United States Patent [19]

Rypinski

[11] **3,861,315**

[45] **Jan. 21, 1975**

[54] **UNIVERSAL TRANSPORTATION SYSTEM BASED ON A CABLE SUSPENDED DUO-RAIL RAILROAD**

[75] Inventor: **Albert Rypinski,** Teaneck, N.J.

[73] Assignee: **Duo-Mode Electric Transport System, Inc.,** Teaneck, N.J.

[22] Filed: **July 16, 1973**

[21] Appl. No.: **379,203**

Related U.S. Application Data

[63] Continuation of Ser. No. 89,266, Nov. 11, 1970, abandoned.

[52] **U.S. Cl.** ..... **104/18,** 104/20, 104/91, 104/94, 104/125, 104/246, 105/155, 213/75 R

[51] **Int. Cl.** **B61b 3/02,** B61b 13/00

[58] **Field of Search** 104/18, 20, 123, 89, 91, 104/94, 125, 246, 247, 248; 105/148, 155; 213/75; 301/5

[56] **References Cited**

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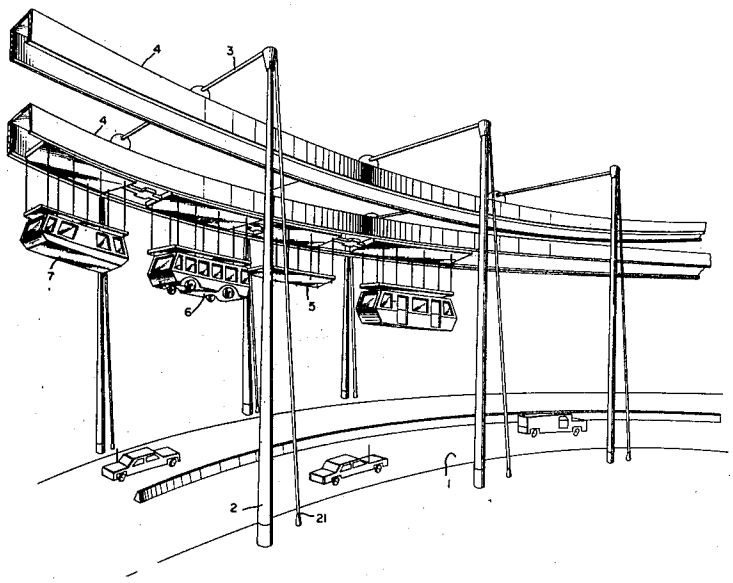
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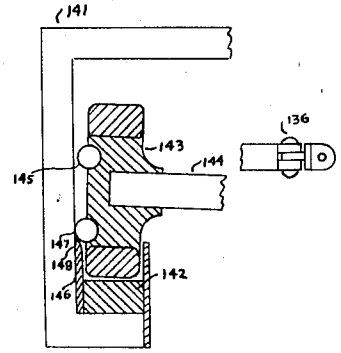
Primary Examiner—Drayton E. Hoffman
Attorney, Agent, or Firm—Karl F. Ross; Herbert Dubno

[57] **ABSTRACT**

A cable-suspended duo-rail railroad comprises a plurality of spaced pairs of columns anchored along the railroad right of way. A trackway is supported along the right of way between the spaced pairs of columns by means of cables extending from the columns to the trackway. The trackway is in the form of an inverted U, with two spaced rails supported on the legs of the U. A motor module is provided with traction wheels on a motor shaft riding on the rails in the U-shaped trackway. Cables are dropped from the module to engage a vehicle such as a car, truck or bus to elevate and combine one or more of these vehicles into a train for transport along the suspended railroad. The traction wheels carry formations which coact with camming surfaces located on the outer leg of the inverted U in a curve of the track to lift the outer traction wheels off their rail by centrifugal action.

10 Claims, 34 Drawing Figures





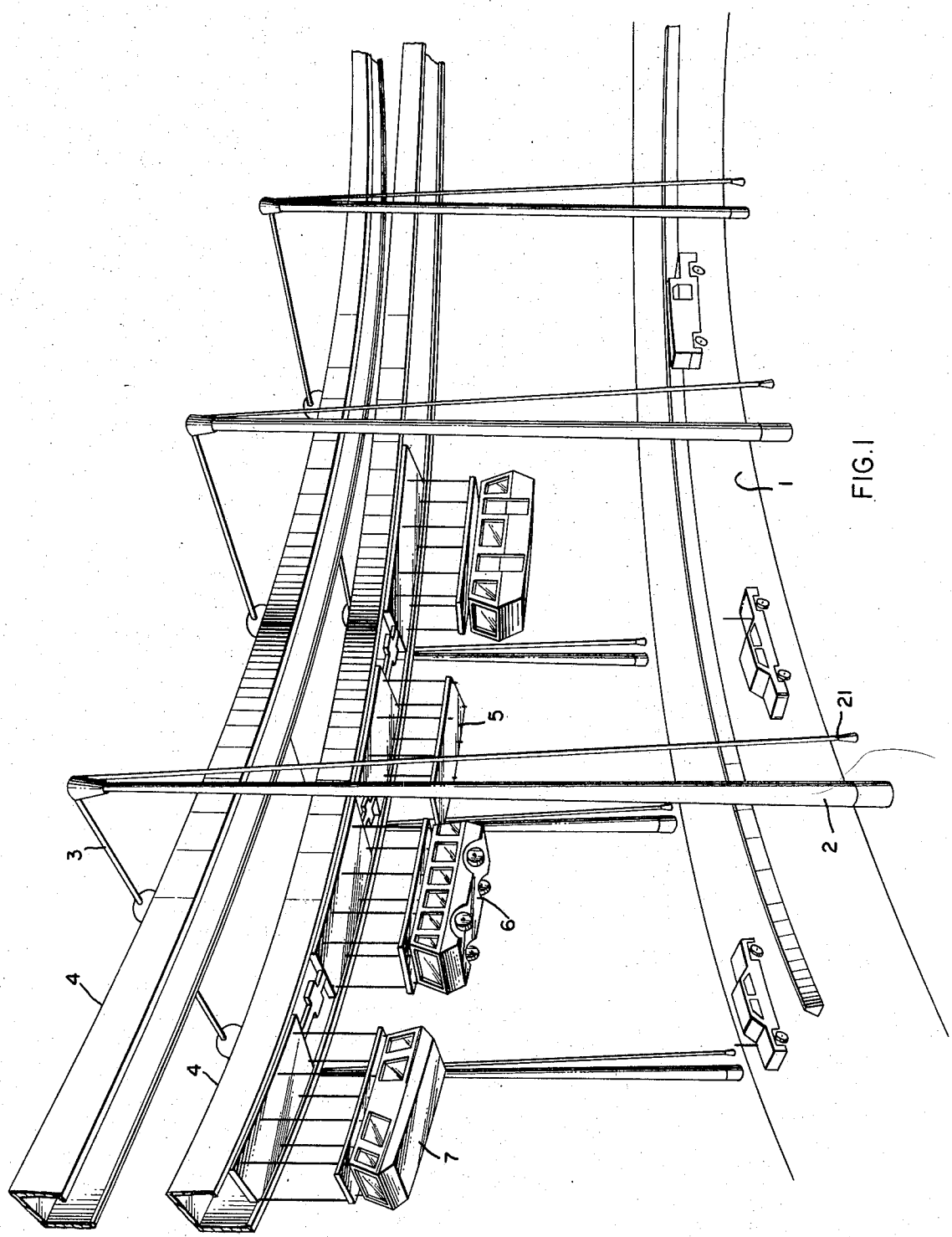


FIG. 1

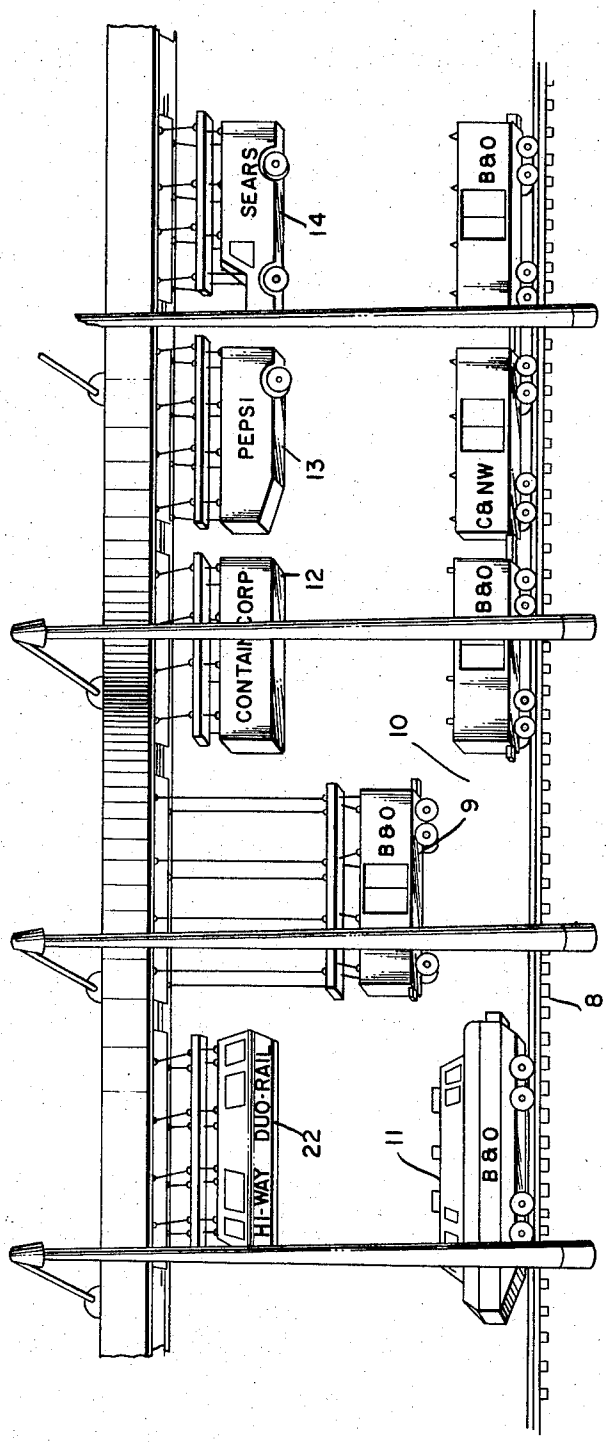

SEARS
14
B&O
PEPSI
13
C&NW
CONTAI
CORP
12
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8
HI-WAY DUO-RAIL
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11
B&O

FIG. 2

FIG. 3.

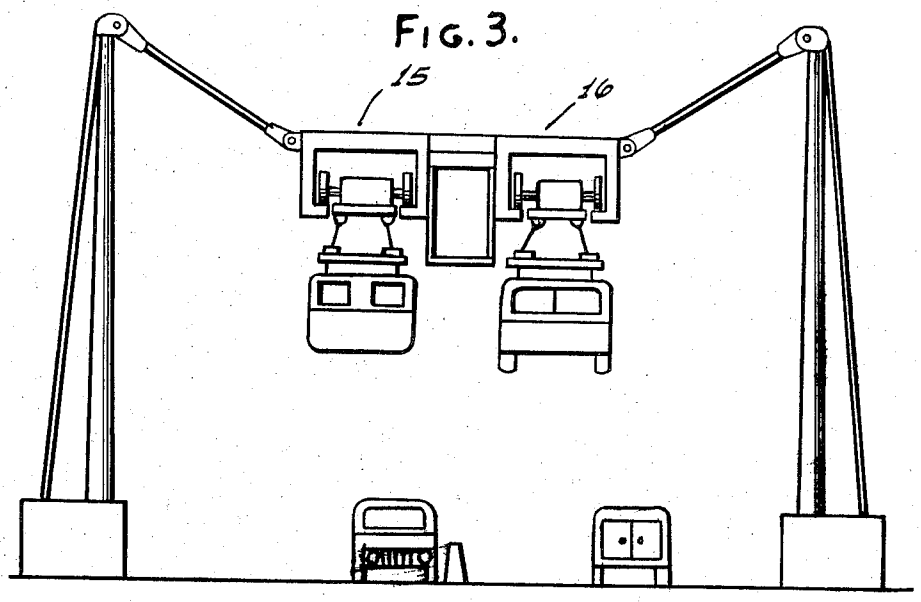
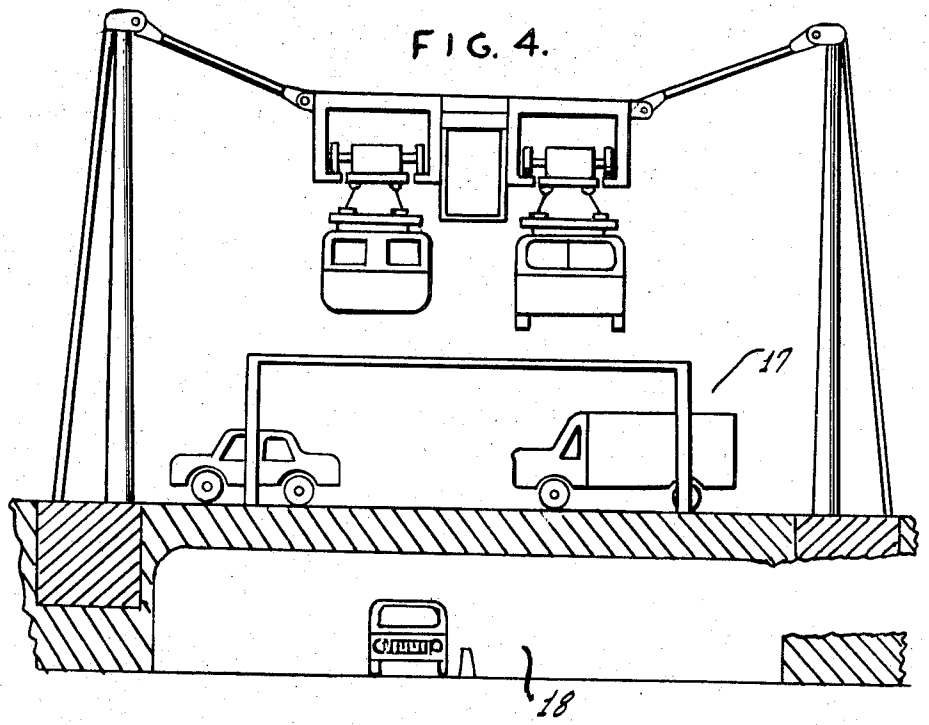


FIG. 4.



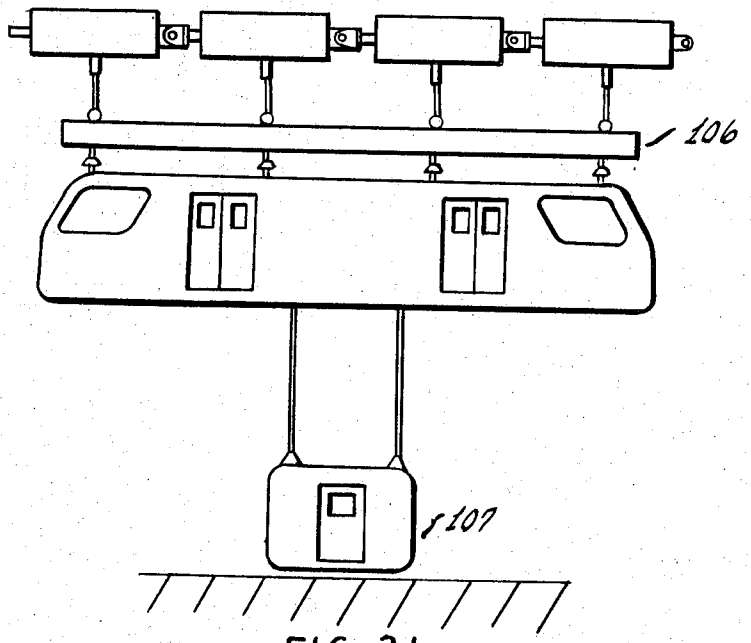
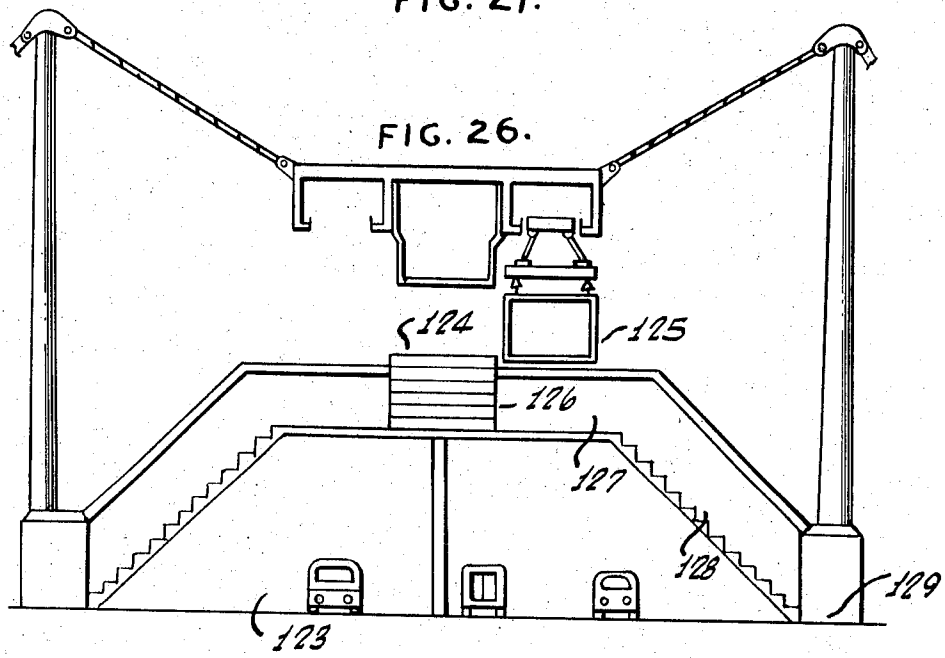


FIG. 21.

FIG. 26.



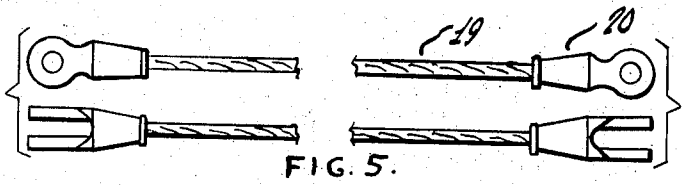


FIG. 5.

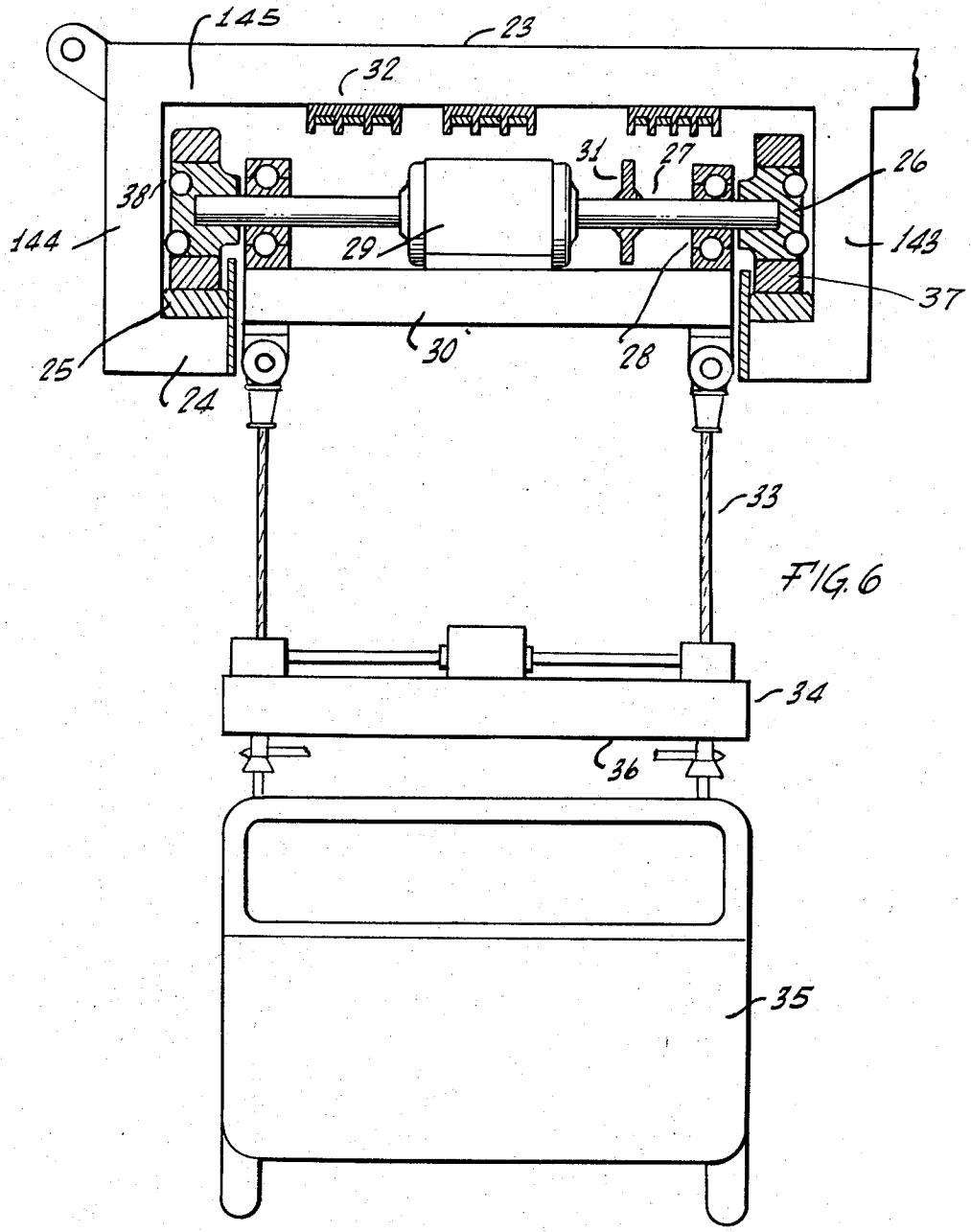


FIG. 6

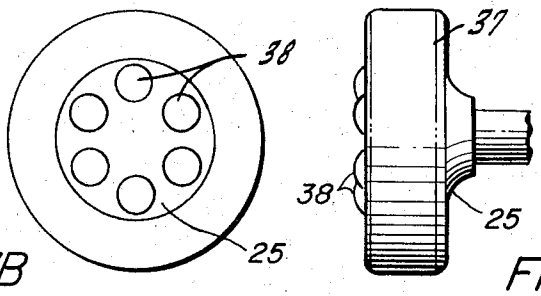


FIG. 7B

FIG. 7A

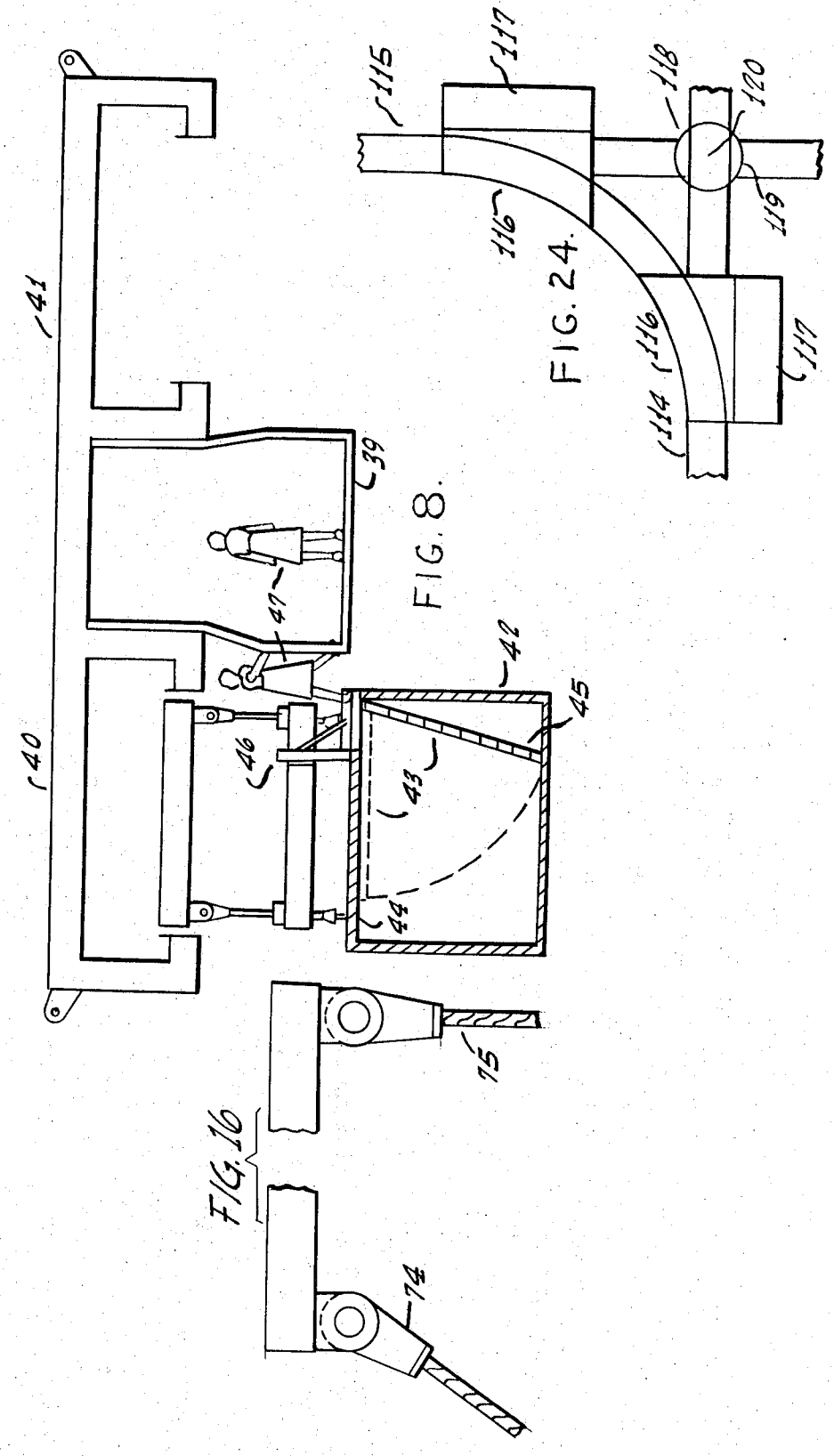


FIG. 24.

FIG. 8.

FIG. 16

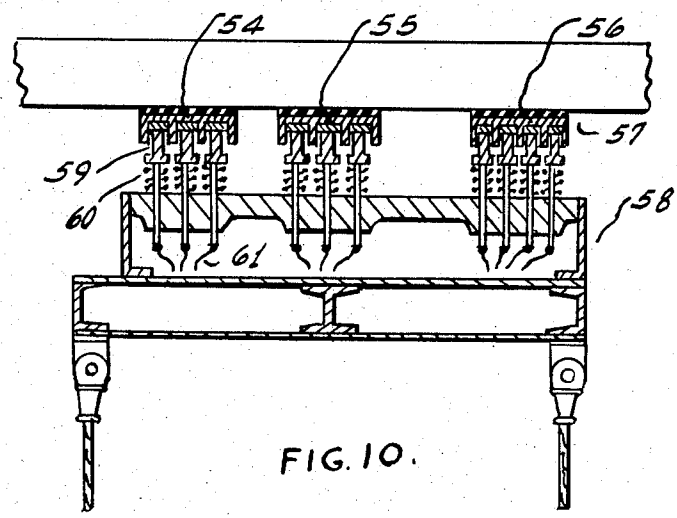


FIG. 10.

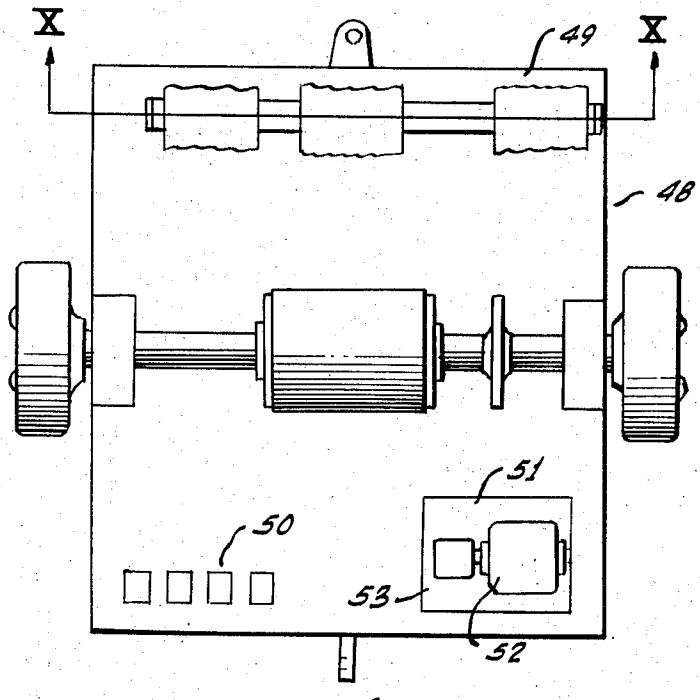


FIG. 9.

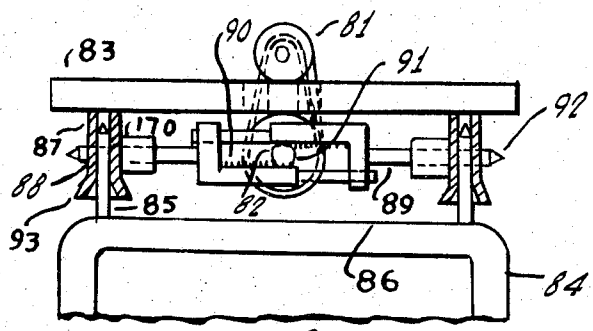


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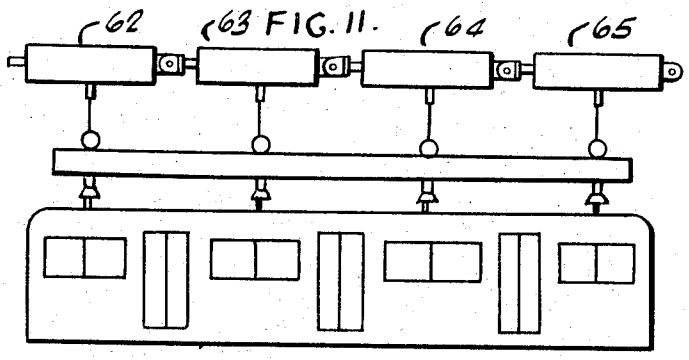


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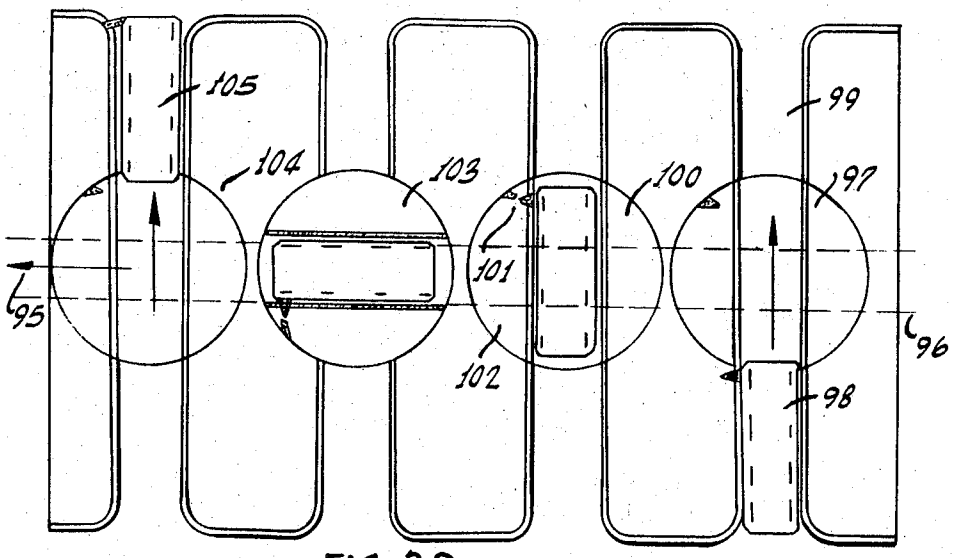
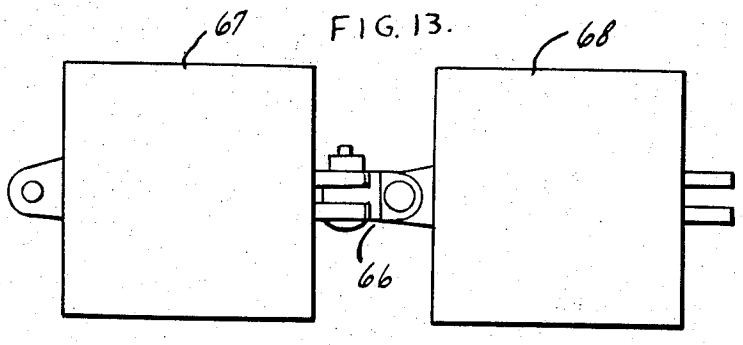


FIG. 20.

FIG. 13.



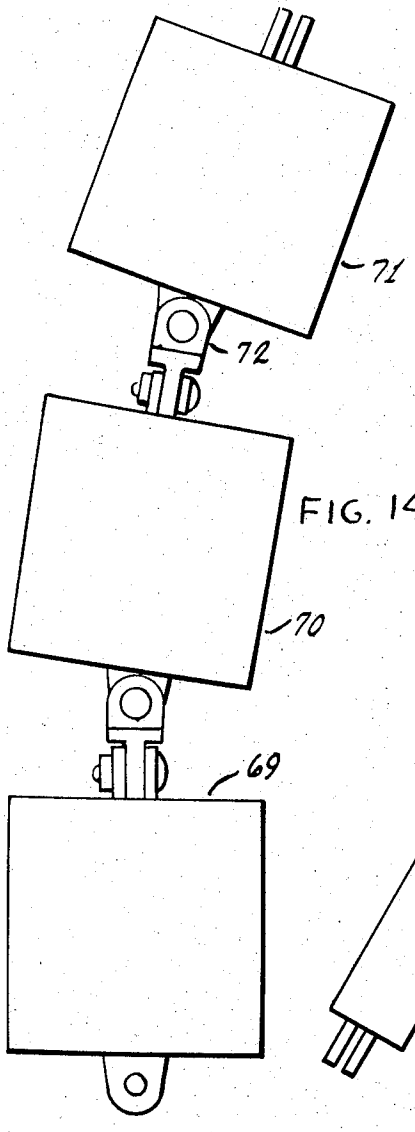


FIG. 14.

FIG. 15.

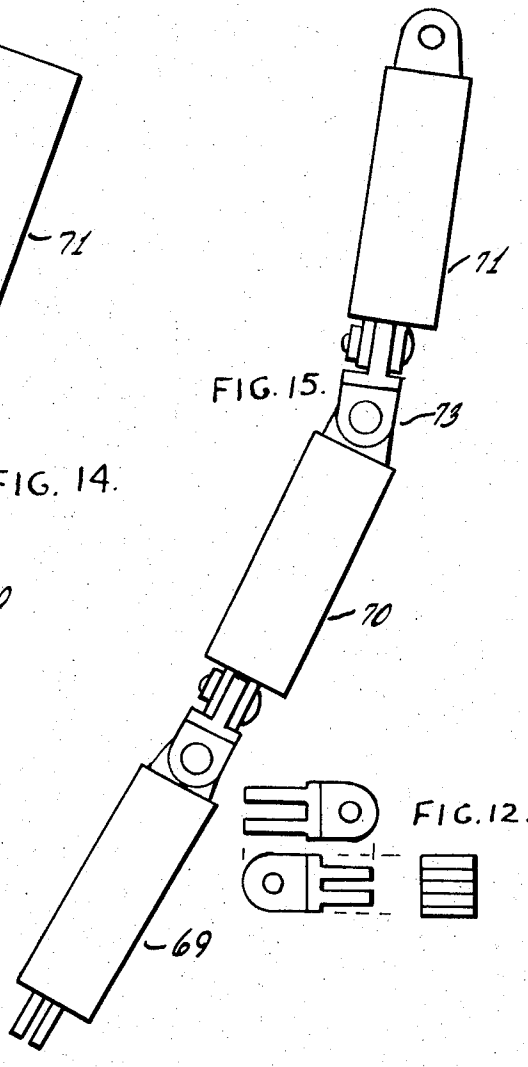


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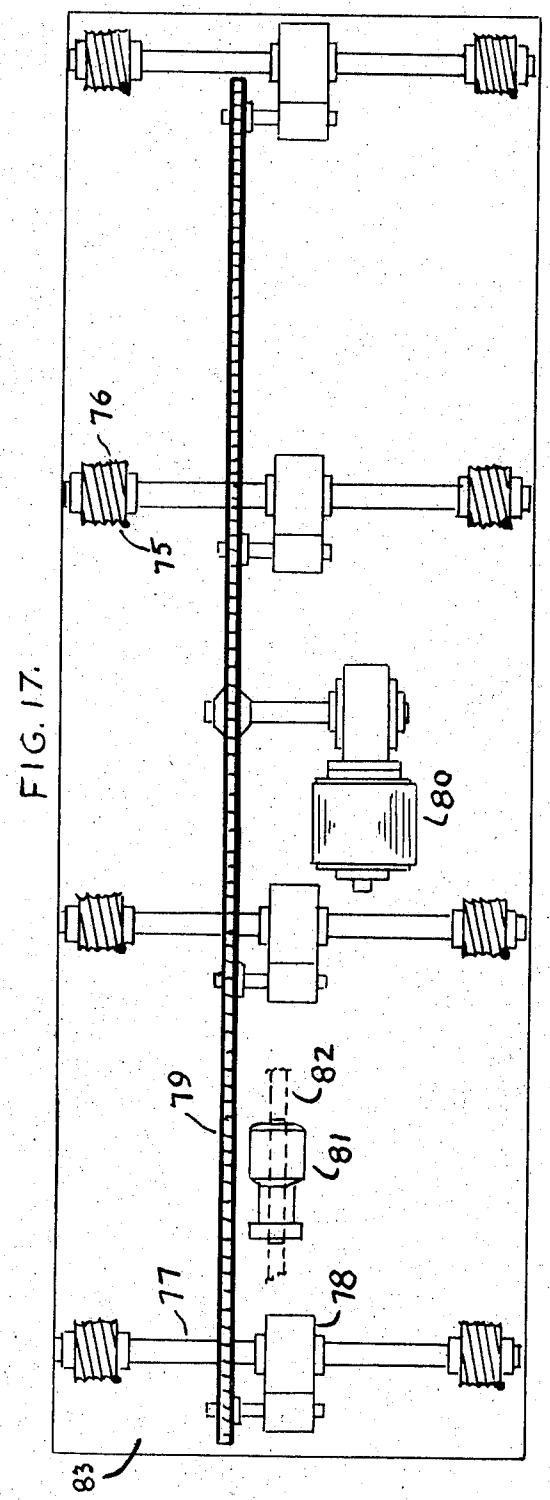


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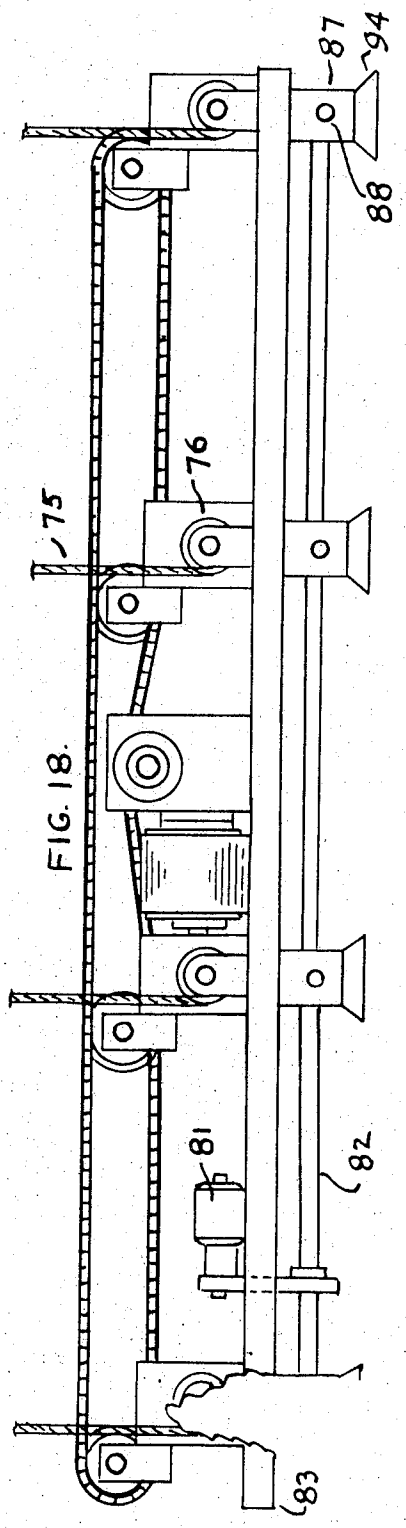


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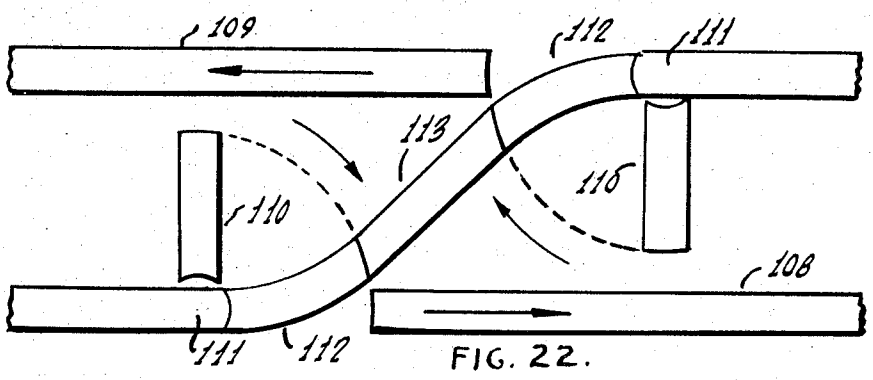


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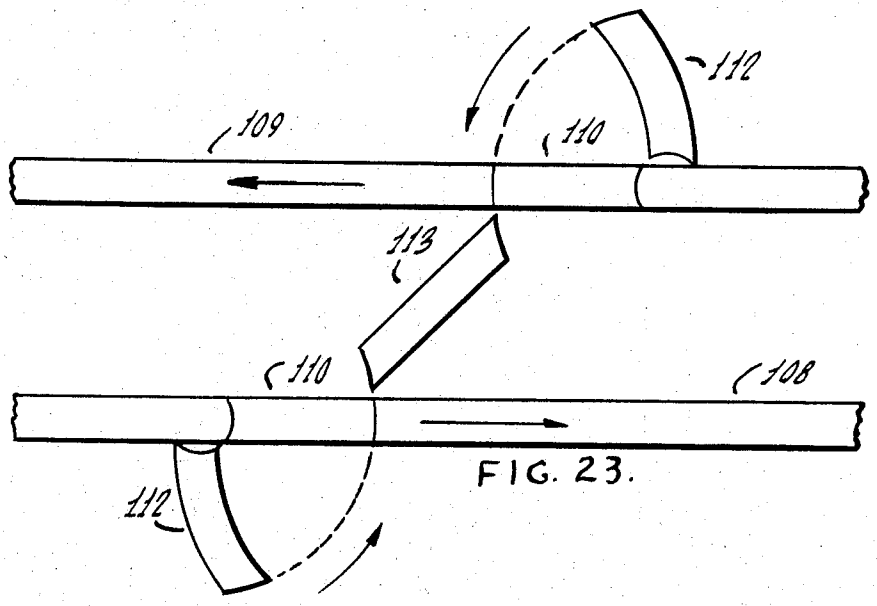


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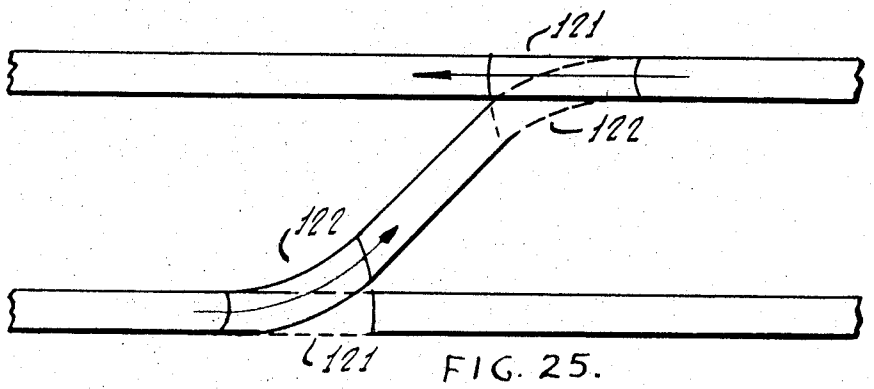


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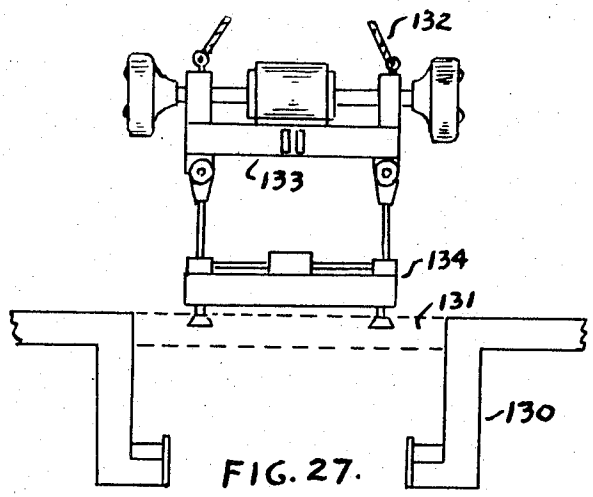


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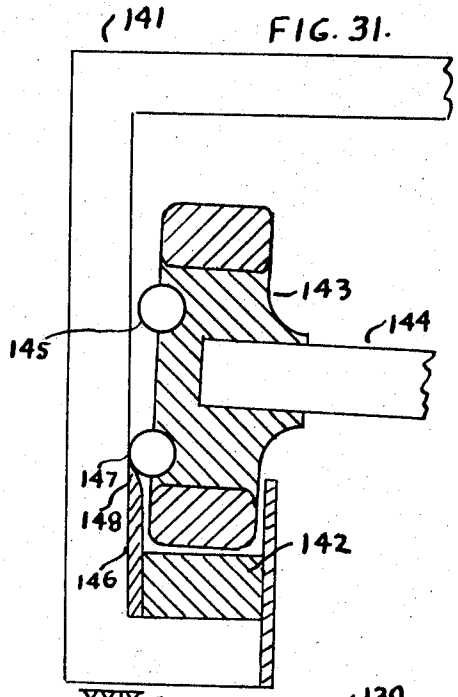


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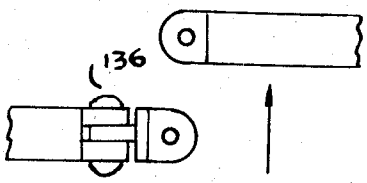


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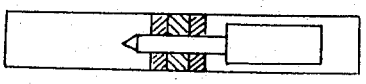


FIG. 29.

FIG. 28.

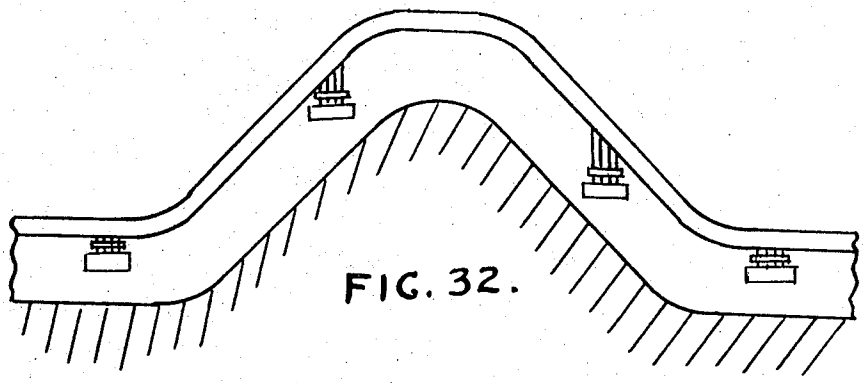


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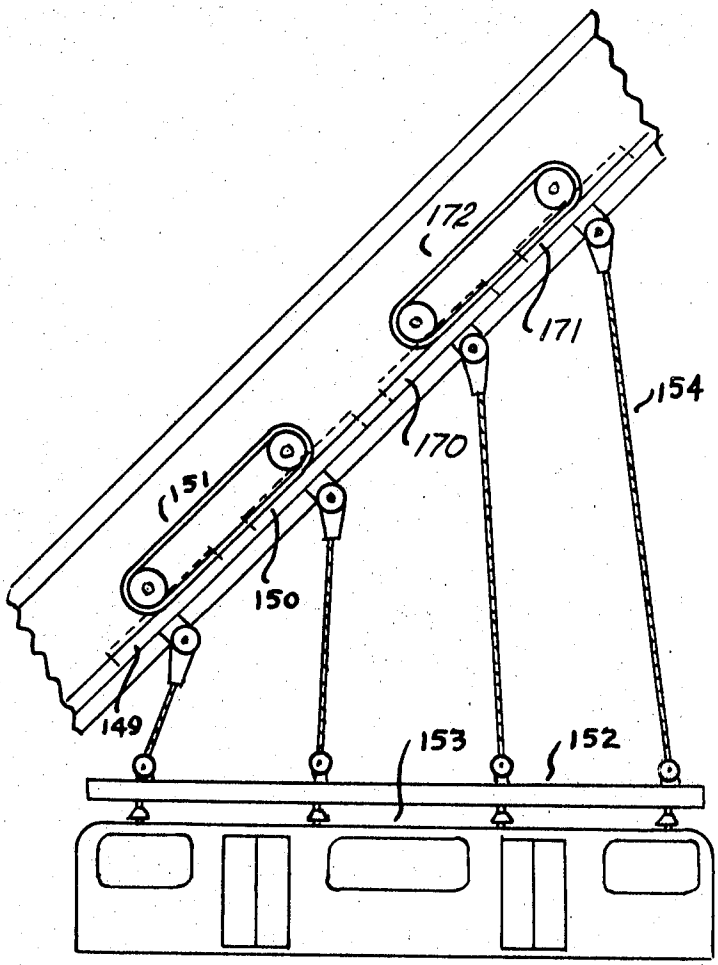


FIG. 33.

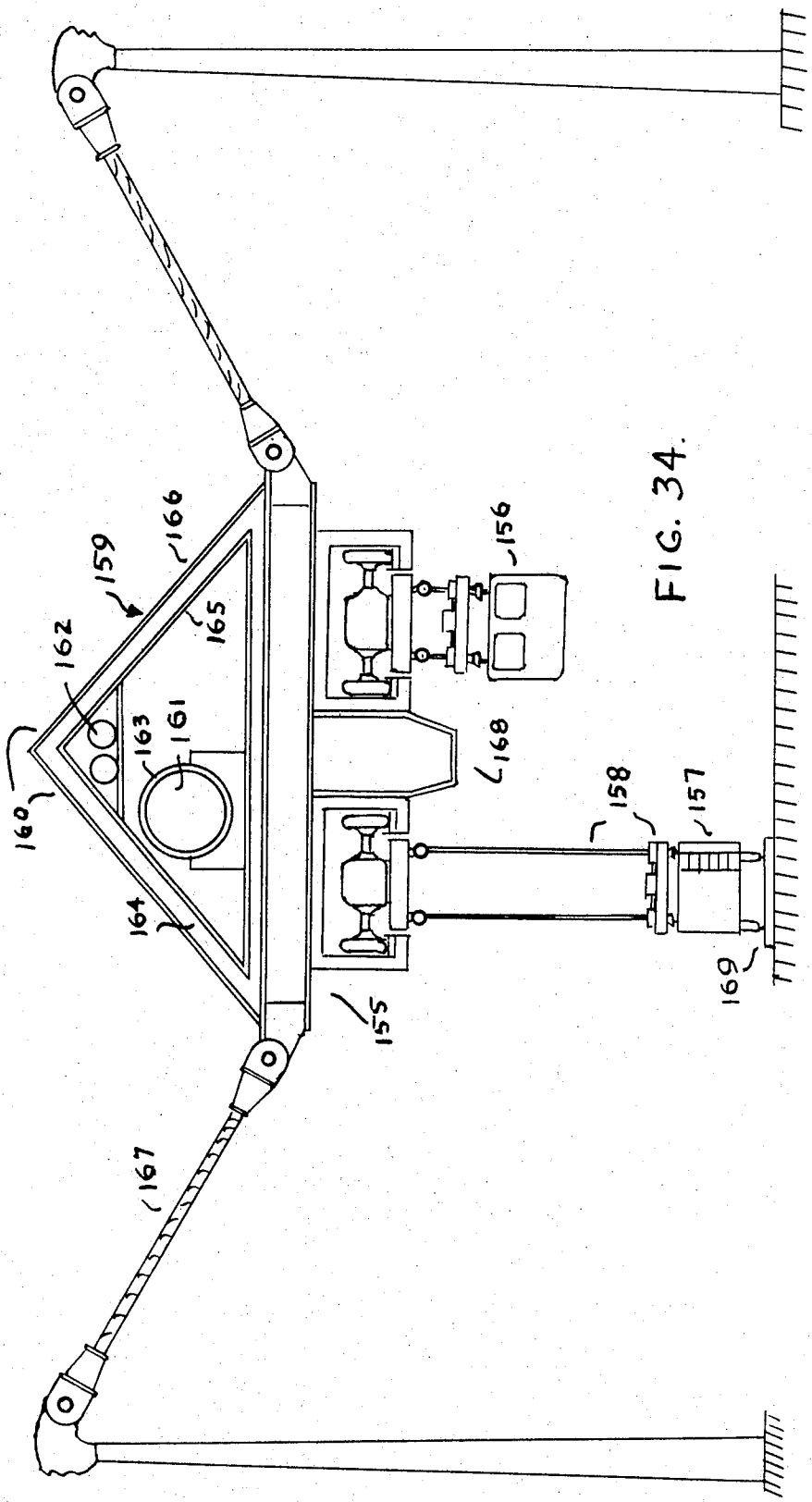


FIG. 34.

UNIVERSAL TRANSPORTATION SYSTEM BASED ON A CABLE SUSPENDED DUO-RAIL RAILROAD

This is a continuation of application Ser. No. 89,266, filed 11 Nov. 1970 now abandoned.

BACKGROUND OF INVENTION

This invention relates to the art of universal land transportation systems, and more particularly to a transportation system permitting a number of conventional land transportation vehicles, such as buses, cars, trucks, and the like, to be rapidly transported from a collection station to a distribution station over existing rights of way.

To qualify as a universal transportation system, the system should be designed to meet the following needs:

To carry masses of passengers; to carry many forms of freight and equipment; to provide means for facilitating the transport of liquids such as oil, water, chemicals; to provide mass transportation at elevated levels above highways, railroads, over rough and rocky country without the necessity for grading the land; to carry people and goods over swamps, wetland, streams, rivers, forests and jungles without the necessity for grading or keeping growing plants or trees cut away; over deserts and Arctic regions; to provide people a means of riding through the air quietly, quickly, smoothly, safely, without the dangers inherent in airplane or surface travel; over hills and mountains, up and down steep grades, without the necessity for trackways winding back and forth up graded rights of way and under snowsheds.

Such a system can carry a large number of passengers in many car trains. The cars of the train are carried by modules having wheels of standard railroad gauge, with any car of the train capable of being picked up and lowered at any point along a train without disturbing the remaining cars. A car can be equipped with railroad wheels, and lowered onto a surface railroad below, and proceed, under its own power, or by locomotive, to any desired location. Buses carrying passengers can be raised or lowered at any point and serve their routes, atr both ends of their travel, under their own power, but can be carried by the railroad at high speed over relatively long distances in between. Containers filled with goods can be picked up individually at or near factories and lowered directly into the holds of waiting ships. Light and heavy mail, express and freight cars can be transferred individually from surface railroads to the suspended line without the necessity for surface switching yards. Trailer and other trucks can be picked up and deposited individually at any location.

The overhead suspended system can, in addition to the transportation means for carrying freight and passengers, be provided with overhead means for the transport of oil, water or electric lines in a housing which can be rendered oil-, sandstorm and water-tight, compartmentalized, insulated against heat and cold, and with facilities to drain off oil, water, or other liquids onto tank cars suspended on the railroad below, in case of pipe breakage. Electric lines can be cabled and be completely protected against lightning, ice or any other damage.

The system adapts itself to the transportation of earth, rock, etc. incidental to the digging of a canal beneath it. For example, it can be used to dig the canal, transport the removed materials, carry in cement and supplies, and after completion of the waterway tow vessels through it while also transporting passengers and freight. Similarly it can dig trenches for a buried pipeline beneath it, lay the pipe, refill the earth, then transport passengers and freight above the line; it interferes not at all with free passage of animals, people or traffic on the surface below.

OBJECTS OF THE INVENTION

The general object of my invention is to provide an improved cable-suspended duo-rail railroad, normally carried through the air, adapted for positioning either over existing right of ways such as highways, railways or canals, or over any surface condition such as rough terrain, hills, mountains, wetlands, waterways, forests, jungles, etc.

Another object of the invention is to provide a transportation system which may be erected over an existing right of way but which offers no interference to traffic on the existing right of way.

A further object of the invention is to provide a transportation system in which existing vehicles may be combined into a train for rapid locomotion to a desired terminal.

Another object is to provide a transportation system minimizing noise and pollution levels of vehicular movement along existing rights of way.

More specifically, my invention aims at providing means in such a system for preventing undue wear on the traction wheels of a vehicle carrier as the latter rounds a curve in its track.

SUMMARY OF THE INVENTION

A transportation system embodying my invention includes a curved track with a pair of rails and a vehicle having at least one pair of driven traction wheels riding the bottom surfaces of these rails, each rail further including a substantially vertical web rising from its bottom surface to limit lateral deviations of the vehicle off a predetermined path. At each bend the track is provided with a camming surface disposed on the web of larger radius of curvature, i.e. on the outer one of the two rail webs, these camming surfaces coacting with formations on the adjoining traction wheels upon a centrifugal displacement of the vehicle in a bend so as to lift the outer traction wheel in a curve off its supporting surface.

In a preferred embodiment of my invention, the rails are part of an overhead structure of inverted-U shape forming junctions with several surface routes, the wheel-supporting surfaces being part of horizontal bottom flanges on the lower ends of the legs of the inverted U. In such a system the aforementioned vehicles are carriers circulating on the overhead structure, each carrier being provided with hoist means for lifting a surface vehicle off its route at one junction and redepositing same on another surface route at another junction.

In this preferred embodiment, as more fully described hereinafter, each motor with its traction wheels is supported by a drawbar platform which also carries all unitary equipment related to control, braking and other functioning of the motor unit. Each such platform, with all its equipment, will hereinafter be referred to as a motor module. Four such modules permanently joined together, including four motors and eight wheels, make up a standard car or bus length of approximately 40 feet.

Suspended below each set of four motor modules by eight cables, two for each motor, is a rigid platform equipped with eight drums for winding and unwinding the cables. The winding and unwinding may either be synchronized so that all cables are payed out or drawn up equally, or be selectively controlled, on a system crossing a mountain at a steep angle, to keep the car horizontal while the motor modules pass up or down the steep grades.

On the under surface of the module platform are sets of support means for the vehicles to be lifted and lowered. These support means comprise sockets into which corresponding parts on the vehicles enter, after which bolts pass simultaneously through all the sockets and vehicle parts to form a rigid support for the vehicle. Cable support of the trackways of this system results in important advantages. Solid or lattice-type beams for support of heavy loads, with a 70–100 foot span are large in cross section, are ugly, and must have a greater cross section for carrying a given load than does a cable.

In a cable each strand of wire can be of high-strength steel, individually and exactly tempered to bring out is maximum strength. This cannot be accomplished with large steel beams.

With cables extending downward between columns and trackways at about a 30° angle below the horizontal, the cable tensile strength need only be as great as for a vertical cable sustaining the same load.

In addition to small size for sustaining loads, cables, because of their non-rigidity, absorb vibration and shocks, and adjust automatically to changes in temperature.

The system is capable of supplying a multiplicity of needs present today.

The most urgent is the need, now at a crisis stage, for mass transportation from the heart of cities, large and small, into relatively far-out suburban areas perhaps 10 or 15 times the size of the central city. Every city in the U.S. now has highways and rail lines threading through and out into these areas. It only remains to install the overhead system over the highways, without the acquisition of new real estate, and transportation will be available for mass travel anywhere in the whole area. Since no new right of way cost is incurred, fares can be low, and many city problems rendered solvable.

Between cities less than a few hundred miles apart, passenger lines suspended above existing rail lines can double the capacity of the railroads without acquiring new real estate, and eliminate interference between freight and passenger traffic, provide low-fare high-speed travel, and successfully compete with other transportation forms.

The system lends itself to implementing some of the most imaginative current development projects. Four of these are:

1. Carrying the Alaskan oil down to existing Alaska cities;
2. Providing rail transportation through Amazonia, the vast territory forming the headwaters of the Amazon River in Brazil;
3. Carrying water from surplus-water areas to dry areas; and
4. Digging a new Panama Canal, and providing towing and passenger and freight haulage after the construction is complete.

In building the system, in each case construction can start at a point where materials are available and the system itself can carry supplies to construction crews as the build up proceeds.

By providing "locomotives" or special trains suitably equipped, the system can be used for transport over mountains, such as the Rocky Mountains, riding directly up grades possibly as steep as 45° . To do this, two wheels on each of two motor modules can be covered with a "caterpillar" tread geared to the rails, and the cars can be automatically leveled, as described above.

The mechanism for picking up and releasing vehicles opens up large new possibilities. Each train of cars can have a control car, and with present-day control and communication equipment, any one car in a long train can be lowered or picked up at any point along the line and carried to any other point. This applies to all kinds of passenger-and freight-carrying vehicles.

Inherent Advantages of the System

Safety

The first consideration is safety. Comparison with surface railroads will show that the cable-suspended system, with motors separated from the cars, and running on rails within inverted U trackways above the cars, is inherently safer than surface railroads.

On surface railroads a flange on each wheel is relied on to prevent derailment. In rounding curves an extra rail called a guard rail is provided to make doubly sure that the flanges do not override the rails under the action of centrifical force.

In the inverted-U construction, the side walls of the U constitute guard rails, but these extend all the way from the rails to the roof of the structure. There is therefore no possibility of derailment, whereas with surface railroads derailment is officially acknowledged to be the cause of most railroad accidents.

The foundations of surface railroads are inherently less safe than those on the cable-suspended system. The wooden ties are subject to rot and termites, and are displaced by frost, and their earth supports are washed away by floods. The supports for the suspended system are concrete-and-steel foundations buried deep in the earth every 50 or 75 feet, and are unaffected by the conditions cited above.

Surface railroad cars, necessarily spring mounted, are subject to violent gyrations, especially at high speed, and must be very heavy to successfully withstand the strains incidental in these gyrations, and those occurring in collisions and overturning in a derailment.

The cable-suspended cars of the duo-rail system are insulated from shock by the cables supporting them, all blows being taken through the motor line above, and passengers are therefore subjected only to a shaking up in any shock less than the most violent collision. The duo-rail cars therefore need only to weigh a fraction of the weight of those on a surface railroad.

Since they are suspended in the air, there can be no collisions with anything on the surface.

With the block-signal system and the 2-voltage power supply to be described below, trains can safely proceed in fog conditions of zero visibility.

Incidental to safety, escape means must be provided in case of fire or other emergency. In the construction to be described, a walkway is made available between the two inverted-U trackways, and access to it is gained

through ladders in the conveyances and trap doors in their roofs.

Independence Of Weather

Weather is a factor in safety of railway travel. Frozen switches, ice and snow on trackways can, at least, interfere with travel and, at the worst, cause derailment of trains.

The system to be described is more nearly independent of weather than other forms of transportation. Since the driving elements are sheltered from rain, snow, ice, lightning, floods, wind, even hurricanes and cyclones, trains can operate under any of these weather conditions. Fog cannot stop travel, as stated above. Winds cannot sway the cars, resting on their two widely spaced-apart rails.

Switching And Crossovers

Switching, while feasible, is more difficult and expensive than with surface railroads. To switch, a section of inverted-U trackway of sufficient length must be moved to replace the straight-line trackway, and insert one curved to the right or left, as the case may be, to line up with a trackway to the right or left. This movable structure must be supported from above, since the cars and trackway must have room to swing below.

For a crossover between one line and another, the tracks must swivel through 90° to align with the other tracks.

For these reasons the system should have a minimum number of switches. The loop system, where a train travels continuously in a forward direction around the entire loop, lends itself to a no-switching concept. With high-speed trains, every train can travel the entire loop. The difference in demand for cars or buses at various times of the day is inherently taken care of by the fact that each train can carry a single car or bus, or as many as, say, ten cars or buses if it has motor modules capable of carrying that many. A freight train with positions for 50 cars can carry any number up to 50. Switches are essential on surface passenger or freight lines, but the ability to release or pick up any one of the cars making up a train removes this necessity with the suspended line.

A feature of the invention resides in the provision of trackways capable of supporting train elements suspended below, these trackways comprising substantially rigid members in the form of an inverted U, with facilities at the lower ends of the U for carrying two rails, one at each open side of the U, constituting the basic unit of a duo-rail suspended railroad system.

Another feature resides in the support of the inverted U trackway by cables secured to the trackway, and to columnar supports spaced away from the trackway and extending transversely to the direction of the railroad.

A further feature resides in the provision of two such trackways, one for trains in each direction, and to provide a walkway for emergency use, suspended between the two trackways.

Another feature resides in the arrangement of electric motors and their current supply, control and supporting means within said trackways, each motor equipped wtih two suitably tired wheels running on the rails at the base of the inverted U.

It is also a feature to so space the legs of the inverted U, witgh relation to the motor driven wheels, as to provide the equivalent of guard rails, preventing any possibility of derailment of wheels.

Another feature resides in the platform supported by each motor and carrying all its accessories, such as current pickup devices, switching contactors, and braking equipment, to be referred to as a motor module.

A further feature resides in each motor module provided with a connecting element at each of its ends joining it to the adjacent modules, said joining elements adapted to permit side wise or vertical movement of each individual module, independently of the movement of adjoining modules.

Another feature is the two cables reaching downwardly from the two lateral sections of each module platform, with facilities at the point where the cable joins the platform, to permit sidewise swiveling action at this point, to assist in taking up the movement differences between rigid cars and swiveling motor modules.

It is also a feature to provide a swinging rigid platform, supported by eight cables extending from four motor modules, this platform carrying hoisting and lowering means for extending or drawing in the support cables.

Another feature is the dimensioning of the platform and motor modules to be adequate to support and carry conventional transportation vehicles of approximately forty feet in length with suitable clearance between one vehicle and the next.

Another feature is to equip the platform, on its lower face, with means of adequate strength to securely hold cooperating means affixed to the upper surface of vehicles, for the purpose of lifting, transporting and lowering the vehicles.

Another feature is to provide the hoisting means for the cables on the suspended platforms to draw in or let out the cables at exactly the same speed, to insure uniform tension in the cables, and balanced rise and fall of the platform and the vehicle it supports.

A further feature is to provide cars or trains with pairs of motor module wheels having caterpillar treads, of suitable design, to enable the motor means, carrying suspended cars, to safely climb up and down relatively steep grades.

Another feature is to provide the caterpillar-tread equipped units with automatic self-leveling devices, controlling the length of the individual cables lifting and lowering a platform and its load, so that the platform remains horizontal as the motor modules ascend or descend steep grades.

A further feature is to equip each wheel of motor modules with a suitable thrust bearing on its outer face, adjacent to the sidewall of the inverted-U trackway, to limit the endwise movement of any motor module.

Another feature is to provide carrying means for vehicles, on lifting platforms and vehicles, consisting of sockets on the under-surface of the platforms, into which projecting elements on the vehicle enter, and a system of bolts driven simultaneously by a single motor on the platform, adapted to pass through openings in the sockets and the projecting elements, to provide positive and safe means for carrying the vehicle.

Another feature is to provide a control car with each train capable, through electric and eletronic controls, of operating all the electric or electronic or communication equipment throughout the train.

Another feature is to provide the control car with an elevator, controllable from within the elevator or without, capable of raising or lowering the train operator or others.

Another feature is to provide visual, electric, electronic, manual or automatic means to enable the person or persons controlling the pick-up or lowering of a vehicle to accurately align the hoisting platform with the vehicle, or to lower the vehicle at an exact selected position.

Another feature is to provide a simple automatic block safety system including a high-voltage and low-voltage power supply to all trains, dividing the system into blocks, and providing automatic means, when a train enters a block, to cut off the high-voltage power supply to the block it is leaving, so that a following train can proceed only at reduced speed until the train ahead leaves its block.

BRIEF DESCRIPTION OF DRAWING

The specific details of the invention and their mode of functioning will be described in connection with the accompanying drawing wherein:

FIG. **1** is a perspective view of a cable-suspended duo-rail railroad system, showing two trackways, over a six-lane highway, constructed in accordance with the invention;

FIG. **2** is a schematic elevational view of a system over a conventional surface railroad, illustrating the mode of transferring a box car from the system to the surface railroad, and showing various types of suspended loads;

FIG. **3** is a transverse view through the railroad of the invention shown suspended over a highway;

FIG. **4** is a transverse view through the railroad shown passing over an underpass on a highway;

FIG. **5** is a detail illustration of the construction of a cable used in supporting the trackways;

FIG. **6** is a partial cross section of a single trackway, showing the motor module formed by a motor and wheel assembly mounted on a drawbar platform, with a cable-supported load-engaging platform below the drawbar platform, and a bus, partly lowered, secured to the load-engaging platform;

FIGS. **7A** and **7B** show a side view and an end view, respectively, of a traction wheel of the module;

FIG. **8** shows two trackways, with an emergency escape walkway between them, and illustrates the escape method;

FIG. **9** is a plan view of a motor module, indicating the equipment it carries;

FIG. **10** is a cross section on line X—X of FIG. **9** showing three sets of current supply busbars, and the current pickup devices carried by the motor module;

FIG. **11** shows four motor modules joined together to match a 40-foot-long car or bus;

FIG. **12** is a detail showing a top and end view of a universal-joint coupling for connection of one motor module to the next;

FIG. **13** shows two motor modules joined together by the universal coupling of FIG. **12**;

FIG. **14** shows the pivotal action of the coupling when cars are rounding curves;

FIG. **15** shows the pivotal action of the coupling when cars are changing grade;

FIG. **16** shows a swivel hanger joining a cable to the underside of a motor drawbar platform;

FIG. **17** is a top view of a load-support platform carried by motor modules;

FIG. **18** is a side view of the platform of FIG. **17**;

FIG. **19** is an end view, in partial section, of the platform of FIG. **17**, showing locking means for securing the lifting means on vehicles to the platform;

FIG. **20** is a plan view of a station for pickup and delivery of vehicles by the duo-rail railroad, including means for positioning vehicles;

FIG. **21** is a view of a control car equipped with an elevator;

FIG. **22** shows a switching arrangement to transfer trains between the outgoing and incoming tracks, with the tracks shown in switchover position;

FIG. **23** is the switching arrangement of FIG. **22** with the tracks in straight-through position;

FIG. **24** illustrates a switching arrangement for a turnout from one line to another, and a switch at a crossover;

FIG. **25** is a plan view of a switch arrangement in which the tracks move vertically to change from one condition to the other;

FIG. **26** schematically illustrates in transverse elevation a station on a cable-suspended duo-rail railroad;

FIG. **27** shows the method of removing or installing a motor module through an opening in the roof of the inverted-U shaped track;

FIGS. **28, 29** and **30** show detailed methods of uncoupling motor modules,

FIG. **31** illustrates the relationship between track rail and traction wheels showing means for reducing tire and traction rail wear when trains are rounding curves;

FIG. **32** schematically illustrates a cable suspended duo-rail railroad crossing over a steep hill or mountain;

FIG. **33** illustrates a construction of motor modules with caterpillar treads, for steep grades, and the method of keeping the suspended vehicle level during ascent and descent; and

FIG. **34** is a combined cable-suspended duo-rail railroad structure including an insulated housing and means for enclosing oil, water, gas or electric lines.

SPECIAL DESCRIPTION

In FIG. **1**, a six-lane highway **1** has columns **2** erected in spaced pairs along each side of the right of way, and cables **3** extending from the columns to a pair of trackways **4**. Backguys **21** brace the columns against tilting. Suspended from motor modules riding in each trackway **4** are platforms **5** from which are suspended passenger-carrying vehicles **6** and a control car **7**. One trackway is for trains passing in one direction and the other for trains passing in the opposite direction.

FIG. **2** pictures a similar set of spaced pairs of columns and a cable-suspended trackway supported thereby, while below there is a surface railroad **8**. A control car **22** is shown suspended from the trackway, and a variety of vehicles make up the train. A railroad box car **9** equipped with standard-guage wheels for the conventional surface railroad illustrated beneath the trackway is shown being lowered into place in an open position **10** in a train of cars to be pulled by a locomotive **11**. This illustrates the method by which cars can be interchanged between surface railroads and the suspended system without the necessity for switches on either line. Included in the suspended train shown in FIG. **2** is a container **12**, a semitrailer **13**, and a regular truck **14**.

FIG. **3** is a transverse view showing a pair of inverted U trackways, **15** and **16**, suspended over a highway.

FIG. 4 is a comparable view except that the trackway is shown suspended over a crossing between an upper highway 17 and a lower highway 18. The suspended line has changed grade from the elevation of FIG. 3 to that of FIG. 4.

FIG. 5 is a detail showing of the cable used in the suspended system. The cable is straight at 19 and is terminated in two end fittings 20. A shaped cable, passing all the way through from one anchorage to the other over the columns and through both trackways, could be employed, but only if the support fittings at the bends were designed as in catenary construction for equal strains at all points to prevent cable breakage under movement.

As seen in FIG. 6, on inverted-U trackway 23 is shown constructed of I beams, box beams, or other adequately strong structural shapes, and inturned sections 24 at the lower ends of the legs of the U. These are rigid shapes carrying rails 25. Carried on the rails are traction wheels 26, with tires 37 of suitable material. The wheels are mounted on shaft 27 which passes through bearings 28 to motor 29. The motor 29 carries platform 30, hereinafter called a drawbar platform. Disc brake 31 is provided on shaft 27 for the motor-wheel assembly. Mounted on the interior ceiling of the inverted U are sets of busbars 32, the construction and functioning of which will be explained below.

In surface-railroad practice on curves, it is customary to provide an extra rail, called a guard rail, adjacent the rail nearest the center of the curve, to provide extra protection against derailment as the centrifugal forces tend to make the wheel flange on the outside rail rise up and derail.

In the inverted-U track 23 shown in FIG. 6, the two legs 143 and 144 act as guard rails. Since they extend upward all the way from the rails 25 to the roof 145 it is impossible for the wheels to escape and cause derailment.

Suspended below drawbar motor module platform 30 by cables 33 is a second platform 34, hereafter referred to as the load-carrying platform, and a bus 35 is shown secured to the under-side 36 of load-carrying platform 34. The bus is shown in partially lowered position.

Traction wheels 25 are provided with thrust bearings 38, shown in greater detail in FIGS. 7A and 7B.

FIG. 8 illustrates a suggested position and shape of an emergency-escape walkway 39 suspended between two trackways 40 and 41. Passenger vehicle 42 has a ladder 43 normally hinged to and up against the roof 44 of the vehicle. In fire or other emergencies the ladder is pulled down to position 45. On being swung down, it automatically, through a linkage (not shown), raises a hatch cover 46 on the roof of the vehicle, and the passengers escape as indicated at 47.

Alternatively, the escape platform may have its lower end at the same level as the bus floor, making it feasible, by bringing a walkway out from the bus and flush with its floor, for passengers to escape by walking on one level, thus avoiding climbing a ladder.

FIG. 9 is a top view of motor module drawbar platform 48 schematically illustrating the equipment it carries. Included are current-pick-up means 49 to be detailed later, remotely controlled electric switches 50 (contactors), a hydraulic brake system 51 including a motor-driven pump 52, a pressure tank 53, and all necessary accessories for control of braking.

The whole assembly of drawbar platform 48 and all it contains is referred to as a motor module.

FIG. 10 shows the busbar and current-pick-up arrangement for power supply to the motor and to all control and auxiliary equipment. The motor power supply is shown as carried by two sets of busbars 54 and 55, providing three-phase power at a higher and a lower voltage. Busbars 56 are for three-phase 4-wire 120–208-volt supply for all control operations, car light and heat, and door operation.

Busbars 54, 55 and 56 are supported by insulating means 57, and each motor module carries current collectors 58, consisting of brushes or shoes affixed to flexible cables 61 and thence to switches or other equipment. Each motor module carries a control cable made up of multiple conductors, and with plug means to automatically or manually connect it to adjoining modules making up a train. The coupling means for modules will be explained later.

FIG. 11 indicates how a number of motor modules equal in length to that of a vehicle to be carried are combined in accordance with the invention. Four motor modules 62, 63, 64 and 65 are shown joined together to match the length of a car or bus to be carried.

FIG. 12 is a detail of a universal coupling for connection of one motor module to the next. When installed between two motor modules as shown in FIG. 13, it allows movement in a vertical plane between the modules as shown in FIG. 15, and also movement in a horizontal plane between them, as shown in FIG. 14. In FIG. 13 the universal coupling 66 is shown joining two motor modules 67 and 68. FIG. 14 shows a top view of three motor modules 69, 70 and 71 rounding a curve illustrating how the universal coupling 72 allows swiveling in a horizontal plane FIG. 15, showing a side view of motor modules changing grade, illustrates how universal couplings 73 allow swiveling in a vertical plane.

FIG. 16 pictures a swivel hanger pivoted on the underside of a motor-module platform. Where, as preferred, there are a plurality of motor modules to each car or load length, these modules, as shown in FIG. 14, must turn with respect to each other in rounding curves. The car or the load, as the case may be, is a rigid body longer than any one module. Thus by using the swivel hangers 74, along with the flexible cables 75, differential adjustment of the support means is provided sufficient to allow rounding curves without undue strain on the various parts.

As shown in FIGS. 17 and 18, a plurality of motor modules may be combined with a single load-support platform 83. A top view of that is shown in FIG. 17 suspended from four motor modules and carried by cables 75. These cables are wound on winding drums 76, of which there are eight with the drums 76 mounted in pairs on shafts 77, which pass through centrally located worm-gear reducers 78. The reducers are driven by a sprocket chain 79 from a reduction-gear motor 80, the reduction gearing in the motor serving to reduce the output speed to a value suitable for chain drive. The characteristics of worm gears make it generally impossible for the load to cause the platform to be lowered. The drums can be caused to rotate only from the motor input end.

In order to insure secure engagement between a load, such as a bus or the like, and the load-carrying platform 83, as shown in FIG. 19, the vehicle 84 is provided with vertical projections 85 on its roof 86. These are re-

ceived in socket members **87**, on platform **83** shown sectioned in FIG. **19** and in side view in FIG. **18**. These members are formed with openings **88**, and bolts **89** are provided for movement through bearings **170**, sockets **87**, and projections **85** to engage the vehicle **84** with the platform **83**.

Bolts **89** are reciprocated by a double rack and pinion **90–91**, the pinion **91** being mounted on a shaft **83**, driven from a motor **81** as shown in FIGS. **17–19** . Pointed ends **92** on the bolts assist in aligning the holes in the vehicle mounts with those in the sockets. The sockets are flared out at **93** and **94** to guide the vehicle projections **85** into proper position when entering the sockets.

Interlocks and electric indicators are readily applicable to insure that the platform cannot be moved except with the locking means in the desired condition.

FIG. **20** is a schematic showing of a bus pick-up and delivery station under a suspended railroad. Trains run in the direction of the arrow **95** along the dotted line **96** representing the rail line overhead.

Four positions are shown, and a single bus is shown at each position, each representing one step in the pick-up or delivery of buses. In operation all four steps occur at each position, so four buses can be simultaneously picked up or delivered.

At position **97** bus **98** is shown entering a narrow passageway **99**, the width of the passageway insuring correct positioning in one direction.

As shown in position **100** the bus has reached a point **101** where an arrow marker on the bus exactly coincides with a corresponding arrow marker on a turntable **102** on which the bus stands.

The turntable is now rotated as shown at position **103**, at right angles to the entering position, and is correctly located for the bus to be picked up.

At position **104** a bus **105** is shown leaving, after being lowered and rotated through 90° .

FIG. **21** shows a control car. It carries all the control equipment for the train. It can be lowered, attached to load lifting platform **106**, but when it is the control car for a train picking up or lowering a load it may be desirable for a second man to descend and direct the operation, by walkie-talkie or otherwise. In this case he enters elevator **107** and lowers himself to the surface, returning by the same means. In addition, when the car is left vacant for any reason, it may be desirable for it to be left elevated, in which case the elevator can be used, and returned to the interior of the control car, by remote control, after the operator has stepped out.

FIG. **22** shows schematically a switching arrangement for transferring trains between an outgoing track **108** and an incoming track **109**. FIG. **22** shows the switches in position for crossover, whereas in FIG. **23** they are in normal position for through traffic. Each switch employs a relatively large structure capable of rotation around a center **111** and carrying a straight section **110** and a curved section **112**. A stationary trackway **113** extends partway between trackways **108** and **109**.

When the switches are in the position shown in FIG. **23** the trains run straight through in each direction. In the alternative position of FIG. **22** they can cross from one trackway to the other.

FIG. **24** illustrated two other modes of switching. Where a train on a trackway **114** is to be switched to a trackway **115** at right angles to track **114** the switches are moved to the position shown, where curved tracks **116** line up with tracks **114** and **115**. When trains are to run straight through, the switches are shifted transversely to remove curved sections **116** and replace them with straight sections **117**. At a right-angle crossing of two trackways, as at **118**, a circular switch is all that is required. The movable switch is carried on a rotatable through structure **119**, centered at **120**, and rotates 90° to align with track **115** or with **114**.

FIG. **25** is a schematic elevational view of a switch where straight and circular tracks **121** and **122** are carried in a vertical elevator-like structure. By movement vertically the change is made from one condition to the other. The top trackway is shown in the straight-through condition whereas the lower trackway is arranged for crossover.

FIG. **26** is a partial section of a station on a cablesuspended duo-rail railroad. Below is a highway **123**. Above it is a station platform **124** shown with a train **125** in position to receive or discharge passengers. Stairs **126** lead down to a station **127**, extending through stairways **128** to street level.

As illustrated in FIG. **27**, motor modules may be replaced by arranging trackway **130** with a section where the roof (the base of the inverted U) has been left out, as indicated at **131**. Through this opening hoisting means **132** have been attached to motor module **133** and load-lifting platform **134**. After disconnection from the adjoining motor modules and disconnection of control cables, the module **133** is lifted out complete with all its accessories intact, as shown. This can be performed on a single module or any desired number of modules, with hoisting means for each one.

FIGS. **28, 29** and **30** illustrate the coupling and uncoupling of motor modules. In FIG. **28** two modules **139, 140** are coupled together at **135**. A pin **136** passes through the clevis and loop of the coupler and the module, and this pin is permanently secured in place, as indicated in FIG. **30**. A pointed pin **137** on the opposite end of the coupler is made capable of insertion and withdrawal by power means **138**, which can be a motor or a hydraulic or air cylinder, remotely controlled or capable of manual control. When pin **137** is withdrawn, the uncoupling is complete, and module **139** is free to be lifted clear of module **140**. FIG. **30** shows two modules separated, after uncoupling.

FIG. **31** is a partial section of an inverted-U track **141** carrying rail **142** on which rides a traction wheel **143** on a shaft **144**. The wheel contains a thrust bearing **145**, this bearing being similar to that shown at **38** in FIGS. **6**, 7A, 7B and consisting of a set of peripherally spaced balls projecting axially from the flat outer face of the wheel body. Mounted against the sidewall of the U is a beveled cam plate **146**, which is utilized in sections of the track **141** where a train is rounding a curve. When traveling through a bend, the two traction wheels of each motor must traverse different distances for each revolution. The wheel on the curve nearer the center traverses less distance than wheel **143**, represented as the one on the curve farther from the center. Since the two wheels are rigidly secured to the same shaft, one or both must slip on the rails at this time. This can result in excessive wear on the tire, tread, or rail.

Plate **146** serves to reduce or eliminate this wear. Centrifugal force presses wheel **143** to the left in rounding a curve whose center is to the right. As it does

so, ball bearing **147** rides up on the beveled camming surface **148** of plate **146.** In doing so, wheel **143** is lifted partly or fully out of contact with rail **142,** eliminating or reducing the risk of excessive wear on the tire or rail.

The suspended railroad eliminates conventionally encountered problems with surface railroads in going up steep grades, as shown in FIG. **32** illustrating a cable-suspended duo-rail railroad passing over a mountain without winding back and forth up low grades, as is common with surface railroads, but passing in a straight line up grades possibly as steep as 45°.

It is desirable that the passenger car remain almost or fully horizontal. The means to accomplish this are indicated schematically in FIG. **33.** Drawbar modules **170** and **171** have their wheels joined by caterpillar tread **172,** while modules **149** and **150** carry caterpillar tread **151** on their adjacent wheels. The load-bearing platform **152** and passenger car **153,** suspended by cables **154,** are drawn up and down grade by four caterpillar treads. These treads may have gear-teeth meshing into corresponding gear-tooth surfaces on the rails, or with any other suitable construction to insure non-slip traction on grades.

By providing the cables at each of four positions with an automatic device which controls lengthening or shortening the cable between the module and load platform sufficiently to maintain the car level, it can remain so whether the trackway rises up, is brought horizontal, or goes downward.

Such an automatic device may consist of electric switching means in connection with the four sets of two cables each connecting the vehicle-support platforms with the motor modules.

Each pair of drums connected by cables to a motor module has its individual motor, capable of rotation in each of two directions. There is the normal control, operable from the control car, for raising and lowering the platform, with limit switches to stop movement at the extreme up and down positions of travel.

In addition there is superimposed a control system for maintaining the platform horizontal during grade changes. It includes a switching device, preferably a mercury switch, secured to the platform. Each end of the tube has contacts which open or close as the tube is tilted one way or the other.

Closing the contacts at one end by tilting the platform and therefore the tube starts the two motors on the center pair of drum shafts in opposite directions, to bring the platform back to horizontal position. Tilting the platform and tube the opposite way closes the contacts at the other end of the tube resulting in the reverse action. The net result is that when the platform tilts, the motors move to relevel it, until the mercury tube becomes horizontal and both contacts are open.

The cables extending to the other two drum shafts have springs included in their supports, and two sets of contacts, one of which closes when the spring is stretched, the other when it becomes slack. Under normal tension both are open. These function to make their respective motors relieve excess pull on their cables or take up excess slack.

The net result is that as the central mechanism levels the platform, the end motors normalize the cable strains or slack at their respective ends, so that the platform and its suspended vehicle remain horizontal with all cables carrying their correct percentage of the load.

FIG. **34** illustrates a universal transportation system, including a cable-suspended duo-rail railroad **155** for freight and passengers, capable of transporting at high speed passenger cars **156** or vehicles **157** of various types, with means **158** to pick them up and deposit them at any location, whether the vehicles are capable of operating under their own power or are interchangeable between surface railroads and the duo-rail suspended line as shown at **169.**

Also included in the cable suspended system is a roofed-over housing **159,** with a peaked roof **160,** capable of shedding snow, rain or sand from sandstorms. Within the housing pipes **161** and **162** are arranged for transporting oil, water, other liquids, gas or electricity. The oil or water pipe may be insulated and heated through its covering **163,** and the entire housing may be insulated from outside temperature changes by material at **164** placed between the inside coating **165** and the roofing **166.** The inner walls **165** of the housing can be rendered leakproof, and the length of the structure broken up into compartments, so that leakage of liquids or gas can be confined to one compartment.

This compartment can readily be equipped with sensors which instantly notify headquarters of a leak, permitting appropriate action to be taken. Any leakage can then be drained off into tank cars on the duo-rail railroad and taken away, thus preventing danger of fire, and damage to anything on the surface below. A suspended walkway **168** is available for emergency escape from cars or for use in servicing the pipelines above.

Such a system is independent of surface conditions, such as Arctic ice and snow, desert sandstorms, tropical growths, and the like. It interferes not at all with surface traffic and is independent of surface accidents, floods etc.

Suspensions by cables **167** provide resilient support means for the system, absorb train vibration, take up expansion and contraction, and provide shock insulation for the railroad and the pipe lines. By reason of the fact that the columns can be non-rigid, to the extent of giving somewhat under shock, the cables and columns can prevent earth tremors and mild earthquake shocks from reaching the rigid trackways.

What is claimed is:

1. A transportation system comprising:

a network of surface routes;

an overhead rail structure of inverted-U shape forming junctions with said surface routes, said structure having at least one generally horizontal bend and being provided with horizontal bottom flanges on the lower ends of the legs of the inverted U;

a multiplicity of self-propelled vehicles adapted to travel any of said surface routes;

a series of motor-driven vehicle carriers circulating on said structure, each of said carriers being provided with at least one pair of driven traction wheels riding said bottom flanges, the outer leg of said inverted U being formed at said bend with a camming surface, the traction wheels adjoining said outer leg being provided with formations engageable with said camming surface by centrifugal force due to motion of the vehicle through the bend for lifting said adjoining traction wheels off the bottom flange normally supporting same; and

hoist means on said carriers engageable with any of said vehicles for lifting same off a surface route at

one of said junctions and redepositing same on another surface route at another of said junctions.

2. A system as defined in claim **1** wherein each vehicle carrier comprises a train of separately powered motor modules coupled to one another by universal joints.

3. A system as defined in claim **2** wherein each vehicle carrier comprises a single platform substantially coextensive with said train and suspended by said hoist means from all the motor modules thereof.

4. A system as defined in claim **3** wherein said vehicles and the platforms of said carriers are provided with complementary coupling means, further comprising releasable locking means for said coupling means on said platform.

5. A system as defined in claim **1** wherein said structure forms a closed loop with two parallel trackways for circulation in opposite directions.

6. A system as defined in claim **1,** further comprising pairs of transversely spaced columns supporting said overhead rail structure, said surface routes passing between the paired columns at their junctions with said track.

7. A system as defined in claim **1,** further comprising elevated platforms rigid with certain column pairs forming stations for loading and unloading passengers of vehicles suspended from said carriers.

8. In a transportation system including a curved track with a pair of rails and a vehicle having at least one pair of driven traction wheels riding said rails, each of said rails including a wheel-supporting bottom surface, the improvement wherein each rail further includes a substantially vertical web rising from said bottom surface to limit lateral deviations of said vehicle from a predetermined path, said track being provided at each bend with a camming surface disposed on the web of larger radius of curvature, said traction wheels being provided with formations engageable by adjoining camming surfaces upon a centrifugal displacement of the vehicle in a bend for lifting the outer traction wheel in a curve off its bottom surface.

9. The improvement defined in claim **8** wherein said rails are part of a structure of inverted-U shape, the legs of the U forming the webs of said rails and being provided at their lower ends with inwardly directed flanges forming the wheel-supporting bottom surfaces.

10. The improvement defined in claim **9** wherein said traction wheels have tire-carrying bodies with substantially flat outer faces, said formations comprising a set of peripherally spaced balls on said bodies projecting axially from said outer faces.

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