

April 20, 1965

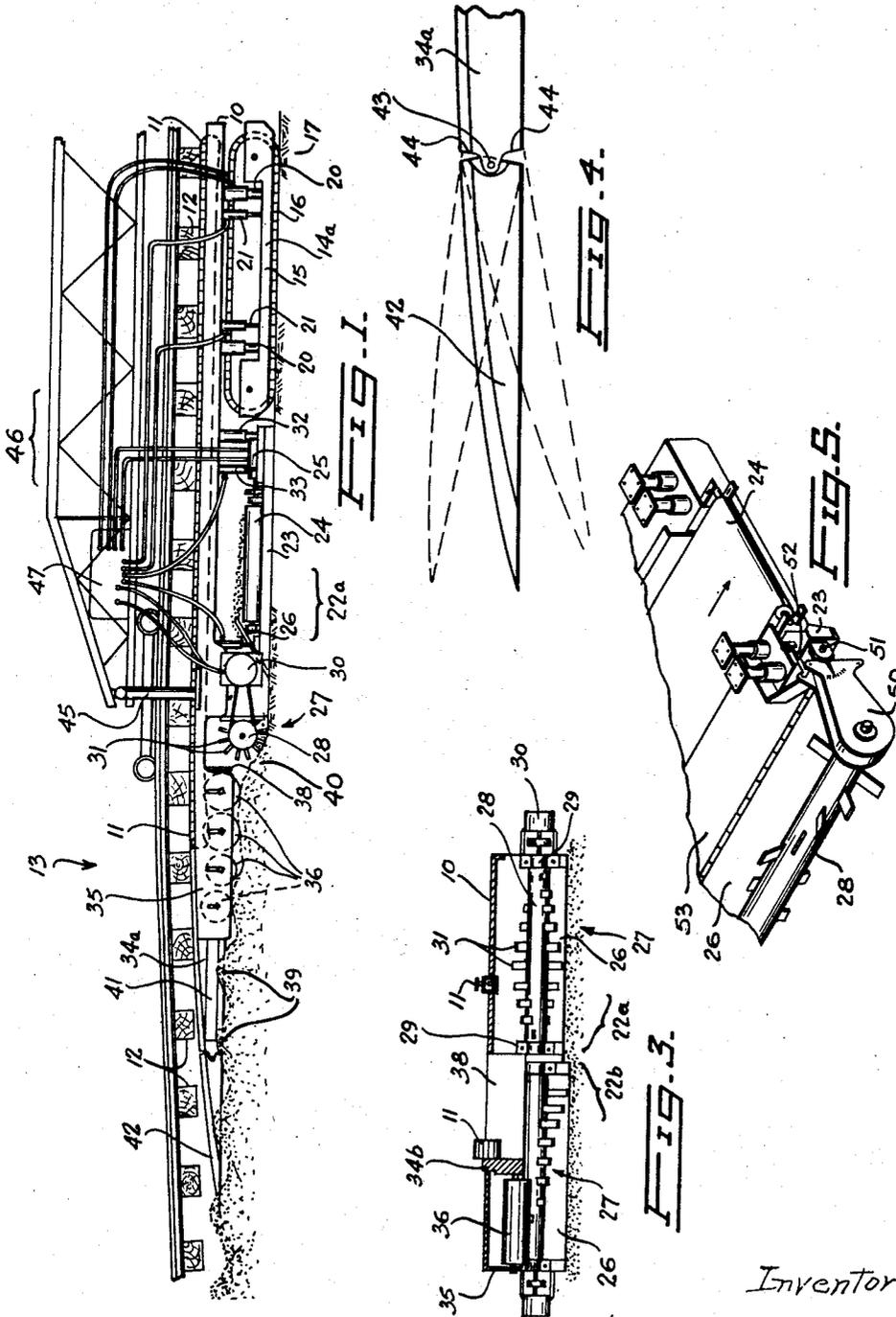
J. W. CHRISTOFF

3,179,062

RAILROAD UNDER-TRACK DEVICE

Filed May 22, 1963

7 Sheets-Sheet 1



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RAILROAD UNDER-TRACK DEVICE

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7 Sheets-Sheet 2

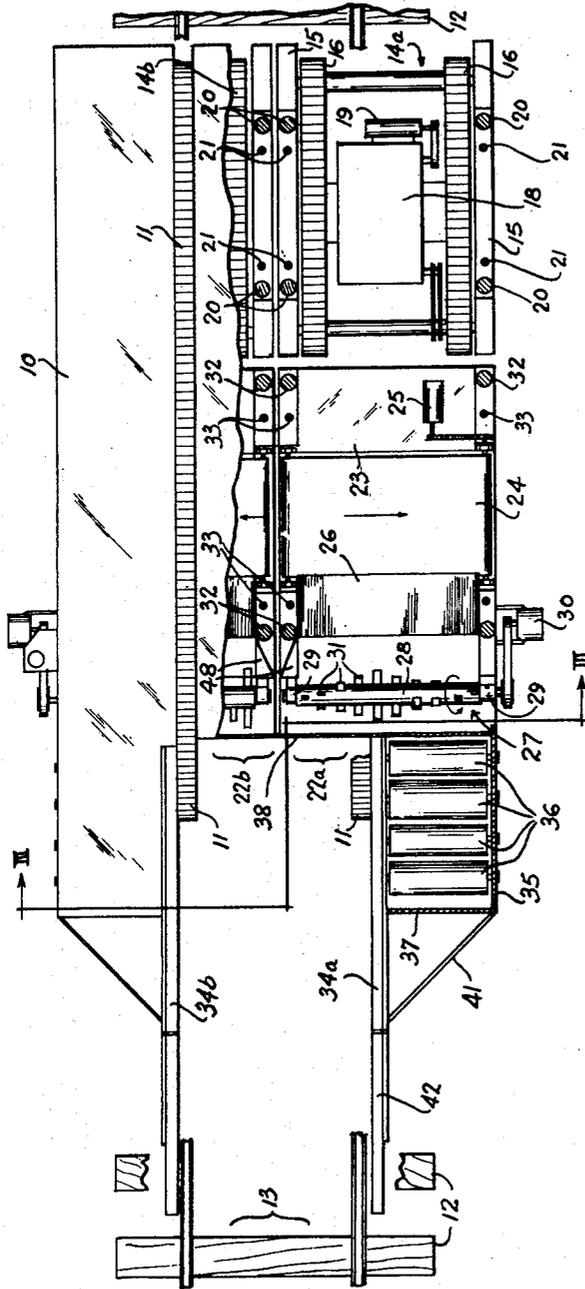


FIG-2-

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7 Sheets-Sheet 3

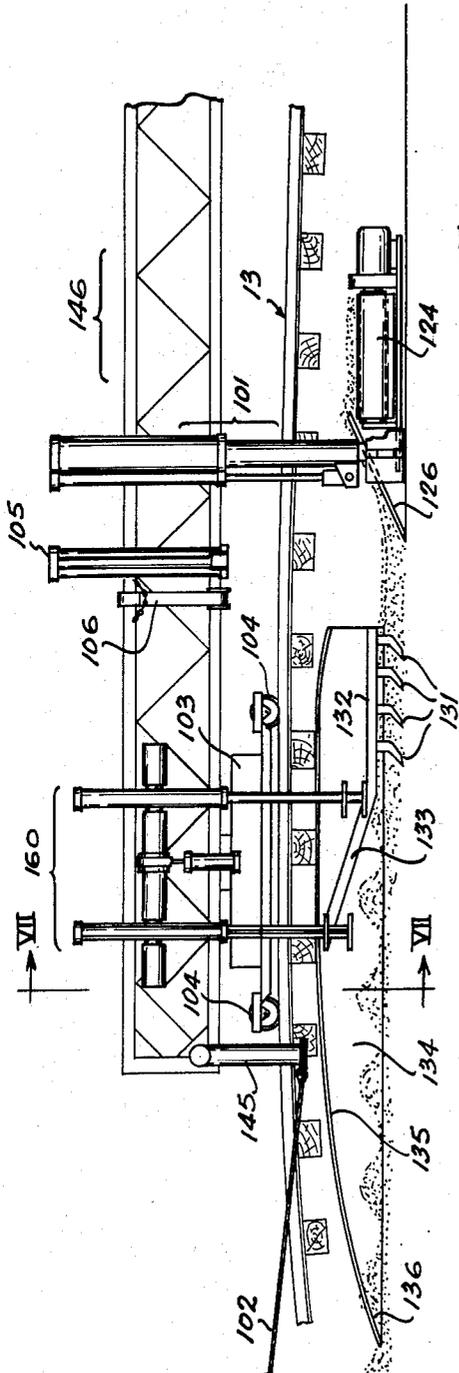


FIG. 6.

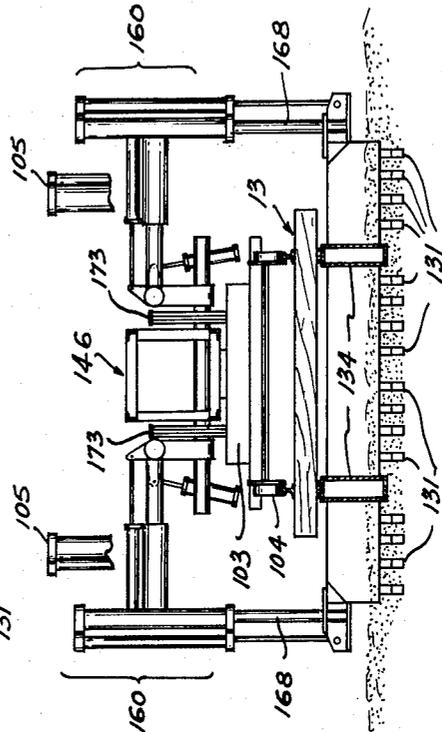


FIG. 7.

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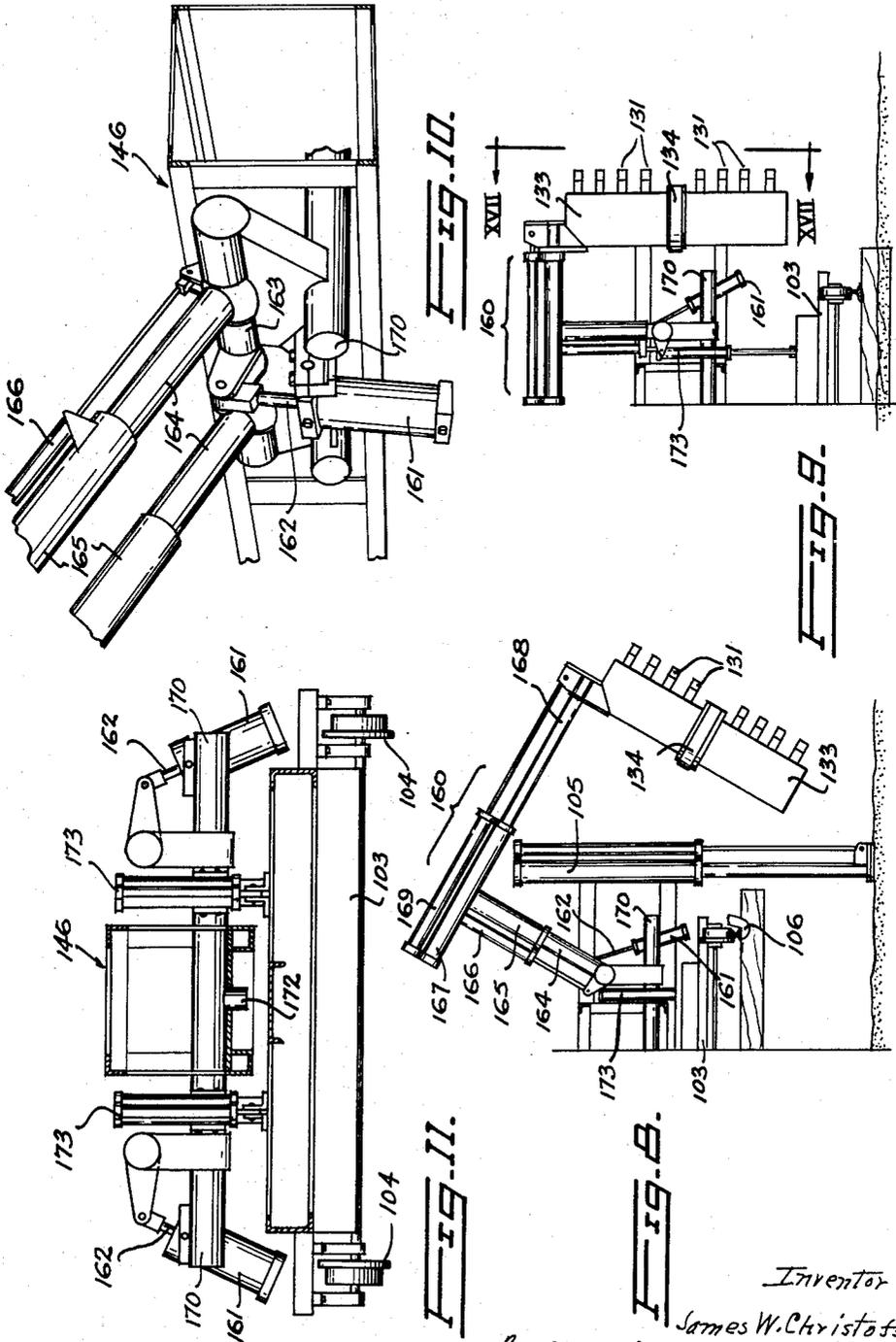
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7 Sheets-Sheet 4



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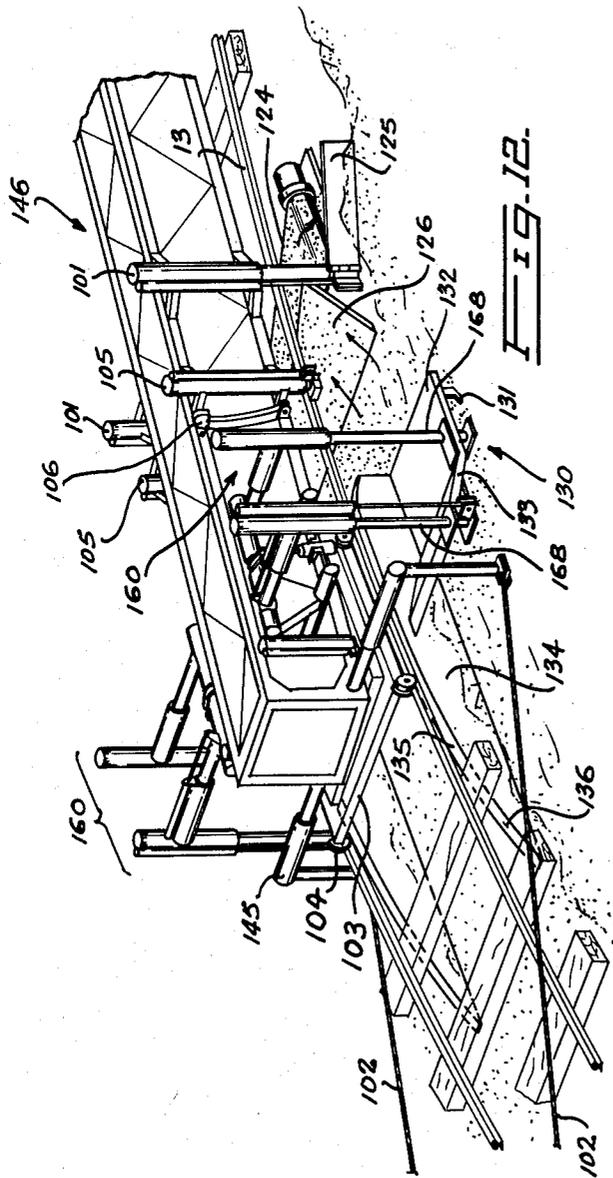
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Filed May 22, 1963

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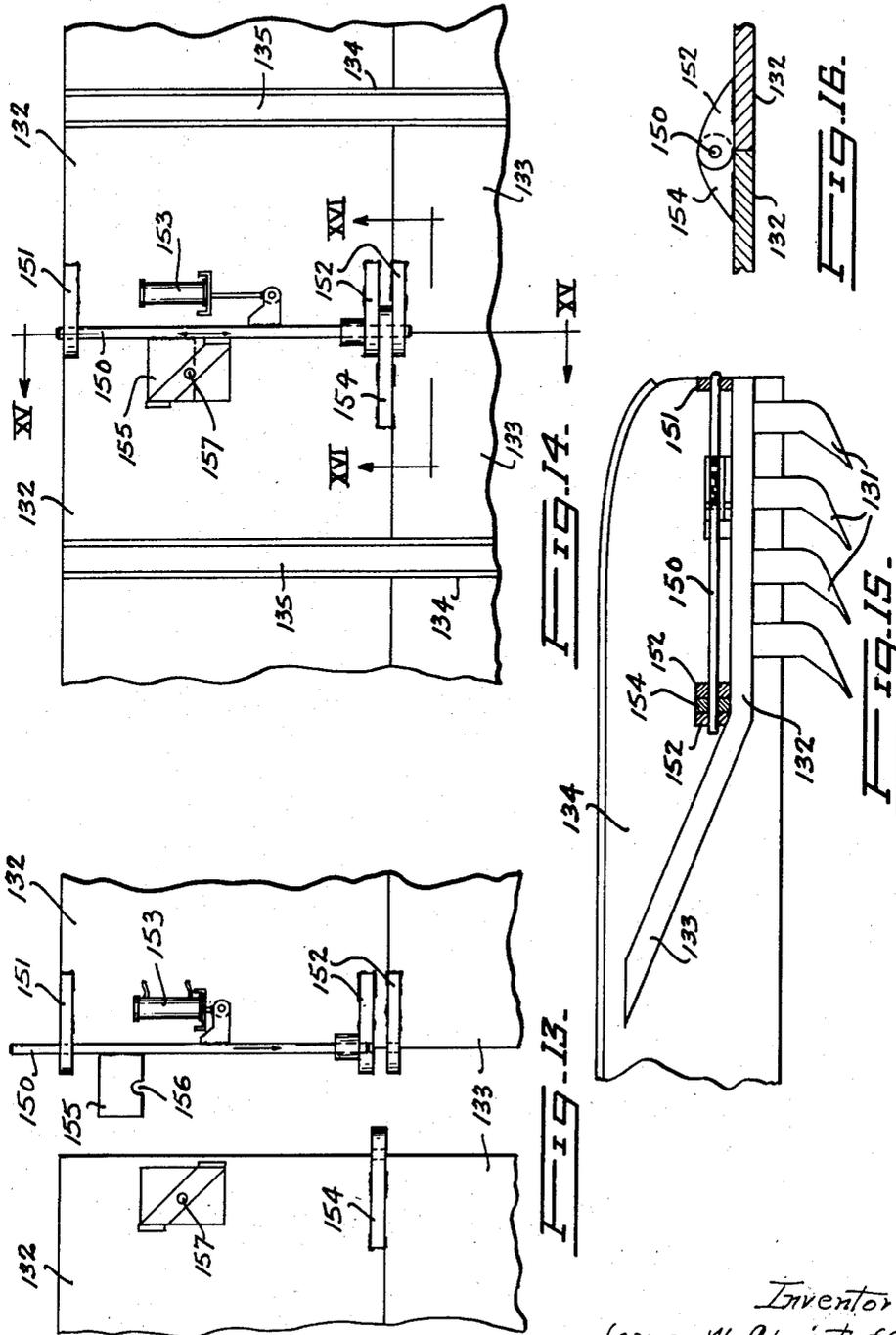
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7 Sheets-Sheet 6



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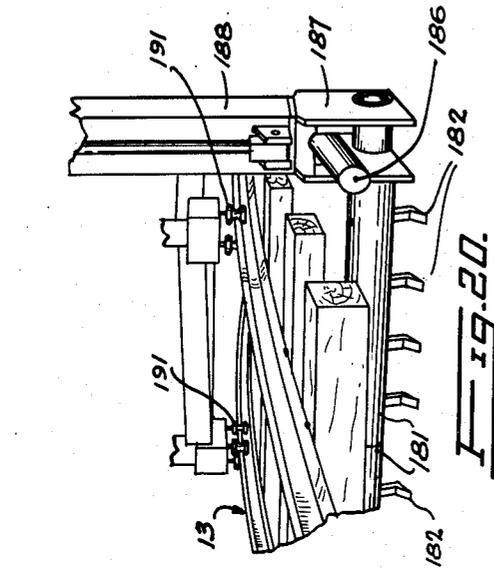


FIG. 18.

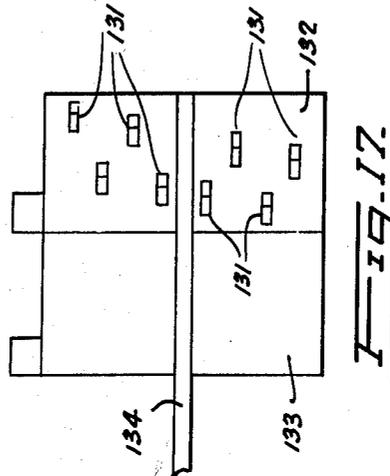


FIG. 17.

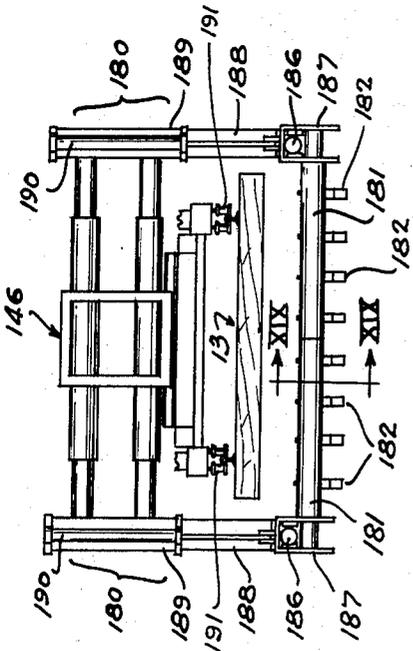
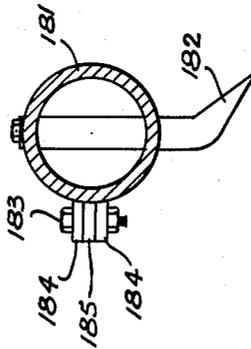


FIG. 19.



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3,179,062

RAILROAD UNDER-TRACK DEVICE

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Filed May 22, 1963, Ser. No. 282,428
18 Claims. (Cl. 104-7)

This invention relates to an under-track device for use in removing material such as earth or ballast from beneath a railroad track.

In one form the invention relates to an under-track device that can be inserted between the roadbed and the ties, and there caused to travel along the track either as a drawn or a self-propelled vehicle while successive portions of the track are progressively elevated and supported. As such progress continues, the device deflects a layer of ballast or earth from the roadbed beneath the ties and conveys this material, along with any crib ballast present, to one or both sides of the track beyond the ends of the ties. Such removed material can then be collected by suitable means and transported away.

Although devices for this general purpose have previously been proposed, none of them has proved fully universal in operation. One of the main reasons for the operational limitations of previous devices has been their inability to deflect the high compacted material that is commonly encountered in the regions of the ballast bed known as the tie beds. The tie beds are those portions of the ballast bed (that is the ballast below the bottom level of the ties, as distinct from the crib ballast which lies in the spaces or "cribs" between the ties) which lie directly under (and in the near vicinity of) those parts of the ties which underlie the rails. Standard railroad practice requires tamping of the ballast in these areas. The consolidation of the ballast which results from this tamping, together with the continual pounding of the ballast in these areas by the passage of trains, results in the tie beds becoming more tightly packed than the remainder of the ballast bed.

When the ballast becomes fouled with mud and debris after long use, the tightly packed pieces of ballast in the tie beds are said to be "cemented" together, that is to say they form large lumps exhibiting a cohesion almost as great as if the individual pieces of ballast actually were joined together with cement. When this happens, drainage is impaired and it becomes necessary to plow out the track to remove the fouled ballast and subsequently replace it with clean ballast. Substantial resistance against being so displaced is naturally offered by the "cemented" ballast in the tie beds.

It is believed that the apparatus of the present invention attacks this problem in a manner superior to any hitherto proposed, and, as a result, permits satisfactory plowing out of difficult track and displacement with a single pass of a deeper layer of ballast than has hitherto been possible. Although prior art devices have been generally successful in plowing out track (especially the towed-type of ballast plow which employs inclined blades to dig out and deflect the ballast), it is characteristic of such prior devices that they tend to remove mainly the crib ballast and only take a comparatively shallow cut, if any, into the main ballast bed, except under the most favourable conditions.

Not only does the apparatus of the present invention permit deeper cuts into the ballast bed, but, in one form, it combines this facility with those of a self-propelled device.

These objects are achieved in the present apparatus primarily by providing, in advance of blade means that deflect ballast up from the ballast bed for subsequent conveyance to a side of the track, digger means comprising

a series of individual ballast-penetrating tines arranged to be in alignment with at least the tie bed portions of the ballast bed. Both the digger means and the blade means maintain the original transverse distribution of the ballast, which is another factor in permitting a deep cut to be taken. Mechanism may be provided for repeatedly driving the tines into the ballast bed and withdrawing them therefrom to loosen the ballast in advance of the blade means. Such mechanism preferably comprises a roller from which the tines project, and it will be convenient to provide for powered rotation of such roller so that the tines can be caused to force their way through the ballast and thus enhance the loosening process. Alternatively, the tines may be fixed in position and be dragged through the roadbed material to loosen it.

Further features that the present apparatus may with advantage incorporate include separate mounting of plowing and propulsion means for independent vertical adjustment, and division of plowing and propulsion means each into a pair of separate units, arranged side-by-side, and capable of vertical adjustment relative to each other.

In another form, the invention provides for the connection of the under-track device to an on-track vehicle for propulsion of the assembly along the track during operation and for transportation of the assembly in two parts housed in stored positions for travel to and from the site of operation.

The accompanying drawings illustrate, diagrammatically and by way of example, various manner in which the invention may be carried into practice. In these drawings:

FIGURE 1 shows a side view of an under-track device according to the invention, in operation beneath a section of track;

FIGURE 2 is a plan view of the under-track device of FIGURE 1 with the top plate of the device partly cut away to reveal the mechanisms below and the track cut away and the ballast omitted for clarity of illustration;

FIGURE 3 is a section on the line III—III in FIGURE 2;

FIGURE 4 is an enlarged fragmentary view of a nose portion of the device of FIGURE 1;

FIGURE 5 is a fragmentary view of an alternative construction;

FIGURE 6 is a side view of another assembly according to the invention;

FIGURE 7 is a section on the line VII—VII in FIGURE 6;

FIGURE 8 is a front view of one half of the apparatus of FIGURE 6 demonstrating its manner of being raised from beneath the track;

FIGURE 9 is a view similar to FIGURE 8 showing the parts in housed position for travelling;

FIGURE 10 is a perspective fragmentary view of the elevating mechanism of the apparatus of FIGURES 6 to 9;

FIGURE 11 is an enlarged front but fragmentary view of the apparatus of FIGURES 6 to 9;

FIGURE 12 is a diagrammatic perspective view of the apparatus of FIGURES 6 to 11;

FIGURE 13 is a fragmentary view showing two parts of the apparatus of FIGURE 12 in separated condition;

FIGURE 14 is a view of the parts of FIGURE 13 inter-locked;

FIGURE 15 is a section on the line XV—XV in FIGURE 14;

FIGURE 16 is a section on the line XVI—XVI in FIGURE 14;

FIGURE 17 is a view taken on the plane XVII—XVII in FIGURE 9;

FIGURE 18 is a simplified front view of yet another construction in accordance with the invention;

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FIGURE 19 is a fragmentary section taken on the line XIX—XIX in FIGURE 18; and

FIGURE 20 is a front perspective view illustrating the manner of operation of the apparatus of FIGURE 18.

The under-track device illustrated in FIGURES 1 to 4 consists of a main, rigid framework of which the principal component is a plate 10, although an open framework could be employed. Mounted with their upper spans projecting above the plate 10 are a pair of endless-track-type conveyors 11. These conveyors 11 support the ties 12 of the elevated span of track 13, and may be motor driven or may idle as the device travels along beneath the track. The use of track-type conveyors reduces friction between the device and the ties it engages, but, if rather more friction can be tolerated, such conveyors can be replaced by free-running rollers turning about fixed axes, or by fixed runners that slide in contact with the tie bottoms.

At its rear, the device is provided with propulsion means, which in the example illustrated, comprises two separate propulsion units 14a and 14b arranged side-by-side beneath the plate 10. Since these units are identical with each other (in mirror image), the plate has been cut away to reveal mainly the parts of the left-hand unit 14a. This unit will be seen to consist of a framework 15 supporting a pair of endless tracks 16 arranged to be in tractive engagement with the roadbed 17 and to be driven through gearing 18 from a hydraulic motor 19. If preferred, driving wheels engaging the roadbed can be used. Each side member of the frame 15 is vertically slidably connected front and back to the plate 10 by a pair of telescoping guides 20 having an associated hydraulic cylinder 21 by which the desired extent of downward projection of the propulsion unit can be set and retained.

In the area forwardly of the propulsion means there are mounted plowing means, which, in the example illustrated, consist of a pair of separate plowing units 22a and 22b also arranged side-by-side beneath the plate 10.

Again, since these units are identical with each other (in mirror image) only the unit 22a has been revealed in detail. It comprises a framework 23 supporting a transversely movable belt conveyor 24 driven by a hydraulic motor 25, and a blade 26 extending transversely across the unit while sloping downwardly and forwardly to deflect ballast up from the roadbed in scoop fashion onto the conveyor 24 while keeping such ballast spread out across the track in essentially its original transverse distribution. The unit 22a also includes a digger 27 arranged in advance of the blade 26. The digger 27 consists of roller 28 mounted in bearings 29 for rotation about an axis extending horizontally across the plowing unit, and under the control of a hydraulic motor 30. Roller 28 has projecting from it a number of individual ballast-penetrating tines 31 distributed along and around its surface.

As in the case of the propulsion units, each of the plowing units 22a and 22b is independently adjustable vertically from the plate 10 by means of four telescoping guides 32 and associated hydraulic control cylinders 33.

Projecting forwardly from the area of the device occupied by the plowing units are a pair of nose beams 34a and 34b, one on each side of the device. Once again these are alike and hence only the beam 34a and its associated parts will be described. It serves firstly to support the leading end of the left hand conveyor 11. It also serves, together with a side plate 35, to mount a series of four preliminary free-running rollers 36 which extend over the area forwardly of the plowing means and outwardly of the nose beam. Each roller is capable of being set in position in regard to vertical adjustment relative to the other parts of the device. Short vertical walls 37 and 38 project down from the plate 10 in front and behind rollers 36 to increase the structural rigidity of the device, but the rollers 36 will normally project below

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such walls to ride on the crib ballast 39. Note that the rollers 36 do not project downwardly as much as the digger 27 which bites into the ballast bed 40 that lies below the level that the tie bottoms occupied.

Still further forwardly, there is provided a preliminary ballast levelling blade 41 inclined to the front to rear axis of the device.

The extreme forward tip 42 of each nose beam 34a, 34b is pivoted to the beam proper (as best seen from FIGURE 4) by pivot 43. Only a comparatively small range of travel is permitted the tip by abutting surfaces 44, but the ability of the tip to follow the lay of the ballast and to swing upwardly if it encounters a strong obstruction provides improved operation by minimising stoppages and breakages.

The under-track device is shown connected by a yoke 45 to an on-track vehicle 46 which houses a power plant and control unit 47. The vehicle 46 may be drawn along the track by the under-track device, or may be separately propelled, in which case it may not be necessary to yoke the two devices together. The operator who is stationed on the vehicle 46 would merely ensure that the vehicle travels along the track synchronously with the under-track device in order not to require excessively long hydraulic lines for feeding the various motors and cylinders of the under-track device.

The operation of the under-track device will have become apparent from the foregoing description. As has been explained in the opening paragraphs, the most resistance to ballast deflection is encountered in the ballast bed, and especially the tie bed portions of the ballast bed, the tie beds being the portions of the ballast bed which underlie the parts of the ties directly under a rail and in the vicinity thereof. Thus the essential requirement for the diggers 27 is that they be arranged in alignment longitudinally of the track with at least the tie bed portions of the roadbed. In practice it is convenient to have the diggers extending across almost the entire front face of the plowing units. A small strip in the centre will normally remain undug by reason of the practical need to support the digger rollers in bearings, but this is a comparatively loose part of the roadbed having lain centrally between the rails and hence between the tie beds. Surfaces 48 will thus be able to deflect this central strip of ballast on to blades 26 without prior digging.

The digger rollers 28 are preferably rotated anti-clockwise as shown in FIGURE 1, and at a speed rather greater than necessary for their tines to move over the roadbed at the same linear speed as the rate of progress of the device. The action results in the tines tending to force their way through and break up the ballast bed and urge the ballast rearwardly towards the deflecting blades 26. However, there may be circumstances in which it is preferred to drive the rollers at the same linear speed as the device, or even more slowly when the tines would tend to drag through the roadbed. The operator has a choice of speeds depending on the many different conditions that can be encountered on a railroad track.

It will be noted that, due to the manner of mounting the digger rollers 28 with each of the tines moving generally in a vertical plane extending longitudinally of the device, so as not to deflect the ballast towards one side when loosening it, and due to the fact that the blades 26 extend across the device at right angles to the direction of travel, the ballast is raised up off the roadbed while maintained with substantially its original transverse distribution. In other words, lateral deflection of the ballast is not attempted until the conveyor belts 24 are reached. The work that it is required to do on ballast to deflect it upwardly and rearwardly (scoop it up a gentle incline) is far less than that required to deflect it horizontally (transversely of the track) while it remains in frictional contact with the roadbed. By devising a system in which transverse displacement of the material to be removed is avoided until a later stage in the operation

(by which time the material has been brought up out of contact with the roadbed and placed on conveyor belts 24), applicant has avoided one of the main problems inherent in the earlier systems, namely the substantial amount of work that had to be done to deflect to the side of the track ballast that is still lying in contact with the roadbed and is thus subjected to the friction of the roadbed tending to inhibit any deflection. By taking advantage of this improvement (reduction in work needed to be done), as well as the avoidance of undue piling up of the material, applicant is able to take an appreciably deeper cut into a roadbed than has been possible with any of the forms of apparatus developed heretofore.

FIGURE 2 shows the belts 24 moving in opposite directions. This will normally be the arrangement adopted, but, in a case where it is desired to move all the ballast on one side of the track, one belt could be driven inwardly (towards the centre of the track) so as to feed its ballast onto the other belt, an articulated transfer plate being positioned between the belt ends if found necessary.

FIGURE 3 shows the plowing unit 22b adjusted to project downwardly from the plate 10 slightly more than does the other plowing unit 22a, thus demonstrating the inherent flexibility of the arrangement. Railroad track that has been in use for a number of years often exhibits many irregularities in the grading and cross-level of the ballast. The ability to correct such faults while carrying out an undercutting or plowing operation is an advantage of the present arrangement. Flexibility of control of the vertical position of the parts is also useful when working on curved, banked track.

The example of the invention so far described permits four basic independent depth adjustments, those of the two plowing units and those of the two propulsion units. Within these adjustments, there could be employed some measure of finer adjustment by tilting one, or other, or all, of these units by separately operating the four hydraulic cylinders that control each unit. There is sufficient slack in the guides 20 and 32 to permit some tilting. Thus, potentially, sixteen separate adjustment points are provided, although in practice this fineness of depth control would seldom be required.

It will be apparent that four, while a convenient number of independent units, is not the only number possible. If the two propulsion units were combined into a single structure, three main adjustments would be available (the two plowing units and the single propulsion means). If the two plowing units were combined into a single structure, while leaving the propulsion units separate, again three areas of adjustment would be available. If both combinations were made simultaneously, then just a fore-and-aft tilting adjustment could be available, subject to any transverse tilt obtainable from independent operation of individual hydraulic cylinders. Yet another possibility arises from the combination of the right hand plowing and propulsion units into one structure, and the combination of the left hand plowing and propulsion units into a second structure independently vertically adjustable relatively to the first such structure.

One particular advantage of an arrangement of units in which those on the right are independent of those on the left (regardless of whether the plowing units are independent of the propulsion units) is the facility that such a construction provides for dividing the whole under-track device down its fore-and-aft centerline so that the two parts can be handled and transported separately. The later embodiments of the invention described below demonstrate this facility.

FIGURE 5 illustrates a refinement in which a further adjustment is available, digger roller 28 being mounted at one end on arm 50 housing a power drive to the roller. Arm 50 is pivotally mounted about pin 51 so that roller 28 can be raised and lowered in relation to the framework 23 by hydraulic control cylinder 52. The blade 26 is secured at its end to arm 50, so that blade 26 pivots with

digger 28. Ballast scooped up by blade 26 passes over fixed surface 53 to conveyor 24. Another pivoted arm (not shown) similar to arm 50 will support the other end of roller 28, the plowing means being either divided into two independent plowing units as in FIGURES 1 to 3, or formed as one single unit an alternative already discussed.

Although a self-propelled under-track device has some advantages, the essential feature of the present invention, namely the tine bearing digger that is provided to loosen the ballast bed in advance of the deflecting means (blades and belt conveyors, in the example), can be employed in an under-track device in which the propulsive force is supplied externally, as from towing cables. This form of construction is demonstrated by a further embodiment of the invention illustrated in FIGURES 6 to 17. FIGURES 6 and 12 show a deflecting blade 126 which functions in the same manner as the blade 26 already described, and conveyor belts 124 similar to the belts 24. An auxiliary deflecting wing 125, shown only in FIGURE 12, can be added if desired to provide some preliminary clearance in advance of the belts 124. This apparatus is mounted beneath the track 13 (some of the ties of which have been omitted from FIGURE 12 for clarity) by means of hydraulic cylinder assemblies 101 secured to the boom 146 of an on-track vehicle. The latter includes a towing yoke 145 by which the whole assembly can be towed along the track by a locomotive (not shown) through the agency of cables 102. The on-track vehicle also includes a front cart 103 with rail engaging wheels 104 and a rear cart (not shown) and preferably a track alignment head (also not shown). These parts, the nature of which forms no part of the present invention, may conveniently be arranged in the manner described and illustrated in James W. Christoff U.S. patent application Serial No. 101,503 filed April 7, 1961.

Since this assembly is designed to be towed along the track by cables 102, the propulsion units provided in the previous embodiment are dispensed with. Lifting jacks 105 are provided on each side of the vehicle boom 146 to cooperate with rail-engaging dogs 106 shown in the drawings in their housed positions (except FIGURE 8). When the dogs 106 (one on each side of the boom 146) are lowered to engage the rails of the track and the lifting jacks 105 (also one on each side of the vehicle) are extended, the track is raised for the insertion or removal of digger mechanisms, as shown in FIGURE 8. For further details of the manner of operation of such dogs and jacks, which also form no part of the present invention, reference may be had to James W. Christoff U.S. Patent No. 3,054,359 issued September 18, 1962.

An important difference between the apparatus shown in FIGURES 6 to 17 and that shown in FIGURES 1 to 5 is the form taken by the digger mechanism. Instead of rotary digger rollers, material-penetrating tines 131 are mounted in fixed position to project from beneath a pair of plates 132 each having a forwardly projecting, upwardly inclined portion 133 and each firmly secured to a forwardly projecting member 134. The upper surfaces of members 134 are curved and are provided with runners 135 for supporting and sliding contact with the ties of the elevated span of track. The forwardmost tip 136 of each member 134 forms a nose in the usual manner of under-track devices. As best seen in FIGURE 17 the tines 131 are distributed across the plate 132. Although no tine has been positioned exactly underneath the runner-supporting member 134, which latter slides over the centerline of a tie bed portion of the roadbed, the tines are sufficiently closely spaced from each other in the transverse direction of the track that they effectively loosen the entire width of roadbed material, including the material with which the tines do not come into direct contact. The two tines positioned one on each side of the member 134 thus effectively dig a tie bed portion of the roadbed, and the other tie bed portion is dug by the corresponding tines on the other plate 132.

The digger mechanism 130 is formed in two parts which meet in the center of the track to form a unitary device. FIGURE 13 shows the inner edges of the two plates 132 disconnected from one another and FIGURE 14 shows the same plates interconnected by means of a slidable rod 150 which slides in brackets 151 and 152 under the control of a hydraulic cylinder 153. As shown in FIGURE 14, in the locked position the rod 150 also engages bracket 154. In addition a plate 155 secured to the rod 150 has a recess 156 which engages a fixed pin 157 on the other plate 132. In this way the two plates can be firmly connected together.

Each part of this digger mechanism is mounted on a hoisting mechanism shown generally at 160 in FIGURES 6, 7 and 12 and in somewhat more detail in FIGURES 8 to 10. When it is desired to remove either part of the digger mechanism from beneath the track, hydraulic cylinder 153 is operated to withdraw the locking rod 150 and thus release the inner edges of the two parts of the mechanism. The track is then elevated by lowering the rail-engaging dogs 106 and expanding the jacks 105 (FIGURE 8). With the track thus supported, a hydraulic cylinder 161 is operated to extend its piston 162 and rotate an assembly 163 (FIGURE 10) which includes a pair of arms 164 telescopically carrying sections 165 movable in and out in relation to the arms 164 by a hydraulic cylinder 166. At their free ends the arm sections 165 carry arms 167 (FIGURE 8) which telescopically support further sections 168 under the control of a hydraulic cylinder 169. As FIGURE 8 demonstrates, expansion of cylinder 161 turns the whole assembly to withdraw the associated half of the digger mechanism from beneath the track. After it has been so withdrawn, retraction of the various telescopic parts brings the assembly to the housed condition shown in FIGURE 9. The other half of the digger mechanism is essentially the same in mirror image and is similarly housed. The operating hydraulic cylinder 161 are supported by a frame 170 (FIGURE 11) which is free to turn within limits about a pivot pin 172 relative to the end of the boom 146 of the on-track vehicle. The cart 103 is mounted beneath the frame 170 by means of extensible hydraulic assemblies 173 shown extended in FIGURE 9, this being the travelling position with cart 103 lowered into engagement with unelevated track, jacks 105 raised and the rail-engaging dogs 106 housed, and the digger mechanisms housed in positions elevated clear of contact with the track.

FIGURES 6, 7 and 12 show the apparatus in operating condition with the digger mechanism 130 supporting the weight of the elevated span of track, the cart 103 resting on such elevated span and the ballast-penetrating tines 131 serving to dig the ballast in advance of the blade 126 across substantially the full roadbed and particularly in the tie bed portions.

FIGURE 8 shows the apparatus halted for removal of the digger mechanism. The blade 126 and conveyor assembly 124 may be removed from beneath the track in a like manner, that is by being divided centrally and swung out by rotation of the assembly 101 about its vertical axis, with subsequent contraction of such assembly to hoist each half of the blade 126 and its associated conveyor 124 into an elevated position. Alternatively, each blade half and its associated conveyor can be pivoted to housed position about a horizontal axis by mechanism analogous to the housing mechanism 160. As yet another alternative, the blade 126 and its associated conveyors 124 can be removed manually from beneath the track after having been unhitched from their supporting assemblies.

FIGURE 9 shows the travelling condition. Insertion of the digger mechanism will be carried out by reversal of the removal procedure just described.

FIGURES 18 to 20 show another alternative form of digger mechanism also formed in two separable parts,

with each part mounted on an individual lowering mechanism 180 on each side of an on-track vehicle boom 146. Each part of this digger mechanism consists of a single tube 181 from which a series of ballast-penetrating tines 182 depend. The two tubes 181 are joined together centrally by a bolt 183 which passes through lugs 184 and 185 formed on their respective rear surfaces. When bolt 183 is removed each tube 181 can be rotated about its own longitudinal axis by hydraulic cylinder 186 to withdraw the tines from the roadbed. Then the entire lower assembly 187 can be rotated about the vertical axis of pillar 188 by a motor that is not visible but is housed within the pillar 188. This action swings the assembly 187 out from beneath the track, after which it can be raised by contraction of the pillar 188 into its cooperating telescoping section 189 under the control of a hydraulic cylinder 190.

The facility whereby the tubes 181 can be turned about their own longitudinal axes by cylinders 186, which applies when the tubes are locked together as well as when they are separate, enables the angle of attack of the tines 182 to be varied.

When using this form of digger mechanism which is not designed to support the track 13, the track is elevated by rail engaging and supporting rollers 191 mounted in depending position beneath the on-track vehicle rearwardly of the cart 103. In this case both carts of the vehicle will rest on unelevated track and the elevated span will be held up by rollers 191 located approximately centrally of the length of the boom 146.

The blade and conveyors will be the same as before and will be positioned behind the digger tubes 181, although for simplicity they have been omitted from FIGURES 18 and 20.

This application is a continuation-in-part of application Serial No. 91,186 filed February 23, 1961.

I claim:

1. Apparatus for removing material from beneath a railroad track, comprising

(i) means for travelling along the track including means for elevating a span of said track above the roadbed,

(ii) blade means extending transversely across substantially the full width of the track,

(iii) means mounting said blade means on said travelling means for travel therewith along the track, said mounting means mounting the blade means beneath said elevated span of track with the blade means projecting forwardly and downwardly in scoop fashion to deflect material upwardly from the roadbed,

(iv) said blade means extending substantially at right angles to the direction of travel whereby material thereby deflected rearwardly remains spread out across the width of the track in substantially its original transverse distribution,

(v) conveyor means mounted on said travelling means in position beneath said elevated span rearwardly of said blade means to receive material deflected thereby and to convey such deflected material towards a lateral edge of the track,

(vi) and digger means mounted on said travelling means in position beneath said elevated span in advance of said blade means,

(vii) said digger means comprising a plurality of depending material-penetrating tines distributed across the apparatus and aligned longitudinally of the track with at least the tie bed portions of the roadbed for loosening the material of said portions for scooping up by said blade means, said tines leaving such loosened material spread out transversely of the track in substantially its original transverse distribution.

2. Apparatus according to claim 1, wherein said digger means comprises a generally horizontal member, said material-penetrating tines depending in fixed location from said member.

3. Apparatus according to claim 1, wherein said digger means comprise at least one tubular member extending transversely across the track, said material-penetrating tines depending in fixed location from said tubular member, said digger means further including means for rotating said tubular member about its own longitudinal axis to vary the angle of attack of said tines in relation to the roadbed.

4. Apparatus according to claim 1, including means for moving each said tine generally in a vertical plane extending longitudinally of the track to repeatedly drive said tines into the roadbed and withdraw them therefrom to loosen the material of said roadbed.

5. Apparatus for removing material from beneath a railroad track, comprising

(i) a framework constructed to travel along the roadbed beneath the ties while elevating and supporting a span of track,

(ii) blade means extending transversely across substantially the full width of the track,

(iii) means mounting said blade means for travel with said framework along the track, said mounting means mounting the blade means beneath said elevated span of track with the blade means projecting forwardly and downwardly in scoop fashion to deflect material upwardly from the roadbed,

(iv) said blade means extending substantially at right angles to the direction of travel whereby material thereby deflected rearwardly remains spread out across the width of the track in substantially its original transverse distribution,

(v) conveyor means mounted for travel with said framework in position beneath said elevated span rearwardly of said blade means to receive material deflected thereby and to convey such deflected material towards a lateral edge of the track,

(vi) and digger means mounted on said framework in position beneath said elevated span in advance of said blade means,

(vii) said digger means comprising a plurality of depending material-penetrating tines distributed across the apparatus and aligned longitudinally of the track with at least the tie bed portions of the roadbed for loosening the material of said portions for scooping up by said blade means, said tines leaving such loosened material spread out transversely of the track in substantially its original transverse distribution.

6. Apparatus according to claim 5, wherein said digger means comprises a generally horizontal member, said material-penetrating tines depending in fixed location from said member.

7. Apparatus according to claim 5, including means for moving each said tine generally in a vertical plane extending longitudinally of the track to repeatedly drive said tines into the roadbed and withdraw them therefrom to loosen the material of said roadbed.

8. Apparatus according to claim 5 including propulsion means mounted on said framework for tractive engagement with said roadbed.

9. Apparatus according to claim 8, wherein said propulsion means is mounted on said framework for vertical adjustment relative to said framework, and said plowing means is mounted on said framework for vertical adjustment relative to said framework independently of the vertical adjustment of said propulsion means.

10. Apparatus according to claim 5 including

(i) a pair of propulsion units arranged side by side, each for tractive engagement with said roadbed,

(ii) and means mounting each said propulsion unit on said framework for vertical adjustment relative to said framework independently of the other said unit.

11. An under-track device for removing ballast from beneath a railroad track, said device comprising

(i) a generally flat framework constructed to travel

along the roadbed beneath the ties while supporting an elevated span of track,

(ii) propulsion means mounted on said framework for tractive engagement with said roadbed,

(iii) a pair of plowing units arranged side by side each to encounter undisturbed ballast as the device is driven along the roadbed by said propulsion means,

(iv) and means mounting each said plowing unit on said framework to travel beneath the elevated span of track forwardly of said propulsion means, said mounting means mounting said plowing units for vertical adjustment relative to the framework independently of each other,

(v) each said plowing unit comprising

(a) blade means extending transversely across substantially the full width of a respective side of the device while projecting forwardly and downwardly in scoop fashion to deflect ballast upwardly from the roadbed, said blade means extending substantially at right angles to the direction of travel whereby ballast thereby deflected rearwardly relative to the device remains spread out across the width of the device,

(b) conveyor means positioned to receive ballast deflected thereto by said blade means and to convey such deflected ballast beyond a lateral edge of the track, and

(c) digger means positioned in advance of said blade means and comprising a series of individual ballast-penetrating tines distributed across the device in alignment longitudinally of the track with a respective side of the ballast bed including the tie bed portion of the ballast bed beneath the rail on said side of the track, and means for moving each said tine generally in a vertical plane extending longitudinally of the device to repeatedly drive said tines into the ballast bed and withdraw them therefrom to loosen the ballast for scooping up by said blade means while leaving such loosened ballast spread out across the track in substantially its original transverse distribution.

12. An under-track device for removing ballast from beneath a railroad track, said device comprising

(i) a generally flat framework constructed to travel along the roadbed beneath the ties while supporting an elevated span of track,

(ii) a pair of propulsion units arranged side by side, each for tractive engagement with said roadbed,

(iii) means mounting each said propulsion unit on said framework for vertical adjustment relative to said framework independently of the other said unit,

(iv) a pair of plowing units arranged side by side each to encounter undisturbed ballast as the device is driven along the roadbed by said propulsion means,

(v) means mounting each said plowing unit on said framework to travel beneath the elevated span of track forwardly of a respective propulsion unit, said mounting means mounting said plowing units for vertical adjustment relative to the framework independently of one another and independently of said propulsion units,

(vi) each said plowing unit comprising

(a) blade means extending transversely across substantially the full width of a respective side of the device while projecting forwardly and downwardly in scoop fashion to deflect ballast upwardly from the roadbed, said blade means extending substantially at right angles to the direction of travel whereby ballast thereby deflected rearwardly relative to the device remains spread out across the width of the device,

(b) conveyor means positioned to receive ballast deflected thereto by said blade means and to

- convey such deflected ballast beyond a lateral edge of the track, and
- (c) digger means positioned in advance of said blade means and comprising a series of individual ballast-penetrating tines distributed across the track with a respective side of the ballast bed including the tie bed portion of the ballast bed beneath the rail on said side of the track, and means for moving each said tine generally in a vertical plane extending longitudinally of the device to repeatedly drive said tines into the ballast bed and withdraw them therefrom to loosen the ballast for scooping up by said blade means while leaving such loosened ballast spread out across the track in substantially its original transverse distribution.
13. Apparatus for removing material from beneath a railroad track, comprising
- (i) a framework constructed to travel along the roadbed beneath the ties while elevating and supporting a span of track,
 - (ii) an on-track vehicle including means connecting said vehicle to said framework for travel therewith along the track,
 - (iii) blade means extending transversely across substantially the full width of the track,
 - (iv) means mounting said blade means on said on-track vehicle for travel therewith along the track, said mounting means mounting the blade means beneath said elevated span of track with the blade means projecting forwardly and downwardly in scoop fashion to deflect material upwardly from the roadbed,
 - (v) said blade means extending substantially at right angles to the direction of travel whereby material thereby deflected rearwardly remains spread out across the width of the track in substantially its original transverse distribution,
 - (vi) conveyor means mounted on said on-track vehicle in position beneath said elevated span rearwardly of said blade means to receive material deflected thereby and to convey such deflected material towards a lateral edge of the track,
 - (vii) and digger means comprising a plurality of material-penetrating tines depending from said framework and aligned longitudinally of the track with at least the tie bed portions of the roadbed for loosening the material of said portions for scooping up by said blade means, said tines leaving such loosened material spread out transversely of the track in substantially its original transverse distribution.
14. Apparatus for removing material from beneath a railroad track, comprising
- (i) an on-track vehicle including means for elevating a span of track above the roadbed,
 - (ii) blade means extending transversely across substantially the full width of the track,
 - (iii) means mounting said blade means on said on-track vehicle for travel therewith along the track, said mounting means mounting the blade means beneath said elevated span of track with the blade means projecting forwardly and downwardly in scoop fashion to deflect material upwardly from the roadbed,
 - (iv) said blade means extending substantially at right angles to the direction of travel whereby material thereby deflected rearwardly remains spread out across the width of the track in substantially its original transverse distribution,
 - (v) conveyor means mounted on said on-track vehicle in position beneath said elevated span rearwardly of said blade means to receive material deflected thereby and to convey such deflected material towards a lateral edge of the track,

- (vi) and digger means mounted on said on-track vehicle in position beneath said elevated span in advance of said blade means,
 - (vii) said digger means comprising a plurality of depending material-penetrating tines distributed across the apparatus and arranged longitudinally of the track with at least the tie bed portions of the roadbed for loosening the material of said portions for scooping up by said blade means, said tines leaving such loosened material spread out transversely of the track in substantially its original distribution.
15. Apparatus according to claim 14, wherein said digger means comprise at least one tubular member extending transversely across the track, said material-penetrating tines depending in fixed location from said tubular member, said digger means further including means for rotating said tubular member about its own longitudinal axis to vary the angle of attack of said tines in relation to the roadbed.
16. A method of removing material from beneath a railroad track, comprising
- (i) continuously elevating successive portions of said track to raise the ties from the roadbed,
 - (ii) continuously loosening substantially the entire width of the roadbed beneath the elevated track including the tie bed portions thereof, while maintaining the loosened material in substantially its original transverse distribution,
 - (iii) rearwardly of said loosening operation, continuously deflecting the loosened material upwardly from the roadbed, while continuing to maintain the deflected material in substantially its original transverse distribution,
 - (iv) continuously conveying such deflected material beyond at least one lateral edge of the track,
 - (v) and continuously allowing the track to settle back on the roadbed rearwardly of the elevated portion thereof.
17. Apparatus for removing material from beneath a railroad track, comprising
- (i) means for travelling along the track including means for elevating a span of said track above the roadbed,
 - (ii) blade means extending transversely across substantially the full width of the track,
 - (iii) means mounting said blade means on said travelling means for travel therewith along the track, said mounting means mounting the blade means beneath said elevated span of track with the blade means projecting forwardly and downwardly in scoop fashion to deflect material upwardly from the roadbed,
 - (iv) said blade means extending generally transversely to the direction of travel whereby material thereby deflected rearwardly remains spread out across the width of the track, without deflection towards the centre of the track,
 - (v) conveyor means mounted on said travelling means in position beneath said elevated span rearwardly of said blade means to receive material deflected thereby and to convey such deflected material towards a lateral edge of the track,
 - (vi) and digger means mounted on said travelling means in position beneath said elevated span in advance of said blade means,
 - (vii) said digger means comprising a plurality of depending material-penetrating tines distributed across the apparatus and aligned longitudinally of the track with at least the tie bed portions of the roadbed for loosening the material of said portions for scooping up by said blade means, said tines leaving such loosened material spread out transversely of the track without deflection towards the centre of the track.
18. A method of removing material from beneath a railroad track, comprising

- (i) continuously elevating successive portions of said track to raise the ties from the roadbed,
- (ii) continuously loosening substantially the entire width of the roadbed beneath the elevated track including the tie bed portions thereof, while maintaining the loosened material spread out across the track without deflection towards the centre of the track, 5
- (iii) rearwardly of said loosening operation, continuously deflecting the loosened material upwardly from the roadbed, while continuing to maintain the deflected material spread out across the track without deflection towards the centre of the track, 10
- (iv) continuously conveying such deflected material beyond at least one lateral edge of the track,
- (v) and continuously allowing the track to settle back 15

on the roadbed rearwardly of the elevated portion thereof.

References Cited by the Examiner

UNITED STATES PATENTS

2,911,734	11/59	Sublett et al. -----	37—104
3,054,359	9/62	Christoff -----	104—7
3,055,309	9/62	Moss -----	104—7

FOREIGN PATENTS

1,033,896	4/53	France.
1,122,989	5/56	France.

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