A train assembly is moved continuously along a right of way during a track renewal or replacement operation, with a first train section of cars moving on the old track rails and a second train section of cars moving on the new track rails. In an intermediate trackless section, the old track is replaced by the new track, and an intermediate train section bridges the trackless section of the right of way. The intermediate train section is pivotally coupled to the first and second train sections, the latter being held at a predetermined distance. Track renewal means operable in a timed sequence during the continuous movement of the train assembly are mounted on the cars.

18 Claims, 11 Drawing Figures
MOVABLE APPARATUS FOR REPLACING AN OLD TRACK BY A NEW TRACK

The present invention relates to the continuously progressing replacement of old track by new track by means of a train moving along a right of way consisting of a section of old track, a section of new track and a trackless intermediate section wherein the old track is replaced by the new track. The replacement preferably includes not only the two track rails but also the ties whereon the rails are supported on ballast.

Track replacement apparatus of this general type has been described, for instance, in our U.S. Pat. No. 3,330,219, dated July 11, 1967, and U.S. Pat. No. 3,521,565, dated July 21, 1970. Such apparatus includes a first train section of cars moving on the old track rails and a second train section of cars moving on the new track rails. Means on respective cars, including vertically and/or laterally moving implements, transport and support the rails and/or the ties of the old and new track, respectively receive and lay the rails and/or the ties of the old and new tracks, and guide without friction the track rails bridging the intermediate trackless section of the right of way. All these implements are controlled and operated in timed sequence during the continuous movement of the train assembly.

In known apparatus of this type, various means are arranged for movement in the trackless intermediate section of the right of way independently of the movement of the train sections, which sections also move independently of each other. The independently movable means include implements for receiving and/or laying track parts, and for working on the ballast.

This combination of three independently moving sections results in delays in putting together the entire apparatus, as well as difficulties and delays in the operation of the assembled apparatus. The efficiency of such an apparatus is further reduced because each independently moving section requires an independent drive and it is difficult to synchronize these drives during the continuous forward movement of the apparatus. If the movement of only a single section or vehicle is out of step, the work of the entire apparatus is affected thereby.

In addition to these difficulties, the accuracy and quality of the track replacement also suffer because of varying distance between the point where the old track parts are received and the point where the new track parts are laid correspondingly varies the conditions for the guidance and fixing of the rails. In this respect, it may be noted, for instance, that the rails are subjected to flexing as they are lowered from the transport cars to the intermediate section where they are laid or where they are lifted to enable work to be done on the ballast, the flexing load depending on the curvature of flexing which is a function of the distance between the transport cars and the point where the rails are laid.

It is the primary object of this invention to avoid the above difficulties and disadvantages in track replacement apparatus of the indicated type.

It is a concomitant object of the invention to structure such an apparatus so that it assures a continuously uniform and accordingly highly efficient, automated cooperation of all the operating portions of the apparatus.

The above and other objects are accomplished by maintaining the respective cars of the first and second train sections which are adjacent the intermediate trackless section of the right of way at a constant distance. Accordingly, an intermediate train section bridges the trackless intermediate section of the right of way. The intermediate train section is respectively linked, for instance by pivotal couplings, to the first and second train sections to interconnect the same for common movement, and means is provided for maintaining the respective linking means at a predetermined, preferably adjustable, distance in the direction of the right of way.

With an apparatus of such structure, it is possible to renew a track truly continuously and under constant operating conditions in a timed sequence of operating steps in the manner of a mass producing conveyor. This structure makes it further possible to arrange in the intermediate section of the right of way all the implements required to lay the track and/or treat the ballast, these implements being combined with the train cars which transport the rails and ties in a single unit, rather than being assembled on the track renewal site.

In accordance with an important feature of the present invention, the desired operation of these implements is further facilitated and simplified by selectively operable vehicles arranged to move on the track and to move on the trackless intermediate section of the right of way, preferably including full-track vehicles capable of moving on the ballast in the intermediate section.

This feature enables the intermediate train section to start or stop its track renewal work without any change in the structure, and thus to change from a forward movement during renewal to a forward movement from one renewal site to the next.

The above and other objects, advantages and features of this invention will become more apparent from the following detailed description of certain now preferred embodiments thereof, taken in conjunction with the accompanying schematic drawing of track replacement apparatus, wherein

FIG. 1 is a side view of the central portion of a train assembly according to the invention;

FIGS. 1a and 1b show the respective left and right end portions of the train assembly of FIG. 1;

FIG. 2 is a top view of the central portion of the train assembly in the direction of arrow II of FIG. 1;

FIG. 3 is a side view similar to FIG. 1 but showing a modified embodiment of the intermediate train section;

FIGS. 4 and 5 schematically illustrate a track laying procedure with another embodiment of the train assembly;

FIG. 6 is a side view similar to FIG. 1 and showing yet another embodiment of the train assembly;

FIG. 7 is a transverse section of the train assembly of FIG. 6, along line VII—VII; and

FIGS. 8 and 9 are side views illustrating modifications of running gears or vehicles forming part of the intermediate train section.

It will be understood that, throughout the specification and claims, the terms "new" track and track parts refer only to the fact that they form part of a newly laid track and that such replacement rails or ties may, in fact, be used parts.
Referring now to the drawing, wherein like reference numerals in all figures refer to like parts functioning in a like manner to avoid redundancy in the description, FIGS. 1, 1a and 1b show the inner ends of the first and second train sections of cars used to transport and support the old and new track parts, respectively. These inner ends face each other and are adjacent an intermediate trackless section of the right of way, the first train section shown in the left portion of FIG. 1 and in FIG. 1a moving on the old track and transporting the old ties and new rails, as indicated by a first of a series of transport cars 1, while the second train section shown in the right portion of FIG. 1 and in FIG. 1b moves on the new track and transports the new ties and old rails, as indicated by a first of a series of transport cars 2. The working direction of the train assembly is indicated by a horizontal arrow, the first train section forming the forward section of the train assembly in this working direction while the second train section forms the rear section of the train assembly in this direction.

A flat car 3 forms the rear end of the forward train section and carries a schematically illustrated device, such as a trolley, for transporting the old ties 5 to the cars 1 and to place them on respective ones of these cars as the trolley runs over the flat platforms of these cars. Car 3 also carries a schematically illustrated implement 6 for loosening the rail spikes of old rails 7 which are shown in full lines.

All the cars of the first train section have running gears 8 moving on the old tracks 7.

A suitable rail gripping and guiding implement 9 for receiving the old track 7, after the rail spikes have been loosened, is mounted at the rear end of flat car 3.

A universal pivot 11' vertically above the running gear 8 of car 3 pivotally supports a support arm 11 extending towards the intermediate trackless section of the right of way and carrying a device 12 for receiving the old ties 5. Like the implement 9, the device 12 is only schematically shown because they may take any desired form. As more fully disclosed in our above-mentioned U. S. Pat. No. 3,521,565, means is provided for guiding without friction the old track rails 7 and the new rails 10 (shown in chain-dotted lines) which bridge the intermediate trackless section of the right of way, the schematically illustrated frictionless rail guiding means including preferably adjustably mounted guide rollers 13 on support arm 11, the guide rollers being divergently arranged so that the rails are spread apart beyond the track gage in the trackless section of the right of way whereby the track laying implements as well as any ballast working apparatus in the trackless section may operate without hindrance. A support 14 is pivotally connected to the support arm 11 and a vehicle or running gear 15 with wheels arranged to move on the track is vertically adjustable mounted on a guide column 14' of the support 14 for selectively lifting and lowering the vehicle 15 out of and into an operable position on the track.

An intermediate train section is shown to comprise a frame 16 which is a connecting part between the first and second train sections, and whose respective ends carry full-track vehicles 17, 17 which are selectively operable for moving on the ballast in the intermediate section of the right of way, an end bracket of the support extending over and being supported on the frame 16. In the illustrated embodiment, the frame 16 carries a ballast working machine. The frame is pivotally connected to the supports 14, 14 to provide the connecting train section intermediate the first and second train sections. The supports 14 are vertically adjustably mounted on the frame 16 by means of a hydraulic drive 18 to control the relative vertical position of these train portions.

Any suitable ballast working machine may be used, the illustrated machine being a ballast cleaning machine which comprises an endless bucket conveyor continuously moved by drive 19' through a triangular path, one stringer of which extending transversely of the right of way and clearing excess ballast from ballast bed 20 while another stringer moves the excess ballast upwardly to a chute 21'. A transversely moving conveyor receives the cleaned ballast from the chute and moves it to the lateral edges of the ballast bed or, by means of an elongated conveyor 24 to a rearwardly positioned chute 25. The machine is operated from stand 28. Ballast cleaning machines of this and similar types are known and may include ballast storage containers to supply controlled quantities of ballast to selected portions of the ballast bed.

In the illustrated embodiment, the chute 25 is mounted on a first car 26 of the rear train section. Similarly to flat car 3, car 26 carries a trolley 4' for transporting the new ties 27 from the cars 2 and to place them in position for laying as the trolleys run forwardly over the flat platforms of these cars. All the cars of the second train sections have running gears 8 moving on the new track rails 10.

The pivotal connection of the second train section to the intermediate train section is a mirror image of the above-described connection thereof to the first train section, thus including the support 14 with the vertically adjustable vehicle 15 and a support arm 11. This support arm, however, carries a suitable device 32 for laying new ties 27, the structure of this device forming no part of this invention and being, therefore, only schematically shown.

In the modified embodiment of FIG. 3, parts of the intermediate train section are shown in such a position that the train assembly may be moved from one track renewal site to another. Thus, while FIG. 1 shows the running gears 15, 15 of the intermediate train section lifted into an inoperative position while the full-track vehicles 17, 17 move the intermediate train section on the ballast, the frame 16 with vehicles 17, 17 are lifted into an inoperative position in FIG. 3 while the running gears move on the track so that the entire train assembly is supported on the track for movement thereover. In this position, the rail guiding implements 9, 9 are lifted out of rail gripping position. Hydraulic drive means 19' is connected to the bucket conveyor 19 of the ballast cleaning machine so that, as shown in broken lines in FIG. 3, the conveyor may be moved into an operating position in engagement with the ballast even in the lifted position of frame 16. The conveyor may scoop up ballast and move it upwardly to a vibratory screen 21 where it is cleaned, and the cleaned ballast is moved by a chute 23 to elongated conveyor 24. A second conveyor 22 moves the waste ballast laterally away from the ballast bed. A third conveyor 30 moves
cleaned ballast towards the input side of the bucket conveyor 19.

When the train assembly is moved from one renewal site to another, it is desirable to limit the length of this assembly. Therefore, the cars for transporting the track rails are uncoupled so that they do not travel with the train assembly. Instead, the new rails are stored on wheeled stands laterally adjacent the track of the renewal site and the old rails are placed on the wheeled stands after they have been replaced.

In accordance with the invention, the distance between the last car 3 of the first train section and the first car 26 of the second train section may be adjustable. This distance is selected in dependence of varying the working conditions and, more particularly, the flexing load to which the new rails to be laid and the old rails to be taken up is subjected, these loads varying with changing levels of the rails. Excessive loads must be avoided to prevent permanent deformation of the ballast. In this respect, it is also important to note that the rails must be guided and spread without undue friction.

The train assembly of the present invention need not include a ballast cleaning machine in the intermediate trackless section of the right of way but have other devices for working on or treating the ballast in this trackless section, as will become evident from the following description of other embodiments of the intermediate train section holding the first and second train sections at a predetermined, preferably adjustable distance.

As shown in FIG. 4, for instance, the intermediate train section may consist merely of a spacing rod 16' whose ends are linked respectively to the last car 3 of the first train section and the first car 26 of the second train section. In the illustrated embodiment, the spacing rod is a telescoped structure enabling the length of the rod, and thus the distance between the first and second train sections, to be adjusted to a selected length. Obviously, it would also be possible to provide a series of rods of different lengths which may be detachably connected and selectively exchanged. Also, if a frame such as 16 is used, it may be detachably connected in the train assembly and/or it may carry other track maintenance implements rather than a ballast cleaning machine. Thus, the possible variations in the nature of the intermediate train section can be adapted to any track maintenance need, the only requirement being that this section is linked to the first and second train sections so as to maintain a selected distance therebetween and so form a train assembly moving together along the right of way.

In the embodiment of FIG. 4, the spacing rod 16' is linked directly to the first and second train sections and has no running gear support of its own. This embodiment provides only for the replacement of old rails 7 for new rails 10, the nature of this replacement being more fully disclosed and claimed in our above-mentioned U. S. patents.

In the embodiment of FIG. 5, on the other hand, a spacing frame 16'', functionally similar to spacing rod 16', is used in a structure which is otherwise like that of FIGS. 1 and 2, i.e. the spacing frame forming the intermediate train section is supported on selectively operable vehicles 15' and 17' arranged, respectively, to move on the track and on the trackless section of the right of way in a manner fully described hereinabove.

FIG. 6 shows an embodiment similar to that of FIGS. 1 and 2 in an operating phase at the end of a renewed track section, at which point the support arm 11 with the trolley 12 for old ties 5 and support 14 have been moved onto the platform of last car 3 of the first train section, thus making the entire train assembly ready for movement along the track to another renewal site.

In this embodiment, the support 14 carries a full-track vehicle 17'' instead of a wheeled running gear arranged to move on tracks. The intermediate train section with its ballast cleaning machine is quite similar to that of FIGS. 1 and 2 but the frame 16 is slightly different, being supported at one end by a full-track vehicle 17'' and at the other end by a running gear comprising a series of roller rollers 40 (see FIG. 7). The vehicles 17''' and 40 serve to move the intermediate train section on the ballast 20 of the intermediate trackless section of the right of way. In addition, the frame 16 carries wheeled vehicles 15'', these vehicles as well as vehicles 17''' and 40 being selectively operable by lifting or lowering them respectively off and into contact with the track rails or the ballast.

The ends of intermediate train section frame 16 carry auxiliary running gears 41, 41 which may be lifted and lowered into operable positions by pressure fluid drives 41' at the end of a track renewal operation so that the intermediate train section is supported on the track rails until the main running gears 15''' move onto the track for movement of the train assembly to another track renewal site.

The rubber rollers 40 serve the following purpose:

Operation of the bucket conveyor 19 produces a concave-ballast bed, as shown in FIG. 7. To obtain a proper support for the ends of ties 27, the outer rollers 40, 40 exert a heavier load or pressure on the ballast than the central rollers 40' so as to produce proper ballast supports for the tie ends while the central portion of the ballast bed 20 remains concave. In this manner, the ties are securely fixed in position. The laterally extending mounds of ballast seen in FIG. 7 are produced by the ballast moved to the sides of the track by conveyor 24', and this excess ballast may be used to fill the cribs.

Additional modifications of the intermediate train section are shown in FIGS. 8 and 9. These embodiments are designed solely for replacement of the old ties 5 by new ties 27 while the rails are merely lifted at the intermediate trackless section of the right of way, whereupon they are lowered again and fastened to the newly laid ties.

In the embodiment of FIG. 8, the supports 14 carry full-track vehicles 17', as in the embodiment of FIG. 6. The frame 16a, on the other hand, may be selectively supported on wheeled running gears 15a mounted at the ends of the frame. A ballast leveling implement 29 is mounted on the frame for vertical movement into and out of engagement with the ballast, a drive 29' being provided for the vertical movement of implement 29.

The frame 16b of FIG. 9, on the other hand, carries selectively operable full-track vehicles 17b as well as rail-engaging running gears 15b, which are retractable so that the frame may run either on the trackless section of the right of way or on the track.
It will be obvious from the above description that a great many variations and modifications of the intermediate train section are possible to adapt the train assembly to various operating conditions without departing from the spirit and scope of the present invention as defined in the appended claims.

We claim:

1. An apparatus for the continuous replacement of an old track by a new track consisting of track parts including two rails and ties supporting the rails on ballast, comprising a train assembly continuously moving along a right of way during the replacement; the right of way consisting of a section of old track, a section of new track and a trackless intermediate section wherein the old track is replaced by the new track; the train assembly consisting of a first train section moving on the old track rails, an intermediate train section bridging the trackless intermediate section of the right of way, a second train section moving on the new track rails, and means linking the intermediate train section respectively to the first and second train sections to interconnect the same for common movement, the linking means being at a predetermined distance in the direction of the right of way; and means on the train assembly for transporting and supporting at least one of the track parts of the old and new tracks, for respectively receiving at least one of the track parts of the old track and laying at least one of the track parts of the new track, and for guiding without substantial friction the track rails bridging the intermediate trackless section of the right of way.

2. The apparatus of claim 1, wherein said last-mentioned means are arranged for supporting and transporting, receiving and laying the rails and the ties.

3. The apparatus of claim 1, wherein the linking means comprises pivotal couplings between the intermediate train section and the first and second train sections, respectively.

4. The apparatus of claim 1, wherein the intermediate train section includes vehicles selectively operable to move on the track and to move on the trackless intermediate section of the right of way.

5. The apparatus of claim 4, wherein the intermediate train section includes full-track vehicles.

6. The apparatus of claim 1, wherein the intermediate train section means comprises a ballast conditioning apparatus.

7. The apparatus of claim 1, wherein the intermediate train section includes means for maintaining the respective linking means at said predetermined distance.

8. The apparatus of claim 7, wherein the means for maintaining the respective linking means at a predetermined distance is adjustable for selecting said distance.

9. The apparatus of claim 8, wherein the adjustable distance means is arranged to select a maximum distance limited by the permissible deformation of the new track rails being lowered from a respective one of said cars to the intermediate trackless section of the right of way or of the old track rails being raised in the latter section.

10. The apparatus of claim 7, wherein the intermediate train section means includes a pair of frame parts respectively linked to the first and second train sections and a connecting frame part linked to the pair of frame parts and extending therebetween, and the means for respectively receiving and laying the track parts being mounted on the pair of frame parts.

11. The apparatus of claim 10, wherein each frame part of the pair comprises a running gear vertically movably mounted in the frame for selective operative engagement with the track, and the connecting frame part comprises full tracks for operative engagement with the trackless intermediate section.

12. The apparatus of claim 11, wherein each of the first and second train sections has a running gear moving on the respective tracks, the supported arm ends being in vertical alignment with the running gears of the train sections.

13. The apparatus of claim 12, wherein each of the first and second train sections has a running gear mov-