

Feb. 8, 1938.

R. E. MADISON

2,107,639

RAILWAY BALLASTING MACHINE

Original Filed July 1, 1932

3 Sheets-Sheet 1

Fig. 1

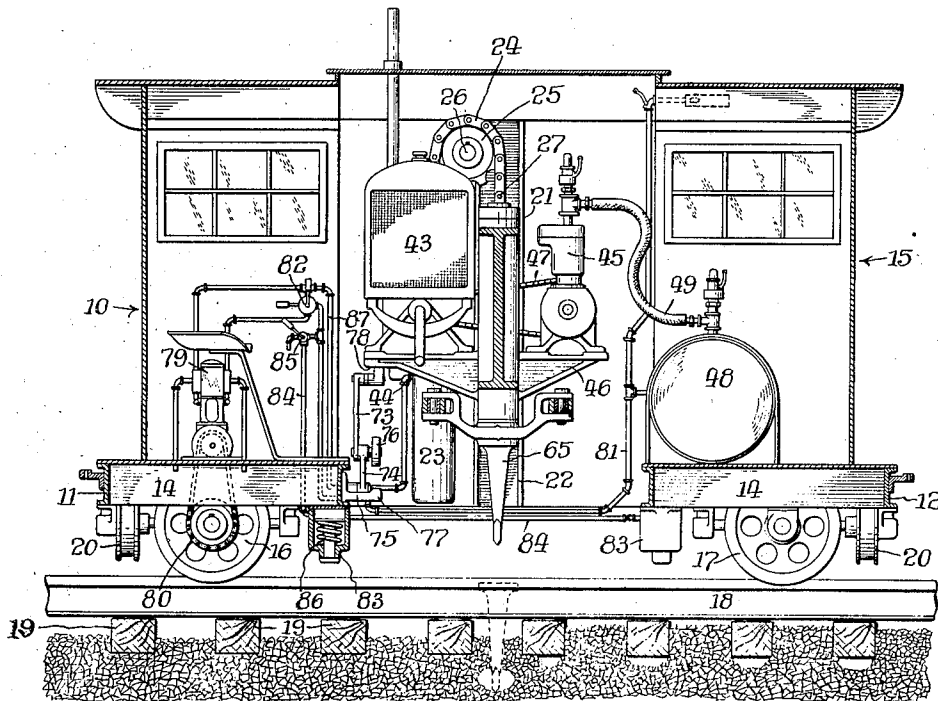


Fig. 7

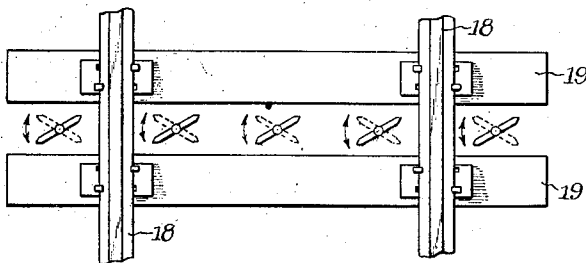
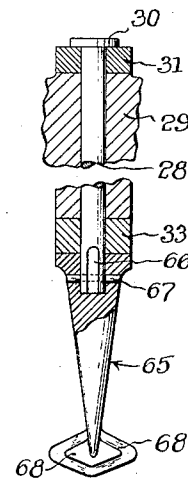


Fig. 8



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Fig. 2

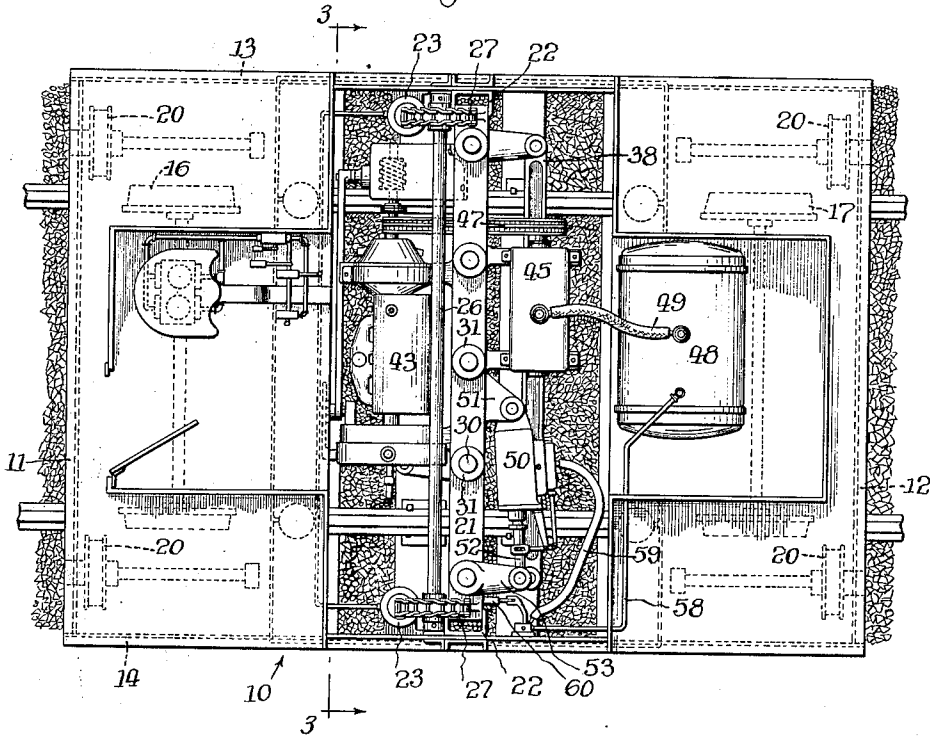


Fig. 4

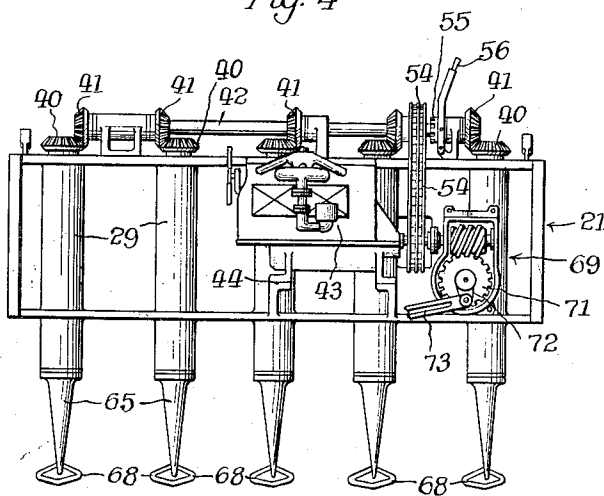
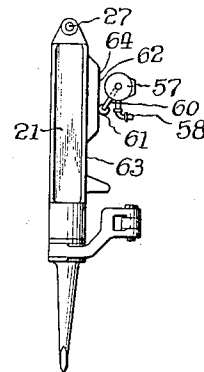


Fig. 5



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UNITED STATES PATENT OFFICE

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RAILWAY BALLASTING MACHINE

Robert E. Madison, Harvey, III.

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Renewed June 11, 1937

13 Claims. (Cl. 104—12)

The present invention relates to an improved method of and apparatus for ballasting railway ties.

After prolonged subjection to the pounding and compressing effect which results from passage of locomotives and cars over railroad tracks, the ballast underlying the supporting ties is displaced laterally and then upwardly between the ties until the supporting foundation is substantially destroyed. Heretofore, it has been common practice to restore the ballast to a position underlying the ties by impacting tools operated from above the upper surface of the ties at an angle inclined to the plane thereof so as to generally direct the movement of ballast toward the area beneath the ties.

However, the conventional spacing of ties is not sufficient to permit the tool to assume an angle of much in excess of 45° from the vertical with the result that a large part of its power is wasted in driving the ballast downwardly into the sub-grade rather than horizontally into position to support the ties. Furthermore, the impacting action is, of itself, objectionable because of its tendency to crush and pack the ballast thereby interfering with drainage and frequently occasioning washing away of the ballast with attendant undermining of the road bed. In addition, hard spots are formed which injure the ties because of lack of uniform distribution of bearing surface.

It is accordingly an important object of this invention to provide a new and improved method of and machine for ballasting railroad ties in which the force utilized to restore the ballasting material to supporting position beneath the ties acts in a substantially horizontal plane underlying the plane defined by the bottom surface of the ties.

It is another object of the invention to provide a novel method of and machine for ballasting railroad ties in which a non-percussive as distinguished from an impacting force is utilized to restore the ballast to a position underlying the ties.

A further object of the invention is the provision of a novel method of and machine for ballasting railroad ties in which ballast is impelled in two directions from a position between adjacent side walls of the ties, and below the plane defined by their under surfaces, to a position underlying the ties; the ballast immediately above that which was displaced being caused to move downwardly under the influence of gravity into a position to be acted upon by the impelling means.

Yet another object of the invention is to provide a ballasting machine comprising a plurality of impelling vanes arcuately movable in a horizontal plane and vertically adjustable from a po-

sition above the plane of the ties to a position below the plane defined by the bottom surface of the ties.

It is another object of the invention to provide a ballasting machine comprising a plurality of impelling vanes and improved means effective to move the vanes toward and away from a position underlying the plane defined by the bottom surface of the ties and parallel with the longitudinal axis of the ties.

A more specific object of the invention is the provision of a ballasting machine such that the vertically movable element which constitutes the support for the impelling vanes may also be employed as a mounting for the prime mover thereby eliminating the necessity of employing dead-weight counterweights to force the vane-supporting element to its lower or operative position.

Other objects and advantages will become apparent from the following description taken in connection with the accompanying drawings, in which:

Figure 1 is a side elevational view of a mechanism effective to carry out the method constituting the invention.

Fig. 2 is a plan view of the mechanism shown in Fig. 1.

Fig. 3 is a vertical elevational view taken on the line 3—3 of Fig. 2.

Fig. 4 is a view of a vertically movable element or cross head utilized to operatively support the ballast impelling means.

Fig. 5 is an end elevational view of a cross head and mechanism effective to automatically control movement of the impelling means.

Fig. 6 shows a method of connecting a plurality of ballast impellers for simultaneous movement.

Fig. 7 diagrammatically illustrates the extent of arcuate movement of the ballast impelling means.

Fig. 8 is a detailed sectional view of an impelling vane and its associated operating shaft.

In the embodiment of the invention selected for purposes of disclosure, the mechanism of the ballasting machine is carried on a car comprising end and side frame members 11, 12, 13 and 14 upon which is mounted a suitable enclosing cab 15. A pair of trucks 16 and 17 support the car for movement along rails 18 carried on cross ties 19, an auxiliary set of wheels 20 being employed to move the car from the rails when occasion demands.

A structural cross head 21 (Fig. 4) of I-beam cross section as indicated in Fig. 1, is slidably supported in similar inwardly facing vertically disposed channel beams 22, the channel beams in turn being mounted on the side frames 13 and 14 of the car. Vertical movement of the cross

head 21 is effected by means of a pair of air cylinders 23 mounted on the respective side frames of the machine and operatively connected to the cross head by means of chains 24 which lead over sprocket wheels 25 carried by a common shaft 26, the ends of the respective chains being pivotally connected at 27 to the ends of the cross head.

A plurality of spaced, vertically disposed shafts 28 (Fig. 8) are journaled in the cross head 21 for movement about their respective longitudinal axes. In this instance the cross head has integrally formed therewith a plurality of bearings 29 to receive the shafts 28, the shafts being restrained against downward movement in the bearings by integrally formed heads 30 which engage the upper end surfaces of annular collars 31 interposed between the upper ends of bearings 29 and heads 30. In the embodiment of the invention selected for purposes of disclosure, five such bearings and shafts have been illustrated but it will be understood that a lesser or greater number might be employed.

Driving connections effective to produce simultaneous arcuate or rotary movement of the shafts 28 are provided. Referring to Figs. 1, 3, 4, 5 and 6, a lever 32 having oppositely extending arms 32^a and 32^b is rigidly attached to the central one of the shafts 28 with the upper surface of an integrally formed collar 33 in bearing engagement with the lower end of the shaft-bearing so as to prevent upward displacement of the shaft relative to the bearing.

The remaining shafts 28 are provided with lever arms 34, 35, 36 and 37 having collars 34^a to 37^a respectively, the adjacent levers preferably, although not necessarily, extending in opposite directions from the vertical plane common to the axes of the several shafts as illustrated in Fig. 6. The levers 34 and 37 are connected to the similarly extending arm 32^a of the lever 32 by means of a link 38 whereas the levers 35 and 36 are connected to the arm 32^b by means of a link 39.

An alternative means of interconnecting the several shafts 28 so as to effect rotary movement is illustrated in Fig. 4. In this instance the upper ends of the respective shafts are provided with beveled gears 40 which mesh with corresponding gears 41 carried by an overlying drive shaft 42 rotatably supported on the upper end of the cross head.

The weight of the prime mover from which power is derived to actuate the drive shafts 28 augments the force acting to move the cross head 21 to its lower or operative position. To this end an internal combustion engine designated 43 is mounted upon a bracket 44 formed integrally with, or rigidly connected to, the cross head 21. In the embodiment of the invention illustrated in Fig. 1 the engine 43 is drivingly connected to a compressor 45, supported on a bracket 46 rigid with the cross head 21 by means of a chain 47, the weight of the compressor thereby contributing to the force tending to move the cross head downwardly. The compressor 45 is effective to charge a compressed air reservoir 48 through a flexible conduit 49, the reservoir being carried on the frame of the car. A piston and cylinder device 50, the cylinder of which is pivotally supported on a lug 51 rigid with the cross head, is drivingly connected to the several shafts 28 through the medium of piston 52 and crank arm 53, the lever arm in this embodiment of the invention being nonrotatably connected to the up-

per end of that one of the shafts 28 which is adjacent the side frame 14 is viewed in Fig. 2.

In the alternative construction shown in Fig. 4, the engine 43 is drivingly connected to the shafts 28 by means of a chain 54 operating on suitable sprocket wheels rigidly connected to the engine drive shaft and shaft 42 respectively. A jaw clutch 55 adapted to be operated by a hand lever 56 effects engagement and disengagement of the engine with the shaft.

Operation of the shafts 28 is automatically initiated in the construction shown in Figs. 1, 2, 3, 5 and 6 by means operable as an incident to the lowering of the ballasting mechanism to operative position. Referring to Fig. 5 a valve 57, which is interposed between a conduit 58 and a flexible hose 59 communicating with the air reservoir 48 and the piston and cylinder device 52 respectively, is effective to automatically control a flow of compressed air from the reservoir to the cylinder.

A valve operating arm 60, the outer end of which is provided with an anti-friction roller 61, is spring pressed into engagement with a cam surface 62 rigid with and arranged vertically upon the cross head 21.

When the cross head is moved to its upper or inoperative position, the valve 57 is closed through the action of arm 60 in contacting a depressed portion 63 of the cam 62 whereas when the cross head is moved to its lower or ballasting position as illustrated in Fig. 5, the roller 61 of the arm 60 will contact a raised portion 64 of the cam thereby rotating the valve to its open position to permit a flow of compressed air to cylinder 50 thereby automatically effecting reciprocating movement of the piston 52 which, through its connection with the crank arm 53 operates to arcuately oscillate all of the several shafts 28.

The invention contemplates apparatus effective to move ballast from a position between the ties and below the plane defined by their under surfaces to a position underlying the ties. To this end the oscillatory arcuate movement of the shafts 28 is utilized to force ballast in two directions from a series of points in the crib between adjacent ties and below the plane defined by their under surfaces, toward the area underlying the ties. Referring to Fig. 8, the shafts 28 will be seen to depend below the respective collars of the lever arms 32 and 34 to 37 inclusive, their respective depending ends having ballast impelling elements 65 non-rotatably and detachably secured thereto.

In the present embodiment of the invention, the lower ends of the shafts 28 are milled at 66 to provide a non-circular cross section which is adapted to be received in a recess of corresponding contour in the upper end of the element 65. A pin 67 projecting through the telescoping portions of element 65 and the lower end of the shaft 28 further serves to provide a nonrotatable connection between the two and removal of the pin permits of ready disengagement of the parts. Formed integrally with the lower end of element 65 are a pair of laterally extending surfaces 68 which for purposes of disclosure have been indicated to be generally of diamond shaped contour, although it will be understood that particularly with respect to those shafts 28 which are adjacent the rails, it might be desirable to provide the parts 65 with surfaces of a somewhat different contour and size so as to cause the ballast operated on by the elements associated with those

particular shafts to move under the ties at points directly beneath the rails.

Referring to Figs. 1 and 3, the ballasting elements 65 are shown in outline in their lower or operating positions while Fig. 7 diagrammatically indicates the approximate extent of arcuate movement of the ballasting elements. It will be obvious, particularly from an analysis of Figs. 1 and 7 that ballast in contact with the faces of the respective surfaces 68 will be impelled toward the area underlying the ties through the arcuate movement imparted to those surfaces through the shafts 28. When the elements 65 are rotated by means of the driving connections shown in Fig. 4, the ballast will similarly be impelled normally to the longitudinal dimension of the ties to force the ballast into position beneath the ties.

To insure uniform distribution of ballast throughout the entire length of the area underlying the ties, the cross head 21 and consequently each of the shafts 28 and their respective elements 65 are reciprocated horizontally when the cross head is in its lower or operating position, the extent of reciprocatory movement in each direction (as indicated in Fig. 3) being equivalent to one-half of the distance between adjacent elements 65. Furthermore, it is contemplated that this reciprocatory traversing of the space between the elements 65 will be initiated and terminated automatically as the cross head is moved to and from operative or ballasting position.

Referring particularly to Figs. 2, 3 and 4, it will be seen that the vertical channel members 22, which guide the cross head 21 for vertical sliding movement, are of relatively deep construction thus permitting bodily shifting of the cross head in the plane of Fig. 3 without effecting its disengagement from the respective channels. Referring to Figs. 3 and 4, a speed reduction unit 69 comprising a worm 70 drivingly connected to engine 43, meshes with a worm wheel 71. A crank arm 72, rigid with the worm wheel 71, is pivotally connected to a link 73, the opposite end of which is pivoted to a crank arm 74. Referring to Fig. 1, the crank arm 74 is pivoted to a bracket 75 which, in turn, is rigidly attached to the frame of the car. The pivotal connection between link 73 and crank arm 74 forms the axis of an antifriction roller 76 which lies in the vertical plane of a laterally extending shoulder 77 formed integrally with the bracket 75, and a horizontal portion 78 of the bracket 44.

When the prime mover 43 is in operation, and the cross head 21 in its upper or inoperative position, the crank arm 72 is rotated at a relatively slow rate of speed and this rotary movement is communicated through the downwardly inclined link 73 to crank arm 74 which idly oscillates between positions on either side of the vertical. As the cross head moves downwardly, link 73 approaches a horizontal position and in doing so, shifts bodily to the right to such an extent that oscillation of arm 74 becomes limited to an arc extending in a clockwise direction from the vertical.

Thus, when surface 78 contacts roller 76, the arm 74 will inevitably extend upwardly and to the right of its pivot and as the cross head completes its downward movement the roller 76 will be constrained between surface 78 and shoulder 77 of bracket 75 in which position it virtually acts as a fixed pivot for link 73, thereby causing the cross head itself to move under the influence of crank arm 72.

It will be obvious that as the cross head is ele-

vated to inoperative position, roller 76 will be released and arm 74 will again idly oscillate in response to rotation of crank 72, the cross head meanwhile coming to rest.

The ballasting mechanism is adapted to be propelled along the rails 18 from crib to crib by means of an air engine 79 (Fig. 1) rigidly attached to the frame work of the car and drivingly connected to the truck 16 by means of chain and sprocket wheels 80.

Compressed air is piped from the reservoir 48 to the engine 59 through conduit 81 and control valve 82.

The car may be elevated from the rails to permit the placing of an auxiliary pair of short rails in underlying position with respect to the trucks 20, the car thereafter being lowered until the trucks 20 are in bearing engagement with the auxiliary rails thereby permitting removal of the machine from the tracks for any desired purpose.

The elevating means in this instance comprises four air cylinders and pistons 83 connected with the source of air pressure in the reservoir 48 by conduits 84 and control valve 85. The cylinder and piston devices 83 are, as indicated in Fig. 1, normally urged to their upward or retracted position by means of coil springs 86 surrounding the respective pistons within the cylinders, and acting between the lower end of the cylinder and the piston proper to force the piston rod to its upper position.

Compressed air is conveyed to the cross head elevating cylinders 23 from the valve 82 through conduits 87, the air pressure being utilized solely to elevate the cross head, its weight being depended upon to effect a downward movement to ballasting position. Any desirable form of blocking means may be employed to support the cross head in its upper position when the machine is not in service.

It will be observed that all functions of the machine are adapted to be controlled by valves 82 and 85 which are located in close proximity in one end of the cab thereby insuring ease of operation and flexibility of control.

Prior to commencing operation of the machine, the parts will occupy the positions shown in Fig. 1 with the cross head and its associated tamping elements in elevated position above the crib. The prime mover is set in motion to charge the reservoir 48 with compressed air from compressor 45. Thereafter the cross head is lowered under the influence of gravity until the ballasting elements have reached the position shown in outline in Figs. 1 and 3. At the time the surfaces 68 of the ballasting elements contact the upper surface of the ballast in the crib, the camming surface 64 on the cross head operates to rotate the arm 60 of valve 57 to initiate operation of the piston and cylinder device 50, thereby oscillating shafts 28 and consequently elements 65 and surfaces 68 as the combined weight of the cross head, prime mover and compressor act to drive the ballasting elements to their extreme lower position.

Simultaneously with initiation of movement of elements 65, the roller 76 is acted upon by surface 78 to cause the cross head to assume a horizontal movement in the plane of Fig. 3, this movement reaching its maximum proportions when the cross head is in its lower position. The horizontal movement of the cross head is sufficient in this position to insure reballasting of the ties throughout their entire lengths.

It will be seen that the reballasting operation is accomplished without resorting to an impacting action and that the force imparted by the vanes to the ballast is effective to drive the latter in a horizontal plane to a position underlying the ties. Furthermore it will be seen that the operation of the device is such that only a single raising and lowering action is necessary in the cross head at each crib to be reballasted so that the weight of the prime mover may be utilized to drive the cross head to its ballasting position without involving the possibility of movement of the cross head impairing the prime mover.

Furthermore, the non-percussive character of the operation of the device prevents deterioration of the prime mover and eliminates the possibility of hard spots being formed in the ballast. The action of the cross head in traversing the ballasting elements longitudinally of the ties effects an even distribution of ballast throughout the length of their bearing surfaces.

I claim as my invention:

1. The method of ballasting adjacent pairs of railway ties which comprises agitating ballast from a point between the ties in a substantially horizontal plane lying below the plane of the bottoms of the ties by a member having a rotary motion about a vertical axis to effect lateral movement of the ballast from the point of agitation to positions underlying the ties, the displaced ballast being replaced as it is moved laterally by the ballast above that which was agitated.

2. In a machine of the class described, the combination of a ballast actuating element mounted for oscillatory movement about a vertical axis, means to move said element vertically between a plane above the plane defined by the upper surface of a tie and a plane defined by the lower surface of a tie and means to oscillate said element.

3. In a machine of the class described, the combination of a cross head, a plurality of spaced vertically disposed shafts rotatably supported on said cross head, means to move said cross head in a vertical plane between an operative and inoperative position, means to move said cross head in a horizontal plane, and a prime mover mounted on said cross head to operate said cross head in said vertical and horizontal planes.

4. A ballasting machine including a frame, a cross head vertically and horizontally movable relative to said frame, a prime mover mounted on, and movable with said cross head, a lever freely pivoted on said frame, a crank arm driven by said prime mover, a link operatively connecting said lever and crank to impart an idle oscillating movement to said lever when the cross head is in its upper position, said cross head operating to constrain said lever in contact with said frame when the cross head is moved to its lower position.

5. In a machine of the class described, the combination of a vertically movable cross head, a prime mover mounted on said cross head, means to move said cross head horizontally, a normally inoperable driving connection between said prime mover and said last mentioned means, and means acting automatically to render said driving connection operable when said cross head is lowered.

6. A railway ballasting machine having in combination, a structure movable up and down, a non-percussive ballast moving element on said

structure, and a prime mover mounted on said structure and arranged to actuate said element.

7. A railway ballasting machine having in combination, a structure movable up and down, a non-percussive ballast moving element on said structure and a prime mover mounted on said structure and arranged to oscillate said element and to reciprocate said structure.

8. A railway ballasting machine having in combination, a frame, a structure movable up and down and horizontally relative to said frame, a non-percussive ballast moving element operatively supported by said structure, a prime mover on said structure arranged to actuate said element, a lever freely pivoted adjacent one of its ends to said frame, a link operatively connecting the other end of said lever to said prime mover to effect a free oscillatory movement of said lever when said prime mover is in its upper position, and means operating to restrain said lever against movement when said structure is lowered to effect horizontal reciprocatory movement of said structure.

9. A ballasting machine comprising, in combination, a vertically movable frame structure, a ballast-moving element adapted to oscillate about a vertical axis, and a prime mover mounted on said frame structure for oscillating said element, said frame structure, element and prime mover having substantial weight whereby the ballast-moving element on oscillation thereof will sink into the ballast.

10. The method of ballasting pairs of railway ties which comprises providing a ballasting element adapted to oscillate on a vertical axis and a support therefore having substantial weight, placing said element on the upper surface of the ballast, oscillating said element whereby said weight with the oscillatory movement causes said element to penetrate the ballast to a level below said ties, and continuing said oscillatory movement at said level to move the ballast under the ties.

11. A ballasting machine comprising a vertically movable structure comprising a ballast-moving element adapted to oscillate about a vertical axis and a prime mover for oscillating said element, said structure having substantial weight whereby the ballast-moving element on oscillation thereof will sink into the ballast.

12. A ballasting machine comprising, in combination, a vertically movable frame structure, a ballast-moving element adapted to oscillate about a vertical axis, a prime mover mounted on said frame structure for oscillating said element, said frame structure, element and prime mover having substantial weight, whereby the ballast-moving element on oscillation thereof will sink into the ballast, and means for controlling the vertical movement of said frame structure.

13. The method of ballasting pairs of railway ties which comprises providing a ballasting element adapted to oscillate on a vertical axis and operating mechanism therefor having substantial weight, placing said element on the upper surface of the ballast, oscillating said element whereby said weight with the oscillatory movement causes said element to penetrate the ballast, limiting the penetrating movement of said element to a level below said ties, and continuing said oscillatory movement at said level to move the ballast under the ties.

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