July 5, 1955 E. ZURMUHLE 2,712,287

RAILWAY TRACK TIE TAMPING MACHINE

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FIG. 2

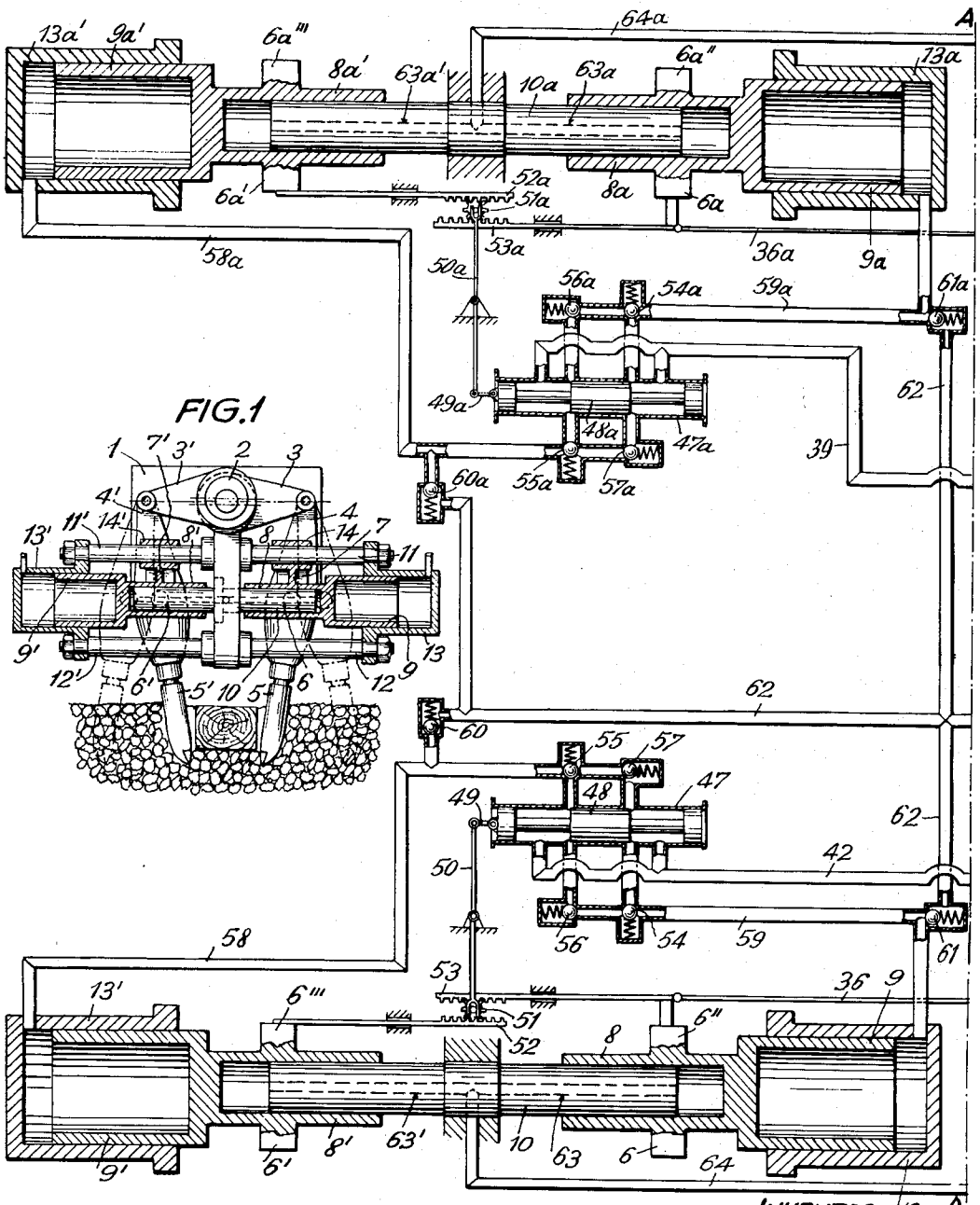


FIG. 1

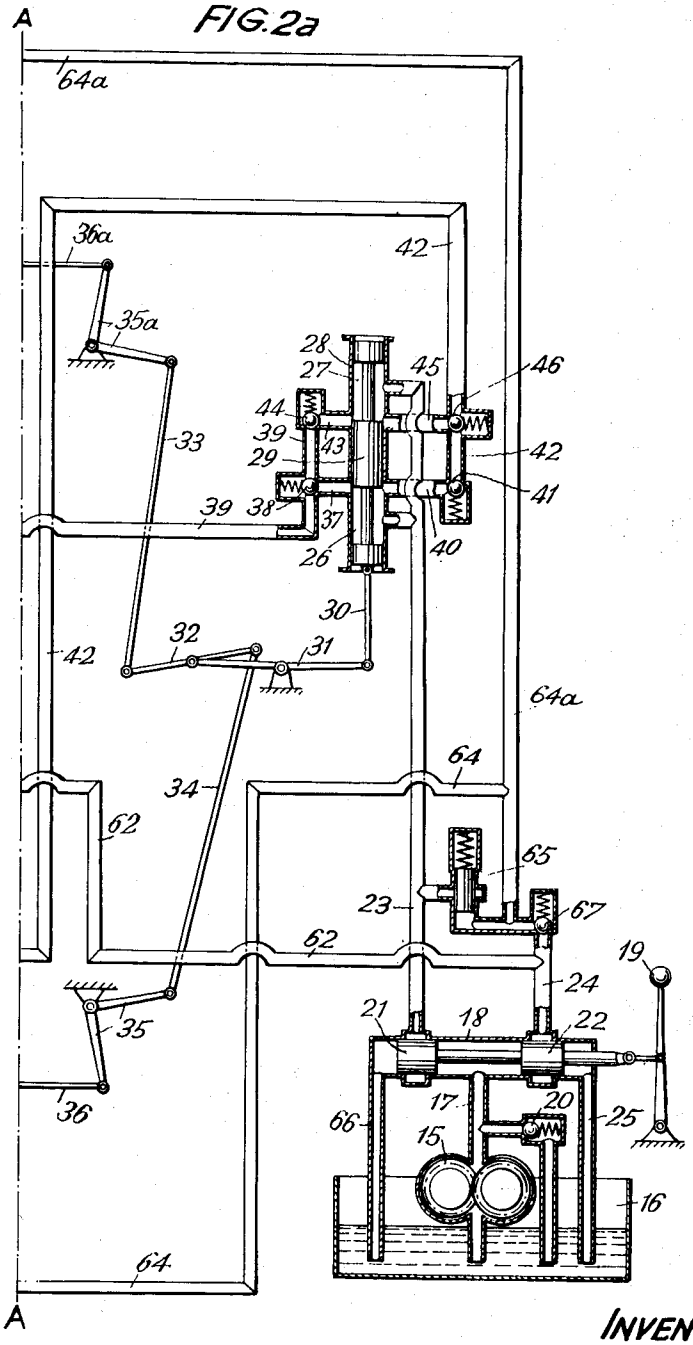
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FIG. 2a



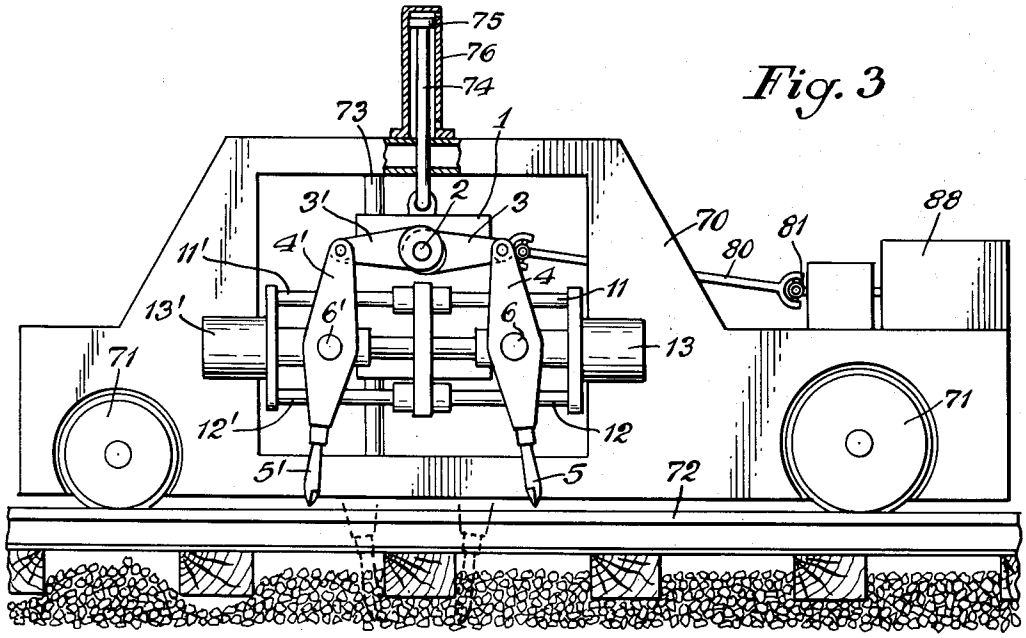
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RAILWAY TRACK TIE TAMPING MACHINE

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Fig. 3



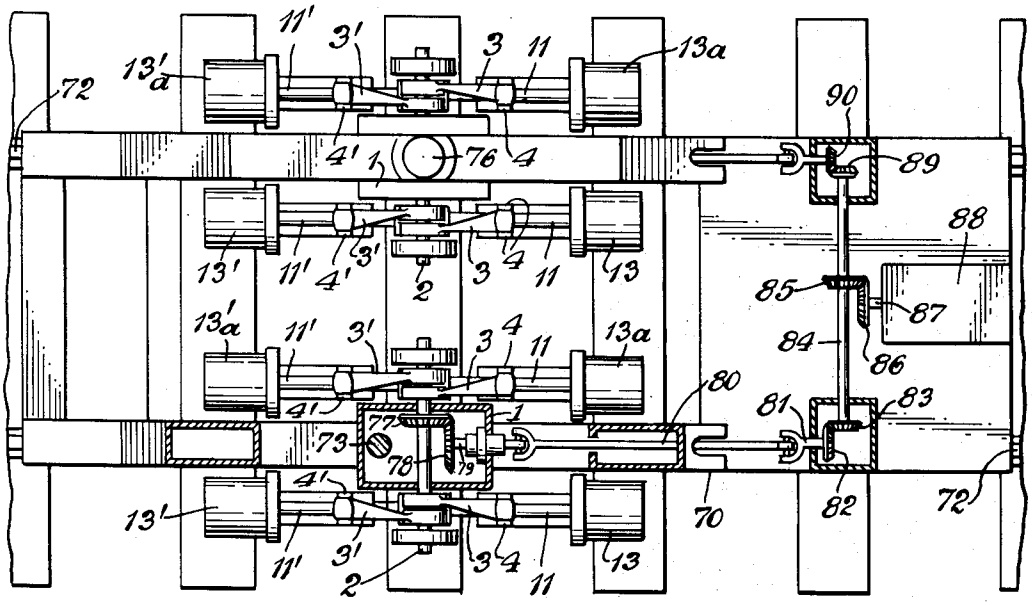


Fig. 5

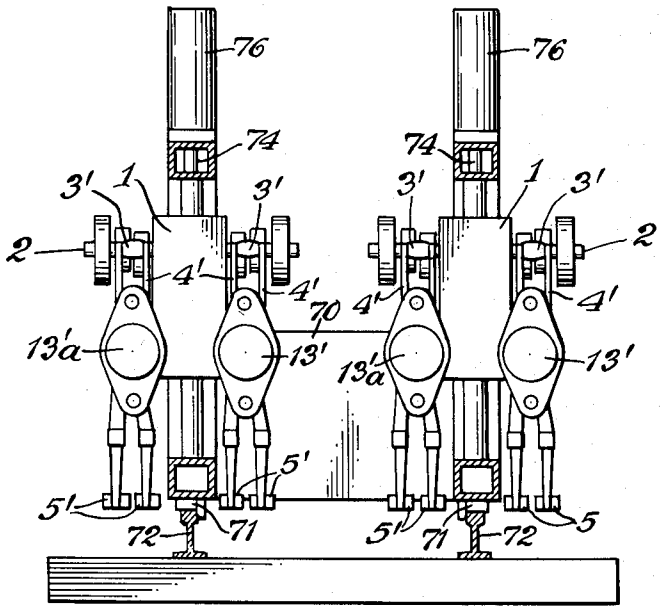
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Fig. 4



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United States Patent Office 2,712,287 Patented July 5, 1955

2,712,287

RAILWAY TRACK TIE TAMPING MACHINE

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Application December 7, 1949, Serial No. 131,620

Claims priority, application Switzerland December 10, 1948

9 Claims. (Cl. 104—12)

My present invention relates to improvements in tie tamping machines for railway tracks, in which the vibratory tamping tools are arranged in pairs and simultaneously moved to approach each other in order to force the ballast under the ties. A machine of this type is described in U. S. Letters Patent Nos. 1,980,704 of November 13, 1934, and 2,052,943 of September 1, 1936. My present invention constitutes an improvement on the latter tamping machine, substituting hydraulic means for the mechanical means for imparting a vibratory movement to the pairs of cooperating tamping tools, for the mechanical means acting on the pivots of said tools for varying the distance between the tools of each pair, and for the mechanical means responsive to the resistance offered by the ballast against being tamped for rendering said distance-varying means inoperative.

The main object of my present invention is to safeguard the machine against excessive mechanical stresses by providing pressure relief valves in the hydraulic system.

The horizontal movements of the tools towards the tie as well as the return stroke in all prior machines of this class are effected by mechanical means. This system never proved to be satisfactory because breakage of various parts of the machine often occurred, whenever the tools happened to strike against a tie. Safety devices of various description have been tried, but proved unsatisfactory. Air cushions and springs are impracticable as yielding elements on account of the very high frequency of the vibrations. Friction clutches do not give satisfactory results and are subjected to heavy wear and tear.

In the tie tamping machine according to my present invention, these drawbacks are eliminated by applying hydraulic power for the horizontal working stroke as well as for the return stroke of the tamping tools. The use of hydraulic power offers the great advantage that excessive forces, which may result from the striking of the tools against ties or from other causes, can easily be eliminated by means of pressure relief valves.

According to my invention, a tamping machine for the purpose set forth above comprises a carriage for movement on the rails, said carriage being provided with vertical guide means for tool carriers movable along side guide means. Each tool carrier has a horizontally extending frame with means reciprocably mounted thereon and forming, together with said frame, a double acting piston and cylinder assembly for moving said reciprocable means towards and from each other. Tamping tools are pivotally mounted on a horizontal axis on said reciprocable means and disposed in engagement with vibrator means suitably driven from a power source, while each piston and cylinder assembly is connected with a source of pressure fluid through connecting means containing means for controlling the movement of said reciprocable means and safety valves for limiting the pressure in the piston and cylinder assembly.

One form of my present invention is illustrated in the accompanying drawings, in which—

Fig. 1 is a side elevation, partly in section, of a vertically movable tool frame,

Figs. 2 and 2*a*, separated on the line A—A, together show a horizontal section through the hydraulic system on both sides of a vertically movable tool carrier or holder,

Fig. 3 is a diagrammatic side elevation view of the tie tamping machine,

Fig. 4 is a diagrammatic front elevation view of the tie tamping machine, and

Fig. 5 is a plan view of the same.

The Figs. 3–5, inclusive, illustrate a rail carriage **70** having wheels **71** traveling along the rails **72**. In the frame of this carriage there is arranged on both sides each a tool carrier **1** which is vertically slidable along a column **73**. The carrier **1** is connected with a piston rod **74**, the upper end of which has a piston **75** attached thereto, which is slidable in a cylinder **76**. By admitting the pressure medium into the cylinder **76** above or below the piston **75** through conduits and valves (not shown), the piston is caused to move downwards, or upwards, respectively, and by means of the piston rod **74**, the tool carrier is actuated. Within the tool carrier **1**, an eccentric shaft **2** is journaled upon which a bevel gear **77** is mounted which meshes with a bevel gear **78**. The latter is mounted on a shaft **79** which extends through the wall of the tool carrier **1** and by means of a universal joint is connected with a transmission shaft **80**. The shaft **80** is drivingly connected with a shaft **81** which by means of bevel gears **82**, **83** is connected with a shaft **84** which in turn by means of bevel gears **85**, **86** is connected with the shaft **87** of the drive motor **88**, which latter may be an internal combustion engine or an electric motor. The shaft **84** by means of additional bevel gears **89**, **90** and other transmission elements is connected with the eccentric shaft of the second tool carrier **1**. The eccentric shaft **2** by means of eccentric rods **3**, **3'** is connected with one end of levers **4**, **4'** pivotally mounted between their ends, so that these levers **4**, **4'** are caused to oscillate quickly. This oscillating movement of the tools is independent of the movement of the tools toward and from a tie, as described below. There are arranged two levers **4**, **4'** in pairs adjacent each other so that altogether eight pairs of levers **4**, **4'** are employed (Fig. 5). The levers **4**, **4'** may be moved from the inoperative position shown in Figs. 3 and 4, into the operative position, shown in Fig. 1, by lowering the tool carrier **1** by means of the piston **75**. Fig. 1 shows in dash-dotted lines the initial position and in full lines the end position of the tamping tools. The levers **4**, **4'** carry at their lower ends tamping tools or jaws **5**, **5'** and are pivoted on pins **6**, **6'** of supporting webs **7**, **7'**. The latter form parts of a symmetrically disposed horizontally reciprocatable structure which further comprises two cylinder portions **8**, **8'** and two plunger portions **9**, **9'**. The cylinder portions **8**, **8'** are guided on a common plunger **10** which at its center is fixed to the tool carrier **1**. The piston portions **9**, **9'** are working in the cylinders **13**, **13'** which are fixedly secured to the tool carrier **1** by means of two tie bolts **11**, **11'**, and **12**, **12'**. The said reciprocatable structure further comprises guideways **14**, **14'** formed integral or secured to the webs **7**, **7'** for guiding the structure on the bolts **11**, **11'**. It is to be noted that the structure comprising the parts **1—3** and **10—13** is vertically movable with respect to the tie tamper truck, while the structure comprising the parts **4—9** and **14** is horizontally reciprocatable with respect to the former structure and vertically movable therewith. The tools and their actuating mechanism shown in Fig. 1 are duplicated at the other end of the tool-holder **1**, as shown in Fig. 2, it being understood that the tie

tamping machine comprises a total of sixteen tools, viz. eight on each side.

In Figs. 2 and 2*a*, 15 is a pump of the positive displacement type, which draws fluid, e. g. oil from a sump 16, delivers it through tube 17 to a control slide valve 18, which comprises two pistons 21, 22 controlled through a hand-lever 19. Connected to the tube 17 is a pressure relief valve 20. The valve pistons 21, 22 co-act with tubes 23 and 24. 25 and 66 are return pipes from the valve 18 to the sump 16. The tube 23 connects the valve 18 with the annular chambers 26 and 27 of a second control slide valve 28 of which the piston 29 through its stem is connected by means of a link 30 to one end of a lever 31 pivoted between its ends. The other end of lever 31 forms the fulcrum of a second lever 32 pivoted between its ends. One end of the latter is linked through a rod 34 to a bell-crank lever 35, and through a further rod 36 to the pin 6''. The other end of lever 32 pivoted between its ends is joined to pin 6*a* through a rod 33, bell-crank 35*a* and rod 36*a*.

From the annular space 26 of valve 28 a port 37 leads via a non-return valve 38 to a tube 39, and a second port 40 is connected via a non-return valve 41 to a tube 42. Similarly from the annular space 27 at the other end of valve 28, a port 43 is joined through a non-return valve 44 with tube 39, and a fourth port 45 through a fourth non-return valve 46 with tube 42.

The tubes 39 and 42 lead to additional control slide valves 47 and 47*a* of similar construction as valve 28. These two additional valves serve to uniformly distribute the flow of fluid to and from the two pairs of opposite cylinders 13, 13' and 13*a*, 13*a*'. The piston 48 of valve 47 is connected by means of a link 49 to one end of the lever 50 pivoted between its ends, the forked other end of which engages the axle pin of a pinion 51. The latter is in mesh with two racks 52 and 53, rack 52 being joined with pin 6''', and rack 53 with pin 6''. In the same way, the piston 48*a* of valve 47*a* is connected via link 49*a* with one end of a lever 50*a* pivoted between its ends of which the forked end engages the axle pin of a pinion 51*a*. The latter is in mesh with two racks 52*a* and 53*a*, rack 52*a* being joined with pin 6*a*' and rack 53*a* with pin 6*a*.

From valve 47 a tube 58 leads to the cylinder 13' and tube 59 to the cylinder 13. Further, the valve 47*a* is connected through a pipe 58*a* to the cylinder 13*a*', and through a pipe 59*a* to the cylinder 13*a*. The non-return valves 54—57 and 54*a*—57*a* built into tubes 58, 59 and 58*a*, 59*a*, respectively, have the same functions as the non-return valves 38, 41, 44 and 46 belonging to valve 28. The non-return valves 56, 57 and 56*a*, 57*a* are fitted with stronger springs than the non-return valves 54, 55 and 54*a*, 55*a* and serve at the same time as throttles.

The tubes 58, 59 and 58*a*, 59*a* are provided with pressure relief valves 60, 61 and 60*a*, 61*a*, from which pipes 62 lead to the tube 24.

Axial bores 63, 63' and 63*a*, 63*a*' in the plungers 10 and 10*a* serve for interconnecting the cylinder portions 8, 8' and 8*a*, 8*a*' of the reciprocatable structure, respectively, and are connected through pipes 64 and 64*a* to an overflow valve 65.

The tie tamping machine described works as follows.

For the working stroke, i. e. the feed-motion of the tamping tools 5, 5', the hand lever 19 must be moved from the center position shown in the drawing to the left. The fluid supplied through the pump 15 passes now through the tubes 17 and 23 to the valve 28. At the same time, the tube 24 is connected to the fluid return pipe 25. The piston 29 of valve 28 is actuated by the differential mechanism 30, 31, 32, 33, 34, 35, 35*a*, 36, 36*a* in such a way that it remains in the center position (Fig. 2) as long as the pins 6'', 6*a* are at the same distance from the center line of the tool carrier 1 and move at the same speed. Under these conditions, the fluid is equally distributed on both sides of the tool carrier. However, as soon as one of the two pins 6'', 6*a* travels faster than the other, for example when the tools on one side encounter less resistance than those on the opposite side, the valve piston 29 will be moved out of its center position, thus increasing on one side the cross-sectional area for the passage of fluid and throttling the same on the other side until a position of equilibrium is attained again. In its center position, the piston 29 leaves all four ports 37, 40, 43 and 45 open. During the working- or feed-stroke, however, the non-return valves 41 and 44 remain closed, so that the lower control edge of piston 29 can only regulate the passage of fluid through the port 37 to pipe 39 and the upper control edge can only regulate the flow through the port 45 to pipe 42. The valve 28, therefore, during the working stroke uniformly distributes the fluid to both sides of the tool carrier.

The valves 47 and 47*a* are of the same design as valve 28 and their duty is to uniformly distribute the fluid between the working cylinders 13, 13' and 13*a*, 13*a*', respectively. As long as the pins 6'' and 6''' have the same distance from the center of the tool carrier 1, the piston 48 remains in its center position. If, however, one of the pins travels faster than the other, the piston 48 moves out of this position until again equal distance of the tools is ascertained.

When in one of the cylinders 13, 13' and 13*a*, 13*a*' the pressure of the fluid exceeds a predetermined magnitude, the relief valves 60, 61 or 60*a*, 61*a* open and let the fluid pass through the tubes 62 and 24 back into the valve 18. During the working stroke, the valve piston 22 is on the left side, permitting the fluid to escape through tube 25 to the sump 16.

During the working stroke, the fluid in the return-stroke cylinders 8, 8' and 8*a*, 8*a*' is being displaced and flows through the bores 63, 63' and 63*a*, 63*a*' and the tubes 64, 64*a* to the overflow valve 65 and from there into the tube 23, thus augmenting the fluid supply to cylinders 13, 13' and 13*a*, 13*a*'.

The overflow valve 65 is adjusted in such a way that during the working stroke the pressure in the cylinders 8, 8' and 8*a*, 8*a*' considerably exceeds the pressure of the fluid supplied by pump 15. Therefore, the oscillatable structures comprising the cylinder portions 8, 8' and 8*a*, 8*a*', piston portions 9, 9' and 9*a*, 9*a*', the pins 6, 6'', 6''' and 6''', 6*a* and 6*a*', 6*a*'' and 6*a*''' remain rigidly clamped and cannot vibrate in sympathy with the oscillating levers under normal working conditions.

For the return-stroke of the tamping tools, the hand-lever 19 of valve 18 must be swung to the right. Tubes 23 and 26 are now communicating, whereas the pressure fluid is directed from tube 17 to tube 24 and through the non-return valve 67, pipes 64 and 64*a*, the bores 63, 63', 63*a*, 63*a*' into the return-cylinders 8, 8' and 8*a*, 8*a*'. The fluid displaced during the return stroke from the feed cylinders 13, 13' and 13*a*, 13*a*', is discharged through the non-return valves 56, 57, and 56*a*, 57*a*, the valves 47 and 47*a*, pipes 42 and 39, the non-return valves 41, 44, valves 28, tubes 23 and 66 to the sump 16. During the return-stroke the three valves 28, 47 and 47*a* act in the same way as during the working stroke, i. e. to maintain a uniform speed for all the tools.

The non-return valves 56, 57 and 56*a*, 57*a* are adjusted so as to serve at the same time as throttle-valves for the purpose of keeping the pressure in the cylinders 13, 13' and 13*a*, 13*a*' sufficiently high in order to prevent the pins 6, 6', 6*a*, 6*a*' from vibrating during the return stroke. In case that one of the tamping tools during the return-stroke strikes against a sleeper, the machine is safeguarded through the safety-valve 67 which acts to relieve an excessive pressure in the cylinders 8, 8' and 8*a*, 8*a*'.

What I claim as new and desire to secure by Letters Patent is:

1. In a tamping machine for forcing ballast under the rail supporting ties in a railway bed, a carriage for

movement on said rails, vertical guide means on said carriage, tool carriers in engagement with said guide means, means for moving said tool carriers along said guide means, horizontally extending frames in each of said tool carriers, means reciprocably mounted on each of said frames and forming, together with said frame, a double acting piston and cylinder assembly for moving said reciprocable means towards and from each other, tamping tools pivotally mounted on a horizontal axis on said reciprocable means, vibrator means in engagement with said tamping tools for vibrating the same, drive means for said vibrator means, means connecting said piston and cylinder assembly with a source of pressure fluid, control means in said connecting means for controlling the movement of said reciprocable means, and safety valves in said connecting means for limiting the pressure in said piston and cylinder assembly.

2. A machine as set forth in claim 1, in which said tamping tools are pivotally connected in pairs to said vibrator means.

3. A machine as set forth in claim 2, in which said reciprocable means comprises a cylinder at one end and a piston at the other end, said cylinder being reciprocably mounted on a fixed piston and said piston on the reciprocable means being reciprocably mounted in a fixed cylinder, and separate conduit means from said connecting means to the source of pressure fluid terminating adjacent the bottom of said fixed cylinder and at the inner end of said fixed piston.

4. In a tamping machine for forming ballast under the ties in a railway bed, a plurality of tamping tools, means pivotally connecting said tamping tools in pairs across said tie, means for imparting vertical reciprocatory movement to said tamping tools, means for vibrating said tamping tools, double-acting hydraulic means comprising a piston and cylinder assembly for each of said tools for imparting movements to said tools in each pair toward and from each other, means pivotally connecting a movable element in said piston and cylinder assembly to said tamping tool, means connecting said hydraulic means to a source of pressure fluid, control valves in said connecting means including reduction valves for admitting reduced pressure fluid to one side of said movable element while full pressure fluid is admitted to the opposite side thereof so as to provide a cushion for said oscillating movements, manually controlled means for reversing said pressure fluid admittance, and safety valves for limiting the pressure in said hydraulic means so as to avoid damage due to excessive resistance encountered by said tamping tools.

5. A machine as set forth in claim 4, in which the pressure area is larger at one side of said movable element than at the opposite side.

6. In a tamping machine for forcing ballast under the ties in a railway bed, a tool carrier, means for moving said tool carrier up and down, a plurality of levers pivotally attached to said tool carrier at a point between the ends of said levers, means for oscillating said levers, a depending tamping tool pivotally attached to each end of said levers, double-acting hydraulic means secured to said tool carrier each comprising a substantially horizontal piston and cylinder assembly, means pivotally connecting the movable element in said assembly to said tamping tool, valve means, separate conduit means connecting the assembly at opposite ends of said movable element with said valve means, means connecting said valve means with a source of pressure fluid, control valves in said connecting means, and safety valves for limiting the pressure in said hydraulic means.

7. A machine as set forth in claim 6, in which said valve means are slide valves biased through a differential mechanism which is connected to the movable element in said piston and cylinder assembly.

8. A machine as set forth in claim 6, in which each of said valve means is connected with two pairs of said tamping tools, a common control slide valve being connected with two of said valve means, and a differential mechanism being connected with said common control slide valve and so biased as to cause all of the four pairs of tools to move simultaneously and uniformly.

9. A machine as set forth in claim 8, in which said slide valves comprise a cylinder, a piston reciprocably mounted in said cylinder, one control port in said cylinder adjacent each end of said piston, conduits connecting said ports with said connection means to said piston and cylinder assembly, and a non-return valve in each of said conduits said non-return valves adapted to open in opposite directions, whereby flow in either direction between said slide valve and said piston and cylinder assembly is feasible.

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