April 13, 1965 J. K. STEWART 3,177,813

RAILROAD MAINTENANCE DEVICE

Filed Sept. 9, 1960 10 Sheets-Sheet 1

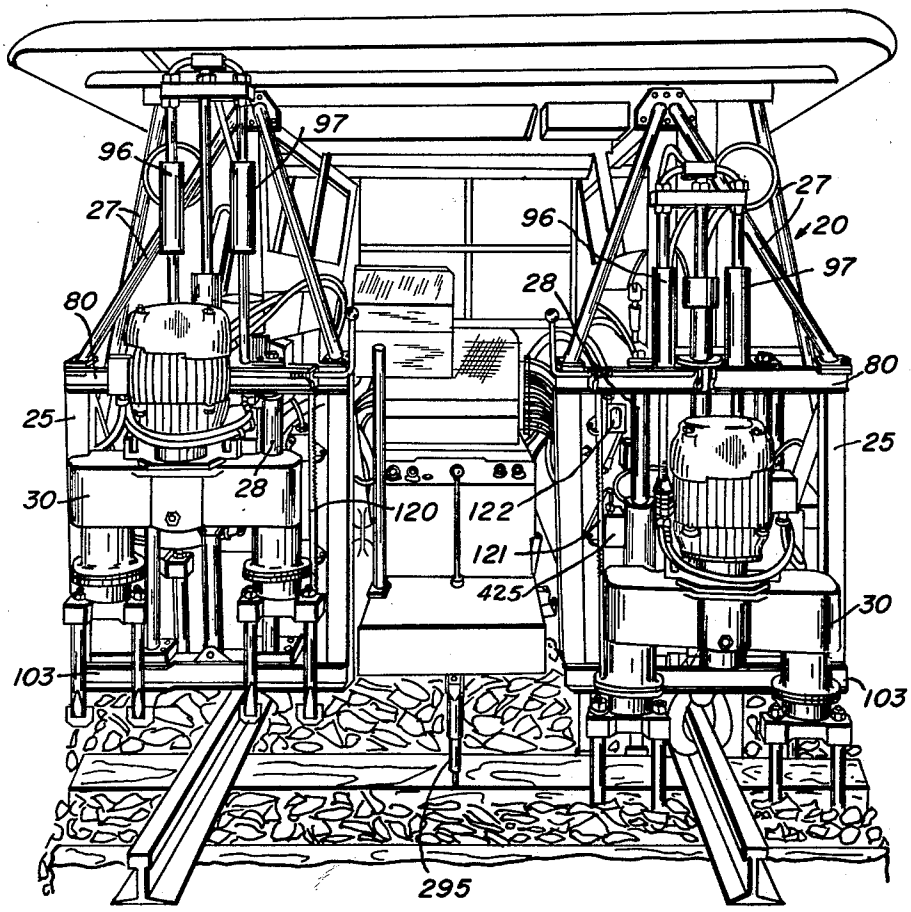


FIG. 1.

INVENTOR
JOHN K. STEWART
BY Smart & Biggar
ATTORNEYS.

April 13, 1965 J. K. STEWART 3,177,813

RAILROAD MAINTENANCE DEVICE

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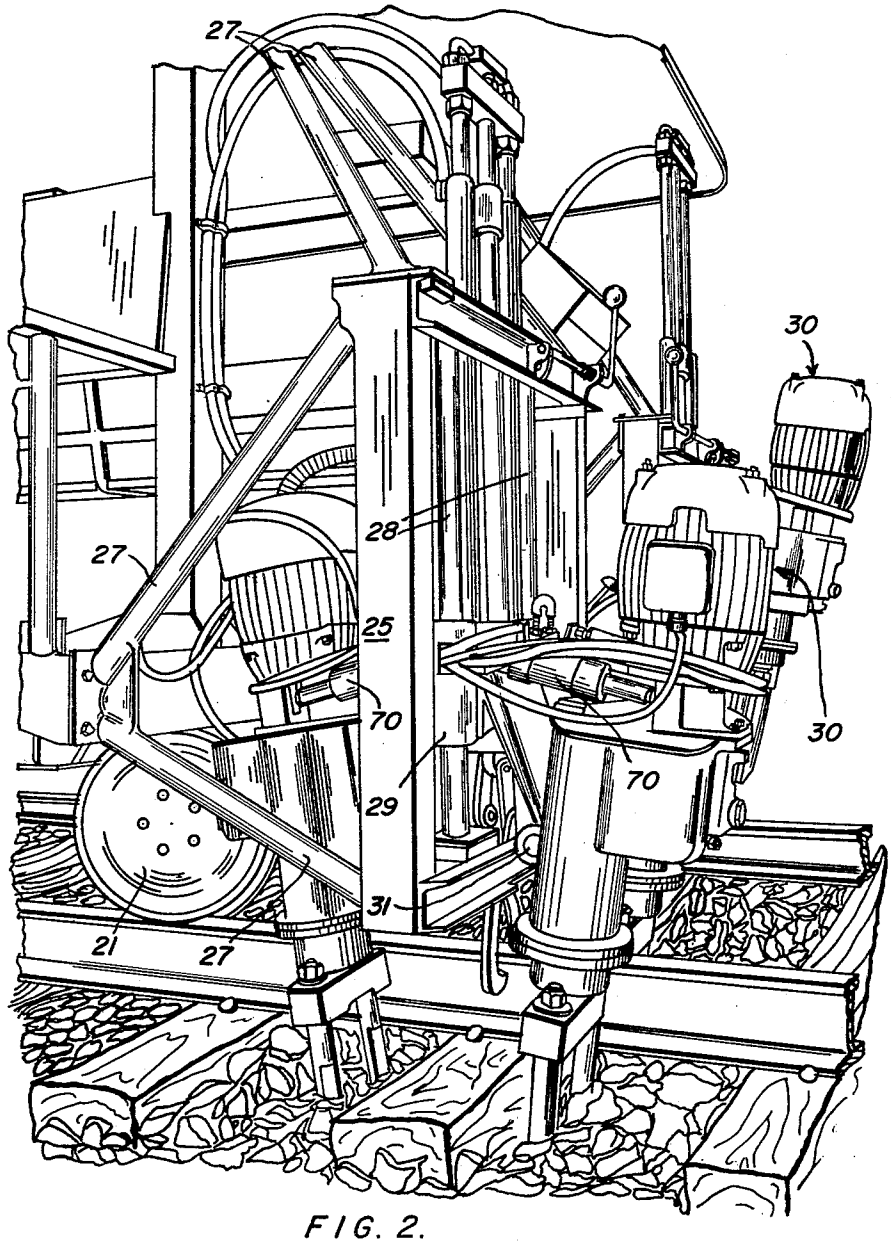


FIG. 2.

INVENTOR
JOHN K. STEWART
BY Smart & Biggar
ATTORNEYS.

April 13, 1965 J. K. STEWART 3,177,813

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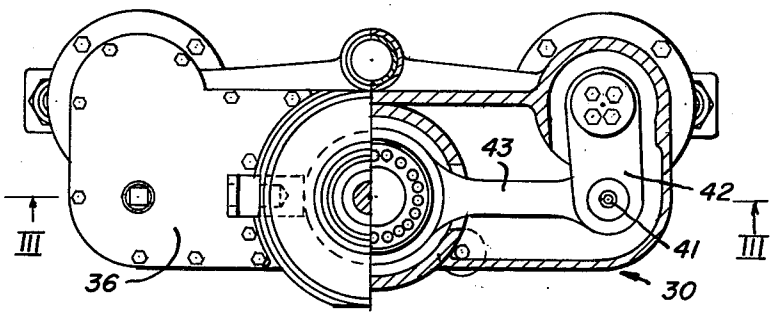


FIG. 4.

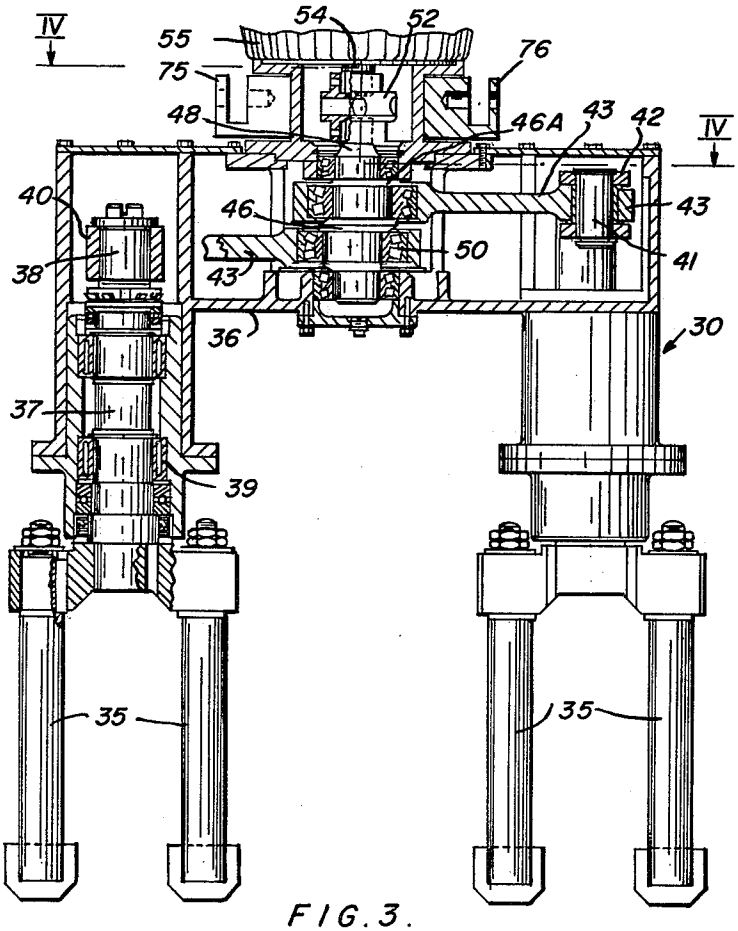


FIG. 3.

INVENTOR
JOHN K. STEWART
BY Smart & Biggar
ATTORNEYS.

April 13, 1965 J. K. STEWART 3,177,813

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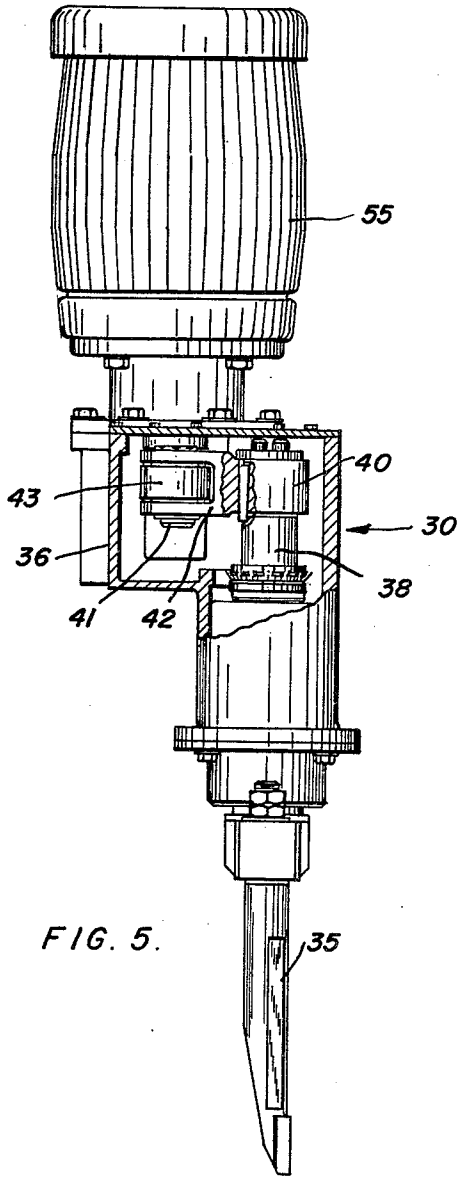


FIG. 5.

INVENTOR
JOHN K. STEWART
BY Smart & Biggar
ATTORNEYS.

April 13, 1965 J. K. STEWART 3,177,813

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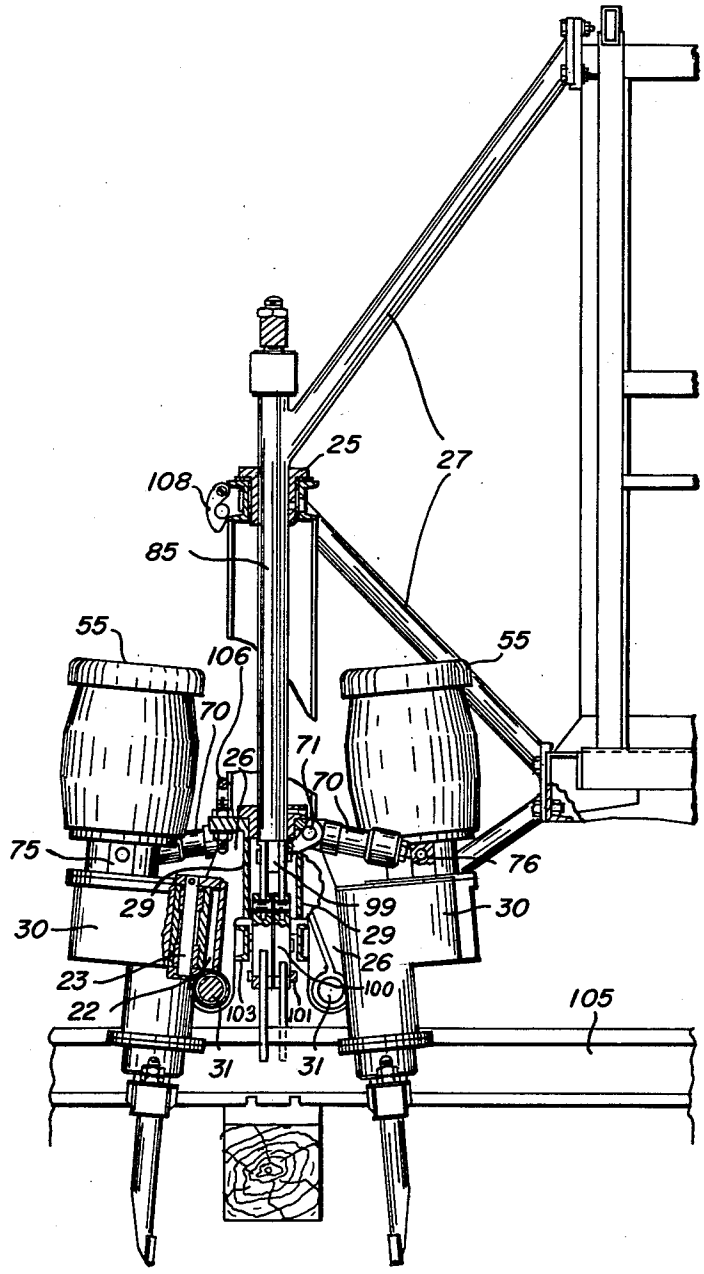


FIG. 6.

INVENTOR
JOHN K. STEWART
BY Smart & Biggar
ATTORNEYS.

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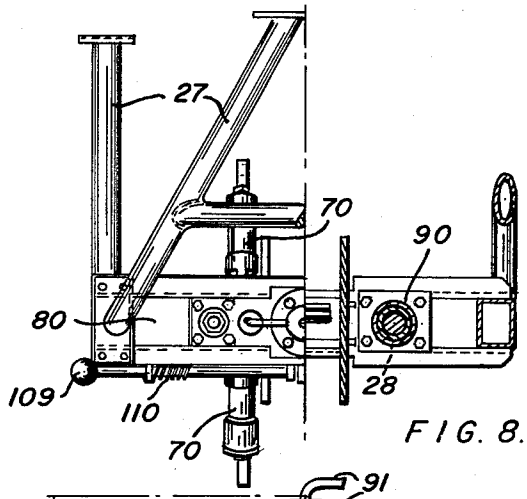


FIG. 8.

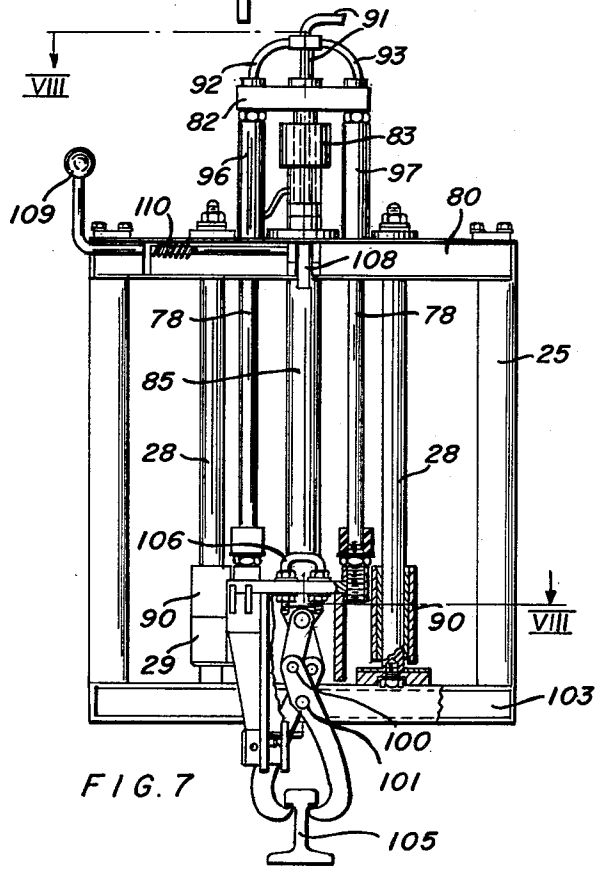


FIG. 7

INVENTOR
JOHN K. STEWART
BY Smart & Biggar
ATTORNEYS.

April 13, 1965 J. K. STEWART 3,177,813

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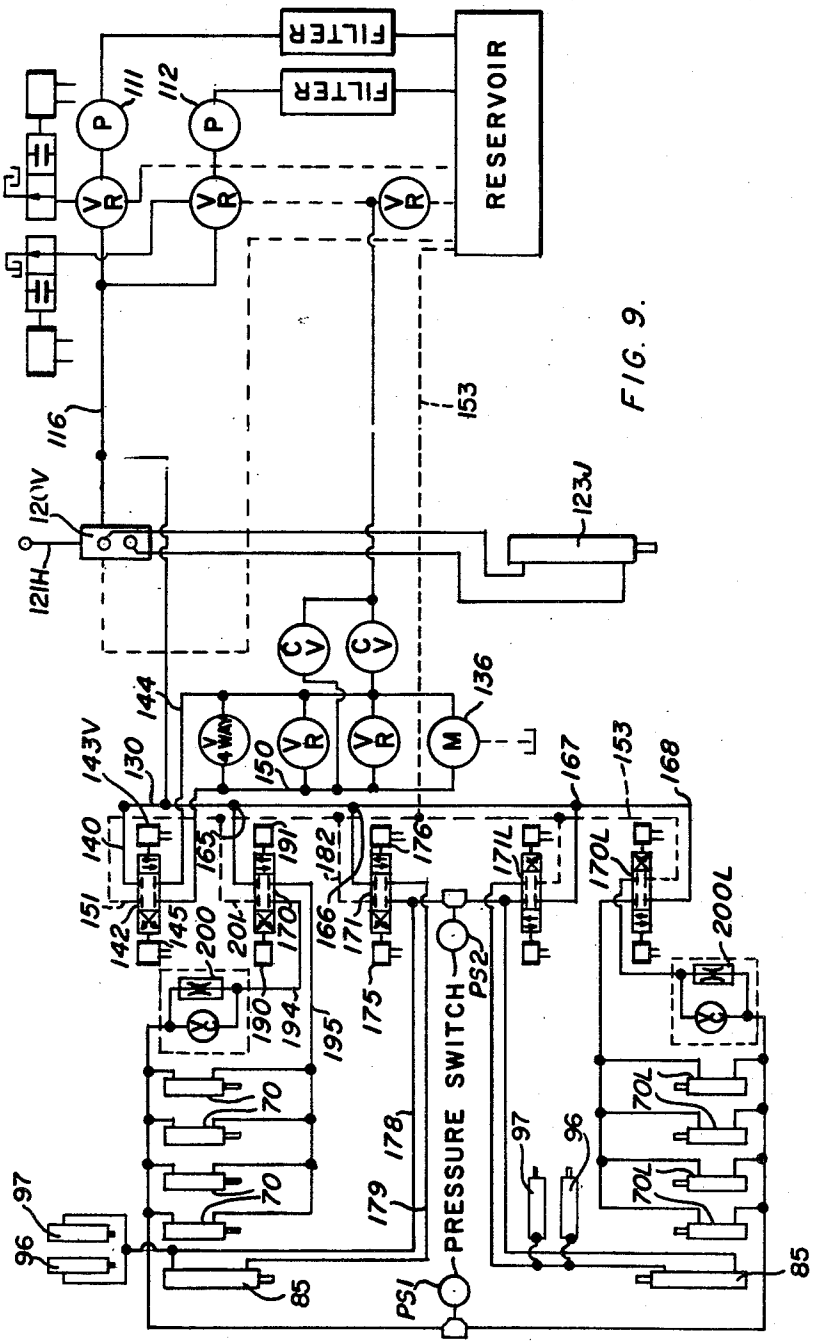


FIG. 9.

INVENTOR
JOHN K. STEWART
BY- Smart & Biggar.
ATTORNEYS.

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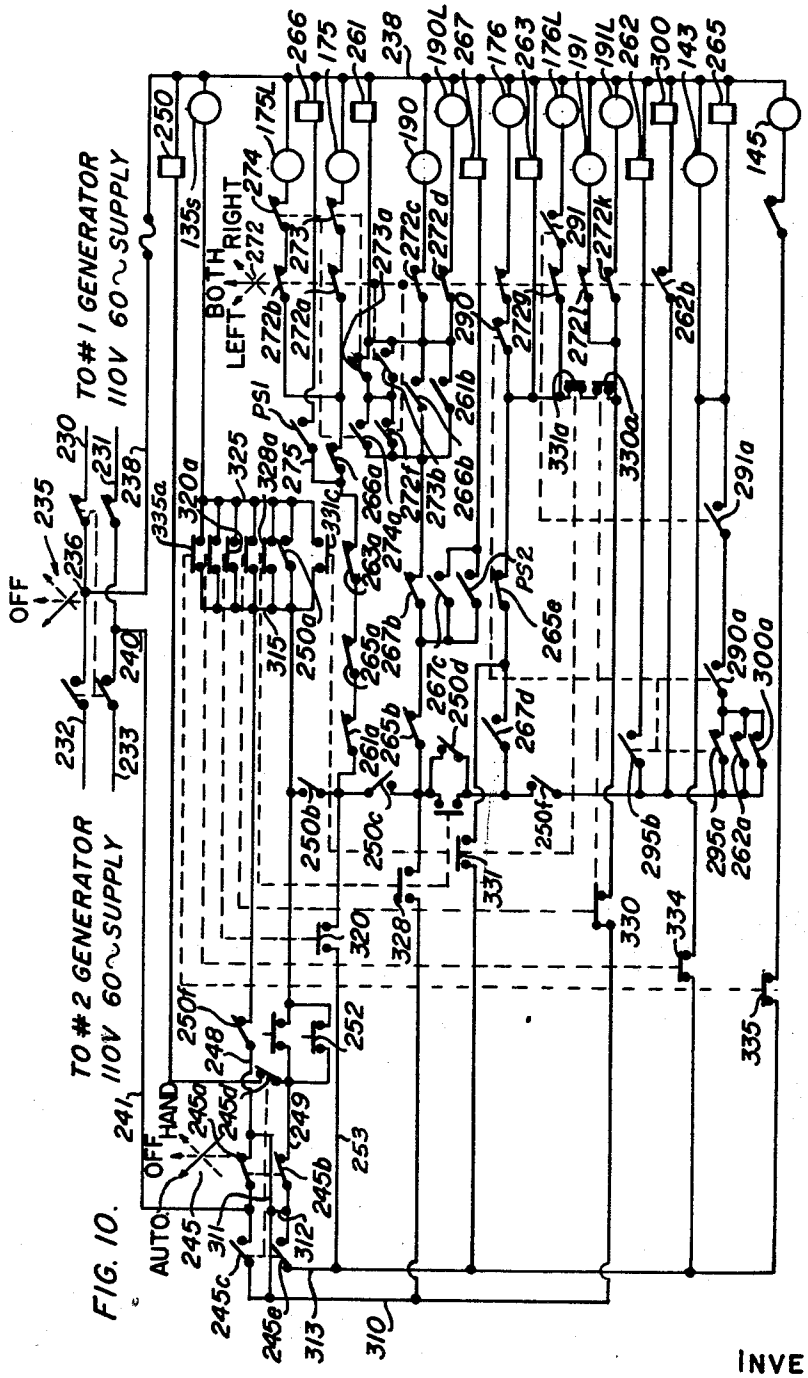


FIG. 10.

INVENTOR
JOHN K. STEWART
BY Smart & Biggar
ATTORNEYS.

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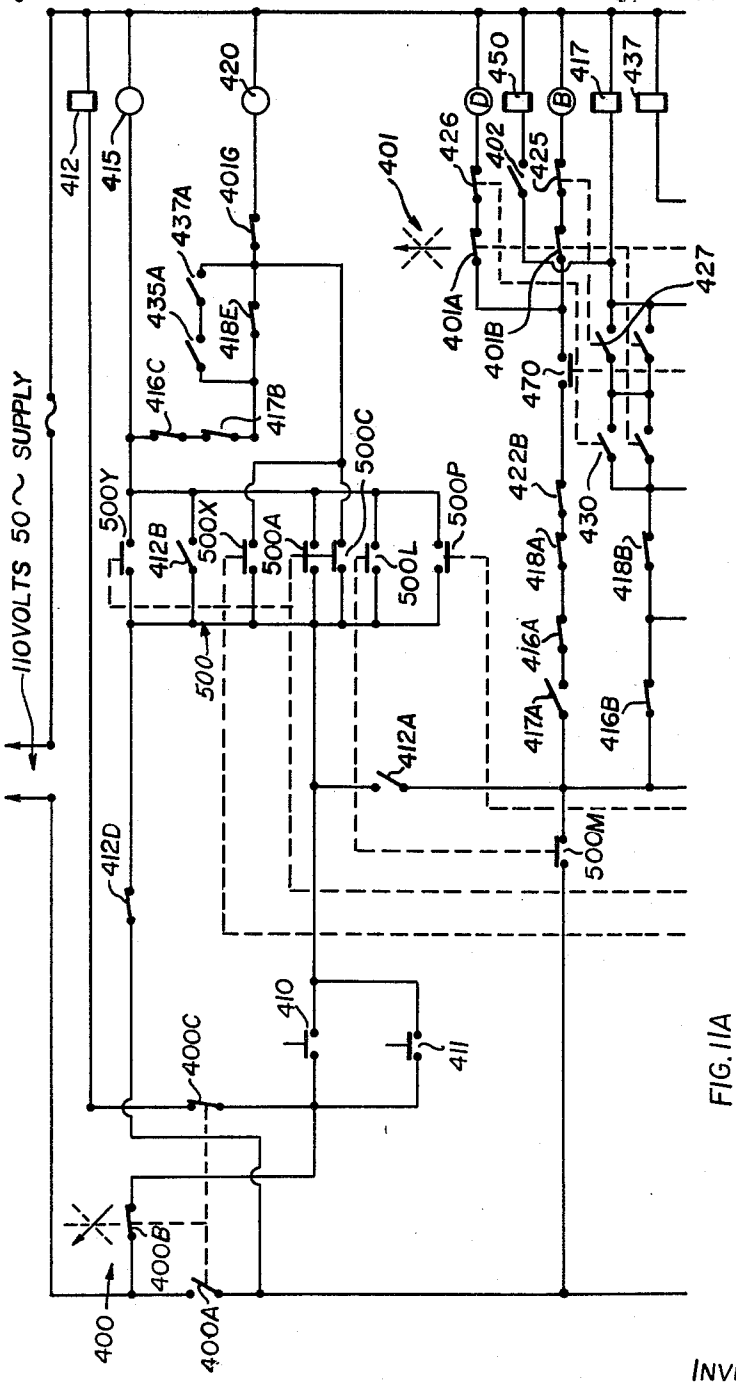


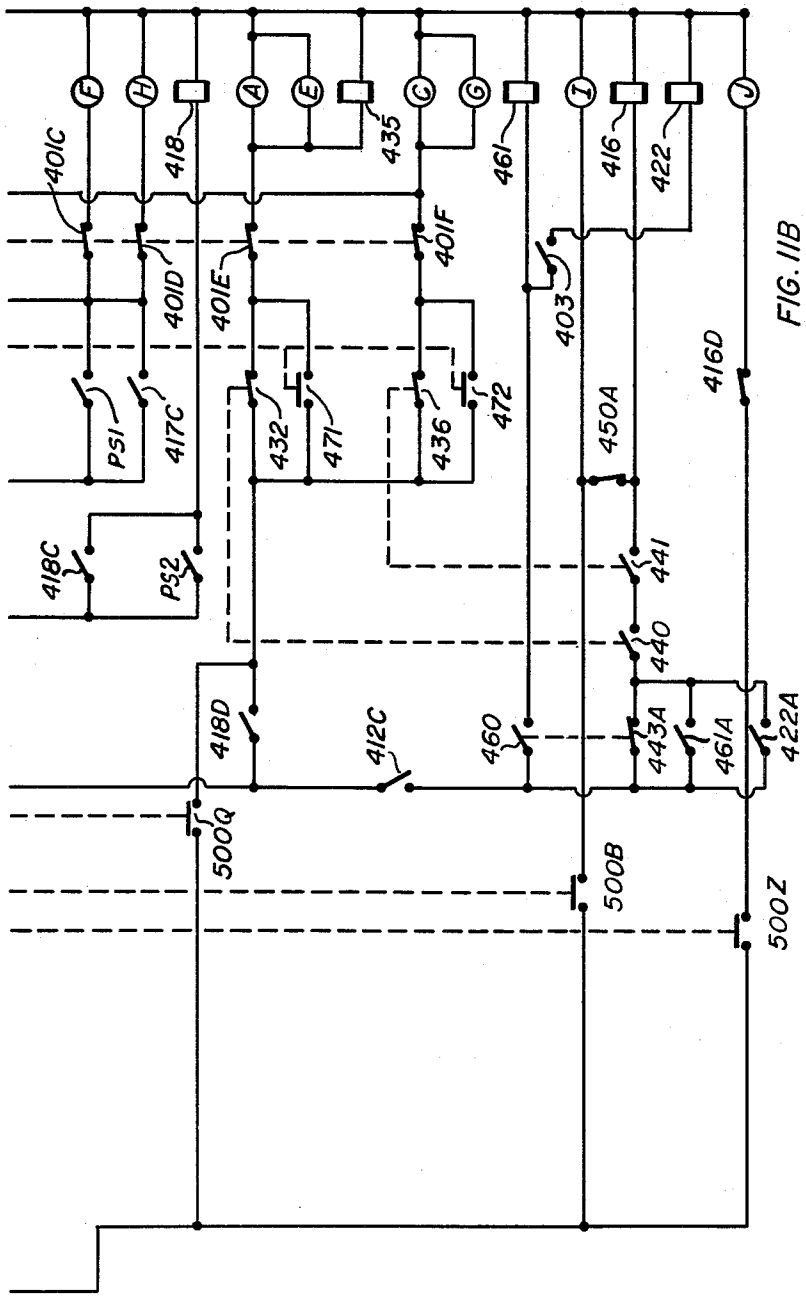
FIG. 11A

INVENTOR
JOHN K STEWART
BY- Smart & Biggar.
ATTORNEYS

April 13, 1965 J. K. STEWART 3,177,813

RAILROAD MAINTENANCE DEVICE

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INVENTOR
JOHN K. STEWART
BY- Smart & Biggar
ATTORNEYS.

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3,177,813

RAILROAD MAINTENANCE DEVICE

John Kenneth Stewart, 223 Dubord Crescent, Strathmore, Montreal, Quebec, Canada

Filed Sept. 9, 1960, Ser. No. 55,071
13 Claims. (Cl. 104—12)

This apparatus relates to tamping equipment and particularly to tamping equipment adapted to consolidate the ballast of a railway track under the ties thereof.

It is an object of the present invention to provide a tamping unit of novel design which permits of accurate and speedy tamping.

It is a further object of the present invention to provide a tamping head which due to interconnection of tamping units permits of a very satisfactory quality of tamping of the ties of a railway track.

It is a further object of the present invention to provide a tamping vehicle capable of a semi-automatic or a totally automatic tamping operation.

According to the present invention a tamping unit comprises a pair of tamping fork arms arranged in spaced relationship, drive shafts located centrally of each of the forked arms and extending longitudinally thereof, drive means connected to said drive shafts, said drive means comprising, motor means for driving said drive shafts, a crank shaft depending from said motor means, a pair of laterally extending connecting rods each mounted on an eccentric on said crank shaft spaced apart 180°, and a rocker arm connected to the outer extremity of each of said connecting rods and to said drive shafts whereby to transmit a high frequency low amplitude vibration to said fork arms.

In a preferred construction a tamping head is adapted for up and down reciprocation on a rail travelling vehicle and comprises a pair of tamping units of the type described pivotally mounted on a frame member for swinging action towards and away from each other, hydraulic jack means being provided on the frame for imparting a squeezing action to said tamper units and hydraulically operated jack means for raising and lowering said beam and said tamping heads under power.

Preferably the tamping heads are universally mounted on the frame.

The present invention also provides a control system for automatically and sequentially tamping the ballast about the ties of a railway track which system comprises position sensing means adapted to engage a tie and operated means to bring a railroad maintenance vehicle to a stop with its tamping heads located above said tie in tamping position, means for sequentially operating hydraulic means to lower said tamping heads into engagement with said ballast, to a depth determined by switch means operated by pressure or depth beneath the underside of the tie to be tamped; hydraulic means adapted to cause said tamping heads to be moved towards each other whereby to compact the ballast beneath a tie; switch means adapted to stop the tamping action of the tamping heads after the ballast has been tamped to a predetermined depth or pressure; switch means operable to operate the hydraulic means to raise said tamping heads out of engagement with said ballast and to simultaneously operate said hydraulic means to pivot said tamping heads away from each other; and switch means operated at the end of the cycle of operations to actuate motor means to drive said vehicle along the track until the position sensing device brings the vehicle to a stop over the next tie to be tamped.

It is a feature of the present invention to provide in a railroad maintenance vehicle a supporting frame, a pair of tamping heads universally mounted on said frame and

located one above each rail of the railroad track and adapted for vertical reciprocation relative to said vehicle, said tamping heads each comprising a pair of tamping units having two pairs of transversely spaced tamping bars, means for vibrating said tamping bars at a high frequency low amplitude vibration, said tamping heads being arranged on said frame so that, in transportation position, the tamping bars are spaced apart a distance greater than the width of a tie and the bars on each tamping unit are spaced apart a distance sufficient to span a rail, motor means for driving said vehicle along said track, position sensing means adapted to engage a tie to be tamped and to stop said vehicle when the tamping unit is located above said tie, hydraulic means for lowering said tamping unit into the ballast around said tie, each of said tamping heads being universally mounted on said frame and being provided with hydraulic jack means adapted to swing said tamping heads towards each other whereby to tamp the ballast beneath and around the tie, and pressure distribution means adapted to ensure that each pair of tamping bars on each tamping head engages and tamps said ballast to an equal pressure depth and means adapted to withdraw said tamping unit out of engagement with said ballast and to cause said maintenance vehicle to move to the next tie to be tamped.

The following is a description by way of example of one embodiment of the present invention, reference being had to the accompanying drawings in which

FIGURE 1 is a pictorial representation of a wheeled rail travelling vehicle with tamping heads thereon, looking at the front of the vehicle;

FIGURE 2 is a pictorial view of the tamping heads and the mounting masts therefor;

FIGURE 3 is a cross sectional elevation of a tamping unit taken on section line III—III of FIGURE 4;

FIGURE 4 is a plan view partially in section of the unit shown in FIGURE 3 taken on the section line IV—IV of FIGURE 3;

FIGURE 5 is a sectional side elevation of the tamping unit;

FIGURE 6 is a side elevation partially in section of the front end of the machine as seen in FIGURE 1 showing the universal mounting of the tamping heads;

FIGURE 7 is a front elevation partially in section of the frame on which the tamping head is mounted, the tamping head being removed;

FIGURE 8 is a sectional plan view of the elements of FIGURE 7 on the section line VIII—VIII of FIGURE 7;

FIGURE 9 is a schematic diagram of the hydraulic connections for the device;

FIGURE 10 is a schematic representation of the electrical circuit permitting of semi-automatic or automatic operation of the device; and

FIGURES 11A and 11B together forming FIGURE 11 which is a schematic representation of an alternative circuit.

Turning now to the drawings, a vehicle **20** is mounted on four rail engaging wheels **21**, each wheel having an individual hydraulic turbine **136** for direct driving of the wheel. All four turbines are supplied from a common reservoir and two pumps are available for either single or combined use.

Two frames **25** are mounted one on either side at the front of the vehicle by rigid arms **27**. Within each of the frames is a vertically extending cylindrical guideway **28** on which a sliding frame **29** is mounted. The sliding frames **29** each carry at the front and rear thereof an outwardly extending bracket **26** at the extremity of which is mounted a pivot pin **31** (see FIGURE 6). Pivotally mounted on each pin **31** is a universal swivel joint **22** having an upstanding pivot post **23**. A tamping unit **30**

is pivotally mounted on each pivot post and through the joint 22 and the pins 31 is capable of universal pivoting relative to the sliding frame 29. The two tamping units on each frame 29, together form a tamping head.

Turning now to FIGURES 3, 4 and 5, which are details of the individual tamping units 30, two pairs of forked arms are spaced apart from each other on the housing 36 of the tamping unit. Extending centrally and longitudinally of each pair of forked arms is a drive shaft 37 which is mounted on the housing 36 in roller races 39. The upper end 38 of each drive shaft 37 is surrounded by a collar 40 which is keyed thereto and from which extends a bifurcated rock shaft 42 (FIGURE 4). Each rock shaft 42 is pivotally connected to a connecting rod 43 by a common pin 41 and each connecting rod 43 is in its turn conventionally connected to an eccentric of a central crank shaft 48. The crank shaft is mounted in the housing 36 in roller races 50 and its pair of eccentrics 46, 46A are of small throw and spaced apart 180°. The crank shaft 48 is connected through a coupling 52 with the drive shaft 54 of an electric motor 55.

In operation the electric motor revolves at high speed driving the crank shaft 48 which through the connecting rods 43 and rock shafts 42 rock the drive shafts 37 clockwise and counter-clockwise at high speed and at low amplitude. This motion is imparted to the fork arms 35 whereby a high frequency low amplitude tamping vibration is set up in the fork arms 35 which rock clockwise and counter-clockwise with the drive shaft 37.

Each of the tamping units being universally mounted relative to the sliding frame 29 the tamping units on each sliding frame may be selected, in a manner which will presently become apparent, to move in towards each other at a common rate, there being pivoting about the pivot pins 31 but no pivoting about the posts 23, the right-hand fork on the front tamping unit and the left-hand fork of the same unit move in towards the left-hand and right-hand forks of the rear unit respectively. However, if one of the forks of one of the tamping units meets with undue resistance on the ballast and its progress towards its aligned tamping unit is arrested, the other fork on the same unit may continue its travel towards its respective fork on the other tamping unit by reason of the facility to pivot about the post 22. Consequently any irregularities in the ballast are accounted for by this manner of universal mounting. The movement of the tamping units towards each other beneath the ballast (hereinafter referred to as the squeeze-in movement) and their movement away from each other after tamping (hereinafter referred to as the squeeze-out movement) is brought about by hydraulic jacks 70. The squeeze-in and the squeeze-out movement together form the squeezing cycle. The squeeze jacks are mounted in pairs on each side of the sliding frame 29 and are pivotally mounted thereon at 71. Each pair of jacks are connected to the brackets 75, 76 (FIGURE 3, FIGURE 6) on the sides of the tamping units 30 spaced on either side of and immediately below the electric motors 55 which vibrate the fork arms. The sliding frames 29 slide up and down the guideways 28 on the frames 25 and are connected to drive rods 78, as best seen in FIGURE 7, which extend through the upper cross member 80 of the frame 25 and are connected at their outermost ends at a cross head 82, which cross head is centrally connected to the piston rod 83 of the piston of a hydraulic piston and cylinder arrangement 85. By reason of the sleeves 90 on the sliding frame 29 which engage with the guide rods 28 straight line vertical motion of the sliding frame 29 relative to the fixed frame 25 is ensured. Hydraulic connections 91 are made with the top of the piston rod 83 and provides for the introduction of hydraulic fluid down through the hollow piston rod 83 and through the piston in the cylinder 85 to the underside of the piston. This connection provides the necessary hydraulic pressure to lift the sliding frame 29 and with it its tamping head. Hydraulic connections,

not shown, are connected to the top of the cylinder 85 to provide a power down feed of the tamping head. Floating bumper cylinders 96, 97 cooperate with pistons secured on the rods 78 and form hydraulic seals with the rods 78 so as to permit of relative movement of the cylinders 96, 97 on the rods 78 to the pistons thereon. Fluid is admitted to the hollow inside of the rod 78 by means of the connections 92, 93 and through orifices in the rods 78 with the inside of the cylinders 96, 97. Thus pressure to lift the sliding frame 29 is communicated to the cylinders 96, 97 in addition to the cylinder 85. The bumper cylinders 96 and 97 are connected in parallel with the cylinder 85 in such a manner as to form a hydraulic lock when the sliding frame 29 is in the lowered position with the bumper cylinders 96 and 97 bottoming against the cross-members 80 of the frame 25, provided that the valves controlling the admission of fluid to the cylinders 85 to cause the downfeed have been closed. In this condition the cylinders 85 and the cylinders 96 and 97 together support the tamping heads, that is to say the load is distributed over the three cylinders on each frame.

Connected to a lug 99 (FIGURES 6 and 7) on the bottom of the cylinder 85 is a lazy tong 100 which passes through the lower cross member 103 of the frame 25. The tong 100 is limited in its upward movement relative to member 103 by the studs 101 which abut against the member 103A of the member 103.

Thus since each of the cylinders 5 is a floating cylinder when their respective tamping heads are fed downwardly into contact with the ballast relative movement will occur between the heads and the cylinders whereupon the respective lazy tong engages and clamps on the rail 105 to anchor the cylinder, whereupon to force the tamping head into the surface to be tamped and at the same time to dampen the transmission of vibration. The sliding frame 29 is provided with a "U-shaped" eye 106 which when the tamping head is in the raised, or transporting position, cooperates with a locking hook 108 on the cross member 80 of the frame 25. When the tamping operation is to be commenced hook 108 is released by rotation of the lever 109 to disengage the hook 108 from the eye 106. The hook is normally biased by a spring 110 to the closed position and it is against the action of the spring 110 that the lever 109 is pivoted to release the eye 106.

During operation the tamping motors are normally left running continuously.

Referring again to FIGURE 1 rigidly secured to the frames 25, and extending between their upper and lower cross members 80 and 103, are racks 120, 121, each rack carrying a pair of limit switches 122, 123 which engage with and are tripped by movement of the sliding frame 29 past the switches. In this manner travel of the sliding frame up and down relative to the fixed frame 25 is limited in a manner which will be hereinafter more fully described.

Referring now more particularly to FIGURES 9, 10 and 11. In FIGURE 9 there is shown a hydraulic schematic arrangement of the connections of the device illustrated in FIGURES 1 and 2, and in FIGURES 10 through 11 there is shown the electrical connections which control the operation of the hydraulic apparatus which causes the device to operate. It will be recalled that the vehicle has two sliding frames 29 which are identical in construction, one being mounted over the right-hand rail and the other being mounted over the left-hand rail of a railway track.

Hydraulic pressure is obtained for the operation of the machine from pumps 111 and 112. Hydraulic fluid under pressure is applied on a common line 116 on the one hand to a valve 120V operated by a handle 121 from whence the pressure fluid may be applied to a central jack 123H beneath the vehicle at the centre of gravity thereof. The jack 123J is a lifting jack as has become common in the art for lifting the vehicle clear of the rails

so that it may be turned through 90° and removed from the main track on take-off rails. Hydraulic fluid under pressure is also applied to the line 130. Connected to the line 130 through a conduit 140 is a solenoid operated valve 142 having a solenoid control valve member 143V for causing the application of pressure fluid to the line 144 for driving the traction motors or turbines 136 to drive the vehicle in the forward direction and a solenoid operating member 145 operable to connect the valve 142 in such a manner that hydraulic fluid from the line 140 is transmitted through the line 150 to the motor drive to cause the vehicle to be driven in reverse. A line 151 connects the valve 142 with a common return line 153 to connect the valve to exhaust The supply line 130 has connections at 165, 166, 167 and 168 with the right-hand squeeze cylinder operating valve 170, the right-hand raising and lowering cylinder 171, the left-hand raising and lowering cylinder 171L and the left-hand squeeze control cylinder 170L.

The right-hand raising and lowering cylinder valve 171 is operable by two solenoid control members 175, 176 to apply fluid under pressure from connection 166 to a selected one of the lines 178, 179 to apply pressure to the right-hand raising and lowering cylinder 85 whereby to cause it to raise or lower the right-hand sliding frame. The pressure fluid is also communicated to cylinders 96, 97 as described. Return to exhaust through the valve 171 is by line 182 which connects with the common return line 153.

The right-hand squeeze jacks control valve is operated by a pair of solenoids 190, 191 to apply hydraulic fluid under pressure from connection 165 selectively to one of lines 194, 195 to one or other side of each of the two pairs of squeeze jacks operating the right-hand tamping head. A flow regulator valve 200 is included in the line 194. Return to exhaust through the valve 170 is by way of the return line 201.

The left-hand arrangement on the left-hand frame 25 is exactly the same as the right-hand arrangement and for the sake of clarity like parts have been given like numbers with the suffix "L."

The pressure control of the downward feed of the tamping heads is achieved by a pressure switch 210 which operates to dump the system to exhaust if the pressure encountered by the downwardly feeding tamping heads exceeds a pre-determined selected pressure for which the valve 210 is set. Similarly a valve 212 determines by its setting, the pressure by which the squeeze jacks on the squeezing cycle will be caused to dump to exhaust. Since the switch is common to both units on a head if one unit is snagged the other will continue to squeeze in until the desired pressure is reached.

The control circuit

The foregoing mechanical and hydraulic arrangements are arranged, according to the invention, to be electrically controlled and capable of automatic or semi-automatic operation. That is to say the starting, positioning and stopping of the vehicle over a tie to be tamped, and the subsequent operation of left or right-hand or both tamping assemblies may be selectively performed by the vehicle operator, or may be performed automatically according to a preselected order by the apparatus according to this invention, it being necessary for the operator merely to keep a dead-man handle or like switch depressed.

Position sensing of the device is obtained through the medium of a spring-loaded position sensing finger 295 located centrally and forwardly of the vehicle. This device acts as a cycle starting switch when the machine is under automatic control.

Turning now to FIGURE 10 where the electrical control connections are shown, it is seen that a primary selector switch 245 is provided which selects whether the device will operate automatically or whether each operation is to be operated by the operator. A second major selector switch 272 selects whether the left-hand, or right-hand, or both, sliding carriages with their tamping assemblies thereon will be operated. Let it be assumed that the operator has elected to operate both tamping assemblies and has selected that the operation will be automatic, then the sequence of operations is as follows:

Power is obtained from one of two generators (not shown) through connections 230, 231, 232 and 233 through an on-off switch 235. Assuming that generator 1 has been selected, and that the power supply is thus obtained on lines 230, 231, connection 236 which is common to lines 230 and 232 connects one side of the circuit by line 238 with the generators. Common connection 240 connects the other side of the electrical circuit with either one of lines 231, 233. Thus the action of selecting generator 1 causes power to be drawn on lines 230, 231 and applied at lines 238 and 241. Line 241 is connected with the selector switch 245 which is operated by the vehicle operator to select automatic operation, manual operation or can be switched to the "off" position. As has been assumed the automatic selection has been made and thus contacts 245*a*, 245*b* and 245*d* are closed and contacts 245*c* and 245*e* are open. The power supply from line 241 thus is connected by the switch 245 (its contacts 245*a* and 245*b* being closed) with lines 248 and 249.

Power from line 249 through contact 245*d* of switch 245 is applied to the control relay 250 which operates to close its contacts 250*a*, 250*b*, 250*c*, 250*d*, 250*e* and to open contact 250*f*. The starter buttons 252 are then closed manually by the operator and power from line 249 flows through the contact 250*a* to operate the solenoid 135*s* thereby applying hydraulic power to the working cylinders of the device at the same time power is applied through contacts 250*b* to line 253 through contacts 261*a*, 265*a* and 263*a* of the control relays of 261, 265 and 263 through the contacts 266*a* of the control relay 266 to contacts 272*a* and 272*b* of the switch 272 which selects whether the left hand, right hand or both tampers operate. Both tamp heads have been selected and thus power passes through the contacts 272*a* and 272*b* through the lower limit switches 273, 274 to operate the control relays 175, and 175L, thereby causing pressure fluid to be applied to the down feed cylinders of both tamping heads. When a pre-determined limit has been reached the switches 274 and 273 open thereby deenergizes the solenoids 175 and 175L thus closing off power to the down feed cylinders. The pressure switch PS1 is connected in line 275 off line 253 and operates on control relay 266. Thus if the tampers encounter a pressure greater than the pre-selected pressure prior to the reaching of their pre-determined down feed length of travel the pressure switch PS1 (see also FIGURE 9) closes to operate control relay 266 thereby opening contacts 266*a* and consequently stopping the downward travel of the tamping heads.

Let it be assumed that the cessation of travel of the tamp heads has been caused by opening of the limit switches 273, 274. In opening the switches, contacts 273*a* and 273*b* are closed and contact 274*a* is closed, power then is applied through contact 250*c*, contact 265*b*, contact 267*b*, through switch 274*a*, switches 273*a* and 273*b* and since the operation of both tampers has been selected through switches 272*c* and 272*d* to operate the left-hand and right-hand squeeze cylinder solenoids 190 and 190L thus commencing the squeezing action of the tamping heads. On reaching a predetermined squeeze pressure the pressure switch PS2 closes and applies electrical power to the control relay 267 which opens its contacts 267*b* and closes its contacts 267*c*, thereby ceasing the "squeezing-in" part of the cycle.

It will be observed that if the limitation of the downward movement of the tamping heads has been caused by the closing of the pressure switch PS1 with its consequent energization of the control relay 266, then that con-

trol relay in addition to opening its contact 266*a*, closes its contact 266*b* thereby operating the control relay 261 and causing it to close its contact 261*b*, consequently electrical power will be applied to the solenoids 190, 190L through switches 272*c* and 272*d* as before since an electric path will have been formed by the closing of the contacts 266*b* and 261*b*. Limitation of the squeezing in part of the cycle will be governed as before by the pressure switch PS2 (see also FIGURE 9).

On the cessation of the squeeze-in part of the cycle control relay 267 will be held closed since its contact 267*c* has been closed and thus contact 267*d* remains closed.

Now electrical power is applied through contact 250*d*, contact 267*d*, contact 265*e*, the upper limit switch 290 and through the upper limit switch 291 for the left-hand tamper to operate the solenoids 176 and 176L to cause the up-feed part of the cycle to commence. At the same time however electrical power is applied through the contacts 272*h* to 272*k* to operate the solenoids 191 and 191L to cause the squeeze out part of the cycle. The action thus will be a simultaneous squeeze out and raising action of the tampers. There, therefore, will not be any disturbance of the consolidated ballast. On reaching the pre-determined upward distance of travel the switches 122 (see FIGURE 1) are mechanically tripped by the upward movement of the tamping heads and the solenoids 176 and 176L (see FIGURE 10) operate to close off further power for moving the tampers upwards.

The upper limits 290 and 291 of switches 122 on being operated by the upwardly travel of the tamping heads close their contacts 290*a* and 291*a* thereby applying electrical power to the control solenoid 143 which causes the motors to drive the device forward on the track.

When the position sensing finger 295 (FIGURE 1) touches the next tie to be tamped the switch contact 295*a* is opened and power is shut off from the solenoid 143 thereby stopping forward travel of the device.

In opening contact 295*a* contact 295*b* will be closed and power is applied to the control relay 262 which closes its contact 262*a* (after 2 seconds). Control relay 262 is a 2 second time closed and a ¼ T.O. contact relay and thus contact 262*a* is closed for an interval of two seconds and thereafter open for an interval of ¼ second. Normally open contact 262*b* in its turn operates control relay 300 which is a quarter second time open relay. This relay closes its contact 300*a* and thus for a period of 2¼ seconds after the actuator switch 295*a* has shut off power to the solenoid 143 power is applied thereto through contacts 262*a* and 300*a* to permit the device to become centered over the tie to be tamped.

Thus, if the sensing finger 295 touches some projection, say a stone, and is tripped, the timing elements are such that the sensing finger will have return to normal, having passed over the stone due to the motion of the vehicle before the vehicle is halted. In this fashion the vehicle is not "fooled" by foreign bodies and responds only to the engagement of a tie.

As a further explanation of the device let it now be considered that the manual operation has been selected and that the right-hand tamper alone is to operate.

Switch 235 again selects the generator to be used and electrical power is applied to the line 238 and thus to one side of the circuit and electrical power is applied by line 241 to switch 245. In the selection of "manual operation" switch 245 has its contacts 245*a*, 245*b* and 245*d* open and 245*c*, 245*e* are closed. Power is applied through the switch 245*e* to the line 310 and through the branch lines 310, 312, switch 245*e* to the line 313. The line 311 also supplies the line 248 and thus through contacts 250*f* to the line 315.

In order to commence the cycle of tamping operations the down feed switch 320 is closed and thus its contacts 320 are also closed and the lines 315 and 325 are electrically connected through the contacts 320 to operate the solenoid 135*s* of the hydraulic supply valve 135. At the same time through switch 320 the line 313 is connected with the line 253 and the right-hand work head cylinder down feed operating solenoid 175 is energized through contacts 261*a*, 265*a*, 263*a*, 266*a*, 272*a* and through switch 273 which are normally closed, contacts 272*b* being opened the left-hand control solenoid 175L is not energized. As with the automatic operation the downward travel of the work head cylinder is governed by the operation of either the limit switch 425 or the pressure switch PS1.

On the squeeze in part of the cycle, that is after completion of the downward travel of the work cylinder the squeeze in operating button 328 is manually pressed by the operator and the additional contacts 328*a* are also closed. Hydraulic pressure is again available since the contact 328*a* connects the line 315 and 325. Line 310 is connected with the right-hand squeeze in cylinder operating solenoid 190 through the switch 328 contacts 265*b*, 267*b*, and if the downward travel of the work head cylinder has been terminated by the pressure switch PS1, contact 266*b* and 272*c* thereby initiating the squeeze in portion of the cycle. If the downward travel of the tamper has been terminated by the tripping of the lower limit switch 273 then the path from the contacts 267*b* to the solenoid 190 will be through contacts 272*f*, 273*a* and 272*c*. As before when the tamping heads have consolidated the ballast to a pre-determined pressure the pressure switch PS2 closes and operates the control relay 267 to open its contacts 267*b* and terminate the squeeze in portion of the cycle. Normally switches 330 and 331 are closed at the same time by the operator, thereby putting the line 313 into contact with the work head upfeed operating solenoid 176 and the line 310 in communication with the squeeze out cylinder operation solenoid 191, thereby withdrawing the tampers from the ballast and squeeze out at the same time. If for some reason it is desired to do the upfeed and the squeeze-out operation separately it will be observed that this can be achieved since the contacts 331*a* are opened when the switch 331 is closed and the contacts 330*a* are opened on closing the switch 330. The upper limit switch 290 is tripped open by the physical movement of the tamper and thus the up-feed cylinder solenoid is operated to cause the hydraulic fluid to be cut off from the cylinder the operation of the limit switch 290. By closing the switch 334 the forward motion of the vehicle on the tracks is started since the line 313 is connected with the forward traction solenoid 143 only and similarly the reverse travel device is brought about by closing the switch 335 which brings the line 313 into communication with the reverse traction control solenoid 145.

The following is a description of an alternative circuit in which provision for double and skip tamping has been made. In order to avoid confusion like parts in the circuits have not been given the same references.

FIGURES 11A and 11B illustrate an alternative circuit which is controlled by four major selector switches; switch 400 which selects the automatic or manual operation of the device; switch 401 which selects whether both or which one of the tamping heads is operated; switch 402 which controls whether a tie will be tamped once or twice in sequence; and switch 403 which determines whether each successive or every other tie shall be tamped. In addition, there is provided, a portable station switch 410 which is attached to the vehicle on a long electrical lead and enables the operator to walk alongside the vehicle and view the operation from ground level, and a floor or foot switch 411 which is in the nature of a "dead-man" switch and is normally held down by the foot of the operator when the machine is in operation.

Down feed

(*a*) When either portable station (410) or floor foot switch (411) is depressed, current is allowed to flow through—

(1) 400B–400C to energize relay 412
(2) 410 or 411–412B to energize solenoid 415
(3) 416C–417B–418E–401G to energize solenoid 420
(4) 412A–417A–416A–418A–422B–push-button 470–401B–425 to energize solenoid B
(5) 401A–426 to energize solenoid D.

(*b*) Both heads move downward with two pumps.

Depth control

(1) When the right-hand head reaches its preselected depth position, 425 (physically illustrated as 123 in FIGURE 1) opens to de-energize solenoid B and 427 closes
(2) When the left-hand head reaches its depth position, 426 opens to de-energize solenoid D and 430 closes.

Pressure control

(1) When right-hand and left-hand heads reach the set pressure PS1 closes and current now flows through 400B–switch 410 or switch 411–412A–416B–418B–PS1 to energize relay 417.

Note: This circuit is an alternative to the one described immediately hereunder.

Squeezed-in

(*a*) Current now flows through 400B–switch 410 or switch 411–412A–416B–418B to

(1) 430–427 to energize relay 417
(2) 418B–PS1–401C to energize solenoid F
(3) 417C–401D to energize solenoid H
(4) 417A opens to prevent further lowering of the heads.

Squeeze-out and up feed

(*a*) When preset pressure on squeeze-in circuit is reached, PS2 closes energizing relay 418 as the contact 416B is closed.

(*b*) Current now flows through 416B (and 418B) holding 418C closed through 418 even if PS2 reopens as the pressure decreases.

(*c*) Normally closed contact 418B opens de-energizing relay 417 and solenoids F and H preventing further squeeze-in.

(*d*) 418A opens when the relay 417 is de-energized upon contact 418B opening to prevent down feed as normally open contact 417A is now closed.

(*e*) Contact 418D closes allowing current to flow to

(1) 432 and 401E to energize relay 435 and solenoids A and E causing the right-hand head to squeeze-out and move up.
(2) 436 and 401F to energize relay 437 and solenoids C and G causing the left-hand head to squeeze-out and move up.

(*f*) Normally closed contact 418E opens and 435A and 437A being closed allows current to feed solenoid 420 through 400B–410 or, depending upon which switch 410 or 411 is used, 411–412D–416C–417B–435A–437A–401G to solenoid 420, and as 415 solenoid is closed, both pumps are used for squeeze-out and up feed.

(*g*) As soon as either head contacts its upper limit switch.

(*h*) The head will complete its travel.

(1) Right-hand head opens contact 432 of upper limit switch 122 (FIGURE 1) de-energizing relay 435 and solenoids A and E stopping right-hand head. At the same time 435A contact opens de-energizing solenoid 420 to allow one pump only to complete the travel on the opposite head.

(2) Left-hand opens 436 de-energizing relay 437 and solenoids C and G stopping left-hand head. At the same time 437A contact opens de-energizing solenoid 420 to allow one pump only to complete the travel on the opposite head.

Forward travel

(*a*) When both heads have contacted their upper limit switches 440 and 441 close and the current now flows through 400B–410 or 411–412A–412C–limit switch 443A–440–441 and relay 416 energizes. At the same time, current flows through 450A to solenoid I causing the vehicle to move forward along the rails.

(1) Contact 416C has opened to de-energize solenoid 420 allowing one pump only on the automatic forward traction.
(2) Contact 416A opened providing a safety interlock preventing solenoids D and B from energizing, or lowering of the heads.
(3) Contact 416B is opened preventing relay 417 and solenoids F and H from energizing and squeeze-in.
(4) 416B opened de-energizing relay 418.
(5) 418D is opened de-energizing solenoids A–E–C and G and relays 435 and 437, preventing any further up movement of the heads.
(6) 416D is opened preventing solenoid J from energizing or reverse traction of the vehicle.

Stoppage

(*a*) When indexing finger contacts a tie, 443A opens de-energizing solenoid I causing the vehicle to stop by shutting off power for forward traction.

(*b*) At the same time, the indexing finger closes contact 460, energizing 461 time delay relay to "time in" and 461A contact closes after approximately one second.

(*c*) At the same time, relay 416 de-energizes, closing contact 416A allowing the operation to repeat, as described in par. 1 (*a*); as long as cycle switches 410 or 411 are kept depressed, sequence will repeat continuously.

(*d*) When relay 461 times out approximately two seconds, 461A contact closes to re-initiate the traction movement and as the heads have dropped down, as described above, 440 and 441 have opened preventing 416 from re-energizing.

It will be clear that Time out setting of 461 must be shorter than one complete cycle, otherwise the machine will repeat continuously at same position.

This control is the button adjustment of relay 461. Furthermore, Time out setting of 461 must be long enough to permit both heads to leave their limit switch cams, 440 on right-hand and 441 on the left-hand head. If set too long, the machine will not stop on the next tie, thereby moving continuously.

This control is located on top of relay 461.

By-pass switches

(*a*) By-pass switches 470, 471 and 472 have been incorporated in the up feed circuit to allow the heads to by-pass the upper limit switches 432 for right-hand and 436 for left-hand in order to lock the heads up mechanically when travelling along the rails.

(*b*) As the switches are turned to "ON" position, by-pass

(1) Switch 470 opens the down feed circuit.
(2) Switch 471 by-passes 432 allowing right-hand head to move up to maximum position.
(3) Switch 472 by-passes 436 allowing left-hand head to move up to maximum position.

Selector switch set on right-hand

(*a*) When selector switch 401 selects the right-hand head side, 401F is opened preventing solenoids C and G, and relay 437 from operating, thereby preventing the left-hand head from by-passing.

Selector switch set on left-hand

(*a*) When selector switch **401** is positioned to select the left hand head, contact **401E** is opened preventing solenoids A and E and relay **435** from operating, thereby preventing right-hand head from by-passing.

Double tamping

It is sometimes considered desirable to tamp a particular tie not once but twice in immediately successive tamping operations, The device according to the present invention has provision for such a feature.

(*a*) When selector switch **402** is positioned to double tamping, the operation is identical, as described above, except that relay **450** energizes at the same time as **417** opening contact **450A** preventing solenoid I from energizing and from the machine moving forward at every second operation, thereby causing the machine to repeat tamping at each tie, or at every second tie, depending on the position of switch **403**.

Skipping

It is also sometimes desirable to tamp every second tie, for example when two tamp vehicles are working the same section of track, one following the other. Provision has been made for such skipping.

(*a*) When selector switch **403** is closed, relay **422** will energize simultaneously with relay **461** closing contact **422A** and by-passing contact **443A**, thereby preventing the vehicle from stopping at this actuation. **422A** contact will open at every second actuation of ratchet relay **422**, thereby making the machine skip every second tie.

(*b*) Contact **422B** opens when **422A** is closed to prevent the tamping heads from dropping and opening **440** and **441** during the skipping operation.

When automatic operation is not desired and the operator of the machine wishes to initiate each operation, the machine is set for manual operation

(*a*) The switch **400** is moved to manual operation, contact **400B–400C** opens and **400A** closes

(*b*) Current is now flowing through **412D** to the manual control pushbuttons **500**.

Manual forward traction

(*a*) When this pushbutton **500** is depressed, current is allowed to flow through.

(1) **400A**, **412D**, contact **500Y** to solenoid **415**.
(2) Contact **500C–401G** to solenoid **420**.
(3) Forward traction switch **500B** (see FIGURE 11B) to solenoid I causing the vehicle to move forward with both pumps on.

Reverse traction

(*a*) When the reverse traction contacts **500X**, **500Y** of switch **500** is depressed, current is allowed to flow through

(1) **400A–412D**, contacts **500Y** to solenoid **415**.
(2) **400A–412D**, contacts **500X** and **401G** to solenoid **420**.
(3) **400A**, reverse travel switch **500Z** (see FIGURE 11B) **416D** to solenoid J, causing the vehicle to move backward with both pumps on.

Down feed

(*a*) When the down-feed button is depressed, current is allowed to flow through.

(1) **400A–412D** down feed switch **500L** to solenoid **415**.
(2) **400A** downfeed switch **500L–416C–417B–418E–401G** to solenoid **420**.
(3) **400A** downfeed switch **500M–417A–416A–418A–422B** by-pass switch **470–401A** and **401B–426** and **425** to solenoids D and B causing both tamping heads to feed down.

Up feed

(*a*) When the up feed button is depressed, current flows through

(1) **400A–412D** up feed switch **500P** to solenoid **415** and to **416C–417B–418E–401G** to solenoid **420**.
(2) **400A** up feed switch **500Q–432–436–401E** and **401F** to solenoids A–B–C and G and also to relays **435** and **437**.

What I claim as my invention is:

1. A tamping unit comprising a housing adapted for up and down reciprocation on a wheeled railroad vehicle, motor means mounted substantially centrally of said housing, a crank shaft connected with said motor and extending along the vertical axis of said housing, a pair of eccentrics on said crank shaft disposed in 180° phase relationship one above the other, two pairs of tamping bars depending downwardly in the vertical plane beneath said housing in spaced apart relationship, a centrally located drive shaft for each pair of tamping bars extending into said housing in the vertical plane thereof, bearing means in said housing to mount said drive shafts, a pair of connecting rods each connected at one end to one of said eccentrics, and a rocking arm connected to each of said connecting rods at its free extremity and to said drive shafts, whereby to impart a high frequency low amplitude rocking motion to said pairs of tamping bars.

2. A tamping unit comprising housing means; a pair of tamping forks depending from said housing means and spaced apart thereon; drive shafts located centrally of each of the forks and extending longitudinally thereof and rotatably mounted in said housing means; drive means connected to said drive shafts, said drive means comprising, motor means for driving said drive shaft, a crank shaft operatively connected to said motor extending within said housing and located inwardly of each of the drive shafts, a pair of laterally extending connecting rods each mounted on an eccentric on said crank shaft, and a rocker arm connected to the outer extremity of each of said connecting rods and to said drive shafts whereby to transmit a high frequency low amplitude vibration to said forks.

3. A tamping head adapted for up and down reciprocation on a rail travelling vehicle comprising a pair of tamping units each comprising housing means, a pair of tamping forks depending from said housing means and spaced apart thereon; drive shafts located centrally of each of the forks extending longitudinally thereof and rotatably mounted in said housing means; drive means connected to said drive shafts, said drive means comprising, motor means for driving said drive shafts, a crank shaft operatively connected to said motor extending within said housing and located inwardly of each of the drive shafts, a pair of laterally extending connecting rods each mounted on an eccentric on said crank shaft; and a rocker arm connected to the outer extremity of each of said connecting rods and to said drive shafts whereby to transmit a high frequency low amplitude vibration to said fork arms mounting means for pivotally mounting said tamping units on a frame member for swinging action towards and away from each other; hydraulic piston and cylinder jack means on said frame for imparting a squeezing action to said tamping units; and hydraulically operated jack means for raising and lowering said frame and said tamping head.

4. A device as claimed in claim 3 further comprising a lazy tong arrangement connected to the cylinder of each jack for raising and lowering said tamping heads and adapted to engage and grasp a rail on relative movement between said cylinder and its tamping head, whereby said cylinder is clamped to the rail when said tamping head meets with ballast resistance thereby to cause said cylinder to utilize said rail to force said tamping heads into said ballast.

5. A device as claimed in claim 3 in which means is provided for sequentially moving the tamping head into the ballast, causing said tamping head to impart a squeez-

ing action to the ballast and removing the said tamping head from the ballast on the completion of the tamping operation.

6. A device as claimed in claim 3 in which each of the tamping units is additionally mounted for pivotal movement above a vertical axis of the tamping head.

7. A device as claimed in claim 6 in which the piston and cylinder jack means for imparting the squeezing action to said tamper units are adapted to permit the tamping units to pivot about the said vertical axis; pressure distribution means being provided and commonly connected to the said piston and cylinder jack means whereby to permit a fork of one tamping unit to compensate for a fork of the other tamping unit of the tamping head if said fork of said other tamping unit is snagged during a tamping operation.

8. In a railroad maintenance vehicle a pair of tamping heads mounted on a frame for vertical reciprocation relative to said vehicle, each tamping head comprising a pair of tamping units universally mounted on said frame, each tamping unit having two pairs of transversely spaced tamping bars; means for vibrating said tamping bars at a high frequency low amplitude vibration, said tamping units being arranged on said frame so that, in transportation position, the tamping bars of the two units are spaced apart a distance greater than the width of a tie and the bars of each tamping unit are spaced apart a distance sufficient to span a rail; motor means for driving said vehicle along the track; position sensing means adapted to engage a tie to be tamped and to operate a control circuit including time delay relay means operable to maintain the forward motion of the vehicle for a predetermined time after the actuation of said position sensing means to stop said vehicle when the tamping heads are located above said tie; hydraulic means operable by said control circuit for lowering said tamping heads into the ballast of said tie, hydraulic jack means adapted to swing said universally mounted tamping units towards each other whereby to tamp the ballast between and around the tie; and pressure distribution means adapted to ensure that each pair of tamping bars of each tamping unit engages and tamps said ballast to an equal pressure and means adapted to withdraw said tamping head out of engagement with said ballast and to cause said maintenance vehicle to move to the next tie to be tamped.

9. A tamping unit comprising a pair of tamping forks, motor means, a crank shaft operatively connected to said motor means and depending therefrom, and a connecting drive between said crank shaft and each of said tamping forks, each such connecting drive comprising a connecting rod mounted at one end on an eccentric of said crank shaft and extending outwardly therefrom, a rocker arm connected at one end to the other end of said connecting rod, and a drive shaft connected to the other end of said rocker arm and extending downwardly into operative engagement with one of said forks.

10. A tamping unit for mounting on a wheeled railroad maintenance vehicle comprising housing means a pair of tamping forks depending from said housing means and spaced apart thereon; motor means mounted on said housing; a crank shaft operatively connected to said motor means and depending therefrom into said housing; and a connecting device between said crank shaft and each of said tamping forks, each such connecting drive comprising a connecting rod mounted at one end on an eccentric of said crank shaft and extending outwardly therefrom normally thereto; a rocker arm connected at one end to the other end of said connecting rod, and a drive shaft connected to the other end of said rocker arm and extending downwardly into operative engagement with one of said forks.

11. A railroad maintenance device comprising a vehicle mounted on wheels for travelling on a railroad track; prime mover means for moving said vehicle forward or in reverse travel along said track, a tamping head mounted at one end of the vehicle and adapted for up and down reciprocation relative to the vehicle into and out of engagement with ballast to be tamped; position sensing switch means projecting from beneath said railroad vehicle and adapted to engage with a reference on said track to operate a control circuit including means to ensure that the correct reference has been engaged whereby to bring said vehicle to a stop over a tie to be tamped and to initiate control means for causing the sequential downfeed of the tamping head into the ballast to be tamped; and after tamping, the up-feed of the tamping head out of engagement with the ballast and to initiate forward motion of the vehicle along the track, and means to cause the tamping head to tamp twice at the same spot before initiating motion of the vehicle.

12. A railroad maintenance device comprising a vehicle mounted on wheels for travelling on a railroad track, prime mover means for moving said vehicle forward or in reverse travel along said track, a tamping head mounted at one end of the vehicle and adapted for up and down reciprocation relative to the vehicle into and out of engagement with ballast to be tamped; position sensing switch means projecting from beneath said railroad vehicle and adapted to engage with a reference on said track to operate a control circuit including means to ensure that the correct reference has been engaged whereby to bring said vehicle to a stop over a tie to be tamped and to initiate control means for causing the sequential downfeed of the tamping head into the ballast to be tamped, and after tamping, the up-feed of the tamping head out of engagement with the ballast and to initiate forward motion of the vehicle along the track, and means for stopping the vehicle in response to every second actuation of the position sensing switch whereby the vehicle is brought to a stop over every other tie on the track.

13. A railroad maintenance device comprising a vehicle mounted on wheels for travelling on a railroad track; prime mover means for moving said vehicle forward or in reverse travel along said track; a tamping head mounted at one end of the vehicle and adapted for upward and downward movement relative to the vehicle into and out of engagement with ballast to be tamped; position sensing switch means projecting from beneath said vehicle and adapted to engage with a selected reference along said track to operate a control circuit to bring said vehicle to a stop in correct position in relation to the tie to be tamped and to initiate control means for causing the sequential downward movement of the tamping head into the ballast to be tamped and the upward movement of the tamping head out of engagement with the ballast after tamping, and to initiate forward motion of the vehicle along the track; said control circuit including time delay means to ensure that the correct reference has been engaged, said time delay means comprising control means for preventing stoppage of said vehicle for a predetermined time after said switch means engages a reference along said track.

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LEO QUACKENBUSH, *Primary Examiner.*

LEO J. LEONNIG, *Examiner.*