with the belt surface and the total friction comprises the sum of components exerted by the pad and by the ring.

For a rapidly entering vehicle, the slope of the mast provides for a frictional engagement with the belt only when the vehicle slows to speed adapting the pad to engage with the belt to provide tension on the mast just sufficient to carry the vehicle up the ramp at the chosen speed. Speeds of from 15 to 20 miles per hour are contemplated for the lifts and similar coasting speeds for the downslopes.

Transportation systems with a plurality of small capacity vehicles each capable of individual and separate routing, such as that described herein, have recently been classified by the publishing media as paratransit systems.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a fragmentary, side elevational view of a viaduct embodying the invention;

FIG. **2** is an enlarged, perspective, sectional view on the line **2—2** of FIG. **1**;

FIG. **3** is a diagrammatical, fragmentary, perspective view of an upslope portion of the viaduct of FIG. **1** with the roof portion removed and shown in phantom lines;

FIG. **4** is a fragmentary, diagrammatical, transverse cross-sectional view of a lift and the upper portion of a vehicle mast with attached grabber device, the grabber being shown in a position adapted to engage in endless belt which is not shown;

FIG. **5** is a fragmentary, diagrammatical, side elevational view of a lift with the support beam omitted and other portions cut away;

FIG. **6** is an enlarged sectional view in more detail of the lift on the line **6—6** of FIG. **5**, the grabber being shown in a lifted position as it enters the lift;

FIG. **7** is an enlarged side elevational view of the grabber device as viewed from the left in FIG. **4**;

FIG. **8** is a top plan view thereof;

FIG. **9** is a sectional view on the line **9—9** of FIG. **8**;

FIG. **10** is a fragmentary front elevational view of the grabber device of FIG. **7**, certain parts being omitted;

FIG. **11** is a fragmentary vertical sectional view through a vehicle mast showing pressure adjusting mechanism for the grabber spring;

FIG. **12**, on sheet **2** of the drawings, is a sectional view on line **12—12** of FIG. **11**;

FIG. **13** is a fragmentary, side elevational view of a vehicle mast showing a grabber disconnect mechanism for a bicycle;

FIG. **14** is another side elevational view of a grabber device showing the side opposite to that shown in FIG. **7**, a portion being cut away for clarity;

FIGS. **15** and **16** are fragmentary side elevational views of a viaduct similar to FIG. **1** showing the viaduct applied to an uphill contour and a downhill contour of the ground, respectively;

FIG. **17** is a diagrammatical perspective view of a viaduct crossing and interchange between viaducts for travel in directions at an angle of 90°, the floor or roadbed only of each viaduct being shown; an

FIG. **18** is a fragmentary view of a vehicle for travel on the viaduct showing a connection between the vehicle mast and the steering mechanism of the vehicle.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. **1–3** inclusive, the viaduct **20** of the present invention comprises a way **21**, shown in section in FIG. **2**, having a floor or roadbed **22**, a roof **23**, and sides including sidewalls **24** and windows **25** enclosing the way for protection of the passengers. The way **21** is preferably elevated, supported on cantilever arms **26** from pillars **27** so that ground space under the way may be used for ground travel.

Viaduct **20** has downslope portions **28** interspersed with upslope portions **29**, each upslope portion having one or more endless belt lifts **30**. Each way is for travel in one direction only, as shown by the arrows, and the end of each downslope may merge arcuately with the succeeding upslope portion, the radius of the arc *r* being of the order of **75′**, and each upslope may merge arcuately with the succeeding downslope portion, the radius of the latter arc R being of the order of **150′**.

The way **21** is wide enough for two or more vehicles abreast, typically **9′** wide for two vehicles **31**, the vehicles being small and lightweight and being either two, three or four wheeled. The roadbed **22** is substantially planar and vehicles are rubber-tired. Each vehicle has an upwardly and forwardly inclined mast **32** terminating in a grabber device **33**. The mast **32** for bicycles and for tricycles with a caster type steered wheel may be secured directly to the vehicle frame but the masts for the other vehicles must be connected to the vehicle steering mechanism so that pressure on one side of the mast causes the vehicle to be steered toward the opposite side. Such a connection will hereinafter be described.

Referring to FIGS. **2** and **3**, each downslope portion **28** has an overhead, guiderail **34** at each side of the way supported from the sub-roof ceiling **23***a* and adapted to contact the upper end of the masts for steering the vehicles away from contact with the way sidewalls **24**. At the end of each downslope another overhead guiderail or rails **35** is provided converging on either side with each of the guiderails **34** to guide the mast top into the entrance of each lift **30** as shown in FIG. **3**, two parallel lifts being shown. A rubber flipper **35A**, or other antistall mechanism, may be provided at the apex of guiderail **35**.

Each vehicle **31** has a source of power, foot pedals for the bicycle and motor means, not shown, for the other vehicles, preferably a battery operated electric motor for environmental reasons. The downslopes **28** have approximately a 2½% slope and each lift at the upslopes is designed to raise the vehicles **10′** in a distance of **60′** or about a 17% slope.

The comparatively gentle downslope is adapted to carry a coasting vehicle at approximately a 15 to 20 mile per hour speed and the lifts are run at a speed designed to tow a vehicle up the upslope at substantially the same speed. Since the guiderails **34** overlie the outer sides of the roadbed **22**, they are widely spaced and vehicles may be speeded up by the driver applying power to pass a slower coasting vehicle on the comparatively long downslopes, each vehicle being steerable by the driver.

Each lift **30** has an endless belt adapted to be engaged by gripping means in the grabber device **33** at the top of the vehicle mast. It will be apparent that the endless belt may be of any flexible material, rope, leather, fabric or any other conventional belt material and the grabber device may have means for engaging the belt on opposite sides or for frictionally engaging the belt. For reasons of wear resistance and for automatic engagement and disengagement of the grabber with and from the belt, the novel lift and grabber device, now described, is preferred.

Referring to FIGS. 4, 5 and 6, each lift 30 comprises an endless belt 36 of polished flexible stainless steel, now readily obtainable and weldable at a seamless joint by modern techniques. The belt is supported by rollers 37 at each end (FIG. 5), one of which is driven by a motor 38. Preferably the drive speed is manually set by a variable speed device indicated at 39.

The upper run 36*a* (FIG. 6) of the belt is supported throughout its length by the belt support assembly 40, the upper surface of which has a sheet or strip 41 of filled teflon or similar material whose coefficient of friction is less than 0.15 against stainless steel so that the belt is supported by its slider bed with minimum friction.

The belt support 40 comprises the upper channel member 42, to which sheet 41 is secured and the lower angle member 43, one flange of which has a sheet 44 of low friction material secured thereto on which the lower run 36*b* of the belt rides. The support assembly completely encloses the lower run of the belt.

One flange of channel 42 is bolted to a roof or ceiling supported beam 45 as at 46 and a diagonal brace 47 has one end bolted to beam 45 at 48, the other end of the brace being bolted to the angle 51 and channel member at 49, as shown. The side flange 50 of angle 43 is secured at 49*a* to the other flange of channel 42. Angle 51 has an upper flange which acts as a retainer or hold down guide for the belt upper run 36*a* and another retainer or guide for the opposite edge of the belt is provided by the angle 52 bolted to beam 45.

At each lift entrance a channel shaped entrance guide 53 is provided to guide the mast and grabber 33 until the grabber engages the belt.

Referring to FIG. 5, the entrance guide 53 is there-shown cutaway to reveal a curved grabber liift plate 54 whose upper edge is carefully shaped to lift the grabber 33 upon its entrance to the lift and then to release the grabber onto the belt with the least shock at the belt speed contemplated. The lift plate 54 is shown in contact with an appropriate portion of grabber 33 in FIG. 6. A similar release plate 55 is shown in FIG. 5, its upper edge being curved so as to remove the grabber from engagement with the belt and to release it gradually without bouncing or bending of the mast.

It will be apparent that instead of each lift 30 shown in FIG. 3, each lift may comprise two lift sections, as shown, in tandem, one after the other, when it is desired to lift the vehicles up a substantially greater height or to provide stepped acceleration at an entrance.

Referring now to FIGS. 7–10 and 14, the grabber device 33 is shown in detail. In FIG. 7, showing the grabber device as viewed from the left in FIG. 6, the mast 32, which extends upward from the vehicle at an angle of substantially 60° from the roadbed 22, is shown fragmentarily in section and the grabber has a portion 56 which fits down into the hollow mast at its top and is secured thereto by the screws 57.

Portion 56 is integral with or welded to an elongated, hollow, generally rectangular, grabber body 58 which is widened at 59 as indicated in FIG. 8. A ring body 60 has an integral, bifurcated bracket or neck 61 embracing the narrower portion of body 58 and a bolt 62 pivotally secures the bracket to the body 58, the ring body having only limited movement with respect to the grabber body. Since the bracket 61 is comparatively loose with respect to the grabber body 58, a rattle preventing strip of foamed plastic or foamed rubber 61*a* may be inserted between the lower ends of the grabber body and the end of the slot in the neck as shown in FIG. 14.

The upper surface of grabber body 58 has a bent plate 63 secured thereto by screws 64. The forward end of plate 63 has an extension angle 63*a* secured thereto and the upwardly directed flange of angle 63*a* carries an axle 65 on which are journalled a pair of wheels 66 (FIGS. 7 and 8) to prevent the grabber from harmful contact with the ceiling 23*a* or entrance guides 53. At each side, plate 63 has a curved plate 67 pivotally secured by a bracket 68 to a tubular swivel 69 pivotally secured to bent plate 63, as shown. The outer surface of each plate 67 has a layer 70 of a furry material secured thereto for deadening the sound of any engagement of plate 67 with guiderails 34 or 35. The plates 67 are capable of limited movement only, in either direction, with respect to bent plate 63.

The grabber body 58 is U-shaped, as shown in FIGS. 9 and 14 and a lever 71 of the second class lies in the hollow of the body having one end pivotally connected to body 58 by a pin 72 (FIG. 14). The opposite, free end of lever 71 is bifurcated and is pivotally connected to the flattened end of a plunger rod 73 by a pin 74 (FIG. 7). The other, free end of rod 73 is flattened and provided with a hole 75 for a purpose to be described.

At the point of alignment with the bifurcated ring body bracket 61 (FIG. 10), the lever 71 has a downwardly projecting tongue 76 extending down into the ring body 60 which has a hollow opening downward. In this hollow a friction pad 77 is secured having limited movement up and down within the ring body 60, as shown in FIG. 9.

The friction pad 77 has an oblique seat 78 for the tongue 76 and has a flange 79 therearound at its top providing a downwardly facing shoulder 80. The ring portion 81 of the ring body 60 has secured therearound a ringed layer 82 of nylon or other low friction material having a coefficient of friction of less than 0.2 against stainless steel. The ringed layer 82 has a flange 83 extending inwardly under ring portion 81 and therebeyond providing a stop cooperating with shoulder 80 for preventing pad 77 from falling out of the hollow interior of the ring 60.

The pad 77 has a surface layer 85 of a material having a high coefficient of friction partially inset in the bottom surface of the disk, as shown, and secured thereto by adhesive. Layer 85 is shown exaggeratedly thick in FIG. 9 and the material used is a high density rubber having a coefficient of friction with the belt slightly higher than 1.0 when dry.

It will now be apparent that the grabber body 58 holds the pad 77 and ring 81 laterally offset from mast 32, as shown in FIGS. 4 and 6, for engagement with the upper run 36*a* of the belt approximately at its center. Since mast 32 is at an angle of substantially 60° with the roadbed and lift 30 is substantially parallel with the roadbed, the bifurcated bracket 61 extends at an angle of substantially 60° from the pad body 60 for supporting the flat annular lower working surface of ring 81 and the flat working surface of disk 77 substantially flat with respect to the surface of belt 36. Since the working surface 83 of ring 81 is of low frictional material and the working surface of the layer 85 is of comparatively high frictional material the ring will hereinafter be referred to as low-friction and the disk will be referred to as high-friction.

For guiding pad **77** for movement on a line parallel to the direction in which lever **71** and its tongue **76** are adapted to move, two holes **86** are provided in the bracket **61**, as shown in FIG. **10.** A pin **87**, shown in FIG. **9**, is secured in each hole **86** and projects into an aligned hole (FIG. **9**) in pad **77.** To lengthen these aligned holes, pad **77** is provided with a circular boss **88** at the end of the hole, the boss **88** being counterbored in a circular hole in the rubber friction layer **85.** The circular bosses also serve to help fix the rubber layer in place.

Referring now to FIGS. **11, 12** and **13,** the plunger rod **73** within the hollow mast **32** is connected by a bolt **89** to a pressure regulator mechanism shown in FIG. **11,** which shows in section a portion of mast **32** below the portion shown in FIG. **10.** The upper end of bolt **89** is forked and secured to rod **73** by a pin **90** through hole **75** shown in FIG. **7.**

The lower end of bolt **89** is threadedly connected to a serrated nut **91**, the longitudinally extending serrations of which are clearly shown in FIG. **12.** A window **92** is provided in one side of mast **32** through which a screwdriver or other tool may be inserted to turn the nut **91.**

The lower end of nut **91** is tubular, being internally threaded for the bolt **89** and at its lower extremity the nut is connected by a swivel connection at **93** to a rod or wire **94.** In a portion of the mast below that shown in FIG. **11,** the wire **94** is connected, as shown in FIG. **13,** to one end of a lever **95** which extends through an appropriate opening in mast **32** and projects therefrom.

Lever **95** is pivotally supported on a bracket secured to the mast by a pin **96.** The projecting end of lever **95** has a cup-shaped socket **97** secured thereon and a similar socket is secured by a hollow screw **98** threaded through a bracket **99** below and spaced from lever **95.** An expansion coil spring **100** extends between the two sockets putting tension on the wire **94** and through the elongated linear elements above described inside the mast and through lever **71** biasing the pad **77** downward and outwardly from the ring **81.**

A grabber or clutch disabling mechanism is operable by means of a lever **101** shown mounted on a bicycle handlebar **102** fragmentarily shown in FIG. **13.** One end of lever **101** is connected by a wire **103** extending from the lever through the hollow screw and spring to the projecting end of lever **95**, as shown. By operation of lever **101,** lever **95** is moved toward a position, shown in broken lines in FIG. **13,** relieving the tension on wire **94.** It will be apparent that instead of the hand operated lever **101,** the wire **103** may be connected to a foot operated pedal such as a brake pedal so that the clutch **33** may be disengaged from the lift belt by applying the brakes.

Referring again to FIGS. **6** and **10,** the grabber body **58** has a depending hardened steel shoe **104** secured thereto and projecting downward between ring **60** and mast **32** to cooperate with the lifter **54.** It will also be noted that a strip **105** (FIG. **6**) of low friction material extends along a lift **30** above the hold down angle **51** for guiding the clutch in the lift. The left edge of strip **105** is adapted to contact and guide mast **32** and the right edge is adapted to contact and guide the pad **60** when it is engaged with the belt **36.**

In operation, the grabber mechanism **33** acts as a clutch when it engages with the belt **36.** A vehicle **31** entering a lift **30** has its grabber shoe **104** (FIG. **6**) engaged by the curved upper edge of the lift plate **54** (FIGS. **5** and **6**), lifting the grabber device above the belt upper run **35***a* and then dropping the ring body **60** and disk **77** onto the belt. When a vehicle makes a fast entry the ring and disk do not grip the belt, because their backward drag tends to lift the sloping mast and so relieve the force. When the speed of the vehicle has been reduced by the upslope to substantially the speed of the belt, the forward pull of the clutch pad is converted by tthe mast into a proportionate downward pull which locks the clutch solidly to the belt.

When a vehicle make a slow entry, however, the operation of the grabber device prevents an immediate secure engagement with the belt which might cause an objectionable surging forward of the vehicle. The disk or pad **77** is spring biased outward of the ring **81** and when the pad engages the belt with more than a maximum permitted friction, depending on the tension setting of spring **100,** the spring bias is overcome and the ring **81** is forced against the belt by reason of its connection to the grabber body. The pad and the ring both exert pressure on the belt, the former being high frictional and the latter comparatively low frictional. The total friction applied to the belt has a ring component and a pad component and the total friction is governed by the tension exerted by spring **100.** When the total friction is too great the pad is pressed into the ring against the bbias of the spring and the ring component becomes proportionally larger and, the ring being low frictional, the total friction becomes less. When the total friction is too small the spring forces the pad out of the ring and the pad component becomes proportionally larger increasing the total friction. When a vehicle first enters a lift there is always some friction, the maximum permitted friction, which continues until the speed of the vehicle is increased to the speed of the belt.

The ring **81,** which has a low friction working surface is annular and the pad **77** which has a high friction working surface is disk-shaped and lies inside the ring for the sake of compactness. It will be apparent that each part may be of any shape so long as the one has a flat low friction surface and the other has a flat high friction surface, the operation is the same so long as both parts have a common support from the grabber body and so long as the high friction parrt is spring biased downward with respect to the other part. The spring bias determines the maximum permitted friction. Both parts are forced against the belt and each provides a component of the total frictional engagement with the belt. Until the high frictional part is depressed with respect to the low frictional part, the total frictional engagement is the maximum permitted friction.

After the shoe **104** leaves the lift guide **54** the friction of the grabber with the belt tends to hold the pad and ring at the center of the belt. Should slippage occur, however, the strip **105** of nylon (FIG. **6**) between ring **60** and mast **32** prevents more than minimal transverse movement of the grabber with respect to the belt.

Other than in urban areas, viaducts **20** usually extend radially of the urban area or in directions dictated by the intended use. In FIG. **15,** the viaduct **20** is built on terrain **106** sloping upward and in FIG. **16** the viaduct is built on terrain **107** sloping downward. An entrance ramp **108** and an exit ramp **109** are indicated in the latter Figure.

An interchange **110** is indicated in FIG. **17**, showing roadbeds only for reasons of clarity, such as would be provided in urban areas. An east to west viaduct would be provided along one street and a west to east viaduct would be provided along the next parallel street, for example.

In FIG. **17** a westbound way is indicated at **111** and a northbound way at **112**. An upslope with lift is shown at **113** and a level or downslope ramp **114** is provided for westbound vehicles desiring to change direction to the north. At **115** an upslope ramp is provided complete with lift for northbound vehicles desiring to turn west. An exit ramp is shown at **116** and an entrance ramp, with lift, is shown at **117**. A similar interchange would be provided for all intersections so that vehicles can proceed over the routes and to the destinations desired by their passengers.

Also by way of example, a connection between a mast **32**, of a vehicle shown fragmentarily at **31**, and the conventional steering mechanism of the vehicle is shown in FIG. **18**. The mast is mounted at **119** on a shaft and on the shaft a pulley or capstan **120** is secured below the roof. An endless cord or belt **121** is looped around the capstan **120** and around a similar capstan **122** keyed to the steering rod **123** of the vehicle steering mechanism, the belt **121** passing over directional change pulleys **124** all within the vehicle, as shown.

With this arrangement or with a similar arrangement of connecting rods known in the art, lateral movement of the grabber **33** at the top of the mast aids the normal steering of a passenger to turn the vehicle when a plate **67**, such as shown in FIGS. **7** and **8**, comes in contact with a side guiderail **34** or a lift entrance guide **35** such as shown in FIG. **3**.

We claim:

1. A viaduct for small and powered wheeled vehicles has an enclosed unidirectional way, the way roadbed being substantially planar and comprising comparatively long downslopes alternating with comparatively short upslopes, each vehicle having an upwardly projecting mast adapted to steer the vehicle, each downslope being of a width sufficient for at least two vehicles abreast and having an overhead guiderail at each side adapted to contact a mast top to steer a vehicle away from the way sidewall, each upslope having endless-belt lift means and converging overhead guiderails at the bottom end of the lift means for contact with a mast top to guide a vehicle to the lift means, each mast top having a grabber adapted to automatically engage the lift means belt at the bottom of the lift means and to be automatically disengaged therefrom at the top of the lift means, and entrance ramp and exit ramp means for the vehicles, whereby the vehicles are automatically towed up the lift means, can pass one another on the downslopes and are capable of travel both on and off the way.

2. The viaduct defined in claim **1** wherein each upslope has the same number of endless-belt lift means as the number of vehicles abreast accommodated by the downslopes, whereby there is no delay of vehicles at the lift means.

3. In combination, an enclosed unidirectional vehicle way having a substantially planar roadbed, aand a plurality of lightweight, rubber tired wheeled, powered vehicles; the roadbed consisting of alternating, comparatively-long, gently sloping, downslopes and comparatively-short, comparatively-steep upslopes; the upslopes and downslopes being arcuately joined; each vehicle having an upwardly and forwardly projecting substantially non-rigid mast connected to the vehicle for towing it and for intermittently steering it; each downslope being of a width capacity for at least two vehicles abreast and having an overhead guiderail at each side adapted to contact a mast top to steer a vehicle away from the adjacent way sidewall; each upslope having endless-belt lift means equal in number to the number-of-vehicles-abreast downslope capacity and converging, overhead guiderails at the bottom end of each lift means for contacting the vehicle mast tops to guide the vehicle to the lift means; each mast top having a grabber adapted to automatically engage the lift means belt at the bottom of the lift means and to be automatically disengaged therefrom when the vehicle reaches the top of the upslope; and entrance ramp means and exit ramp means for the vehicles; whereby the vehicles are automatically towed up the upslopes, can pass one another on the downslopes, and are capable of travel both on and off the way.

4. The way and vehicle combination defined in claim **3**, wherein the way is elevated, and the entrance ramp means are upslopes having endless-belt lift means and converging overhead guiderails associated therewith, the exit ramp means being downslopes and having overhead guiderails at each side.

5. The way and vehicle combination defined in claim **3**, wherein each mast top grabber has a pad adapted to frictionally engage the lift means belt.

6. The way and vehicle combination defined in claim **3** wherein the endless-belt lift means comprises an endless belt of flexible material and a supporting roller at each end of the lift, one of the rollers being driven by motor means, the upper run of the belt being supported by sheet material having an upper surface of a material having a low coefficient of friction with the belt, and the mast-carried grabber comprises a grabber body secured to the mast and two friction members each supported by the grabber body and having a flat working surface adapted to contact the upper surface of the belt upper run, the working surface of one member being of a material having a low coefficient of friction with the engaged belt surface and the working surface of the other member being of a material having a high coefficient of friction with the engaged belt surface, the high friction surfaced member being biased toward the engaged belt surface with respect to the low friction surface member, whereby a slow entry of the vehicle onto the lift results in slippage of the grabber with respect to the belt until the vehicle reaches a speed substantially equal to the speed of the belt and the slope of the mast prevents full engagement of the friction members with the belt for a fast entry of a vehicle onto the lift until the vehicle speed is slowed to substantially the speed of the belt by the upslope.

7. The way and vehicle combination defined in claim **3** wherein the endless-belt lift means comprises an endless belt of flexible metal and a supporting roller at each end of the lift, one of the rollers being driven by motor means, the upper run of the belt being supported by sheet material having a low coefficient of friction upper surface, and the mast-carried grabber comprises a disk-like friction pad having a working surface of material having a high coefficient of friction and a ring of material having a working surface of a low coefficient of friction loosely surrounding the pad, the ring and pad being pendently supported from a grabber body laterally offsetting the ring and the pad from the mast top, the pad being spring biased outward from the ring, the ring being supported by a bracket projecting from the grabber body at an angle to the body for carrying the ring and pad flat with respect to the upper surface of the belt, the pad being guided on a plurality of pins secured to the bracket and telescopically received in holes in the pad for allowing limited movement of the pad with respect to the ring in a direction substantially aligned with the grabber body, whereby a slow entry of the vehicle onto the lift results in slippage of the grabber until the vehicle reaches a speed substantially equal to the speed of the belt and the slope of the mast prevents full engagement of the grabber with the belt for a fast entry of a vehicle onto the lift until the vehicle speed is slowed to substantially the speed of the belt by the upslope.

8. The way and vehicle combination defined in claim **7** having a grabber body substantially U-shaped in cross section, and having a lever of the second class pivotally secured to the grabber body at one end and extending between the legs of the U-shaped body, the other end of the lever being pivotally secured to one end of a series of elongated linearly extending elements connected end to end, the vehicle mast being hollow and the elongated elements extending inside the mast, the lever having a downwardly extending portion between its ends in contact with the grabber pad, and the series of elongated elements connecting the lever with spring means associated with the vehicle mast, whereby the spring means biasing the pad outward from the ring is positioned remote from the grabber device.

9. The way and vehicle combination defined in claim **8** wherein the series of elongated elements include one element terminating in a bolt and another element terminating in a nut, the nut and bolt being threadedly connected, and the mast having an opening therein aligned with the nut, whereby the nut may be turned to regulate the spring pressure applied to the pad.

10. A transportation system having a plurality of viaducts for travel in different directions, and a plurality of lightweight rubber-tired wheeled-vehicles; each viaduct being an enclosed, unidirectional, vehicle way having a substantially planar roadbed consisting of alternating, comparatively-long, gently sloping, downslopes and comparatively-short, steeply sloping upslopes, the upslopes and downslopes being arcuately joined; each vehicle being powered for self propulsion and having an upwardly and forwardly projecting, nonrigid, mast connected to the vehicle for towing it and for assisting in the steering of the vehicle by a passenger; each downslope being of a width capacity for at least two vehicles abreast and having an overhead guiderail at each side adapted to contact a mast top to steer a vehicle away from the adjacent way sidewall; each upslope having lifts equal in number to the number of vehicle-abreast-downslope-capacity, each lift having an endless belt of flexible metal and a supporting roller at each end of the belt, one of the rollers being driven by motor means, the upper run of the belt being supported by sheet material having a low friction upper surface; each lift having converging, overhead guiderails at its bottom end for contacting the mast tops to guide the vehicle to the lift means; each mast top having a grabber adapted to automatically engage the lift belt at the bottom of the lift and to be automatically disengaged therefrom at the top of the lift, the grabber including a disk-like pad having a high friction working surface and a ring of low friction material loosely surrounding the pad, the ring and pad being pendantly supported from a grabber body laterally offsetting the ring and pad from the mast top, the pad being spring biased outward from the ring, the ring being supported by a bracket projecting from the grabber body at an angle to the body for carrying the ring and pad flat with respect to the upper surface of the belt, the pad being guided on a plurality of pins secured to the bracket and telescopically received in holes in the pad for allowing limited movement of the pad with respect to the ring in a direction substantially axial of the ring and the pad; each way having at least one vehicular exit downslopes ramp, the exit ramp having an overhead guiderail at each side; and each way having at least one vehicular entrance upslope ramp, the entrance ramp having an associated lift and associated overhead, converging guide rails at the bottom of the associated lift.

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