ABSTRACT: Local cars may be detached from a nonstop express train in motion at various communities and provided with road wheels for circulation through such communities. A through car has a center rail undercarriage and lateral stabilizer wheels engageable with side tracks. A local car can be connected to a through car by the local car being propelled by a switch engine. Alternatively a harness on the through car can be caught by a hook depending from an overhead local car to start the local car and pull it down a descent onto the main track, after which such harness can be shortened to couple the local car and the through car. Bottom and side rails are carried by cradles suspended from catenary cables supported by towers.
A principal object of the invention is to enable passengers to be entrained and detrained at various communities without stopping the train and with minimum decrease in its speed. More specifically, it is an object to couple a local car carrying passengers to a through car at one community for transfer of passengers from the local car to the through car and other passengers from the through car to the local car, and to uncouple the local car at a subsequent community. Such coupling and uncoupling and related car operations, control and propulsion may be partially or fully automated.

It is also an object to provide such a local car which can be converted from a rail car to a road car easily at a particular community for circulation through the community.

A further object is to eliminate stopping or even pausing of an express train for the purpose of picking up or letting go of a local car at a particular community.

It is also an object to provide a suspension arrangement for railway tracks which will support such tracks at a considerable elevation from the ground to avoid completely conflict with surface traffic, and which will also facilitate supporting the track in a smooth and substantially level fashion, so as to afford smooth travel of the train over the track.

FIG. 1 is a diagram of an intercommunity rail line which may be of any length in combination with a representative variety of local community routes, and FIG. 2 is an enlarged diagrammatic view of a junction of a main line and a branch line.

FIG. 3 is a side elevation of a train including the minimum number of units.

FIG. 4 is a side elevation of a through car, FIG. 5 is a traverse section through such car on line 5-5 of FIG. 4, FIG. 6 is a traverse section on line 6-6 of FIG. 4, and FIG. 7 is a fragmentary traverse section on line 6-6 of FIG. 4 on an enlarged scale, showing parts in a relationship different from those shown in FIG. 6.

FIG. 8 is a side elevation of a local car and a switch or local engine, and FIG. 9 is a plan of such combination. FIG. 10 is an end elevation taken on line 10-10 of FIG. 8, and FIG. 11 is a similar view with parts shown in a different relationship. FIG. 12 is a side elevation of the front portion of a local car and the rear portion of a switch engine shown in a relationship different from that of FIG. 8.

FIG. 13 is an end elevation similar to FIG. 10, showing a modified undercarriage, parts being broken away.

FIG. 14 is a side elevation of a branch line and main line junction. FIG. 15 is an enlarged detail side elevation of a switch at such junction on line 15-15 of FIG. 16 and FIG. 16 is a traverse section on line 16-16 of FIG. 15. FIG. 17 is a traverse section through a central portion of such a junction.

FIG. 18 is a side elevation of a local car front portion and a through car rear portion showing pickup connecting mechanism. FIG. 19 is a traverse section through the apparatus of FIG. 18 on line 19-19. FIG. 20 is a side elevation similar to FIG. 18 showing parts in a different relationship.

FIG. 21 is a detail traverse section through a track and cooperating brake mechanism.

FIG. 22 is a side elevation of an elevated rail suspension installation, and FIG. 23 is a traverse section through such structure on line 23-23 of FIG. 22. FIG. 24 is an enlarged elevation of a tower fitting having parts broken away.

FIG. 25 is a plan of an elevated rail suspension curved in plan, and FIG. 26 is a traverse section through such structure on line 26-26 of FIG. 25. FIG. 27 is an enlarged detail traverse section of a portion of the structure shown in FIG. 26.

FIG. 28 is a side elevation of the elevated rail suspension structure shown in FIG. 25.

FIG. 29 is a plan of a double track rail suspension, and FIG. 30 is a traverse section through FIG. 29 on line 30-30. FIG. 31 is a side elevation of such structure.

FIGS. 32 and 33 are plans of one type and FIG. 34 is a plan of another type of switching track arrangement.

FIG. 35 is a plan of a switch-track mounting and FIG. 36 is a section through FIG. 35 on line 36-36. FIG. 37 is a rail connection horizontal section.

THE RAILWAY SYSTEM

The purpose of the railway system is to meet modern demands for higher speed transportation between cities and suburbs in particular, as well as between cities which are not very far apart. The system includes two principal types of components: First, an intercity component 1 along which express trains will travel at high speed, such as 200 to 300 miles per hour, and which can be provided with end loops 2 at opposite ends of the route to enable the train to turn around easily if it is to remain in service. The second major type of component in the system is the local loop which connects to the intercity component at a transfer location 3. Any number of such transfer locations can be spaced along the intercity track.

The local loops 4 connecting to the intercity component 1 can be of various sizes and shapes depending upon the respective local communities which they serve. Also, the distances between such local loops will vary depending upon the locations of the intermediate communities. In FIG. 1 one of the representative local loops are elongated transversely of the intercity right of way 1, and other local loops are located interiorly or exteriorly of the intercity turnaround loop.

As will be explained in greater detail hereinafter, it is essential for the intercity component of the railway system to have express trains traveling on tracks. While the vehicles traveling around the local loops could also travel on tracks, it is preferred that they have road wheels to travel along roads, both for the purpose of reducing the cost of such local loops and to enable the size and location of such local loops to be altered readily from time to time. The only factor of the local loops which cannot be altered readily from time to time in accordance with the requirements of a particular community is the location of the junction 3 between a particular local loop 4 and the intercity component 1, 2. Special equipment and facilities involving considerable installation cost are provided at each junction between a local loop and the intercity component.

While the railway system of this invention may include an express intercity component which has no stops whatever along its route, it may be desirable in some installations to provide one or more stops 5 for the through train. Such stops 5 could be provided at intermediate metropolitan centers. Such main line stops 5, junctions 3 and selected locations along the local loops 4 can provide waiting stations and automobile parking facilities for the convenience of the patrons. The most important consideration of the system, however, is to eliminate the necessity of a through or express train running on the main line 1, 2 stopping in order either to pick up or to let off passengers at a junction 3. Various characteristics of the system contribute to this capability.

Instead of a through or express train picking up or letting off individual passengers at a junction 3 the express train picks up or lets go a local car or cars which carry passengers. When such a local car is picked up by a through train the passengers on it can transfer to the through train to continue their passage. Conversely, passengers on a through train can transfer to a local car while it is traveling as a component of the through train; and when such a local car has been let go from the through train while the through train remains in motion, the local car can stop to enable individual passengers to detrain and others to entrain. Such passengers may detrain or entrain at the locations of junctions 3 or at any location around a loop 4 at which the local car stops.

At each junction 3 one or more local cars can be picked up by a through train or can be let go from a through train. Ordinarily such a local car or cars can serve the community adjacent to such junction more adequately if each local car is a road vehicle. At each junction, therefore, it is preferable to convert the local car from a rail vehicle which can travel along the main line 1, 2 to a road vehicle or vice versa. If two or
more local cars are let go from a through train at a particular junction, each such vehicle can travel a different route along which to discharge its passengers and pick up others.

A typical diagrammatic arrangement for a transfer location is illustrated in FIG. 2, showing a local loop connecting track 4 meeting the main track 1. At opposite sides of the main track are storage depots 6 for road wheel trucks that can be attached to local cars with suitable mechanism for attaching such wheeled trucks to the local car and detaching them from the local cars. Such transfer locations may also include a passenger waiting, loading and unloading station 7. A local car 8 having no motor facilities can be propelled around a local loop 4 by a tractor or switch engine 9 which can also move the local car into and out of a transfer location. While the storage area for road wheel trucks and the passenger station have been shown as being located alongside the main line tracks 1 such facilities could, if preferred, be located alongside a track portion of the local loop 4 adjacent to the main track.

THE ROLLING STOCK

Representative rolling stock for the local feeder and express train is shown more particularly in FIGS. 3 to 13. FIG. 3 shows a representative local car 8, a through car 10 and a road engine 11 connected to form a train. It will be understood that a considerable number of additional through cars 10 could be included in the train and some local cars 8 as represented in FIG. 3. A large part of the road engine 11 may be arranged to carry passengers if the road engine is of the electric type, but such engine might still accommodate some passengers if it is of the diesel or turbine type.

A representative through car is shown in FIG. 4 as being supported by a plurality of front and rear wheels 12 which are located at the sides of the car as shown in FIGS. 6, 5 and 7 to run on a single supporting track 13. Higher rails 14 can be supported in positions along opposite sides of the train for engagement by lateral stabilizing wheels 15 projecting from opposite sides of the through car and road engine, preferably adjacent to the ends of such vehicle, as shown particularly in FIG. 4. Such lateral wheels stabilize the vehicle so as to control its sidewise tilting because the vehicle is supported on the single rail 13. For a car supported on wheels 15 can be carried by yokes 16, as shown in FIG. 6, mounted on the opposite ends of a rod slideable through a housing 17.

The housing 17 can enclose a compression spring connected to the rod extending between the yokes 16, so that when a through car or locomotive is traveling along a straight track, the spring force will hold the vehicle yieldingly in a centered upright position. Normally in rounding a curve centrifugal force would tilt the vehicle body away from the center of the curve. By suitable gyrosopic sensing mechanism and accelerometer means, the action of centrifugal force can be applied to actuating mechanism for moving the yoke 16 laterally with respect to the car. Such movement will cause the vehicle to bank, as shown in FIG. 7, sufficiently so that compensation would be provided for the centrifugal force. Such movement of the yokes 16 can be effected by double-acting jacks in the housings 17.

To enable the vehicle body to tilt without requiring the guide rails 14 to be banked, or to tilt relative to horizontal at an angle different from the angle of bank of the guide rails, the housing 17 is tiltedly mounted by pivot means 18 having a longitudinal axis. The passages 19 in which the wheel forks carried by the yokes 16 are received are sufficiently deeper than the thickness of such yokes so that the yokes can tilt through a substantial angle relative to the vehicle, as shown in FIG. 7. When the vehicle resumes a straight course, the compression spring means in housing 17 will right it.

The local car 8 is supported by side wheels 20 running on top of arms 21 mounted on axles 22 extending transversely through the lower portion of the local car. When the local car is to travel around a road local loop 4, the vehicle body is supported by trucks 23, supporting cradles 24 in which the vehicle body can rest. Such truck includes conventional rubber-tired wheels 25. Relative movement of the trucks and local car body is prevented by stop projections 26 shown in FIGS. 10, 11 and 12, which can engage recesses in the vehicle body or can abut the ends of such body.

Road wheel trucks for converting a local car into a roadable vehicle can be of any variety of types. Separate front and rear trucks can be provided for each local car. Alternatively, a single truck with front and rear wheels of a length comparable to the length of the car can be provided. Another alternative is illustrated in FIG. 13 in which the road wheels 25 are mounted on the ends of pivoted axles 27 which can fold upwardly to retract the wheels into the lower portion of the local car body. The important consideration is that the local cars be convertible at transfer locations from a rail vehicle to a roadable vehicle and vice versa.

The local cars 8 are shown as not being self-powered but as propelled around the local loops 4 by switch engines or tractors 9, although such local cars may be self-propelled if desired. Such a tractor which is shown in FIGS. 8, 9 and 12, is equipped both with roadable wheels 28 and flanged wheels 29 spaced for traveling along the side tracks 14. The local cars may similarly have fixed roadable and flanged wheels.

Such a switch engine or tractor can be connected to a local car 8 by a conventional coupling 30. Such coupling must be engageable between the switch engine and the local car when both vehicles are traveling on the rails 14 and also when both vehicles are traveling along a road. As shown by a comparison between FIG. 8 and FIG. 12, the switch engine and the local car must be at different relative elevations for road travel and for track travel. The local car is considerably higher relative to the switch engine when both vehicles are traveling along the road than when both vehicles are traveling along the rails 14. To enable the relative elevations of the switch engine and the local car to differ while they are coupled together, the part of the coupling 30 attached to the switch engine is carried by the lower end of a stanchion 31 reciprocable vertically in a guideway 32 in the end of a tractor or switch engine.

As the relative elevation of the switch engine and local car is altered, the stanchion will slide vertically between the positions of FIG. 8 and FIG. 12 to prevent relative tilting of the vehicles and to maintain the drawbars always in a plane parallel to the longitudinal axes of the local car and the switch engine. It is desirable for the switch engine to be operated either to push or to pull a local car. When the switch engine is pushing such a car, the operator may sit in a cupola 33 which can be elevated above the switch engine to permit the operator to look over the top of the local car as shown in FIG. 8. Such a switch engine should be constructed to run well in either direction for long periods of time and should be capable of driving the local car at least for short distances at speeds comparable to the speed of the express train composed of the road engine 11 and through cars 10.

LOCAL CAR TRANSFERRING

As has been discussed above, the most important aspect of the present invention is to be able to save the time required for stopping and starting the intercity express train at least at most junction locations by enabling the express train to pick up and let go local cars at junction locations without stopping and with minimum slackening of speed. At a particular junction location an express train should be able to drop one or more local cars containing passengers wishing to detrain and then pick up one or more local cars containing passengers wishing to entrain. The local car or cars being dropped can simply be disconnected from the express train and then be towed or driven or carried into the local station or to a location to be picked up by a local switch engine or tractor 9. The local car or cars to be picked up can be accelerated to catch the express train if
self-propelled or if it is pushed with a switch engine; or automatic pickup mechanism can be provided to effect acceleration of the local car or cars and connection of them to the express train. Speed controls can be automatic or operated by train crew.

At each junction location an elevated local junction track 34 is disposed above the main line track 13, 14 as shown in FIG. 14. In order to reduce the rise of the local junction track the main line track 13, 14 can dip below its general level beneath the elevated local junction track as shown in this FIG. The local junction track will include two rails disposed in vertical registry respectively with the side rails 14 of the main track. A switch track section 35 is connected by a hinge 36 to each end of the elevated local junction track so that the switch track can be swung between a lowered position in engagement with a track 14 as shown in solid lines in FIG. 14 and a raised position shown in broken lines in which the connection between the switch track and the main line track is disrupted.

Details of representative track switching mechanism are shown in FIGS. 15 and 16. The stationary track section 34 can be supported at intervals from a suspension member 37 by tie rods 38 spaced along the length of such stationary track section. The track section 35, swingable about the pivot 36, can be supported from an upper supporting member 37' swingable relative to the stationary supporting member 37 and about a hinge 36'. Such supporting action is effected by spaced tie rods 38' pivotally connected to the swingable track section 35 by pivots 39, and to the support member 37' by pivots 40.

Support member 37' can be swung about the axis of hinge 36' by a motor 41 which turns a screw 42 threaded into a nut 43 mounted by a pivot 44 on the swingable support member remote from hinge 36'. As the screw is rotated by the motor to move the nut 43 upward, the support member 37' is swung upward to raise tie rods 38' guided by sleeves 39' for swinging the track section 35 upward from the broken-line position to the solid-line position shown in FIG. 15. Such swingable track sections should be raisable far enough to enable a wheel 20 supporting a local car 8 to move between the raised local track section 35 and the side rail 14 of the main track. In the lowered positions, the cupped swinging ends of track sections 35 embrace the upper portions of tracks 14 to provide smooth transition movement of local car wheels from the side rails onto the switch rails.

ROAD WHEEL CONVERSION

Along the length of an upper local track 34 may be located facilities for applying and removing road wheel trucks 23, 24 from local cars or supporting local cars by such trucks if the road wheels are not simply retractable into the cars as shown in FIG. 13. Storage facilities for trucks for local cars can be provided at such junctions in which trucks removed from local cars transferring to tracks can be stored and from which trucks can be supplied to local cars to be removed from the tracks to follow a local neighborhood course. In FIG. 17 the lower main tracks are shown as passing through a tunnel 45, while the local car road track storage facilities are contained in the building 46 above the tunnel. Preferably the upper local tracks 34 are also housed in a tunnel within the building 46, located directly above the main track tunnel 45. Scissors lift carts 48 are located in the upper tunnel at locations corresponding to the locations for the wheeled road trucks at opposite ends of the local car. Each of these cars is equipped with a lift 49 raisable relative to the local rails 34 into a broken-line position as shown in FIG. 17 in which it can support a road truck when it is detached from a local car 8, or into which position the lifting mechanism can raise a road wheel truck for attachment to a local car.

In registry with the position of the cart 48 is an opening in the roof of tunnel 47 through which the cart carrying a road wheel truck lowered from a local car can be moved onto a platform 51. Such platform is one of a series of platforms which can circulate past the opening 50. As a cart 48, loaded with a road wheel truck, is rolled through the opening 50, it will move onto a movable platform 51. This platform can then be moved upward in the direction indicated by the arrows at the left of FIG. 17 by suitable elevator mechanism until that platform reaches a position even with the top 47' of the tunnel. When the platform is in this position the cart can be rolled off the platform 51 onto the roof 47 of the tunnel, across such roof and onto another platform 51 which can descend.

It is preferred that the two sets of platforms 51 at opposite sides of the tunnel 47 be capable of circulating in an orbit. The platforms at the left of the tunnel 47, as seen in FIG. 17, would be raised along guides 52 between the lowermost position and the uppermost position shown in that FIG. The platform would then descend again to the lowermost position, but along a path spaced from the ascending path. The platform 51 could be lowered by any suitable mechanism while either maintaining the same attitude or a different attitude. The platforms 51 at the right side of the tunnel 47, on the contrary, would be lowered progressively from the upper position shown to the lower position along guides or supporting means 52. Such downwardly moving platforms would receive ground-engaging wheel trucks in the upper position, and in the lower position of each platform such a ground-engaging truck would be moved on its cart 48 from the lower position through the opening 53 into a position beneath a local car body.

The platforms 51 at the right of the tunnel 47 in FIG. 17 could also be circulated in an endless path in which the platforms would move downward in spaced relationship, shown in FIG. 17. They could then be moved upward successively from the lowest position to the highest position in a path spaced from that shown in this FIG. Thus the upwardly moving platforms and the downwardly moving platforms would serve as revolving storage means for the road wheel trucks of the local cars.

When a local car has been moved into the tunnel 47 of FIG. 17 without ground-engaging wheel trucks from the main line tracks 14, such trucks will be supplied to the local car from the lowest platform 51 at the right of the tunnel, raised into the position shown in FIG. 17 and attached to the local car. The local car can then be moved along the tracks 34 on rail wheels 20 to another location where either the local car is hoisted bodily from the rails and set on a roadway to be supported by the road wheel trucks, or the arms 21 are swung downward so that the rail wheels 20 raise the local car into a position such that the road wheels 25 of the trucks 24 are above the tracks 34. The local car then moves to a position in which the space between these tracks has been filled in where it can be lowered by upward movement of the track wheels 20 so that the local car be supported on a roadway surface between and level with the tracks 34. The switch engine can then pull the local car supported by its truck or trucks across the tracks onto a coplanar roadway for travel along a local circuit.

When a local car has completed a local circuit and is to be connected to a through train for transfer of passengers to it, the local car can be propelled onto a portion of an upper track right of way where the space between the rails has been filled with a roadway surface. The wheels 20 are next swung downward to take the weight of the local car on the rails 34. The wheels 25 can then be moved into the retracted, broken-line position of FIG. 13 in the body of the car, if the wheels are retractable. Alternatively the local car can be moved along the rails into tunnel 47 if the road wheels are to be removed. The wheels 20 can then be raised somewhat so as to lower the trucks 24 onto the hoisting mechanism 49 of a truck transfer cart 48. The lift mechanism 49 can then be lowered to remove the road wheel trucks from the local car body so that such trucks can be moved into storage space on a platform 51 at the left of tunnel 47 shown in FIG. 16 as previously described. The wheels 20 can then be swung upward relative to the body of the local car 8 so that the local car can then be driven between the rails 34 in a very stable position. The local car will then be in a condition to descend an end portion of the upper
local rail 34 onto the side rails 14 of the main track to be connected to a through train. While a local car could be propelled by its own momentum from the main track 14 onto the upper local track 34 shown in FIG. 14 after being disengaged from a through train, a local car can gain sufficient forward momentum to descend down the sloping end portion of an upper track arrangement 34 to catch a through train. Consequently, it is necessary either to arrange for the tractor 9 described in connection with FIGS. 8, 9 and 12 to propel the local car at a speed sufficient to overtake a through train so that it can be connected to the through train, or a pickup arrangement actuated by the through train must be provided to enable the through train to accomplish the operation of accelerating the local car and connecting it to the through train. Mechanism which can be utilized for the latter type of operation is illustrated in FIGS. 18, 19 and 20.

In FIG. 18 the upper side tracks 34 are shown in a position elevated above the main side tracks 14 generally comparable to the relationship of such tracks shown in FIG. 17, but on an enlarged scale. A through car 10 is shown as being supported by the wheel 12 on the center track 13 and stabilized by wheels 15 engaged with the lower side tracks 14. The local car 8 is supported on the upper local rail 34 by its wheels 20 mounted on rails 21 connected by pivots 22 to the local car body. FIGS. 18, 19 and 20 also show mechanism engaged automatically between the through car and the local car for initiating movement of the local car, accelerating its movement to a speed equal to that of the through car and coupling the local car to the through car.

From the forward portion of the body of the local car 8 a hook 54 depends, swingable about a horizontal pivot 55. The lower end of such hook hangs in the path of a ring 56 which is supported above the rear end of the through car 10 by harness lines 57, extending from and slidable through hollow posts 57' mounted in spaced relationship at opposite sides of the car respectively. From the lower side of the ring a line 58 extends downward to a winch 59 in the lower portion of the through car.

As the through car 10 passes the local car 8, the ring 56, while attached to the through car, will be caught by the hook 54 carried by the local car, as shown in FIGS. 18 and 19. The force applied to such ring by the hook will disconnect the ring from the harness lines 57. The force exerted by the towline through hook 54 on the local car will accelerate it rapidly to equal the speed of the through car, but not instantaneously, because the towline winch 59 will pay out under stress. Thus the towline provided a yieldable connection between the through car 10 and the local car 8.

Acceleration of the local car to a speed equal to that of the through car will be aided by travel of the local car down the inclined end portion of the upper local track 34, as shown in FIG. 14. At the same time the speed of the through car may be slackened somewhat either by deliberately retarding its speed or because the through car is climbing the grade of the main track at the junction of the upper local track with it as shown at the right of FIG. 14, or for both reasons. As the local car moves onto the main track it will descend to the same elevation as the main car, so that the two cars are in the relationship shown in FIG. 20. In this relationship the two parts of the coupling 30 are at substantially the same level, but such coupling parts are spaced apart a distance substantially equal to the interval between the adjacent ends of the through car and the local car.

The towing connection between the through car and the local car is connected to a braking system for the local car. Sensing mechanism is provided to sense the tension in the towline 58 so that such line will be paid out by unwinding of the drum 59 as long as the tension exceeds a predetermined value. As the local car is accelerated by the tension in line 58, the speed at which such line is paid out will be reduced gradually until the local car is traveling at the same speed as the through car. At this time the length of the towline will be several hundred feet.

The sensing mechanism will then effect rotation of drum 59 in a reeling-in direction to shorten the towline 58 while maintaining it under the same tension until the length of towline between the local car and the through car has been reduced to a predetermined length. The rate at which the drum 59 turns in a reeling-in direction will then be decreased progressively until the coupling parts 30 are engaged. For safety purposes, control mechanism will be provided to limit the speed at which the drum 59 can be turned in the reeling-in direction, so as to avoid a situation where the local car is overtaking the through car at an excessive rate. Also, if the tension in line 58 should suddenly decrease below a predetermined value, which would be occasioned by the through car being braked, the brakes for the local car also will be applied automatically to restore the tension in the towline so that the local car will not overtake the through car and ram its rear end.

Following engagement of the coupling parts 30, the doors in the adjacent ends of the cars are conditioned for opening to enable passengers to move between the cars. If the hook 54 is held in its upper position and the towline 58 slackened, the ring 56 will drop off the hook. The towline 58 can then be paid out again after the local car has been uncoupled from the through car at a subsequent stop, and the ring can be replaced in its upper position shown in FIGS. 18 and 19, held by the harness line 57 ready for engagement by the hook 54 of another local car.

When it is desired to disconnect a local car from a through car at a transfer location, the coupling parts can be disengaged, which will sever all connection between the local car and the through car. The local car will then decelerate and its rate of deceleration will be increased by the local car running up the incline track sections 35 and 34 at the junction location.

BRAKING APPARATUS

Particularly because the through train locomotive and cars are to be operated at high speed the engagement between the wheels and the rails may not be sufficient to afford adequate braking effect. Consequently, it is desirable to provide braking mechanism instead of or in addition to wheel braking mechanism, particularly for the through train. Similar braking mechanism can be used for the local cars.

FIG. 21 illustrates in somewhat representative fashion a type of braking mechanism which provides friction engagement directly between a car and a rail, and preferably the central rail 13, independent of the car weight. Such braking mechanism includes concave clamping brakeshoes 60 which embrace a rail such as the rail 13. Such shoes can be clamped against the rail by suitable clamping mechanism when it is desired to apply the brakes. Any number of such clamps can be provided for each car, and they may engage either the central rail 13 which is preferred, or the side rails 14, or both the side rails and the central rail. If such braking mechanism is provided for the local cars, the brakeshoes would, of course, engage the side rails so that they could be applied to the side rails 14 of the main line or to the siding rails 34 at the transfer points.

The shoes 60 of the brake mechanism should be made of material which will be highly resistant to wear, but which will not scuff the surface of the rail which the shoes engage. At the same time, the brakeshoe material should be of a type which will afford a reasonably good coefficient of friction in engagement with the material of the track. Brakes projectable to produce air drag may also be provided, if desired.

THE TRACK STRUCTURE

As has been emphasized above, a principal capability of the present invention is to provide a high-speed, non-passenger express railway, or at least a section of such railway, which the express train makes only a few major stops. Consequently, it is important for the roadbed of such a train to be very smooth and even and to be free from conflict with other surface traffic. Consequently, there must be no grade crossings, which eliminates the danger of grade
3,552,321

collision, although, as shown in FIGS. 23, 29 and 30 a roadway may be provided beneath and parallel to the suspended track along its right of way. The track for such a high-speed train should be substantially level and, where changes in elevation are mandatory, the grade should be moderate. The locomotive should, however, have sufficient power to move the train at reasonable speeds up such grades as may be required to enable the train to traverse mountain passes.

Because of the high speed of which the through train is capable, little or no braking will be required for trains descending the usual grade. The aerodynamic drag will exert a sufficient slowing action on the train in most instances. Because of the moderate grade of the track, the high-speed character of the train and such aerodynamic drag characteristics, the track can be generally in the direction of the destination corresponding to the descent of an airplane from altitude to its landing field. Additional time is thus saved over tracks which follow switchback courses.

Because it is desired that such trains serve metropolitan centers, it is desirable that the right of way for such high-speed trains be capable of being shared with other types of land use, such as for example as highways. A major portion of the expense in the construction of any railroad is the conditioning of the land on which the tracks are to be placed, including leveling and grading the roadbed, and providing proper drainage and ballast for it before the actual train and ties are placed. It then becomes necessary to replace wooden ties from time to time which involves considerable maintenance work and expense.

The present invention utilizes a type of track system which eliminates the disadvantages mentioned above.

A railway track of the type shown in FIGS. 22 to 31, suspended from pillars 61, has these advantages. In addition, such a suspended track having a generally open lattice type of suspension casts minimum shadow on the land or road below the track structure. Such pillars may be tapered oppositely from their centers, and the lower ends of such pillars may be mounted on footing blocks 62, such as shown in detail in FIG. 22. To enable the pillar to be supported in any desired inclined position its lower end may be recessed to fit a ball 63 carried by a plate 63. Such plate can be raised and lowered to some extent by mounting it on a base 64 supported by a rotatable jack screw 65. The plate may be adjusted horizontally by sliding a tongue 63 projecting downward from its lower side along a semicircular groove 64 in the base. The direction in which such horizontal movement is effected is established by turning such base in the footing block cavity and locking it by a suitable clamp or by set bolts.

By use of such adjustable footing blocks, the positioning of the pillar feet can not only be adjusted for their proper initial locations, but their positions can be corrected to compensate for normal settling of the ground in use, or for settling which may be caused by earthquakes. The pillars can be made in several standard lengths so that the appropriate columns can be selected to suit irregularities in the terrain. The amount and direction of tilt of each pillar 61 can be controlled by the length and location of guys 66 connected to the upper ends of the pillars.

Over the tips of the pillars 61 are draped catenary suspension cables 67 carrying upright generally parallel support wires or rods 68 spaced along their lengths. Such supports 68 preferably converge downwardly, and they carry parallel lower strings 69 and upper strings 70. Between such strings the supports of stiff rigid structure, although above the strings 70 the supports can be flexible cables. The lower strings between opposite supports 68 are connected by rigid crossties 68. As shown best in FIG. 7 such strings are connected by rigid crossties 71 at the locations of the supports 68, respectively, to form rigid scissors truss crawlers for the center rail 13. The side stabilizing rails are suitably connected by a web to the upper strings 70 in positions spaced inwardly from the stringer 68 to accommodate the through car stabilizing wheels 15 and the supporting wheels 20 of a local car. Deep trusses formed by a lattice of crossing wires between the stringers 69 and 70 extend along opposite sides of the track suspension from transverse truss to transverse truss. In addition, the bottom stringers 69 are connected by a lattice work of crossing wires or rods. Preferably such wires or rods cross at approximately right angles, so that such ties are disposed at approximately 45° to the strings. Such ties individually may be either rigid or flexible, but the latticework forms a rigid supporting structure for the tracks.

The catenary suspension for the rail structure is subjected to the same stress at all locations along the track. Such a structure which is stressed entirely in tension is the lightest and least expensive to construct, and also is quick and easy to erect. The only compression members in the support structure are the pillars. Only vertical loads resulting from the weight of the train are imposed on the bottom rail 13, whereas only lateral loads are exerted on the side rails 14 by the through train.

The same general type of system can be used to support a curved portion of the track as shown in FIGS. 25 to 28. In this type of construction the catenary suspension cables 67 and upright supports 68 are replaced by inclined suspension cables 67 which support a rigid trusswork fabricated to the desired degree of curvature of the track. Such trusswork includes supporting crossbars 72 spaced along the track and projecting from the inclined supports 67 along which the inclined support cables 67 are attached. Such support cables at one side of the track can be longer than those at the other side, as shown in FIG. 26, so as to support the trusswork at the desired degree of bank.

The upper stringers 70 are supported at each side of the trusswork by struts 73 and 74 converging upwardly. Gusset tubes 75 connect the lower ends of the struts 73 and 74 and the lower ends of the crossties 71 to form rigid frames at the locations of the crossbars 72. Such tubes are of triangular cross section composed of plates extending from frame to frame so as to form continuous cross sections. The sides of such tubes can have lightening holes in them to an extent which will not impair their structural effectiveness. Such tubes should, however, have an adequate stiffener connecting the upper apexes formed by the sideplates. The trusswork is completed by lattice members disposed generally horizontally and connecting the crossbars 72 and the bottoms of the frames. In FIGS. 25 and 28 illustration of the frames, stringers and rails has been omitted to avoid confusion. Also in FIG. 28 the inclined supports 67 at the far side of the trusswork have been omitted for clarity. Such supports are shaped to resist the resultant sway tendency of the track structure.

FIGS. 29, 30 and 31 show the application of similar track suspension principles to a double track. In this instance the tips of the pillars 61 carry outer catenaries 67 and, through lines 78 and 79, carry inner catenaries 77. Such inner catenaries are relatively short, as shown in FIGS. 29 and 31, and their apexes are supported by inclined support cables 78 inclined downward from adjacent towers. The adjacent ends of such support cables are connected by a horizontal connecting cable 79. The outer stringers 69 and 70 are supported by support cables or rods 68 carried by the outer catenary suspension cables 67 and the inner stringers are carried by upright support cables or rods 80 carried by the inner short crossties 87.

As shown in FIG. 31, the outer supports and the inner supports 68 are arranged in the same transverse planes respectively. At the locations of such supports, therefore, the upper and lower stringers 69 and 70 are connected by crossties 71 as previously described in connection with FIGS. 7 and 23. The tracks 13 and 14 are carried in the same manner by the inverted scissors truss crawlers thus formed.

By the use of a track structure suspended well above the ground such as that described, the aerodynamic or parasite drag on the train is minimized. The aerodynamic interference between the ground and the body of a train or road vehicle traveling on the ground produces more than half of the aerodynamic drag on the vehicle at speeds in the vicinity of 40 to 70 miles per hour. At higher speeds, the proportion of the
aerodynamic drag caused by such interference increases. In addition, the ground-engaging wheels create further turbulence, which increases the parasite drag.

A track system of the type described above will be suspended high enough above the ground to eliminate all aerodynamic interference between the moving train and the ground. Moreover, the supporting structure for the rails is sufficiently open, so that the track-supporting structure, past which the train moves, causes the least possible drag on the train resulting from interference between the track-supporting structure and the moving train. The supporting and stabilizing wheels project only a short distance transversely beyond the contour of the streamline body, as shown best in FIGS. 5, 6 and 7, as to minimize drag caused by them. The streamlined character of the vehicle body can be best preserved by making it of substantially circular cross section.

A practical seating arrangement for a railway car body of circular cross section is disclosed, for example, in my previous U.S. Pat. No. 2,595,607, particularly in FIGS. 5, 6 and 7. Moreover, a car body of circular cross section reduces side loads resulting from wind blowing transversely to the direction of travel. Movement also, a body of essentially cylin-
drical shape can utilize structure similar to that of an airplane fuselage which has a smooth exterior surface that minimizes parasite drag. Boundary layer control devices can be provided, if desired, to reduce skin friction still further.

**TRACK SWITCHING**

More tracks will be required to handle rail traffic in metropolitan areas. Also, it may be desirable to route through trains along different courses. On occasion, it will be necessary to take a through train, or some part of such a train, out of service. In all of such instances, it is desirable to be able to switch a through train from one track to another. Diagrammatic and representative types of track-switching arrangements are illustrated in FIGS. 32 to 33.

In FIGS. 32 and 33, one type of arrangement for switching a train from one track to an adjacent track is shown. Switch-track sections 81 carried by pivots 82 are provided as alternates to the bridging-track sections 83 for connecting track components 13' at opposite sides of the switch gap. In FIG. 32, the bridging-track sections 83 are shown as being aligned with the track components 13' at opposite sides of the switch gap. In FIG. 33, the bridging-track sections 83 have been displaced from their connecting positions and the switch-track sections 81 have been swung on their pivots to connect a track component 13' at one side of the switch gap to a track component at the other side of the switch gap which is offset from the track component at the first side of the gap. To enable such a switch connection to be made, the switch-track section 81 is of somewhat ogee shape and the pivot of the switch-track section is located substantially midway between the track components at opposite sides of the switch gap transversely of the lengths of such components.

In FIG. 34, an alternative type of switch-track arrangement is shown in which only a single switch-track section 81 is provided. Such switch-track section can be shifted to different positions in the switch gap transversely of the lengths of the track components 13'. In this instance, only one switching connection is shown in full lines and a second possible switching connection is indicated in broken lines, as compared to the switching arrangement provided for all four lines of track in the arrangement of FIG. 33. While the bridging-track sections 83 of FIGS. 32 and 33 are displaced from their track-connecting positions by removing them completely from connection with any of the tracks, the bridging-track sections 83' shown in FIG. 34 are simply swingable about one end from a position in alignment with two track components at opposite sides of the switch gap into a swung position in which one end of the switch-track section remains pivotally connected to a track component while the other end of the switch-track section is separated from the track component to which it can be attached.
The plug is carried by a cylindrical slide 95 slidable in the interior of the tubular element. A lug 96 projects from such slide through a slot 97 in the wall of the tube. A force can be applied to such lug to reciprocate the plug between track element-connecting position and retracted position. Such force can be applied manually, by impact, or by a powered thrust-producing device such as a solenoid or a fluid-pressure jack.

Alternatively, the plug slide 95 in each rail and stringer other of a track connection can be spring-pressed outwardly and have a cable attached to it for application of a retracting pull in opposition to the force of the projecting spring. In the operation of coupling or uncoupling track ends, therefore, each of the slides is pulled by its cable until the plug 94 has been withdrawn from the tube into which it is projected by its spring. All of such cables can extend through the tubes of a switch-track section or of a bridging-track section to its center and at that location can be connected to a lever or other mechanism for pulling all the cables of such track section simultaneously. The end of each track-section tube can then be moved into or out of registry with the corresponding tube end of a main-track component 13'. When the tubes have been moved into registry or moved out of registry, as may be desired, the cables can then be released so that the springs will project the plugs again.

While the switch-track sections have been shown as being arranged to connect main lines, a similar arrangement could be used to connect branch lines or to connect main lines to different branch lines. The same arrangement can also be made to switch through trains to or from servicing lines. Also, while the switch-track sections have been shown as providing an offset all in one sense, the ogee curvature could be opposite so as to provide an offset in the opposite sense, depending upon the requirements for a particular switching location.

LOCAL AND EXPRESS TRAIN OPERATION

In operation a through train will travel at high speed along the main line past successive junction locations or transfer stations 3 indicated in FIG. 1 without stopping or slowing appreciably. At each junction location the through train will release all the local cars which it is pulling and it will pick up any local cars waiting for it. Prior to the through train reaching such location, of course, passengers destined for the local route served from it will have moved from the through train to the local cars attached to it and the connecting passageways will have been closed and secured. Similarly the local cars at such transfer station will have been loaded. When the local car or cars have thus been picked up, the passengers in them will move into the through train unless they wish to detrain at the next transfer station. Also, other passengers wishing to detrain at such next transfer station will move from the through train into the local car or cars.

At the next transfer station, then, the local car or cars last picked up will be detached from the through train and left at such next transfer station, and any local car or cars ready at such transfer station will be picked up by the through train. This procedure will be repeated at each junction location along the main course 1. It will be evident that the number of local cars dropped and picked up at each such location will depend upon the traffic demand along the main route, and such traffic demand will be affected both by the size and population of the various communities and the time of day during which the through train is making its run.

As each local car or local car group is dropped at a particular transfer station its momentum will carry it to a location where it will be converted to roadable condition, as described above. The tractor or switch engine will then propel the local car or car group around the local route 4 to service the particular community or the local car group can be self-propelled. When the local car or car group is returned to the main line junction location one or more of the local cars can be stored and others can be transformed from roadable condition to the condition for travel along the main track side rails and placed to be picked up by the next through train. Depending upon the service demands there may, of course, be more than one local car or car group traveling around a particular local route at the same time, or more than one local route can be served from a particular main line junction location. Also, the size and arrangement of any local route can be varied from time to time, even during the course of a day, in accordance with traffic demands.

1 claim:

1. A railway system comprising main track means defining a main route and including a central load-supporting lower rail and upper load-supporting side rails elevated above said central rail and spaced from each other, local track means defining a local route having a portion spaced from said main track means and a portion adjacent to said main route and including spaced load-supporting rails spaced apart the same distance as said side rails of said main track means but without a load-supporting central rail therebetween, a through car adapted to travel along said main track means and including means for supporting the principal portion of its weight on said central load-supporting lower rail of said main track means, a local car adapted to travel along said local route and including supporting means selectively engageable with said spaced rails of said local track means and with said upper side rails of said main track means for supporting the entire weight of said local car therefrom, and transfer means between said main track means and such portion of said local track means adjacent to said main route for transferring said local car to shift its supporting means between said spaced rails of said local track means and said upper side rails of said main track means.

2. The railway system defined in claim 1, in which the portion of the local route adjacent to the main route includes a portion of the local track means spaced rails elevated above and in vertical registry respectively with portions of the upper side rails of the main track means, and the transfer means includes means supporting part of said local track means spaced rails portion for elevational movement between a position spaced above the upper side rails of the main track means therebeneath and a position in engagement with the upper sides of the upper side rails of the main track means therebeneath.

3. The railway system defined in claim 1, and pickup means carried by the through car and engageable with the local car while on the portion of the local track means adjacent to the main route to effect movement of the local car over the transfer means from the spaced rails of the local track means to the upper side rails of the main track means.

4. The railway system defined in claim 1, in which the main track means are located a substantial distance above the ground, and track-supporting means extending above the main track means and including a series of inverted scissors truss cradles suspended from the track-supporting means spaced along the main track means and supporting the main track means suspended from said track-supporting means.

5. The railway system defined in claim 1, in which the main track means is located a substantial distance above the ground, and track-supporting means including pairs of pillars spaced lengthwise of and projecting upwardly above the main track means, the pillars of each pair being located respectively at opposite sides of the main track means and the lower portions of such pillars in each pair being spaced apart a distance at least as great as the transverse width of the track means.

6. The railway system defined in claim 5, in which the pillars of each pair converge upwardly.

7. The railway system defined in claim 5, in which the main track means includes two sets of tracks disposed in side-by-side relationship, both supported by the track-supporting means.

8. A railway system defined in claim 1, in which the main route includes a plurality of generally parallel main track means having a switching gap therein, bridging-track sections normally connecting adjacent ends of adjacent main track means, respectively, and a switch-track section insertable.
between the end of one main track means at one side of such switch gap and the end of another main track means at the other side of such switch gap for transfer of a train component from one main track means at one side of the switch gap to a different main track means at the other side of the switch gap.

9. The railway system defined in claim 3, in which the pickup means includes variable length means for connecting the through car and the local car, and coupling means separate from the pickup means interengagable to connect the through car and the local car.

10. The railway system defined in claim 3, in which the pickup means includes hook means carried by the local car and ring means carried by the through car and engangeable by said hook means.

11. The railway system defined in claim 10, and ring-supporting means carried by the through car operable to support the ring in an elevated position for defining a course in which the hook is located.

12. The railway system defined in claim 11, in which the ring-supporting means includes a plurality of flexible harness lines connected to the ring.

13. The railway system defined in claim 10, a winch carried by the through car, and a towline connected to the ring and wound on said winch.

14. The railway system defined in claim 5, and a base block supporting each pillar for elevational adjustment.