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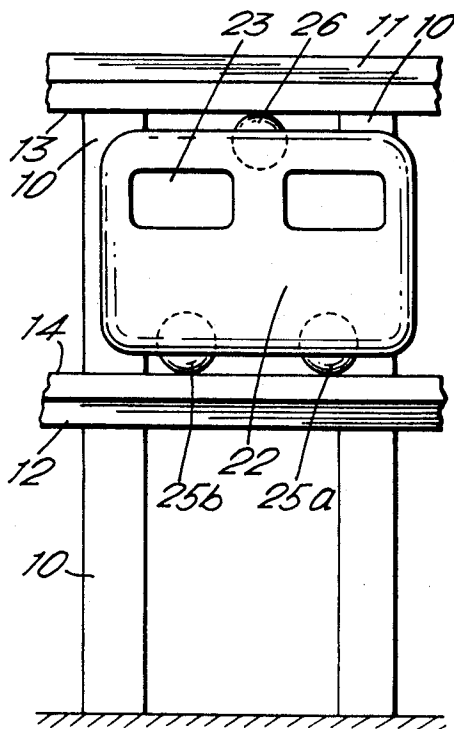
[54] **TRANSPORTATION SYSTEM**
1 Claim, 11 Drawing Figs.

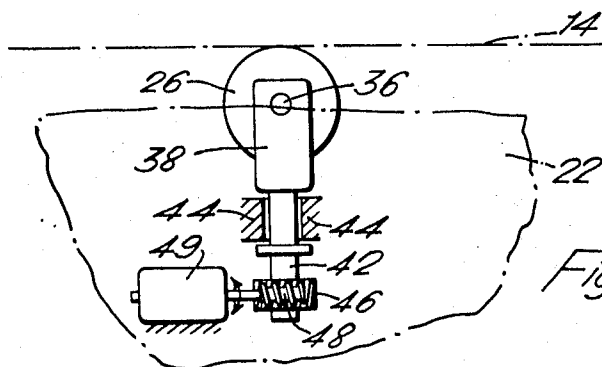
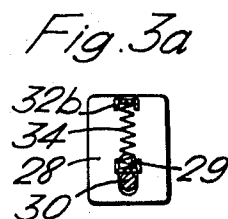
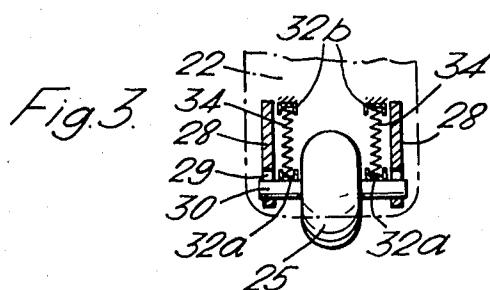
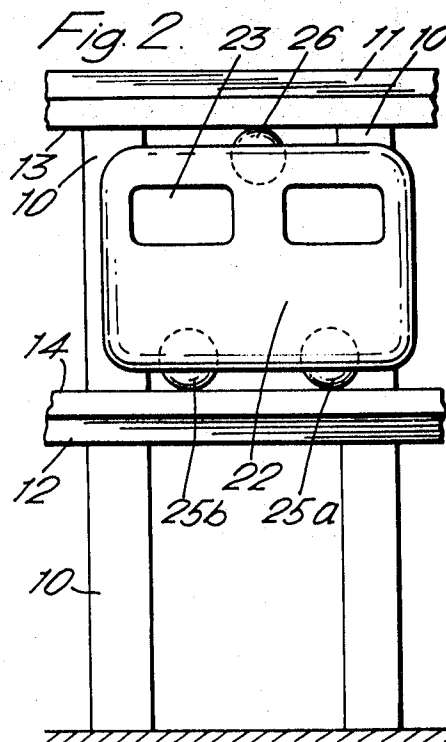
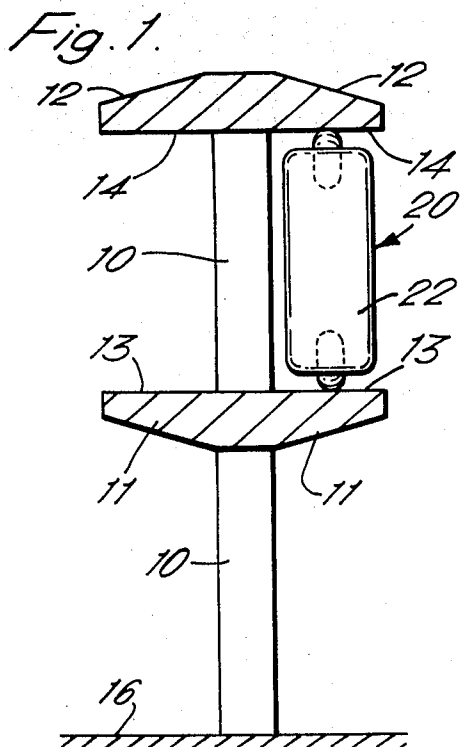
[52] U.S. Cl. **104/121,**
104/245
 [51] Int. Cl. **B61b 5/02,**
E01b 25/08
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121, 244.1, 245, 247; 105/147; 246/415, 415 A;
180/79

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ABSTRACT: A transportation system including vehicles running in a substantially continuous row between two parallel guide surfaces by means of lower and upper wheels engaging said upper and lower guide surface but being freely movable with respect thereto. The lower wheels serve for supporting and steering the vehicles and at least one upper wheel serves for controlling the appropriate inclination of the vehicle with regard to the guide surface. A guide surface may be provided with a guide track separating at bifurcations. A feeler associated with the vehicle engages the guide track, so that the vehicle will follow the one or the other branch of the guide surface at a bifurcation.





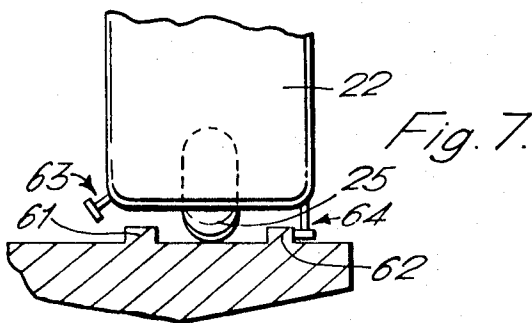
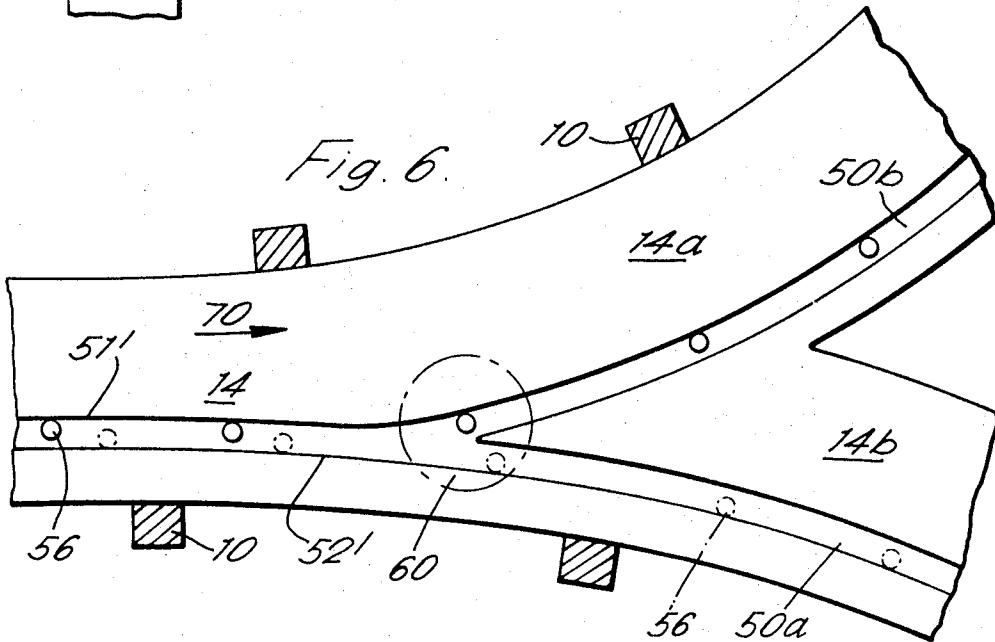
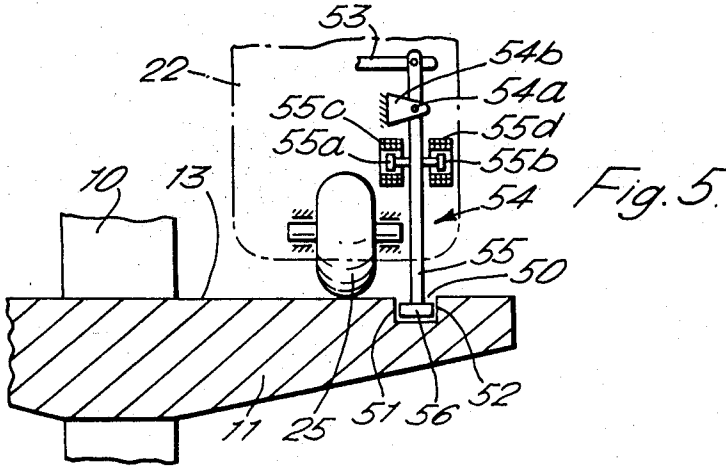
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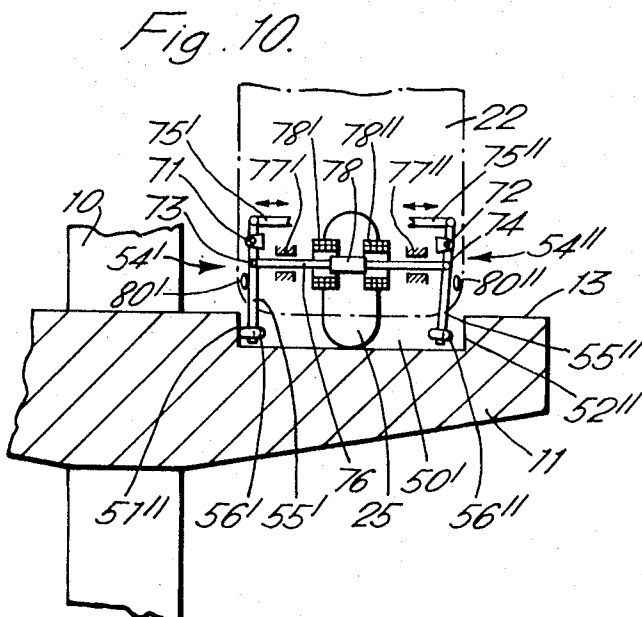
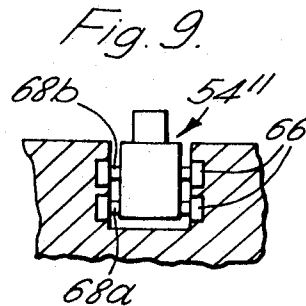
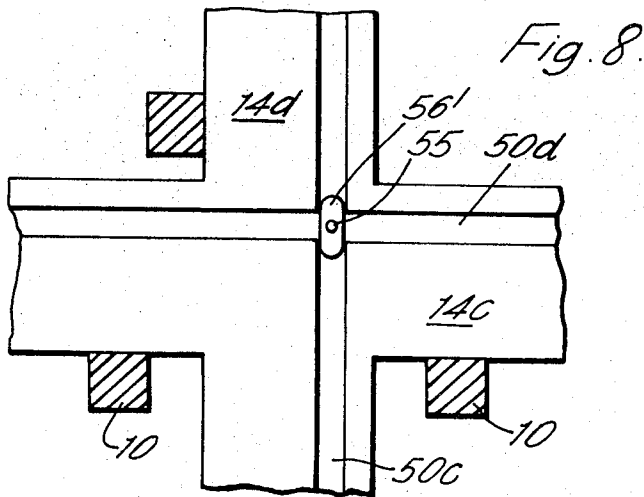
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TRANSPORTATION SYSTEM

This invention relates to transportation systems, in particular to a mass transportation system comprising a plurality of self-driven individual cars capable of following a specific road system independent of the conventional road system in accordance with a predetermined program.

As is generally known, conventional traffic with individual automobiles using the conventional public road system faces increasing problems insofar as the population is continuously growing, more automobiles are owned by more people and more and more use is made of individual automobiles, so that traffic jams, especially during rush hours, in many places, and in particular big cities, are becoming almost a normal situation. As a result, transportation is becoming slower and slower, in spite of the automobiles actually being built increasingly powerful and fast.

Public transportation means such as buses or street cars, for example, basically suffer from the same disadvantage as they, too, have to use the same public conventional road system as individual automobiles, trucks and the like.

With trains, of course, problems of the aforementioned kind are not encountered due to the specific tracks available for the movement of these trains. On the other hand, a passenger using a train is bound to catch that train at a certain time which may not suit him or he may even miss a particular train and then not be able to find another satisfactory connection in lieu thereof. Moreover, normal tracks for trains need comparatively much space and are expensive so that stations for leaving or entering these trains cannot always be located in close enough a distance from the place that the passenger wants to leave or that he wants to go to, respectively.

Due to this situation, new transportation systems are under development using a separate specific road system and a large number of independent individual self-driven cars capable of moving along that specific road system which preferably extends at a different level than the conventional roads do. The road system required therefore does not take up as much space as conventional railroad tracks or the like, and the expenses involved are considerably lower, so that such systems may extend as a comparatively tight network and conveniently may connect a great number of points with each other. Before entering one of these individual cars here in question, the passenger will select his point of destination at a certain station and accordingly will receive a punched card or a similar means by which he may feed the car chosen by him, so that the car is controlled by the program stored in the aforementioned punched card or like means. In accordance with the stored program, the car will run along the specific road system at a substantially constant speed, with the passenger not having to pay any attention to steering problems or to avoiding collisions with other cars as all individual cars are following each other continually in one single row. Only where two branches are merging into each other, special provisions are taken so that the cars running in from the two converging branches will find suitable gaps and will not interfere with each other.

In using such a system, the passenger will enjoy practically all the advantages of a private individual automobile as he will not depend on a certain time but may start his trip any time he wants to do so. On the other hand, he does not have to stay within a train composed of several intercoupled cars, but he may follow exactly the shortest route connecting him with his point of destination, just as this holds true with the conventional road system. Thus, due to the flexibility of the individual cars, no transfer from one train to another is necessary. Beyond that, the transportation system here in question may extend right through business or apartment buildings so that the passenger may leave his means of transportation even closer to his point of destination than this is normally possible when an automobile is used, apart from the problem of parking and so forth.

However, in order to be able to successfully apply such a transportation system in practice, it is one of the conditions, that the specific road system comprised thereby be comparatively inexpensive and especially be as little space consuming as possible.

It is therefore a main object of this invention to provide a transportation system requiring only a comparatively narrow width with the individual cars yet being easily steerable without a rigid rail system as used in conventional train transportation.

It is a further object of this invention to provide a transportation system wherein the direction of movement of the individual cars may be conveniently controlled along a normal section of the specific road system as well as at points where the road system bifurcates, so that switches may be omitted, whereas the proper selection of direction at points of bifurcation is guaranteed in all circumstances.

Accordingly, the invention provides a transportation system comprising a lower and a corresponding upper guide surface extending substantially parallel with respect to each other in spaced apart relationship. The transportation system of this invention further comprises a plurality of individual vehicles each including suitable means for propelling the vehicle. At the lower side of the vehicles, which may be of cabinlike configuration, there are at least two lower wheels mounted that are spaced apart from each other in the direction of movement of the vehicle, and which preferably are located in one common plane. At least one upper wheel is mounted at the upper end of the vehicle and by means of springs or the like the lower and the upper wheels are urged away from each other, so that the vehicle is held in an upright position and prevented from turning over. Due to this solution it is not necessary to prevent the cars from turning over by means of wheels extending next to each other in a direction transverse to the direction of movement of the vehicle and having a comparatively wide distance from each other so to assure the required stability, as this is true with conventional automobiles or railroad cars. Furthermore, there is practically no restriction as to the height of the center of gravity.

As a result, the transportation system of this invention may be of very narrow width and yet offer great comfort and safety.

At least one of the lower wheels will serve for steering purposes, whereas the upper wheel is so mounted and controlled that by proper movement of this wheel about a vertical axis it may keep the vehicle in a proper vertical or inclined position, respectively, depending on whether a straight section or a curve is passed.

Transportation systems including lower wheels as well as upper wheels generally are already known. U.S. Pat. No. 3,238,894 shows such a duo-rail transportation system, for example. However, the means of transportation there is not comprised of individual cars, but is constituted by one single unit receiving a great number of passengers as conventional trains. The vehicles do not engage respective guide surfaces by wheels freely rotatable with respect to the guide surfaces, but are running in recesses that have the function of regular rails. U.S. Pat. No. 1,238,276 discloses an elevated railroad structure, with the passenger cars being guided not only by lower rails but also by upper rails. The upper rails are engaged by wheels in the same manner as the lower rails. The upper wheels in this case merely serve to decrease the likelihood of derailling at high speeds of the train. The upper wheels neither assure the basic stability of the vehicle nor are they freely movable with regard to the rail system so that they do not permit free movement of the vehicle in a direction transverse to the longitudinal direction of the rails.

Further details and advantages of this invention will become apparent from the following description of preferred embodiments of this invention in connection with the accompanying drawings, wherein:

FIG. 1 is a schematic cross-sectional view of a transportation system according to this invention;

FIG. 2 is a partial schematic elevational side view of the transportation system of this invention;

FIG. 3 on an enlarged scale is a partial view of the lower portion of the vehicle according to this invention, showing more structural details;

FIG. 3a shows a further structural detail of FIG. 3;

FIG. 4 on an enlarged scale illustrates structural details of the upper portion of the vehicle used in the transportation system of this invention;

FIG. 5 schematically shows a feeler arrangement for guiding the vehicle, according to a further embodiment of this invention;

FIG. 6 is a partial schematic top view on the specific road system of this invention at a point of bifurcation, substantially corresponding to the embodiment of FIG. 5;

FIG. 7 is a partial end view of a vehicle equipped with feeler means for guiding the vehicle along the specific road system, according to another embodiment of this invention;

FIG. 8 is a schematic top view on an intersection of two branches of the specific road system, each having a guide track in accordance with the embodiment of FIG. 5;

FIG. 9 is a partial cross section through a guide track as used for example in connection with the embodiment of FIG. 5 simultaneously serving for supplying electric energy to the vehicle; and

FIG. 10 is a partial view of the lower portion of a vehicle equipped with feeler means, according to a further modified embodiment of this invention.

Referring now to the drawings, FIG. 1 schematically represents the cross section of the specific road system of this invention and a representative vehicle associated therewith. A lower and an upper pair of brackets 11, 12, respectively, are mounted at opposite sides of an upright 10, which is fastened to the ground 16. The brackets 11, 12, have substantially horizontal lower and upper guide surfaces 13, 14, respectively. Lower bracket 11 preferably extends at a level being sufficiently distant from ground 16, so that conventional vehicles may pass below bracket 11 without any difficulties. The distance between lower surface 13 and upper surface 14 and the width of brackets 11, 12 is chosen such that a vehicle here generally designated 20 may just be received by the U-shaped cross section defined by lower bracket 11, upper bracket 12 and the portion of upright 10 extending therebetween.

The vehicle 20 includes a cabin 22 that may be provided with windows 23 as shown in FIG. 2. At least one front wheel 25a and one rear wheel 25b are mounted to the lower end of vehicle 20. At the top of vehicle 20, and preferably symmetrically between wheels 25a and 25b, there is mounted an upper wheel 26. According to the invention, the vehicle 20 is provided with appropriate spring means so to spread wheels 25 and 26 apart from each other in vertical direction and to press wheels 25, 26 into tight engagement with guide surfaces 13 and 14, respectively.

FIG. 3 schematically illustrates a possible embodiment thereof. As evident, wheel 25 may be provided with two opposite stub shafts protruding through elongated slots 29 provided in lateral plates 28, as apparent from FIG. 3 and FIG. 3a, the plates 28 being fixedly secured to the vehicle 20 in a suitable manner. Lower cup members 32a are connected with stub shafts 30 and upper cup members 32b are fixedly mounted to a suitable frame (not shown) of vehicle 20, so that spring 34 may be received in a pair of corresponding cup members 32a and 32b. Springs 34 then push wheels 25 in a downward direction, with slots 29 assuring proper guidance of wheels 25 during their reciprocal movement in the longitudinal direction of slots 29.

One of the two lower wheels 25a; b is also mounted in such a manner that it may rotate about a vertical axis in order to steer vehicle 20.

Upper wheel 26 is supported in a manner so that it may swing about a vertical axis. Thus, the inclination of the vehicle with regard to the lower guide surface 13 and the upper guide surface 14, respectively, may be controlled and continuously adjusted by rotating wheel 26 about the vertical axis, so that the vehicle will assume a substantially vertical position during normal travel along a straight section of the road system and will assume the proper inclination when passing through a curved section of the road system.

This may be accomplished by mounting wheel 26 by means of a respective stub shaft 36 received in lateral flanges 38 of a forklike support member, which in turn is pivotally mounted in bearings 44 through a stub shaft 42. Due to this arrangement, wheel 26 may freely rotate about the axis of its stub shafts 36 so to follow the movement of vehicle 20, but simultaneously may freely move about the vertical axis of stub shaft 42 thereby controlling the vertical position, i.e., the inclination of vehicle 20.

In order to pivot wheel 26 in connection with stub shafts 42 about an angle so to exert the required action for controlling the inclination of the vehicle, stub shaft 42 may protrude beyond its associated bearing 44 and carry a pinion 46 meshing with a worm gear 48. Thus, by rotating worm gear 48 through a motor 49, the desired angular position of wheel 26 with regard to the direction of movement may be accomplished. The rotational movement of worm gear 48 or the supply of appropriate signals to engine 49, respectively, may be controlled by suitable means responsive to the inclination of vehicle 20, such as a gyroscopic arrangement or by a suitable feeler associated with the vehicle and engaging a guiding surface (not shown) provided at the upper guide surface 14 against which wheel 26 rests. However, as these means are not an actual part of this invention, no further details are given with respect thereto.

Due to this arrangement in accordance with the invention, it is possible to design comparatively narrow cars as no minimum distance of wheels in a direction transverse to the direction of movement of the vehicle is necessary as in conventional vehicles in order to secure the necessary stability.

The control of the direction of the vehicle may be carried out by suitable guide tracks having suitable guiding surfaces and extending along the guide surfaces 13 of the brackets, by electrical conductors or the like, with suitable sensor or special antenna means, respectively, picking up the signals or data supplied by such track or conductors. As illustrated in FIG. 5, two opposite guiding surfaces 51, 52 extend in a direction transverse to the plane of the lower guide surface 13, following the course of the road system. These guiding surfaces constitute the lateral walls of a channellike guide track 50, FIG. 5 showing this track 50 in cross section, whereas FIG. 6 represents a top view thereof. Vehicle 20 is equipped with a feeler generally designated 54 including a vertically extending rod 55 terminating at its lower end in a wiper or roller 56. Rod 55 may be pivotal about a pin 54a fastened to vehicle 20 through wing plates 54b. Rod 55 may have transverse protrusions each terminating in a ferromagnetic core 55a, 55b. Coils of excitation are associated with both cores 55a, b, respectively. By energizing coil 55c, core 55a will be attracted so that wiper or roller 56 will abut against guiding surface 51, whereas with coil 55d being energized and coil 55c being deenergized, core 55b will be attracted, so that wiper or roller 56 will be detached from guiding surface 51 and will abut against guiding surface 52.

In either position, feeler 54 will control the steering wheel 25 through a suitable link rod 53 connected to suitable hydraulic means (not shown), for example, in such a manner that wheel 25 is properly turned and vehicle 20 will follow the desired route. The important aspect of this solution is that it permits to guide the vehicle along a selected route also at bifurcations, as this is illustrated in FIG. 6. In the area designated 60, lower surface 14 separates into a left branch 14a and a right branch 14b and the channellike guide track 50 diverges correspondingly. Therefore, with rod 55 engaging the right lateral guiding surface 52 of FIG. 5, feeler 54 will follow the lower border line 52' in FIG. 6, that is the vehicle (moving in direction of arrow 70) will reach the right branch 14b. If the other position of feeler 54 is selected, with feeler being pushed against guiding surface 51, feeler 54 will follow the upper border line 51' in FIG. 6, so that vehicle 20 will reach the left branch 14a. The decision, whether the feeler 54 should assume the left or the right position is made automatically as a result of the program by which the vehicle was fed at the sta-

tion at which the trip was commenced. As evident, this constitutes a very simple, reliable and inexpensive solution for effecting a switching action at points of bifurcation, with no movable rails or similar portions as in conventional switch arrangements. Moreover, the solution given by the present invention has the additional advantage, that no time is needed to change the position of the switch if a subsequent vehicle is to be guided to another branch than the preceding vehicle.

The width of track 50 may be substantially the same as the width of roller or wiper 56, so that changing the state of energization of the two coils 55c, d actually does not effect the position of feeler 54, but mainly the direction of pressure by means of which roller 56 is urged against one of the lateral guiding surfaces 51, 52 of track 50. However, alternatively track 50 may have a width materially larger than the width of wiper or roller 56, so that member 56 is shifted between two different end positions. In that case, care would be taken that moving feeler 54 from one end position into the other, or vice versa, does not affect the steering wheel 25. In all circumstances, the width of track 50 should be as narrow as possible, if it crosses other routes, so that wheels 25 will not interfere therewith.

The embodiment represented by FIG. 7 is based on the same principle as the embodiment of FIG. 5 (or FIG. 6, respectively). In this case, two guiding rails 61, 62 are provided, and vehicle 20 is equipped with two feelers 63, 64 associated with guiding rails 61, 62, respectively. Thus, if vehicle 20 is to follow the course of the right guiding rail 62, feeler 64 will be actuated so that it comes into contact with the outer vertical surface of rail 62, whereas feeler 63 is pivoted into an outward position in which it is out of engagement with rail 62. If the vehicle 20 is to follow the course of the left rail 61, feeler 64 will be moved outwardly, whereas feeler 63 is lowered and brought into engagement with the outer surface of rail 61.

FIG. 8 shows an intersection of two branches 14c, d of the specific road system each having a channellike guiding track 50 as set forth in connection with FIG. 5. In order to avoid any disturbances at such points of intersection, the wiper 56 at the end of rod 55 of the feeler system may have a comparatively great width in the direction of movement of the vehicle, which width is greater than the width of guiding track 50, so that the feeler 54 may pass the crossing guiding track 50 without being affected thereby.

FIG. 9 demonstrates how the lateral walls of the guiding track 50 simultaneously may be used for receiving a pair of electric live rails 66 supplying electric energy for the vehicle, and correspondingly a feeler 54'' may have two separate bosses 68a and 68b electrically insulated from each other, so that feeler 54'' simultaneously may act as a slidable contact for transmitting the necessary energy to the motor of the vehicle.

FIG. 10 shows another embodiment of a guide track/feeler arrangement. In this case, guide track 50' is considerably wider than guide track 50 of FIG. 5. Guiding surfaces 51', 52' do not both extend at the same side of wheel 25 as in FIG. 5, but are located at opposite sides thereof, so that, at points of bifurcations, wheel 25 does not cross a guide track as this holds true with regard to the embodiment according to FIG. 5. Two different feeler arrangements 54', 54'' are provided for

cooperation with either one of guiding surfaces 51', 52', respectively. Rods 55', 55'' terminating in rollers or wipers 56', 56'', respectively, are pivotally mounted as at 71, 72. A connecting rod 76 is interlinked between rods 55', 55'' through pins 73, 74 and slidably supported in bearings 77', 77''. The center of rod 76 carries a core 78 of ferromagnetic material associated with two relays coils 78', 78''.

Upon energization of relay coil 78', core 78 will be attracted to the left and will turn rod 55' in clockwise direction so that wiper or roller 56' slidably engages guiding surface 51'', whereas wiper or roller 56'' is detached from guiding surface 52''. An abutment member 80' restricts outward movement of rod 55' to the necessary extent. With relay coil 78' becoming deenergized and coil 78'' energized, the opposite movement will occur, the outward movements of rod 55'' then being limited by an abutment member 80''.

At their upper ends, rods 55', 55'' each are linked to control bars 75', 75'' which similarly as linking bar 53 in FIG. 5 affect a suitable hydraulic means (not shown), for example, for turning the steering wheel in accordance with the course of the guiding surfaces 51'' or 52'', respectively. Presuming the situation of FIG. 10, vehicle 20 will follow a branch of the road system including the left guiding surface 51'. If vehicle 20 is to follow the right guiding surface 52', relay coil 78' is deenergized, whereas relay coil 78'' is energized. Thus, core 78 will move to the right, roller 56' will disengage from wall 51' and roller 56'' will engage guiding surface 52' instead.

It will be understood, that various modifications of the embodiments described herein will be possible without departing from the spirit of this invention. Thus, for instance, guide track 50 may be provided in the upper guide surface 14 rather than in lower guide surface 13. Likewise, the solenoids employed in the embodiments of FIG. 5 or 10, may be replaced by hydraulic pistons, for example.

What I claim is:

1. A transportation system comprising a lower and an upper guide surface extending substantially parallel with respect to each other in spaced apart relationship and forming a specific road system independent of the conventional road system, and a plurality of individual vehicles including means for propelling each said vehicle, each vehicle having only two lower wheels spaced apart from each other in the direction of movement of the vehicle, and one upper wheel, said lower wheels engaging said lower guide surface in a substantially freely movable manner and said upper wheel engaging said upper guide surface in a substantially freely movable manner, means for urging said lower wheels and said upper wheel away from each other and towards said upper and lower surface, respectively, to an extent so that said vehicle is prevented from turning over, means for rotating one of said lower wheels about an axis extending in a direction substantially perpendicular to said lower surface for steering the vehicle, means for pivoting said upper wheel about an axis extending in a direction substantially perpendicular to said upper guide surface in response to the inclination of the vehicle with regard to said lower and said upper surface, respectively, so that the appropriate position of said vehicle with regard to said guide surface is continuously maintained.

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