

[54] **SWITCHING SYSTEM**
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[51] Int. Cl. **E01b 25/06**

[58] Field of Search 104/130, 118-119, 104/100, 96, 131; 246/419

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[57] **ABSTRACT**

A displaceable rail section, normally forming a part of a transportation system's main rail, is bodily movable out of alignment with the main rail to effect a transfer of a vehicle from the main rail to branch rails deviating from the path of the main rail.

10 Claims, 8 Drawing Figures

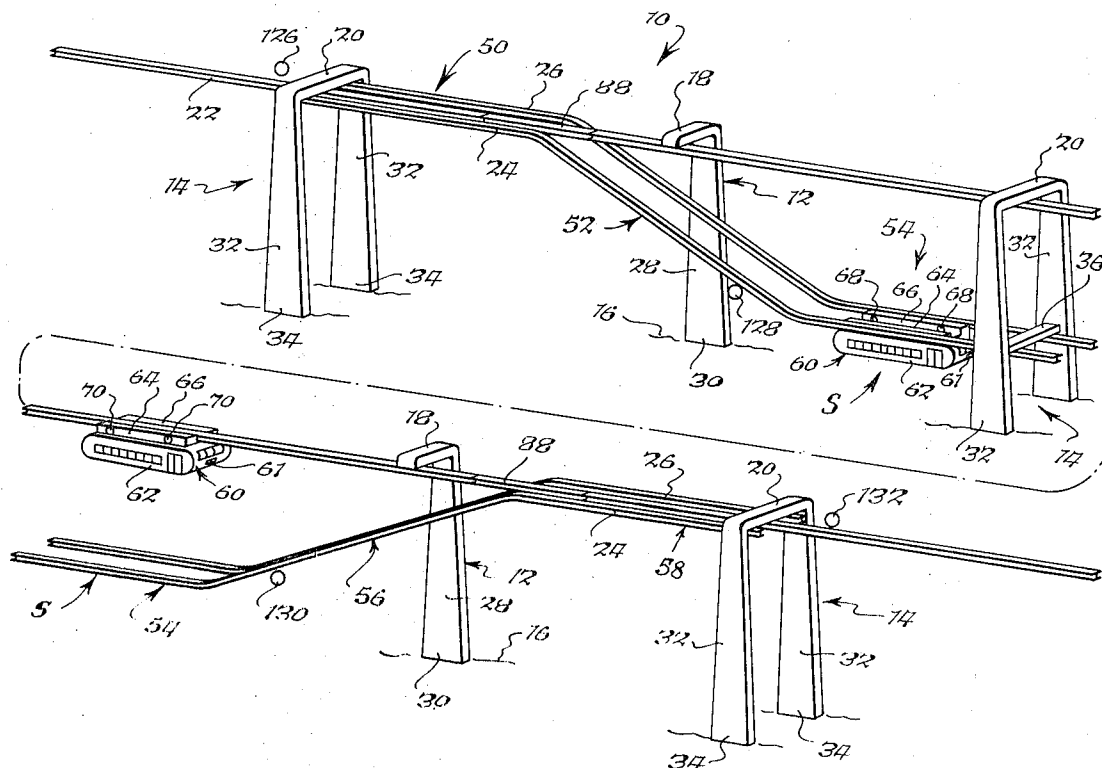
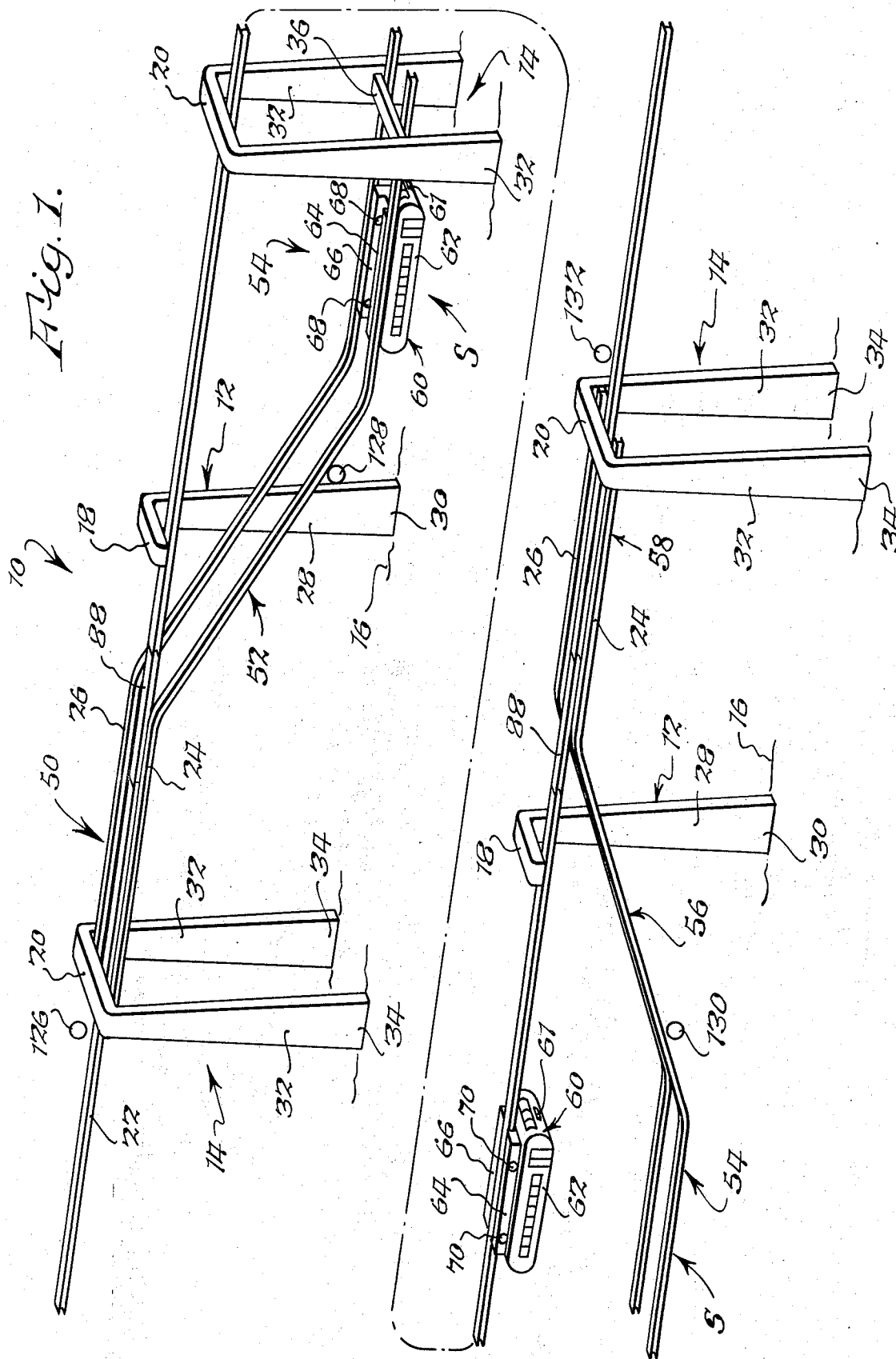
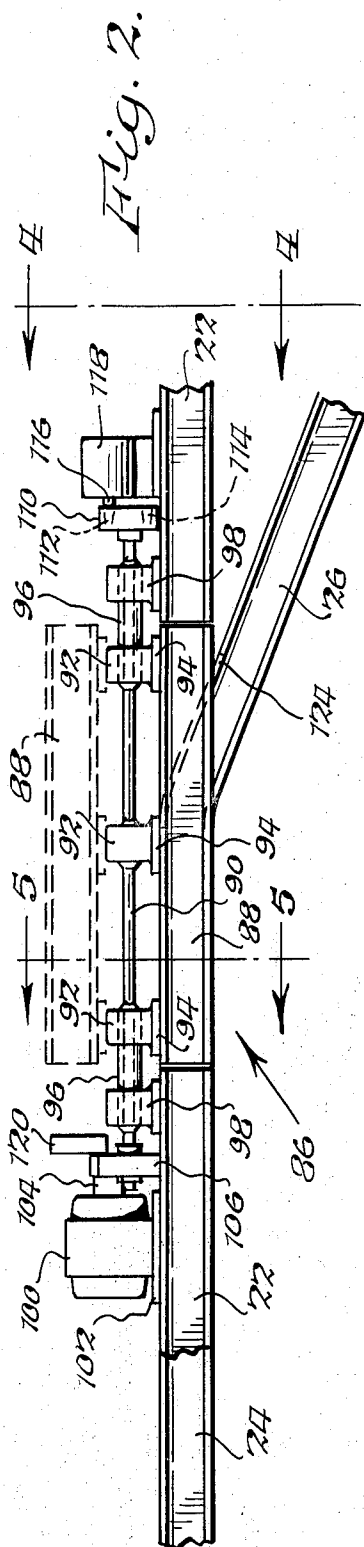
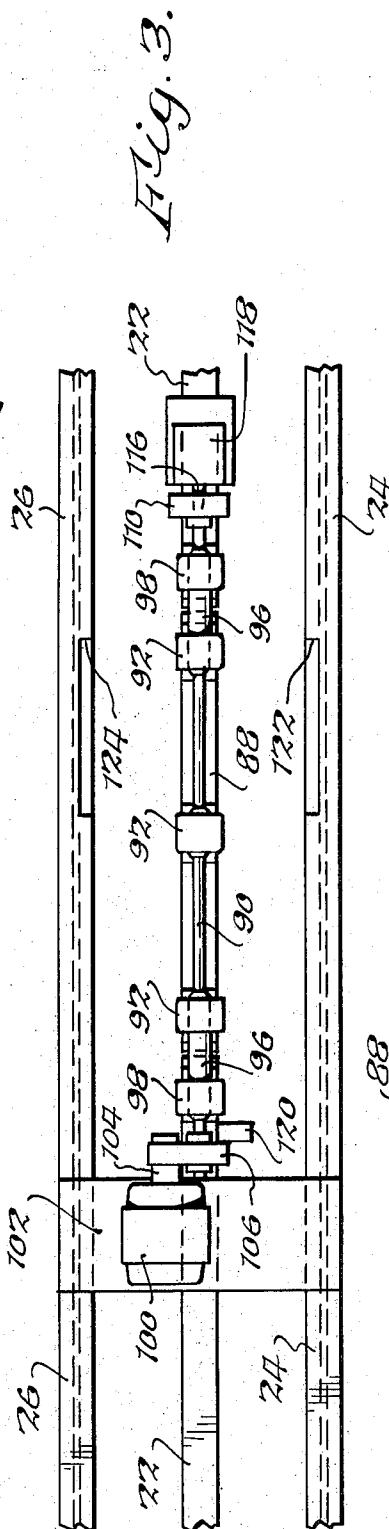
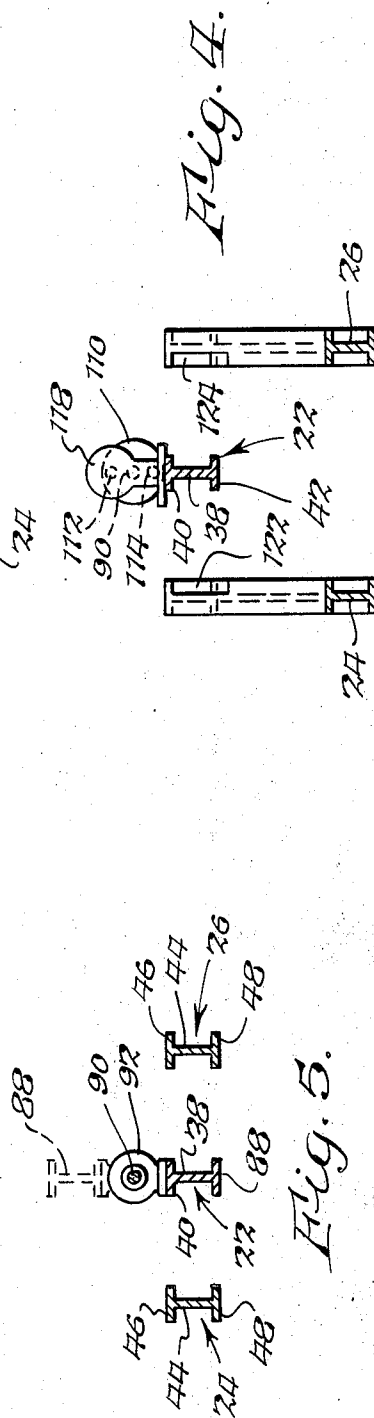


Fig. 1.





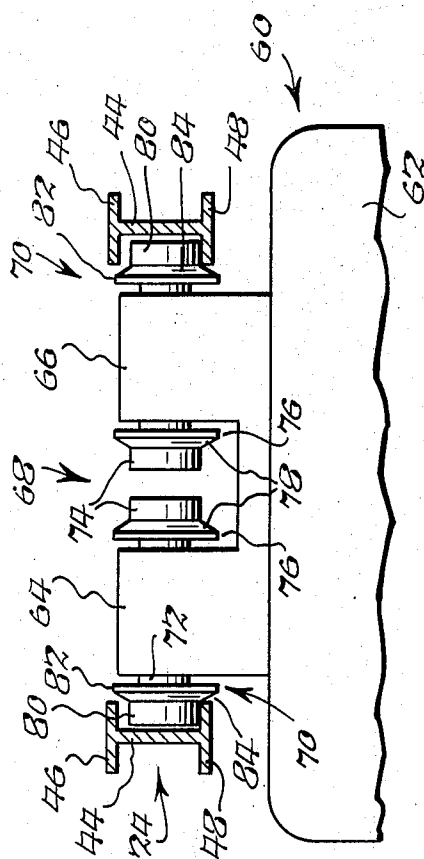


Fig. 6.

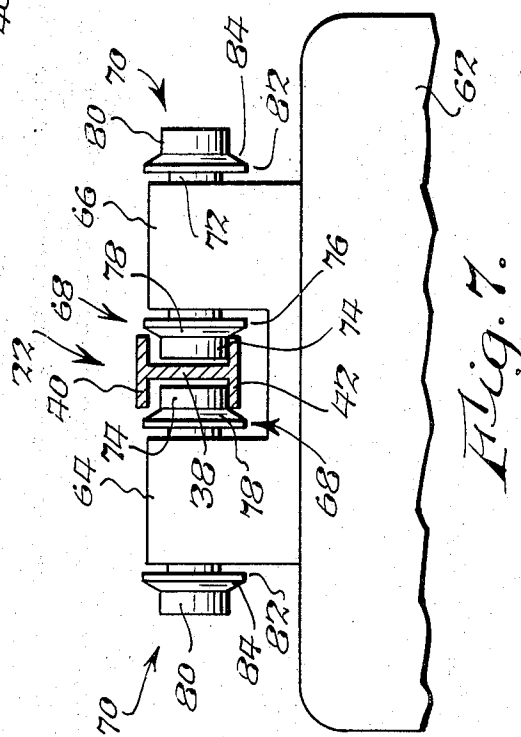


Fig. 7.

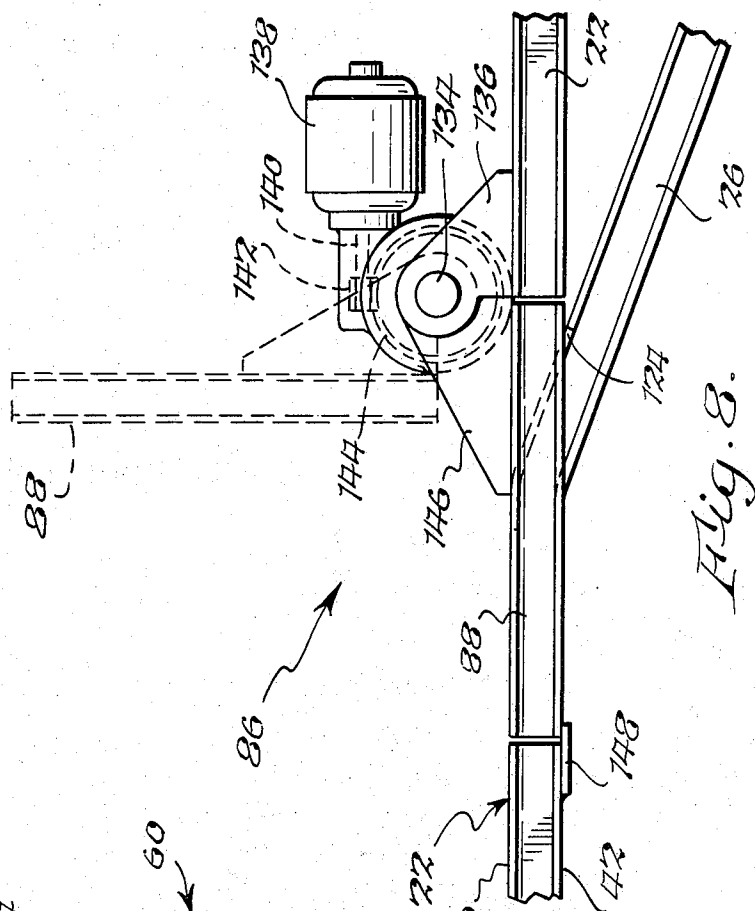


Fig. 8.

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SWITCHING SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to a mass transit transportation system and, more particularly, to a switching arrangement incorporated in such a transportation system.

Of great concern today is the problem of moving or conveying large masses of people cheaply and efficiently, especially to and from and within metropolitan areas, without consequent traffic congestion and pollution. Many attempts have been made to provide a solution to this problem and, although some of these proposals represent technological advances in the rapid transit or conveyance of large masses of people, they have generally been unsuccessful because of the relatively high costs involved and their inefficiency in servicing the general public. While the most promising of the known proposed systems are the monorail systems in which multipassenger vehicles are supported on or suspended from overhead monorail structures, they possess certain disadvantages, especially in the switching of vehicles from one track to another, such as occurs when the vehicles are diverted to loading stations for passenger embarkation and debarkation. Many of these known switching arrangements utilize dual track engaging wheels which are alternately bodily movable into and out of engagement with alternate sets of tracks. Such arrangements require complex gear drives and gear reduction systems including clutching devices, or fluid motors and actuators and the like in each vehicle for bodily moving the wheels. Not only do these wheel engaging and disengaging mechanisms add materially to the initial cost of the vehicles and the overall transportation system, but the moving parts forming such mechanisms are vulnerable to wear and damage, resulting in costly repair, servicing and vehicle down time.

SUMMARY OF THE INVENTION

It is an object of the present invention to obviate the above disadvantages by providing an improved monorail vehicle switching arrangement for bodily displacing main rail sections to effect switching of vehicles.

It is another object of this invention to provide an improved vehicle switching arrangement in a transportation system, which is simple in construction, rugged and durable in use, relatively low in costs, and which possesses the requisite strength and stability.

In one aspect thereof, the monorail switching system of the present invention is characterized by the provision of a displaceable rail section normally forming part of the main track or rail but which is bodily movable out of alignment with such main rail to cause a vehicle to be diverted in a path deviating from the path of the main rail.

The foregoing and other objects, advantages and characterizing features of the present invention will become clearly apparent from the ensuing detailed description of an illustrative embodiment thereof, taken together with the accompanying drawings wherein like reference characters denote like parts throughout the various views.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic perspective view of a portion of a monorail transportation system, including a branch system leading to a loading station;

FIG. 2 is a side elevational view of a rail system, broken away to indicate an indeterminate length, showing the switching arrangement of this invention;

FIG. 3 is a fragmentary top plan view of the switching arrangement of FIG. 2;

FIG. 4 is an end view, partially in section, looking in the direction of arrows 4—4 of FIG. 3;

FIG. 5 is a transverse sectional view, taken about on line 5—5 of FIG. 2;

FIG. 6 is a fragmentary and elevational view of a vehicle, illustrating the outer set of drive wheels thereof in engagement with an outer pair of rails shown in cross section;

FIG. 7 is a view similar to FIG. 6, but showing the inner set of drive wheels in engagement with an inner rail shown in cross section; and

FIG. 8 is a fragmentary side elevational view of a monorail transportation system, showing another form of switching arrangement of this invention.

DETAILED DESCRIPTION OF AN ILLUSTRATIVE EMBODIMENT

Referring now in detail to the illustrative embodiment depicted in the drawings, there is shown in FIG. 1 a portion of a monorail type transportation system 10 including a plurality of support structures 12 and 14 which are securely anchored at their lower ends to a supporting medium, such as sidewalk 16, or some other anchor firmly embedded in the ground surface. These support structures 12 and 14 are provided with transversely extending support beams 18 and 20 for supporting a main rail 22 and at certain locations, a pair of laterally spaced secondary or branch rails 24 and 26 leading to loading platforms or stations S for passenger loading and unloading.

The main rail 22 is located above the street level or ground surface a sufficient distance to clear any surface traffic and appurtenances. Also, main rail 22 is disposed in a generally horizontal plane and normally follows a linear path except at certain curves to form a closed loop arrangement, it being understood that only a portion of the system is shown in FIG. 1. Of course, rail 22 may follow any desired path as desired or required in accordance with a wide variety of geographic patterns. A series of stations S are provided along the path of main rail 22, the number of and spacing between stations S being dictated by the passenger traffic requirements of a specific application.

Support structure 12 comprises an upstanding support column 28 progressively increasing in width downwardly toward its base 30, which is firmly anchored or otherwise fixedly secured to sidewalk 16 or some other supporting medium. The upper end of column 28 supports one end of the transversely extending cantilevered beam 18 to which is welded or otherwise fixedly secured the upper end of a portion of main rail 22. These support structures are spaced longitudinally along the length of rail 22 for supporting the same.

Support structure 14 comprises a pair of laterally spaced columns 32, each progressively increasing in width downwardly toward its respective base 34, which is rigidly secured to sidewalk 16 or some other support-

ing medium. Transversely extending beam 20 is formed integral with or otherwise fixedly secured at its opposite ends to the upper ends of columns 32. As shown in FIG. 1, beams 20 of the two outermost support structures 14 support main rail 22 and the opposite end portions of branch rails 24 and 26 while beam 20 of the intermediate support structure 14 only supports main rail 22. However, the intermediate support structure 14 is provided with a lower cross beam 36 spanning the columns 32 and adapted to support the intermediate section of branch rails 24 and 26 adjacent loading station S. Normally three such support structures 14 are provided at each station S.

Main rail 22 comprises a continuous structural I-beam member (FIGS. 4, 5 and 7) of indefinite length having a vertical web 38, an upper flange 40 and a lower flange 42. Main rail 22 is formed of a multiplicity of I-beams joined to each other in an end-to-end relation in a manner well known in the art. Branch rails 24 and 26 also are formed of a series of I-beams joined to each other in an end-to-end relation and each includes a vertical web 44, an upper flange 46 and a lower flange 48. Each of the rails 22, 24 and 26 carry suitable bus bars or conductors (not shown) for supplying electrical power to the passenger cars or vehicles, hereinafter described.

Branch rails 24 and 26 are disposed on opposite sides of main rail 22 and constitute a branch track system for diverting vehicles from the elevated main rail 22 into and out of a loading station S disposed in generally the same vertical plane as main rail 22, but at a lower level and conveniently located at substantially the street or ground level for ease of passenger embarkation and debarkation. It should be noted that branch rails 24 and 26 do not deviate laterally from the path of travel of main rail 22. Instead, they deviate in a different vertical level in a manner conserving space and reducing right of way costs. This branch track system extends between the two outer support structures 14 as shown in FIG. 1 and includes a first generally horizontally extending section 50 in substantial horizontal alignment with main rail 22, a downwardly inclined entrance section 52 which initially descends gradually from the straight section 50 and then descends more sharply, an intermediate horizontal section 54 connecting the entrance section 52 to an upwardly inclined exit section 56 which rises relatively sharply from horizontal section 54 and then curves forwardly to rise very gradually until it reaches the level of main rail 22 and merges into a generally horizontally extending final section 58, which is in substantial horizontal alignment with main rail 22.

A plurality of cars or vehicles 60 are supported and guided by automatically controlled means along main rail 22 and selectively switched to branch rails 24 and 26 of the various stations S upon demand. Each vehicle 60 comprises a generally rectangularly shaped capsule or body 62 of any desired size, it being contemplated that each vehicle 60 be relatively small having a capacity of from ten to fourteen passengers. A pair of elongated, parallel, laterally spaced housings 64 and 66 are mounted on top of vehicle 60 and extend substantially lengthwise thereof. Each vehicle 60 is provided with an inner set of driving wheels or rollers 68 (FIGS. 6 and 7) engagable with main rail 22 and an set of driving wheels or rollers 70. Each pair of laterally spaced inner and outer wheels 68, 70 are mounted on a common

shaft 72 extending through housings 64 and 66. Two pair of longitudinally spaced shafts 72 are mounted in each housing 64, 66 adjacent the opposite ends thereof. Thus, four inner wheels 68 and four outer wheels 70 are provided on each vehicle 60 of the illustrated embodiment; however, any number of inner and outer wheels can be employed, as desired or required by the size of the specific vehicle 60. Each of the inner driving wheels 68 comprises a circular rail engaging portion 74 and a peripheral rim 76 joined to portion 74 by a beveled shoulder 78. In a similar construction, each of the outer driving wheels 70 comprises a circular rail engaging portion 80 and a peripheral rim 82 joined to portion 80 by a beveled shoulder 84. Each of the driving wheels comprises a wheel similar in design to the type used on trains, that is, utilizing a beveled shoulder 78 or 84.

Shafts 72 are operatively connected for rotation through suitable gear reduction mechanisms to electric motors (not shown) mounted within housings 64 and 66. The motors may be energized from bus or conductor bars (also not shown) carried in insulated relation along rails 22, 24 and 26. Since the means for driving shafts 72, including the electric control circuitry therefor, is conventional and forms no part of the present invention per se, it is believed that no further amplification or description thereof is necessary. It should also be noted that the transportation system is entirely automatic and requires no vehicle operators. In effecting automatic operation, means are provided to control vehicle departure, automatic acceleration, speed, preselection of destination, automatic deceleration, stopping, as well as fail-safe and emergency controls to preclude vehicle collisions and to ensure passenger comfort and safety under all conditions. For example, each vehicle 60 can be provided with a console having a series of buttons numbered for the respective stations S. Each passenger entering vehicle 60 depresses the corresponding button for his desired station and the vehicle 60 will stop at all stations S which have been preselected on the push button console. Also a call or demand signal can be provided at each station S for actuation by a passenger desiring to use the transportation system to bring the next available vehicle 60 down to such station. In addition, a sensor 61 can be mounted on the front of each vehicle 60 to maintain a proper distance between adjacent vehicles traveling along the transportation system 10. Such control means are conventional and need not be described in further detail, except for those electrical switches, hereinafter described, used in conjunction with the vehicle switching operation.

In accordance with this invention, a switching means, generally designated 86 (FIGS. 2 and 3), is provided for effecting transfer of vehicles 60 from main rail 22 to branch rails 24 and 26 and vice versa. Switching means 86 comprises a displaceable rail section 88 normally disposed in the path of main rail 22 in longitudinal alignment therewith as shown in FIG. 1 and having a cross sectional configuration identical to main rail 22. Rail section 88 forms a part of main rail 22, but is bodily movable out of registry with rail 22 to provide an interruption therein for a purpose that will presently appear. Such switching means 86, including rail sections 88, are provided adjacent the entrance section 52 leading to station S and the exit section 56 leading away from station S. Of course, both switching means 86 are identical in construction and operative in the same

manner and it is believed that a detailed description of only one will suffice.

As best shown in FIG. 2, wherein branch rail 24 is broken away for clarity, rail section 88 is suspended from a rotatable shaft 90 by means of a plurality of support blocks 92 rigidly secured to shaft 90. Blocks 92 are provided with integral base portions 94 rigidly secured to the upper flange of rail section 88. The outer opposite ends of shaft 90 are suitably journaled in bearings 96 each mounted in an outer block 92 and a bearing block 98 rigidly secured to upper flange 40 of main rail 22 adjacent the interrupted ends thereof.

Means are provided for rotating shaft 90 to displace rail section 88 out of registry with main rail 22, such means comprising a brake motor 100 mounted on a support plate 102 extending across main rail 22 and between branch rails 24 and 26. Motor 100 is provided with an output shaft 104 operatively connected through a gear reduction mechanism 106 to shaft 90. Energization of motor 100 effects rotation of shaft 90 to bodily move rail section 88 about a horizontal pivot axis parallel thereto and defined by shaft 90. Shaft 90 is rotated in one direction only to first move rail section 88 into its inoperative position shown in phantom in FIG. 2 wherein it is displaced 180° from the operative position, and then rotated another 180° in the same direction to return rail section 88 to its operative position in registry with main rail 22. Of course, motor 100 can be operated in a manner to rotate shaft 90 in opposite directions, if desired, to move rail section 88 between its operative and inoperative positions.

Means are provided for locking shaft 90 and thereby rail section 88 in both the operative and inoperative positions of the latter. To this end, a disc 110 is affixed to the end of shaft 90 remote from motor 100. Disc 110 is provided with diametrically opposed openings 112 and 114 corresponding to the operative and inoperative positions of rail section 88. A spring loaded plunger 116 mounted in a solenoid 118 secured to main rail 22 is adapted to be alternately received in openings 112 and 114 to lock shaft 90 and thereby rail section 88 in either its operative or inoperative positions. Energization of solenoid 118 is effective to withdraw plunger 116 from either opening 112 or 114 to permit rotation of shaft 90. Solenoid 118 is energized through an electric circuit (not shown), including a switch 120, which when closed, completes the circuit to solenoid 118.

Portions of the upper flanges of branch rails 24 and 26 adjacent rail section 88 are cut away, as indicated at 122 and 124 in FIGS. 2 and 3 adjacent entrance and exit sections 52 and 56 to prevent interference of such flanges with the outer set of wheels 70 of vehicle 60 to enable the latter to move linearly on main rail 22 to bypass station S.

The mode of operation is as follows:

Assuming that there are no vehicles 60 at station S, a passenger desiring to use the transportation system 10 will actuate a call button located at station S. This transmits a signal to the first approaching vehicle 60 on main rail 22 and, assuming that it has the capacity for receiving more passengers, or if filled to capacity but is destined to discharge passengers at station S, the control system incorporated in vehicle 60 will be conditioned to close a switch 126 (FIG. 1) located on or adjacent to main rail 22 slightly upstream of station S. The closing of switch 126 is effective to actuate switch 120 to energize solenoid 118 and withdraw plunger 116

from opening 112 of disc 110 to free shaft 90 for rotation. The closing of switch 126 also completes a circuit to energize motor 100 to rotate shaft 90 and swing rail section 88 180° into its inoperative position shown in phantom in FIG. 2. The distal end of plunger 116 rides on and bears against the face of disc 110 under the influence of the spring bias as disc 110 rotates along with shaft 90. When plunger 116 is aligned with opening 114, it will be urged therein to lock shaft 90 and thereby rail section 88 in its inoperative position. Switch 126 can be of the type having a timer therein designed to open when motor 100 has rotated shaft 90 180°.

The leading ends of the lower flanges 48 of branch rails 24 and 26 can be slightly tapered longitudinally a short distance toward such ends to insure smooth engagement of the outer drive wheels 70 of vehicle 60 with rails 24 and 26 as wheels 70 approach and contact the same. As vehicle 60 advances on section 50, the inner and outer set of drive wheels 68 and 70 are in engagement with main rail 22 and branch rails 24 and 26. However, since rail section 88 has been displaced, the inner set of drive wheels 68 will ride off the interrupted end of main rail 22 while the outer set of drive wheels 70 remain in engagement with branch rails 24 and 26 to follow the same, diverting vehicle 60 onto the downwardly inclined station entrance section 52.

As vehicle 60 descends along station entrance section 52, it engages and actuates a switch 128 mounted on or adjacent branch rail 24 to actuate switch 120 for energizing solenoid 118 to withdraw plunger 116 from opening 114 of disc 110. Also, the actuation of switch 128 completes a circuit to energize motor 100 for rotating shaft 180° to swing rail section 88 180° into its operative position shown in full lines in FIG. 2. Plunger 116 is urged into opening 112 under the influence of the spring bias to lock shaft 90 and thereby rail section 88 in its operative position in registry with main rail 22. After motor 100 has rotated shaft 90 180°, switch 128 times out to interrupt the circuit to motor 100.

Switch 126, which initiates operation of switching means 86 to raise rail section 88, also is effective to reduce power in progressively graduated increments to vehicle 60 to gradually reduce the speed thereof as vehicle 60 approaches station entrance section 52. The power to vehicle 60 continues to be reduced until vehicle 60 is gradually brought to a stop at station S, as shown in FIG. 1, for the unloading and loading of passengers. Any suitable means can be incorporated in the control system of vehicle 60 to prevent movement of the latter until the passengers have departed or boarded. The last passenger entering vehicle 60 closes the door which initiates movement thereof to advance vehicle 60 along branch sections 54 and 56.

As vehicle 60 rises on station exit section 56, it engages and actuates a switch 130 mounted on or adjacent to branch rail 24 to actuate switch 120 and energize motor 100 of the exit switching means 86 adjacent station exit section 56 for swinging the respective rail section 88 out of the way enabling vehicle 60 to be advanced along branch rail section 58 and guided onto main rail 22. As vehicle 60 advances on branch rail section 58, the inner set of drive wheels 68 are directed onto and engage main rail 22 so that both the inner and outer sets of drive wheels are at least temporarily in engagement with their respective rails. As vehicle 60 advances further, the outer set of drive wheels 70 ride off

the ends of branch rails 24 and 26 while the inner set of drive wheels 68 remain engaged with main rail 22 to follow the same, directing vehicle 60 forwardly along the path of the transportation system 10. As vehicle 60 leaves branch rail section 58, it engages a switch 132 to actuate switch 120 and energize motor 100 to return the exit rail section 88 to its original, operative position in axial alignment with main rail 22. When a vehicle 60 upstream of station S and travelling straight through on main rail 22 is within a predetermined distance of station S, an automatic interlock is activated to preclude operation of the exit switching means 86 and the advancement of any vehicle 60 on or about to be moved along exit branch section 56 until the former vehicle 60 passes safely beyond switching means 86. This prevents derailling and/or a collision with a vehicle 60 leaving station S.

FIG. 8 illustrates another form of a switching means, generally designated 86', in which rail section 88 is pivoted about a horizontal axis extending normal to the plane of main rail 22. A rotatable shaft 134, defining the pivot axis, is suitably journaled in a bearing bracket 136 secured to main rail 22 adjacent the interrupted end thereof. Shaft 134 is rotated by a motor 138 having an output shaft 140 provided with a worm 142 meshing with a worm wheel 144 rigidly secured to shaft 134. Also secured to shaft 134 is a mounting bracket 146 welded or otherwise fixedly secured to rail section 88. Thus, rotation of shaft 134 in one direction by motor 138 through worm 142 and worm wheel 144 effects pivoting of bracket 146 and displacement of rail section 88 out of registry with main rail 22 to provide an interruption in the latter. Reverse rotation of shaft 134 returns rail section 88 from its inoperative position shown in phantom in FIG. 8 to its operative position in axial alignment with main rail 22. A plate 148, secured to the lower flange 42 of the other interrupted end of main rail 22, projects axially outwardly therefrom and serves as a stop for bottoming the free end of rail section 88 in its operative position. A suitable locking mechanism may be incorporated in switching means 86' to lock rail section 88 in both its operative and inoperative positions. The means for activating motor 138 and the locking means can be similar to that described in connection with the first form of the invention, such means including switches 126, 128, 130 and 132. This form of the invention is operative in the same manner as that described in connection with switching means 86 to bodily displace rail section 88 out of registry with main rail to effect switching of vehicles 60.

While the principles of this invention have conveniently been described in connection with a transportation system incorporating cars or vehicles 60 for the conveyance of passengers, it should be understood that vehicles 60 are representative of any form of movable bodies such as housings or carriages for conveying packages or articles and the like and that the system may be incorporated in warehouses, factories, assembly plants and any other industrial or commercial applications, as desired. Of course, such carriages or vehicles and the system itself would be designed on a much smaller scale than the passenger transportation system herein described.

From the foregoing, it is apparent that the objects of the present invention have been fully accomplished. An improved switching system is provided for displacing a portion of the main rail to divert vehicles along paths

deviating from the main rail path but disposed in substantially the same vertical plane to conserve space.

Preferred embodiments of this invention having been described in detail, it is to be understood that this has been done by way of illustration only.

I claim:

1. A switching system for a transportation system comprising: a main rail extending in an elongated path; branch rail means having opposite end portions in alignment with said path and an intermediate portion deviating from said path; a movable body supported on said main rail and selectively on said branch rail means and having an inner and an outer set of wheels adapted to engage said main rail and said branch rail means, respectively; said main rail having at least one displaceable section normally disposed in axial alignment with said main rail; and means for moving said rail section out of the path of said main rail to form an interruption in the latter whereby said inner set of wheels are disengaged from said main rail during advancement of said vehicle and said outer set of wheels are engaged with said branch rail means to follow said deviating path portion.

2. A switching system according to claim 1 wherein said intermediate portion of said branch rail means is disposed at a level below said main rail in a substantially common vertical plane therewith.

3. A switching system according to claim 2 wherein said intermediate portion comprises a downwardly inclined section, an upwardly inclined section, and an intermediate horizontal section in substantial parallelism with said main rail and connecting the opposed ends of said downwardly inclined section and said upwardly inclined section.

4. A switching system according to claim 1 wherein said rail section moving means comprises a shaft extending parallel to said main rail and in spaced relation thereto; means on said main rail for supporting the opposite ends of said shaft; means fixed to shaft for supporting said rail section; and means for rotating said shaft to displace said rail section out of alignment with said main rail.

5. A switching system according to claim 4 wherein said rail section is displaced 180° out of alignment with said main rail into an inoperative position.

6. A switching system according to claim 1 including means for locking said shaft at 0° and 180° of rotation to secure said rail section in an operative position in alignment with said main rail and an inoperative position out of alignment with said main rail respectively.

7. A switching system according to claim 6 wherein said locking means comprises a disc mounted at one end of said shaft and provided with diametrically opposed openings for receiving a biased plunger mounted on a solenoid, said solenoid being operative to withdraw said plunger from said openings to free said shaft for rotation.

8. A switching system according to claim 1 wherein said rail section moving means comprises a shaft extending in a direction normal to said main rail in spaced relation thereto; means on said main rail for supporting said shaft; means fixed to said shaft for supporting one end of said rail section; and means for rotating said shaft to swing said rail section out of alignment with said main rail.

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9. A switching system according to claim 1 in combination with a transportation system including a plurality of loading stations; said opposite end portions of said branch rail means defining entrance and exit zones leading to and away from each loading station; said main rail being provided with a pair of longitudinally spaced displaceable rail sections at each station and located adjacent said entrance and exit zones, and means for moving said rail sections out of the path of said main rail to form spaced interruptions in the latter adjacent said entrance and exit zones whereby said inner set of wheels are disengaged from said main rail during advancement of said vehicle through said entrance

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zone and reengaged with said main rail during advancement of said vehicle through said exit zone while said outer set of wheels remain engaged with said branch rail means to follow said deviating path portion into and out of said station.

10. The combination of claim 9 wherein said branch rail means comprise a pair of rails disposed on opposite sides of said main rail at said entrance and exit zones and having an intermediate portion following said deviating path portion to temporarily reroute vehicles away from said elongated path.

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