A guided transport system has tracks intersecting at cross-over points. The tracks have longitudinally extending guides which are flexible adjacent the points. The flexible portions of the guides are bowed horizontally to selectively align ends thereof with other ends of guides to establish a selected route through the points. Self-propelled vehicles engage the tracks and guides during movement on the tracks.

10 Claims, 23 Drawing Figures
GUIDED TRANSPORT SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to a transport system. Different types of vehicles guided on pneumatic tires have been proposed for which the guide system is formed, either by a central beam, or by lateral guide rails guiding the guide wheels which have a vertical axis. Nevertheless only lateral guide systems have seen wide application, these being completed by a railway track which is adapted to receive normal railway wheels mounted in parallel with the tires. The vehicles and the tracks of this transport system, employed for the underground systems of many major towns, comprise in reality two support and guide systems. One system is formed by pneumatic tires on tracks and guide rails and the other by flanged wheels on a conventional railway track.

When a conventional rail system is to be converted to a system running on pneumatic tires, this latter system is unavoidable, but only serves on a new line to correct any defects in the tires and to provide the track switching apparatus or points. In the neighborhood of these points, the support tracks drop and the vehicle comes to rest on the rails with metallic wheels.

It is clear that the installation of a double track and support system is relatively expensive even more so as the principle function of the railway track, that is to correct for any accidents to the tires, can be easily realized in another way and splits or bursts of the pneumatic tires are extremely rare. Their useful life often reaches several hundreds of thousands of kilometers.

However a practical system of points has not been proposed until now which only comprises lateral guide rails for pneumatic tires having a vertical axis.

SUMMARY OF THE INVENTION

According to a first aspect of the invention there is provided a guided transport system having several tracks intersecting at a set of points and each provided with a longitudinally extending guide which, in the vicinity of the set of said points has a section of its length transversely flexible and provided with means for bowing it horizontally to align its end selectively with the ends of guides of different tracks, whereby the flexible guide section is able to carry out its guiding function while also serving the additional purpose of establishing a chosen route through the points.

According to a second aspect of the invention there is provided a guided transport system comprising a lateral guide parallel to a track, the guide having a break in its continuity adjacent each set of cross-over points, and flexible portions deformable under the action of a points control device.

The guide may be formed either by a central beam placed within the track or by two lateral guide rails running alongside the track. A thinning of the central beam or an increase in the distance between the lateral guide rails is preferably provided for curves having a small radius.

Each vehicle for running on the system preferably has bogies which suitably have pneumatic support wheels and six guide members rotatable about vertical axes. Four of the guide members are preferably mounted at the corners of the bogie, and two opposite the central pivot of the bogie; each guide member having a vertical axis formed by a wheel, preferably an insulating pulley wheel, which may advantageously be formed by a tire. Each set of points can be locked, and it can be made trailable.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of examples only, with reference to the accompanying drawings, showing preferred embodiments, in which:

FIG. 1 shows diagrammatically the assembly of two tracks through their guide rails adjacent a cross-over point, the guide rails being shown in the straight through position;

FIG. 2 shows the same two tracks, the guide rails being shown in the change-over position;

FIGS. 1a and 2a are analogous to FIGS. 1 and 2 but show the ease of a single track;

FIG. 3 shows the construction of a bogie of a vehicle in accordance with the invention;

FIG. 4 shows how the bogie travels around a curve with a small radius of curvature;

FIG. 5 shows the layout of track apparatus forming a change-over point;

FIGS. 5a, b, c, d, e, f and g show different stages in the passage of a bogie through the discontinuities in the guide rails of a cross-over point;

FIG. 6a is a section through a guide rail;

FIG. 6b shows a portion of a guide rail seen from above the adjacent cross-over points;

FIG. 7 shows the control of the guide rails of a track apparatus forming half of a change-over point;

FIG. 8 is a cross-section of a mobile cross-piece of the track apparatus;

FIG. 9 shows the track above the control rod of the movable cross-pieces of a track apparatus;

FIG. 10 is a cross-section of the control rod of FIG. 9;

FIG. 11 shows a perspective view a pedal for trailable points;

FIG. 12 is a diagrammatic plan view of a vehicle having two axles moving in a straight line, the housing being assumed to be transparent; and

FIG. 13 is a diagrammatic plan view of the same vehicle negotiating a bend.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1, guide rails 1d and 1g of track v1, and 2d and 2g of track v2 are shown adjacent a cross-over point. These guide rails serve to supply the traction current to the trains, for example a direct current. In this case, the rails 1g and 2d are connected to the positive terminal, and the rails 1d and 2g are connected to the negative terminal so that during a change-over of tracks, the polarities of the rails are not altered. Nevertheless when the arrangement of tracks makes a change of polarity necessary, neutral or switchable sections should be provided and the vehicles provided with feelers. Such an arrangement is conventional and does not form part of the invention.

The guide rails are broken at the change-over point and their ends 3d, 4d, 3g, 4g, 5g, 6g and 5d and 6d, are slightly tapered outwards so as to provide an easy entrance, as much for the current friction contacts as for the guide wheels.

The guide rails are shown in FIG. 2 when the cross-over point changes tracks. The ends of the rails 4d and
have not moved from their position shown in FIG. 1, but the ends of the rails 3d and 3g up the line from the track v1 have come to rest opposite respectively the ends of the rails 6g and 6d of the track v2.

The ends 5g and 4g have moved parallel respectively to the ends 3g and 6g to allow free passage, without having touched the fixed ends 5d and 4d. The displacement of each group of three ends of the guide rails, as can be seen immediately in the Figure, is a little less than E+e/2, where E is the separation of the rails of a track and e is the distance between adjacent tracks.

FIGS. 1a and 2b are analogous to FIGS. 1 and 2 and show the case of a change-over of a single track. They do not require any additional description. It should however be noted in FIGS. 1, 2, 1a and 2a that the lateral external guide rail of the track subjected to the change of track is indeformable.

FIG. 3 shows diagrammatically a bogie of a vehicle guided on tires. The bogie shown may for example be of the monomotor type having two conical driving axles.

The chassis of the bogie in the case of a single motor, has fixed housings 8a and 8b of the driving axles 9a and 9b. Each axle 9 has two sheefs provided with tires 10d and 10g and two brake discs 11d and 11g. These brake discs have a diameter slightly less than that of the tires 10d and 10g when fully worn and have a sufficient rigidity to be able to serve as support wheels for a very short time if a tire bursts, splits or deflates. Such an incident is immediately revealed by known means.

On each housing 8 of the driving-axle, are mounted fork joints 12d, 12g and 13d, 13g which receive the axles 14d, 14g and 15d, 15g of the outer guide wheels 16d, 16g and 17d, 17g.

Two fork joints 18d and 18g are also mounted on the housing 7 of the motor, these fork joints receiving the axis 19d and 19g of the guide wheels 20d and 20g situated opposite a bogie pivot. The bogie also includes two friction contacts, one for each guide rail. These contacts have not been shown in order to simplify the Figure.

Similarly, the tires provided a primary suspension, the secondary suspension between the casing and bogie has not been shown.

Finally, the bogies can be fixed in an aligned position with respect to the chassis of the housing to allow over short distances the local omission of the guide rails. This may be necessitated, for example, by level crossings, and can be carried out under ground control by known means, such as entry and exit automatic contacts or a magnetic circuit formed of a steel blade sealed in the drive surface.

In FIG. 4 the bogie is traveling around a curve having a small radius of curvature. In this case, which is exceptional, the flexibility in the tires is not sufficient to maintain the correct cooperation between the wheels and the track and it is necessary to provide an extra width of separation in the track Δ E. The bogie is then guided by the two extreme outer wheels 16d and 17d and the central inner wheel 20g.

FIG. 5 shows the lay-out of the track apparatus forming a cross-over in the track change-over position with the insertion of the guide wheels 16, 17 and 20 at the moment when the bogie is passing over the break in the guide rails.

Each track apparatus forming a half cross-over has a lay-out comprising firstly a parabolic junction line over the angle α, a new parabolic junction line over the angle β and finally a linear portion having a length L greater than the lateral wheel base 1 of the bogie. Thus, for a radius of curvature of 100 meters, the length of the curved portions is on the order of 16 meters and the length L of the intermediate linear portions is on the order of 4 meters, approximately 20 meters in all for each apparatus.

FIGS. 5a and 5g show for one of the guide rails in a simplified way the various stages of the passage of a bogie through change-over points and illustrate that in spite of the break in the guide rails, the bogie is always correctly aligned.

FIG. 6a shows a section through a guide rail 21 and its mounting on the concrete base 22 through an insulator 23 integral with a wing 24 of a T-sectioned bar with a bolt 25. Insulator 23 is held integral with the concrete by bolts 26a and 26b whose heads are locked by wedges 27 in tapped recesses of dover-tails 28a and 28b. In FIG. 6b, a guide rail is shown from above in the region of the cross-over points. To give flexibility to the guide rail, the stiffening wing has been removed except in the region adjacent the fixing points of the guide rails. At these points the guide rail is carried by rods 29 articulated on the guide rail 30 and which are also articulated about shafts 31 carried by points control cross-pieces 32.

In FIG. 7, the guide rails, which are flexible in this region, are carried by cross-pieces 32a, 32b, 32c and 32d through shafts 31a, 31b, 31c, and 31d for the rail 6d and shafts 31e, 31f, 31g and 31h for the rails 4g and 6g and also through insulating rods 29a, 29b, 29c, 29d, 29e, 29f, 29g, 29h, 29i, 29j, 29k, 29l, 29m and 29n. The shafts 31 are fixed to the cross-pieces 32 which slide in recesses 33a, 33b, 33c and 33d of the concrete support.

The length of rods 29 and the position of their pivots are determined in such a way that, when a set of points is on cross-over position, the separation of the guide rails has a correct value throughout the apparatus. The movable cross-pieces 32 are controlled by a control rod 34 placed in recess 35. The straight position of guide rail 6d is shown in dotted line.

FIG. 8 shows a movable cross-piece 32 sectioned through a plane parallel to and adjacent the control rod 34. The cross-piece 32 is a box girder which moves in a recess 33. This is formed from two Z irons 36a and 36b fixed to the concrete support and on which two flat irons 37a and 37b are fixed by bolts 38 whose heads are countersunk.

The cross-piece 32 is guided vertically in the recess 33 by runners 39 and horizontally by runners 40. Shafts 31 are fixed to the cross-piece 32 and each shaft carries a rod 29 which controls the displacement of the guide rail 21.

The displacement of the movable cross-piece 32 is initiated by the control rod 34 which acts on the runners 41 carried by the movable cross-piece. To this end, the control rod 34 (FIG. 9) carries ramps 42a, 42b and 42d which form grooves 43 inclined both with respect to the axis of displacement of the rail 34 and the axis of displacement of each of the movable cross-pieces 32, these two axes being mutually perpendicular.

When a change of position of the points is ordered, the control rod 34, driven in a reversible fashion by an electric motor, is displaced a distance D. Opposite each cross-piece 32, a certain number of grooves 43 are pro-
vided in the rod 34, the shape and inclination of the grooves 43 being determined as a function of the required displacement of the corresponding cross-piece. Each cross-piece carries as many runners 41 as the control rod carries grooves 43 facing that cross-piece. The groove 43, when there is only one, or the outer grooves 43d1, 43d4, when there are several grooves, is or are terminated at its end or their ends by a groove portion 44 parallel to the axis of displacement of the rod 34.

The inclination with respect to this axis and the number of grooves increases towards the free ends of the guide rails.

The operation of the assembly will now be described. The longitudinal movement of the control rod 34 initiates the transverse movement of the movable cross-piece 32 and, at each end of the movement, locks the points, either in the long position, or in the cross-over position, because of groove portions 44.

The control rod 34 (FIG. 10), as is the case of the cross-pieces 32, moves in a recess 35 formed in the concrete support and lined by metal member 45 of U-shaped cross-section and bounded by two flat irons 46a and 46b. The movement of the control rod 34 is guided in the recess, horizontally by runners 47 and vertically by runners 48.

The control rod 34 can be displaced by any known means usually this movement will be caused by an electric motor at one end of the rod and driving a rack fixed to the rod. Contacts at the end of the travel switch off the electric supply of the motor. Such arrangements are well known.

Furthermore, the control rod 34 may be formed of several interconnected parts which facilitates its construction.

The points are readily returned to normal position, as is shown in FIG. 11, by a pedal 49 mounted on a transversal shaft 50 carrying a crank 51. This crank drives an arm 52 substantially parallel to the control rod 34 and terminated by a pusher 53 which comes in contact with the end of the control rod which is furthest away from the points. If a wheel passes over the pedal 49, the arm 52 pushes back the rod 34 a sufficient amount to cause unlocking of the points. Now, in the cross-over position, the two guide rails behave as deflected springs and tend to revert to their normal positions. Owing to the high degree of inclination of the grooves 43 of the movable cross-pieces adjacent the ends of the rod, the system is completely reversible and the release of the flexible guide rails, coupled with the action of the guide wheels of the bogie trailing the points, causes the return of the apparatus to its normal position. A dash pot, not shown in the Figure, damps the movement of the rod 34 at the end of its travel to avoid shocks.

The upper part of the cross-pieces 32 is flush with the upper level of the base support serving as the support surface, and the parts of the recess 35 of the control rod 34 not covered by the movable cross-pieces are closed by rigid covers flush with the same level. In this way a perfect continuity of the drive surface is provided on passing the points which thus substantially eliminates noise or shock.

The vehicle shown in FIGS. 12 and 13 is formed by a carriage 1 supported by two axles 2a and 2b on which are mounted support wheels 3a, 3b, 3c and 3d fitted with pneumatic tires. These axles are centrally fixed to pivots 4a and 4b fixed on the housing of the carriage 1. This carriage carries six devices rotating about vertical axes of which four 5a, 5b, 5c and 5d are fixed at the carriage corners, and the other two 6a and 6b are arranged in the transverse plane of the vehicle at a transverse distance equal to that which separates each pair of devices 5. These rotating devices with vertical axes are preferably electrically insulated pulley wheels.

The wheels 6a and 6b are carried by a cross-piece 7 which slides transversely in two bearings 8a and 8b. This cross-piece carries a longitudinal rocker arm 9 connected by socket joints 10a and 10b with poles 11a and 11b fixed to axles 2a, 2b. The length of each half rocker arm 9 is equal to the half distance between the transverse medial plane and the axis of pivots 4. The socket joints are constructed so as to allow, with a slight longitudinal play, the correct articulation of the poles in the rocker arm whatever the clearance of the rocker arm in the transverse direction and the axes in the vertical direction. Compression springs 13a and 13b on a cross-piece 7 ensure good contact of the wheel 6 with the inner guide rail.

When the vehicle moves in a straight line, as shown in FIG. 12, wheels 5 and 6 are supported on the lateral guide rails 12a and 12b.

When the vehicle moves around a bend, as is shown in FIG. 13, the extreme guide wheels 5a, 5b, 5c and 5d are supported on the guide rails 12a and 12b, a central wheel 6b being supported on the guide rail 12b inside the curve. This displaces the cross-piece 7 towards the outside of the bend, and, owing to the play of the rocker arm 9 and the poles 11a and 11b, turns the axles 2a and 2b toward the center of the curve. The correct approach to the bend by the vehicle is thus provided.

In an alternative embodiment, the lateral guide rails can be replaced by a beam disposed centrally with respect to each track, a transverse thinning of this central beam being provided in the curves having a small radius of curvature. In order to supply a transport vehicle with electric current, this beam may include an insulating web or intermediate insulating elements and conducting wings. This beam is thinned at its ends opposite the points to allow entrance of the guiding wheels.

Similarly, each guide wheel instead of having a pneumatic tire could have a relatively soft insulating pulley wheel formed, for example, of a material having a polyamide resin base, such as nylon. The guide wheels can be applied to the lateral guide rails or to the central beam by resilient members such as springs, and would then not require an increase in their separation or a transverse thinning in the curves having a small radius of curvature.

For by-passing the automatic circuit of a vehicle of the metropolitan type, a stopper circuit should be used carrying an alternating current suitable for signalling.

The vehicles or transport means and the guide means, instead of using electric traction may use any other form of drive, for example, an internal combustion engine as in the case of a guided bus.

The guided transport system of the present invention can be used in railway systems and in particular in underground railways.

What is claimed is:

1. A guided transport system comprising a track, sets of cross-over points in said track, a control device for each of said sets of points, a guide parallel to said track, a break in the continuity of said guide adjacent each of said sets of cross-over points, flexible portions for said guide adjacent each of said breaks of continuity of said
guide deformable by said points control device, a vehicle comprising a bogie, support wheels for said bogie rotatable on horizontal axes and engaging said track and six guide wheels for said bogie on vertical axes on said bogie engaging said guide, each corner of said bogie having one of said guide wheels mounted thereon and each side of the central part of the bogie having one of said guide wheels mounted thereon.

2. A guided transport system comprising a track, sets of cross-over points in said track, a control device for each of said sets of points, a guide parallel to said track, a break in the continuity of said guide adjacent each of said sets of cross-over points, flexible portions for said guide adjacent each of said breaks of continuity of said guide deformable by said points control device, a vehicle, support wheels for said vehicle rotatable on horizontal axes and engaging said track and six guide wheels for said vehicle on vertical axes engaging said guide, each corner of said vehicle having one of said guide wheels mounted thereon and each side of the central part of the vehicle having one of said guide wheels mounted thereon.

3. A transport system as claimed in claim 2, wherein said guide includes guide rails and ends for said guide rails having a slight outward taper adjacent said set of points.

4. A transport system as claimed in claim 3, said plurality of tracks forming two adjacent tracks, four lateral guide rails at a cross-over point for said two tracks, the outer guide rail of said guide rails being rigid for one of the tracks being crossed, the three others of said guide rails being flexible and deformable in the plane of said tracks.

5. A transport system as claimed in claim 2, including a terminal linear portion for said guide having a length greater than the lateral wheel base of a vehicle on said tracks.

6. A transport system as claimed in claim 2, including means for holding each of said flexible portions of said guide comprising insulating rods connected to said portions and articulated on movable cross-pieces slidable in recesses transverse to said track in a support for said track and means for guiding said cross-pieces vertically and horizontally.

7. A transport system as claimed in claim 6, said control device for each of said sets of cross-over points including a control rod parallel to said track, means for guiding said rod vertically and horizontally in a recess below said cross-piece recess, an upper face for said control rod opposite said movable cross-pieces, at least one groove in said face inclined with respect to said track, the number of said grooves increasing towards the ends of said guide, and a runner carried by the adjacent one of said cross-pieces in each of said grooves.

8. A transport system as claimed in claim 7, including a terminal portion for one of said grooves parallel to the direction of displacement of said control rod locking said track in normal position and in change-over position.

9. A transport system as claimed in claim 7, including a pedal, a transverse shaft for said pedal, a crank on said shaft, an arm parallel to said control rod articulated on said crank and a pusher on said arm in contact with the end of said control rod away from the point.

10. A transport system as claimed in claim 2, said bogie having two axles pivotably mounted on their respective centers, pneumatic tires on said axles engaging said track, said six guide wheels engaging said guide, and said two central guide wheels being separated by the same transverse distance as each of said corner guide wheels, a cross-piece slidable in the transverse direction mounting said two central guide wheels and a rocker arm and levers connecting said cross-piece to said axles.

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