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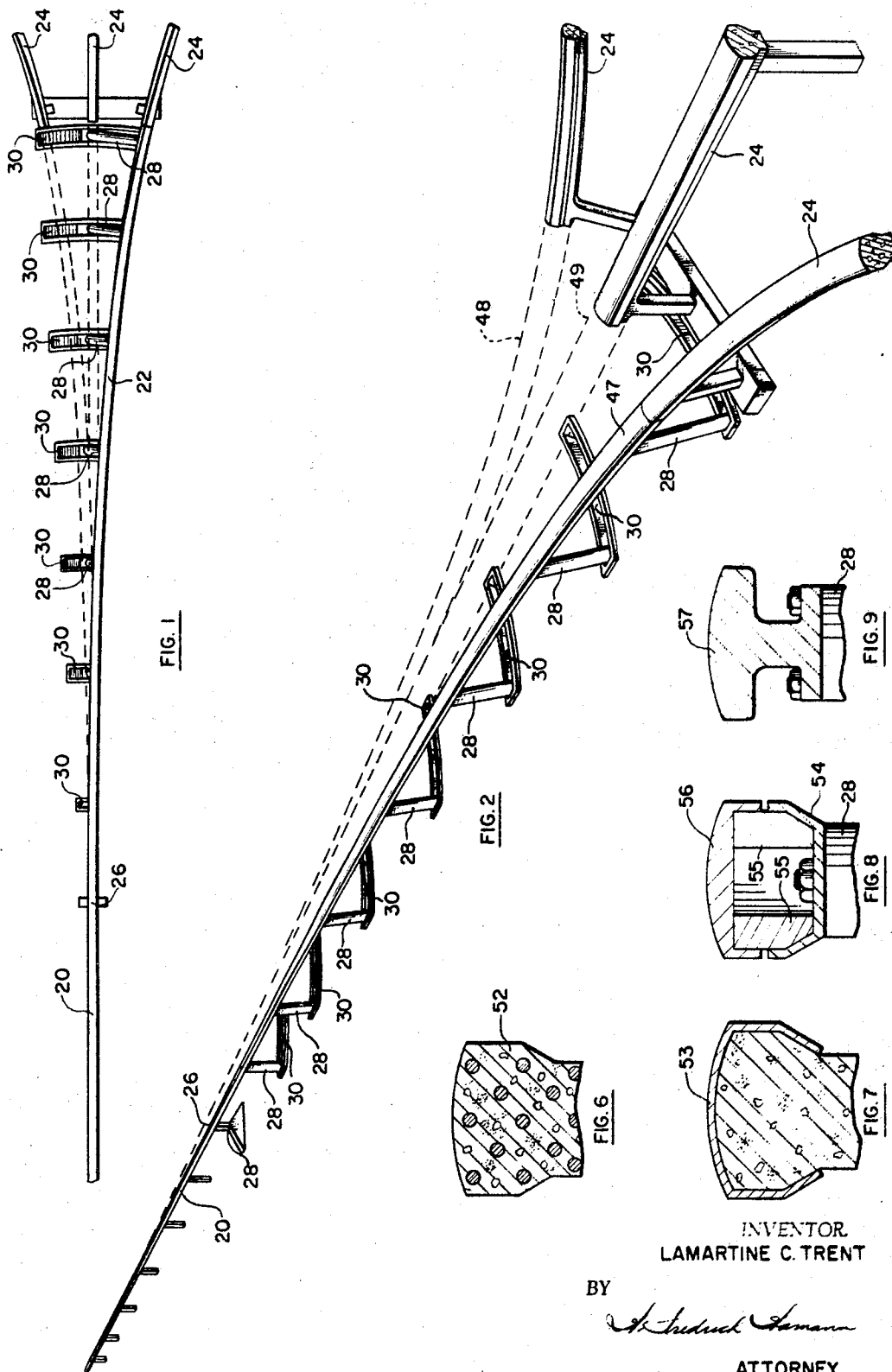
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3,472,176

DEFLECTING BEAM MONORAIL SWITCH

Filed Dec. 23, 1966

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

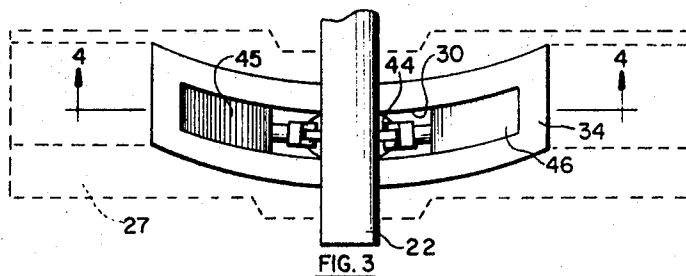


FIG. 3

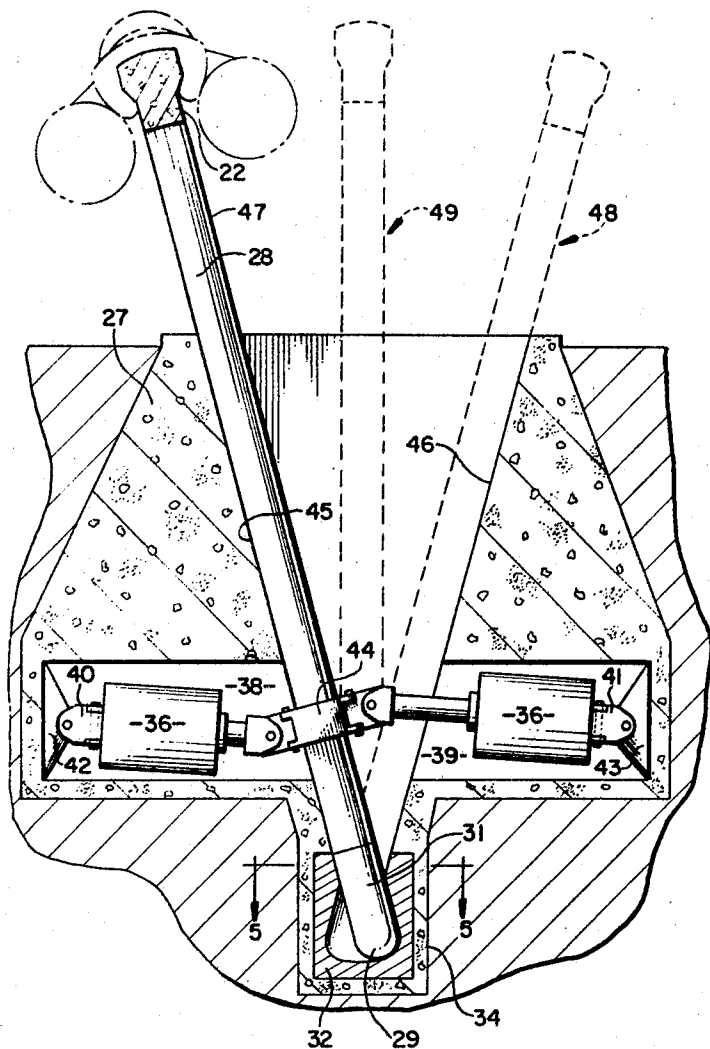


FIG. 4

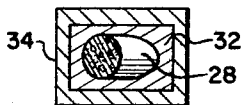


FIG. 5

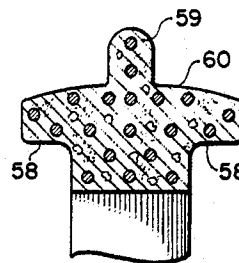


FIG. 10

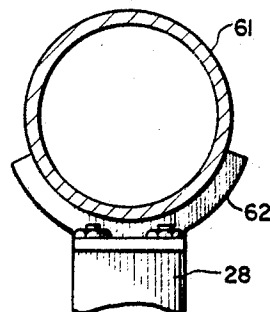


FIG. 11

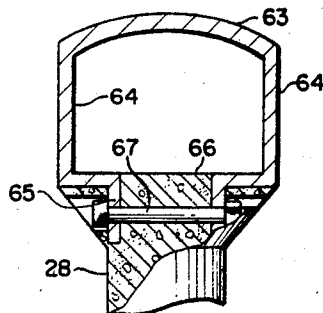


FIG. 12

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DEFLECTING BEAM MONORAIL SWITCH

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9 Claims

ABSTRACT OF THE DISCLOSURE

A monorail switching system is described which provides a spiral curve and bank angle for high speed turns on a beam supported monorail vehicle. The beam is deflected from a fixed end point and is supported by pivotally mounted pillars which provide supports for transferring the vehicle load in a manner which minimizes lateral loading of the beam during switching.

CROSS REFERENCES

The present invention is particularly adapted for use with the vehicles disclosed in the copending application, entitled "Rapid Transit System," by Lamartine C. Trent, Ser. No. 560,558, filed June 27, 1966, the disclosure of which is incorporated by reference.

BACKGROUND OF THE INVENTION

The present invention is directed to monorail transportation systems and more particularly to a switching system for a high speed rapid transit system.

One of the greatest disadvantages to the development of integrated monorail transportation systems is the fact that the switching support beam must be supported at both ends. This requirement results in heavy, cumbersome switching mechanisms which are exceedingly slow in operation and require greatly reduced train speeds during passage through the switch. Such prior art switches usually involve the movement of a multisectional support beam which is rotated about a pivot point normal to the beam surface plane, or the use of heavy sections which are moved along a traverser to shuttle cars between tracks. Where the rotating section switch is used the speed of the train must be reduced to 20 to 25 m.p.h. during passage over the switch. Such drastic speed limitations require the elimination of any such switches from high speed interstation sections of a transportation system and, therefore, place severe operation limitations on beam supported monorail system such as that disclosed in the above-identified copending application.

SUMMARY OF THE INVENTION

The present invention is directed to a switching system which is capable of supporting a monorail vehicle at high speed in any of the switch positions. A beam is deflected in both the horizontal and vertical planes about a fixed point to provide not only horizontal switching but also the proper spiral curve and bank angle to enable high vehicle speed through the switched section. The beam is supported on a plurality of pivotally supported pillars arranged to minimize lateral beam loading over the length of the section in each switch position.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of the switch of the present invention.

FIG. 2 is a perspective view of the preferred embodiment of the switch showing the fixed and movable sections.

FIG. 3 is a detailed top view of one of the support pillar arrangements of FIG. 1.

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FIG. 4 is a sectioned view along line 4—4 of FIG. 3 showing the details of one of the support pillar arrangements.

FIG. 5 is a section along lines 5—5 of FIG. 4.

FIGS. 6—12 show cross-sectional views of various monorail structures which may be used in the preferred embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. 1 and 2 in detail, the deflected beam switch of the present invention is shown having a stationary section 20, a deflecting beam section 22 and a plurality of directional beams 24 for left and right turns and straight vehicle movement. The fixed section 20 terminates at a fixed curve initiation point 26 which preferably has a support pillar 28 of extra strength to prevent any lateral displacement or additional strain on the stationary section 20. The deflecting section 22 is supported on a plurality of pivotally mounted pillars 28 which are laterally movable along arcuate guideways 30 (see FIG. 3 also). The curvature of the guideways 30 decreases in proportion to the distance from the deflection initiation point 26 and is proportional to the curvature required in the reflected beam 22 to accomplish mating with one of the fixed directional beams 24.

Each movable pillar 28 (see FIG. 4) is connected to the deflecting beam section 22 at its upper end and has its lower end 29 pivotally mounted in a concrete base 27 having an embedded metal slot member 32 (see FIG. 5). The pivot point 31 and pillar support base 27 are preferably embedded in the ground. The entire pillar support structure 27 and guideway 30 having a casing of high strength concrete or steel 34 so that pillar 28 pivots about the point 31 in a closely controlled manner. A pair of oppositely disposed hydraulic cylinders 36 are supported in chambers 38 and 39 and have their fixed ends 40 and 41 pivotally connected to wall brackets 42 and 43 and the ends of the movable hydraulic ram pivotally connected to a coupling 44. The coupling 44 is preferably attached to the support pillars 28 at a point between the pivot point 31 and the deflecting beam section 22. In this manner opposing movements by hydraulic cylinders 36 control the exact position of the pillar 28. The casing 34 is provided with sloping sides 45 and 46 against which the support pillars 28 rest in either the left or right hand switching positions 47 and 48. Additional interlocks may be provided for locking the support pillars 28 in the central position 49 if desired.

Referring again to FIG. 2, it is apparent that each pivotally supported pillar 28 is resting against the sloping side 45 of its respective casing 34 when the switch is in its fully deflected positions 47. It is also clear from FIG. 2 that the deflection of the beam from the straight position 49 to either position 47 or 48 will result in a slight shortening of the beam and, therefore, require that the end portions of the three fixed directional beams 24 be arranged along an arc as shown in FIG. 1. In a similar manner, each of the guideways 30 will have a curvature sufficient to accommodate a slight longitudinal movement towards the curve initiating point 26 when the switch is deflected into either of the extreme switching positions 47 or 48.

A high speed ground transit system, i.e., those involving vehicle speeds in excess of 200 m.p.h., requires large mass and long length switching structures. For example, a switching section for a 300 m.p.h., 15 degree bank angle requires a 1650 foot length and a turn radius of 22,400 feet. Similarly, to provide a vertical "g" force of less than 1.035 at a speed of 500 m.p.h. with the same bank angle would require a switch section over 3,000 feet long with a turn radius of about 65,000 feet. The switch structure of the present invention is particularly

adapted to attain these objectives. Furthermore, only a relatively small horizontal load need be applied at one or more of the pivotally supported pillars 28 through hydraulic cylinders 36 in order to obtain the deflections required. For example, with a prestressed concrete deflecting section beam such as that shown in FIG. 6, one three feet wide and 8 feet deep, and assuming a deflecting beam section length of 1650 feet, only about 700 lbs. of force need be applied at the end of the deflected beam in order to provide the required 25 feet deflection from position 49 to either position 47 or 48. Because of the extremely long deflecting beam length the deflection stress resulting at the curve initiating point 26 is less than 500 inch-pounds. Furthermore, support pillars 28 are movable and are always maintained in a direction normal to the load bearing beam surface since the beam is deflected along a spiral curve thereby generating the appropriate bank angle. In this manner the force of the vehicle riding on the beam is always directly down the support pillars 28 even though the beam is in the fully deflected position 47 or 48. Thus, a switching mechanism has been provided over which a vehicle can safely travel at very high speeds and which, through its movement to the deflected position, provides the necessary spiral curve and appropriate bank angle.

Various beam cross-sectional configurations may be utilized although the preferred is shown in FIG. 6 as comprising a prestressed concrete beam 52. Other beam structures which may be utilized in the deflecting beam of the present invention are shown in FIGS. 7-12. FIG. 7 is similar to FIG. 6 except that a metal cap structure 53 is provided for the basic prestressed concrete base 52. FIG. 8 shows an all metal beam structure in which a base structure 54 is affixed to the pillars 28 and includes a pair of support members 55, disposed on opposite sides of the center line, on which a metal vehicle supporting cap member 56 is fixed. FIG. 9 shows an integral beam structure member 57 which has a rounded vehicle supporting surface and lower flange surfaces for maintaining vehicle contact with the beam. FIG. 10 shows another prestressed concrete configuration in which outwardly extending flange portions 58 are provided and which has a projection 60 along the center on the top surface for providing lateral support of the vehicle. FIG. 11 is a cross-sectional view of a tubular beam member 61 which is fixed to supporting brackets 62 which is attached to the support pillars 28. FIG. 12 also shows a hollow support member 63 having straight side walls 64 and an integral bottom surface flange 65 engaging the top portions 66 of the pillars 28 and attached thereto with bolts 67.

It is apparent from the above described preferred embodiment that other modifications and changes may be made without departing from the scope of the invention. For example, only two positions, one a deflected position and the other an undeflected position, could be used. In such an arrangement the undeflected position would require the vertical pillars to engage one side of the arcuate guideway. Further, positioning means other than hydraulic cylinders could also be utilized and an electrical interlock system could be incorporated to insure proper switch positioning. Therefore, various modifications will be apparent to those skilled in the art without departing from the scope of the invention.

I claim:

1. A switch for a vehicle transportation system comprising a flexible beam portion having one end integral

with a fixed beam section and the other end movable from one switching position to another, means for supporting the flexible beam portion so that it may be deflected from a straight undeflected position to at least one other selected switching position in which it forms a curve having a preselected bank angle, and means for moving said beam to said other selected switching position.

2. The beam switch of claim 1 wherein said means for supporting said beam portion includes a plurality of movable pillars each attached along said flexible beam portion, and base means for supporting said pillars for limited movement in a direction generally normal to said beam in said straight undeflected position.

3. The beam switch of claim 1 wherein said means for supporting said beam portion includes a plurality of spaced pillars, each of said pillars having one end integral with said beam and the other end pivotally supported in a base.

4. The beam switch of claim 3 wherein each of said pillars is pivotally mounted for movement around a point adjacent its lower end and is supported within a guideway located generally normally to the longitudinal direction of said beam.

5. The beam switch of claim 4 wherein said means for moving said pillars to said selected positions includes hydraulic means attached to said pillar at a point between said pivot and said one end of said beam.

6. The beam switch of claim 5 wherein each of said guideways includes at least one sloping side for engaging said pillar in one of said selected switch positions.

7. The beam switch of claim 4 wherein said base means includes an arcuate guideway having its center of curvature at the integral end of said beam portion, said guideway supporting said pivotally mounted pillar against longitudinal movement.

8. A monorail switch for an elevated vehicle transportation system comprising a continuous vehicle supporting beam having a fixed beam portion and a flexible beam portion at one end movable to a plurality of switching positions, means for supporting said fixed beam portion in permanent elevated relationship to the ground, means for supporting the flexible portion so that it may be deflected from a straight position to at least one other selected switch position in which it forms a spiral curve having a preselected bank angle, said supporting means including a plurality of pillars having one end fixed to said flexible beam portion and the other pivotally mounted for selected movement generally normal to said beam, and means for selectively moving said pillars and flexible beam to said selected switch positions.

9. The switch of claim 8 wherein said beam is prestressed concrete and said support means includes an arcuate guideway for each of said pivotally mounted pillars.

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