

GUIDEWAY TRANSFER SWITCH
BACKGROUND OF THE INVENTION

1. Field of the Invention

5 The present invention relates to a guideway transfer switch for a people mover or other transportation system.

2. Description of the Prior Art

10 Guided vehicles are well-known in the art, such as U.S. Patent Nos. 1,026,239; 1,138,880; 1,253,800; 1,603,012; 2,887,067; 2,996,017; 3,672,308; 3,735,709; and 4,970,962.

15 Typically guided vehicles, such as people movers, incorporate an electrically powered wheeled vehicle that travels along a guideway. A guide rail is provided with the guideway to coast with the vehicle to guide the vehicle along the guideway. Prior art guideway switch arrangements such as transfer tables and rotary guide switches, such as described in U.S. Patent No. 4,970,962, are well-known in the art. A transfer table is a movable table to which the guide track is secured. The table can either rotate about
20 an axis or move in a lateral direction to enable a vehicle to change tracks. These prior art transfer tables are very heavy and require a substantial amount of lead time to transfer the vehicle. Typically a transfer table weighs on the order of 30,000 pounds. Furthermore, in some instances the transfer table actually moves the guided vehicle as it is changing tracks. This is a time-consuming and cumbersome procedure. Additionally, previous switches require significant structural support due to weight or
25 deep pits which increase the cost of the structure.

30 U.S. Patent No. 3,672,308 teaches a transfer switching arrangement having fixed tracks and movable guide tracks. The switching arrangement operates in a first and second position for guiding a vehicle between fixed tracks.
35 The first and second positions are accomplished using a straight guide track and a curved guide track within the switch. The switch is secured by lock pin arrangements located between the straight and curved guide tracks.

While the prior art switches provide for lateral and vertical support of the guide tracks, they do not prevent overturning of the guide tracks due to vehicle forces through the switch (i.e., rotation in the direction of the moment). Additionally, the prior art switches do not prohibit racking (where one end of the switch moves prior to or more quickly than the other, causing rotation of the guide tracks in the horizontal plane) during switch movement from position to position.

Therefore, it is an object of the invention to overcome the deficiencies of the prior art.

SUMMARY OF THE INVENTION

A guideway switch made in accordance with the present invention is a transfer switch type.

The design of the transfer switch features continuous uninterrupted power collections and allows maximum system speeds in the tangent position. In the turnout position, the radius of curvature limits the train speed to maintain passenger comfort. The ride quality of the vehicle is maintained through the switch in both tangent and turnout directions.

Guidance of the vehicles through the switch is accomplished using one, preferably two, of a plurality of movable guide tracks, for example, a curved and a straight guide track, each identical in cross-section to a fixed guide track. Preferably, the fixed track and the movable guide tracks are located at the same elevation (i.e., contained in the same plane). Switching is performed by shifting the selected movable guide track into position so that its free ends are aligned and locked with the fixed guide track adjacent to the switch.

The fundamental switching action involves shifting the desired movable guide track into alignment with the fixed guide track and moving the other movable guide track to a position where it will not obstruct the undercarriage of the vehicle as it passes through the switch. To accomplish this, preferably an

electromechanical drive assembly is used, such as a hydraulic cylinder attached to a switch guide track frame and an adjacent roadway section structure. Cross beams or trolleys are fastened between the movable guide tracks. A linear bearing is located approximately at the midpoint of the switch to aid the switching action. For example, extension and retraction of the cylinder causes both tracks to transfer in unison. Full extension moves the curved track into the aligned position (switch in reverse position) and full retraction moves the straight track into alignment (switch in normal position). Switching may also be accomplished using a chain drive assembly.

Once the desired switch position has been attained, at least one locking mechanism, preferably a pair of bolt-like lock pins, is engaged, preferably hydraulically, to join the ends of the fixed and movable tracks and provide a continuous path for the vehicle guide tires through the switch.

Safety is one of the most important criteria used in the design of the guideway transfer switch. To prevent vehicle operation through a switch that is improperly aligned, electromechanical devices, for example, limit switches, are mounted to fixed structures. The position of the movable guide tracks activates the limit switches and provides an electrical signal to the central control intelligence for proper automatic train control (ATC) operation of vehicles through the switch. This signal also operates traffic signal lights for use during manual operation. These lights, in turn, provide a visual annunciation of the status of the switch. If the switch is aligned in the wrong position, the corresponding signal and traffic light alerts the ATC system or an on-board operator to this condition to ensure appropriate action. When the vehicle is in the manual operating mode, the on-board operator uses the traffic signal to ensure safe routing through the switch.

To prevent operation through a switch that is not fully aligned in either position, the limit switches, which detect the position of the guide tracks, are designed to annunciate no signal until the track is fully aligned. The
5 absence of a signal to the ATC prevents entry of a vehicle or train through that switch and does not provide the go-ahead signal at the traffic lights.

To prevent operation through a switch that is not mechanically locked, a second set of limit switches detect
10 the position of the lock pins. If the lock pins are not fully seated in the locked position, these limit switches cancel the alignment signal to the ATC and traffic lights, thereby providing the same action described previously for a guide track that is not fully aligned.

While the guideway transfer beam switches are automatically-controlled and hydraulically-operated, they also have semi-automatic and manual control capabilities. The semi-automatic mode allows the switch to be operated by manual actuation of an electric hydraulic pump which allows
20 the switch to be moved by one person with minimal effort and decreases the cycle time. Manual operation permits changing the switch position by use of a hand pump located in a switch control cabinet. No personnel intervention is required for control or operation of the switches in the
25 automatic mode.

Local control capability and isolation from mainline traction power is provided via a hydraulic control cabinet and power disconnect, respectively, that are located in the switch area.

30 The time for one complete automatic operation cycle, including the following breakdown of train control events, is approximately six seconds.

A switch logic control unit located in the switch control cabinet in the switch area performs all the vital
35 checks involved with the operation of the guideway switch. The vital checks include: switch position command logic, which is used to move the switch from one position to

another; switch correspondence logic, which vitally detects the position and mechanical locking of the switch; and logic, which is needed to drive traffic lights in the area of the switch.

5 To accomplish these tasks the switch logic control unit interfaces with a hydraulic control unit and the ATC system. The switch logic control unit is located next to the hydraulic control unit. Housed inside the switch logic control unit are the vital relays which are
10 used to perform the vital checks. Also included in the unit are various circuit breakers, power transformers, and lightning arrestors which make up the control circuits.

BRIEF DESCRIPTION OF THE DRAWINGS

15 Fig. 1 is a top plan view of a guideway transfer beam switch made in accordance with the present invention;

Fig. 2 is an elevational side view of the guideway transfer beam switch shown in Fig. 1;

Fig. 3a is sectional side view of a portion of the guideway transfer beam switch shown in Fig. 1;

20 Figs. 3b and 3c are top and side sectional plan views of the straight transfer track showing the power track in accordance with the present invention;

Fig. 4 is a sectional side view of the intermediate stop used to support vehicle tire loads;

25 Fig. 5 is a sectional side view of the intermediate stop used to support vehicle tire loads;

Figs. 6a and 6b are an elevational view and a top perspective view of a linear bearing made in accordance with the present invention;

30 Fig. 7 is a perspective view of a lock pin made in accordance with the present invention; and

Fig. 8 is a top plan view of the lock pin shown in Fig. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

35 Figs. 1-5 show a guideway transfer switch 10 made in accordance with the present invention. The guideway transfer switch 10 is positioned in a guideway 12. The

5 guideway 12 is typically a concrete slab onto which a wheeled vehicle can travel. The guideway 12 includes an inbound side 14 and outbound sides 16 and 18. The outbound sides 16 and 18 are straight segments. The guideway transfer switch 10 is provided on a switch pit 20 which is positioned between the inbound side 14 and the outbound sides 16 and 18. Like the sides 14, 16 and 18, the switch pit is also preferably a concrete slab.

10 An inbound fixed guide track 22 is secured to side 14, and outbound fixed guide tracks 24 and 26 are secured to outbound sides 16 and 18, respectively. Outbound tracks 24 and 26 are straight. A transfer straight track 28 and a transfer curved track 30 are supported by the switch pit 20 through a trolley arrangement. Tracks 28 and 30 are movable and also referred to as guide tracks.

15 A trolley arrangement supporting the tracks 28 and 30 includes a frog end trolley assembly 32 and a point end trolley assembly 34. The trolley assemblies 32 and 34 are provided in troughs defined in the switch pit 20 and are each secured to the tracks 28 and 30, such that the tracks 28 and 30 are positioned on top of the switch pit 20 and at the same elevation as tracks 22, 24, and 26 (i.e., in the same plane). A power track 35 is positioned under the guide tracks. This overall configuration permits the installation of the equipment after the pit is poured. Thus, no special pour is required for the switch pit 20. Additionally, no special structure is required within the switch pit 20 to support the tracks 28 and 30. Therefore, 20 the switch pit 20 itself is relatively shallow, thereby decreasing the weight of the structure and cost of the switch pit 20.

25 A linear bearing 36 is secured to the switch pit 20 and the tracks 28 and 30. The linear bearing 36 is positioned between the trolley assemblies 32 and 34. Preferably, the linear bearing 36 is positioned approximately at the midpoint of the straight track 28 30

(i.e., approximately the midpoint of the transfer switch 10).

Referring to Figs. 6a and 6b, the linear bearing assembly 36 includes a linear bearing track 46 and two followers 48 slidably received by linear bearing track 46. One follower 48 is mounted below each support 52 and 54. A guide body 51 is attached to the follower 48. A drive pin 50 is secured to the follower 48 through the body 51. Spaced apart supports 52 and 54 are also secured to the body 51. The transfer straight track 28 and transfer curved track 30 are secured to respective supports 52 and 54.

The linear bearing 36 helps prevent racking of the tracks 28 and 30 when they are moving between positions. The linear bearing 36 also provides vertical support for the vehicle forces and allows for thermal expansion of the tracks 28 and 30 along their lengths.

As shown in Fig. 1, limit switches 38, 40, 42 and 44 are provided about the switch pit 20. These switches indicate the correct positioning of the tracks 28 and 30 and will be discussed in more detail during discussion of the operation of the guideway transfer switch 10.

Referring to Figs. 1, 7 and 8, a locking mechanism, preferably a lock pin 56, is shown. Preferably, the lock pin 56 is provided at opposite ends of the transfer straight track 28 and transfer curved track 30 and fixed tracks 22, 24 and 26. Preferably, each of the fixed tracks 22, 24 and 26 is provided with a hydraulically activated pin arrangement or male member 58 at approximately the centerline of the track. Respective ends of the movable tracks 28 and 30 are each provided with a receiver female member 60 at approximately the centerline of the track. The female member 60 essentially is a member that includes a hole passing therethrough and is adapted to receive the male member 58. A limit switch 62 is provided on a rearward end of the female member 60.

The location of the lock pin 56 at approximately the centerline of the tracks 22, 24, 26, 28 and 30 provides not only lateral and vertical support, but also support to prohibit overturning. Additionally, at this location, the female members 60 utilize spherical bearings to aid in locating the tracks to overcome slight misalignments and to compensate for thermal loading and vehicle force distortions.

Referring to Figs. 4 and 5, an intermediate stop pin 68 is actuated vertically out of the guideway and into a receiver 70 using a hydraulic cylinder 64 and a linkage 66. One stop pin is used to support each track 28 or 30 when it is in position. The intermediate stop pin 68 is a removable assembly. Therefore, if it is not needed, it can be removed. Use of the stop pin 68 permits the use of a thinner guide track which decreases the cost of the structure. It also permits the use of a greater radius of curvature which decreases the length of the switch. Therefore, a variety of geometries can be achieved, and the vehicle can travel faster through curves.

The operation of the present invention will now be discussed. Initially, a vehicle is traveling along the inbound track 22. Referring to Fig. 1, if the vehicle is to then travel along the outbound track 26, the guideway transfer switch 10 must be arranged so that the transfer curved track 30 aligns with respective ends of tracks 22 and 26. In this arrangement, the transfer straight track 28 will contact limit switches 38 and 40 which will send a signal to a control system (not shown) to indicate that the straight track 28 is in a proper position to avoid interference with the vehicle traveling along the guideway.

Furthermore, respective male members 58 are then activated so that they are urged into the female members 60 found at opposite ends of the curved track 30. Limit switches 62 are then activated by an end of the male member 58. A signal is sent to the control system indicating that the curved track 30 and tracks 22 and 26 are properly

aligned and that the receiver 60 properly received the pin 58. The intermediate stop 68 for the curved track 30 will be actuated to insert into the receiver 70 on the curved track 30 to prevent lateral movement of and provide support for the curved track 30. In this arrangement, the vehicle can travel smoothly and easily from track 22 to track 26.

If the vehicle is to travel from track 22 to 24, the lock pins are retracted and the trolley assemblies 32 and 34 are actuated by an electro-mechanical drive, causing the curved track 30 to move toward limit switches 42 and 44. Once the curved track 30 contacts limit switches 42 and 44, indicating that it is properly positioned out of the way, the respective male members 58 are then activated and are received at respective ends of the track 28 by female receiving members 60. The ends of the respective male members contact limit switches 62 that send a signal that the straight track is properly aligned with tracks 22 and 24 and that the receiver 60 properly received the pin 58. At this time, the intermediate stop 68 for the straight track 28 is activated. The above process is again reversed if curved track 30 is to be aligned with tracks 22 and 26.

Hence, the present invention provides a guideway transfer switch 10 that includes a plurality of tracks 28 and 30 extending in a substantially first direction and movably secured to transfer drives 32 and 34 for moving the tracks 28 and 30 in a substantial transverse direction with respect to the first direction. The guideway transfer switch 10 can include more than two tracks.

It should be evident that the present invention is much simpler and less expensive to install than if the switch pit 20 were moved by a transfer table which requires movement of the complete arrangement. In other words, only the tracks 28 and 30 need to be moved as opposed to a complete transfer table. The present invention is substantially lighter than a transfer table, namely 7,000 pounds as opposed to 30,000 pounds. This results in a

quicker cycling time, on the order of six seconds, and takes up less space than the prior art arrangements.

5 It will be understood by those skilled in the art that while the foregoing description sets forth in detail preferred embodiments of the present invention, modifications, additions, and changes may be made thereto without departing from the spirit and scope of the invention. Having thus described our invention with the
10 detail and particularity required by the Patent Laws, what is desired to be protected by Letters Patent is set forth in the following claims.

What is claimed:

1. A guideway transfer switch adjacent to a plurality of fixed guide tracks for guiding vehicles between the fixed guide tracks, comprising:
 - 5 a plurality of guide tracks extending in a substantially first direction and movably secured to transfer drives for moving said tracks in a substantially transverse direction with respect to the first direction of the guide tracks; and
 - 10 at least one locking mechanism located at an end of at least one of the fixed guide tracks and at least one end of each of the plurality of guide tracks, which at least one end of each of the guide tracks is near the end of at least one of the fixed guide tracks, and the at least one locking mechanism located at a common approximate
 - 15 centerline of the at least one fixed guide track and each of the plurality of guide tracks, wherein at least one of the plurality of guide tracks is secured into position for guiding vehicles between the fixed guide tracks by engagement of the at least one locking mechanism.
- 20 2. The guideway transfer switch as claimed in claim 1, wherein the plurality of guide tracks are at the same elevation as the fixed guide tracks.
3. The guideway transfer switch as claimed in claim 1, wherein the at least one locking mechanism is at least one lock pin.
4. The guideway transfer switch as claimed in claim 3, wherein the at least one locking mechanism includes a spherical bearing.
5. The guideway transfer switch as claimed in claim 1, further including a structure, wherein the



plurality of guide tracks is located on a top of the structure.

6. The guideway transfer switch as claimed in claim 1, further including a power track positioned under the plurality of guide tracks.

5 7. The guideway transfer switch as claimed in claim 1, further including a movable stop pin arrangement which is actuated to engage and support one of the plurality of guide tracks when in position to guide vehicles between the fixed guide tracks.

5 8. The guideway transfer switch as claimed in claim 1, wherein the transfer drives move the guideway transfer switch such that one of the plurality of guide tracks is aligned with the fixed guide tracks and the others of the plurality of guide tracks are in a position away from the fixed guide tracks so as not to obstruct the vehicle during travel through the switch.

9. The guideway transfer switch as claimed in claim 1, wherein the transfer drives include a linear bearing assembly located approximately at a midpoint of the guideway transfer switch.

5 10. The guideway transfer switch as claimed in claim 1, further including a control system and a plurality of limit switches, wherein the plurality of limit switches detects the positions of each of the plurality of guide tracks, detects the engagement of the at least one locking mechanism and sends signals to the control system.

11. The guideway transfer switch as claimed in claim 1, wherein the plurality of guide tracks includes a substantially straight guide track and a substantially curved guide track, wherein the straight guide track and



5 the curved guide track have substantially the same cross-sectional configuration as the fixed guide tracks.

12. A guideway transfer switch adjacent to a plurality of fixed guide tracks for guiding vehicles between the fixed guide tracks, comprising a plurality of guide tracks extending in a substantially first direction and movably secured to transfer drives for moving said tracks in a substantially transverse direction with respect to the first direction of the guide tracks, wherein the transfer drives include a linear bearing assembly located approximately at a midpoint of the guideway transfer switch.

13. The guideway transfer switch as claimed in claim 12, further including at least one locking mechanism located at an end of at least one of the fixed guide tracks and at least one end of each of the plurality of guide tracks, which at least one end of each of the guide tracks is near the end of at least one of the fixed guide tracks, and the at least one locking mechanism located at a common approximate centerline of the at least one fixed guide track and each of the plurality of guide tracks, wherein at least one of the plurality of guide tracks is secured into position for guiding vehicles between the fixed guide tracks by engagement of the at least one locking mechanism.

14. The guideway transfer switch as claimed in claim 13, wherein the at least one locking mechanism is at least one lock pin.

15. The guideway transfer switch as claimed in claim 14, wherein the at least one locking mechanism includes a spherical bearing.

16. The guideway transfer switch as claimed in claim 13, further including a structure, wherein the



plurality of guide tracks is located on a top of the structure.

17. The guideway transfer switch as claimed in claim 13, further including a power track positioned under the plurality of guide tracks.

5 18. The guideway transfer switch as claimed in claim 13, further including a movable stop pin arrangement which is actuated to engage and support one of the plurality of guide tracks when in position to guide vehicles between the fixed guide tracks.

5 19. The guideway transfer switch as claimed in claim 13, wherein the transfer drives move the guideway transfer switch such that one of the plurality of guide tracks is aligned with the fixed guide tracks and the others of the plurality of guide tracks are in a position away from the fixed guide tracks so as not to obstruct the vehicle during travel through the switch.

5 20. The guideway transfer switch as claimed in claim 13, further including a control system and a plurality of limit switches, wherein the plurality of limit switches detects the positions of each of the plurality of guide tracks, detects the engagement of the at least one locking mechanism, and sends signals to the control system.

5 21. The guideway transfer switch as claimed in claim 13, wherein the plurality of guide tracks includes a substantially straight guide track and a substantially curved guide track, wherein the straight guide track and the curved guide track have substantially the same cross-sectional configuration as the fixed guide tracks.



22. A guideway transfer switch adjacent to a plurality of fixed guide tracks for guiding vehicles between the fixed guide tracks, comprising:

5 a plurality of guide tracks extending in a substantially first direction and movably secured to transfer drives for moving said tracks in a substantially transverse direction with respect to the first direction of the guide tracks; and

10 a stop coacting with the fixed guide track and the plurality of guide tracks to prevent movement in the transverse direction of the plurality of guide tracks.