Nov. 1, 1960 V. J. MOIR 2,958,268

ROAD WORKING MACHINE WITH TAMPING SHOE STABILIZING MEANS

Filed June 4, 1958 3 Sheets-Sheet 1

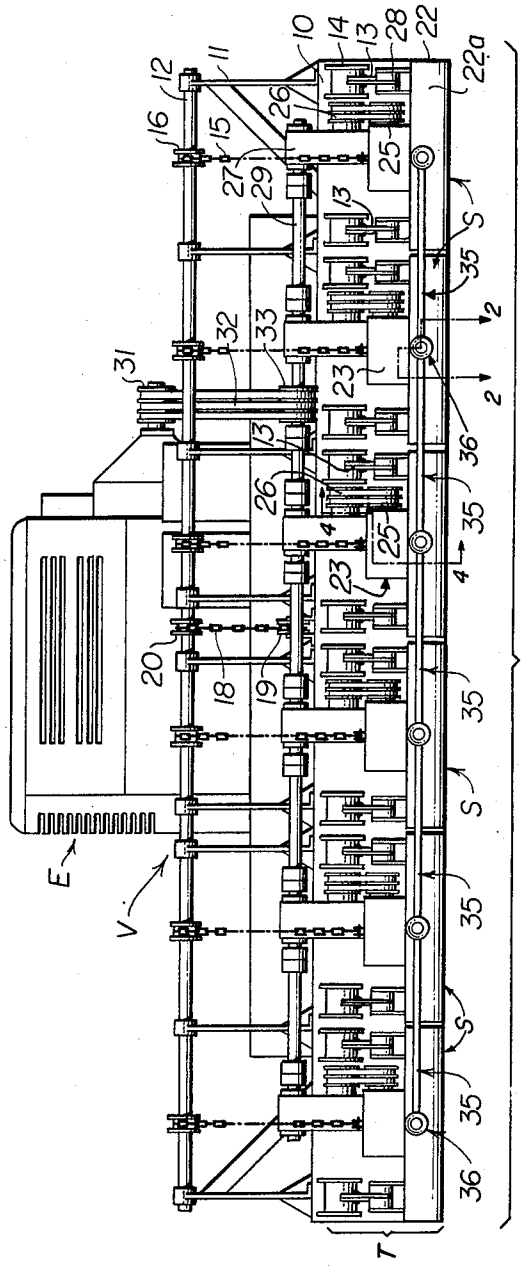


FIG. 1

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ROAD WORKING MACHINE WITH TAMPING SHOE STABILIZING MEANS

Filed June 4, 1958 3 Sheets-Sheet 2

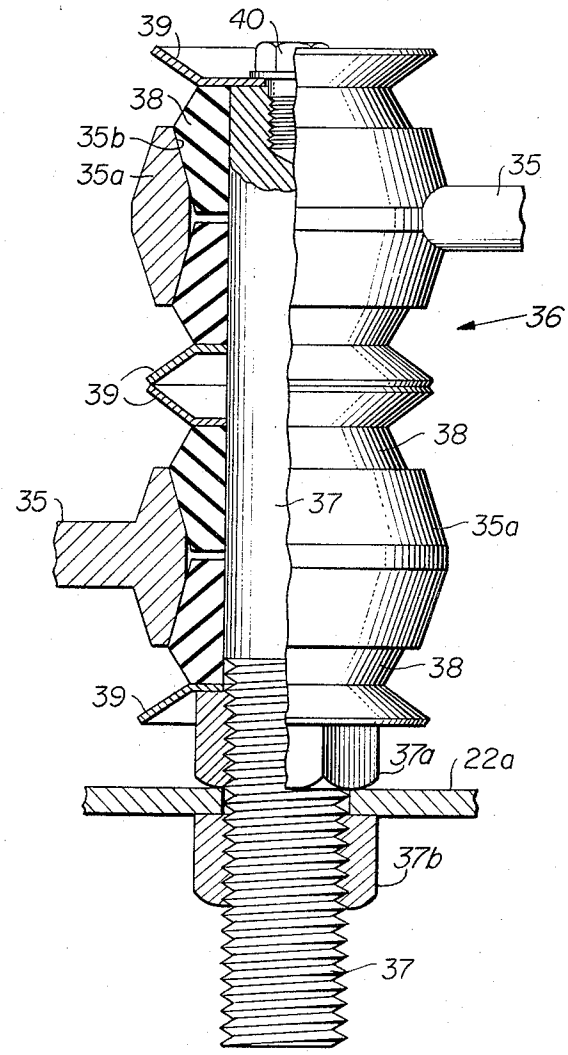


FIG. 2

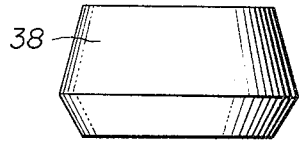


FIG. 3

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ROAD WORKING MACHINE WITH TAMPING SHOE STABILIZING MEANS

Filed June 4, 1958 3 Sheets-Sheet 3

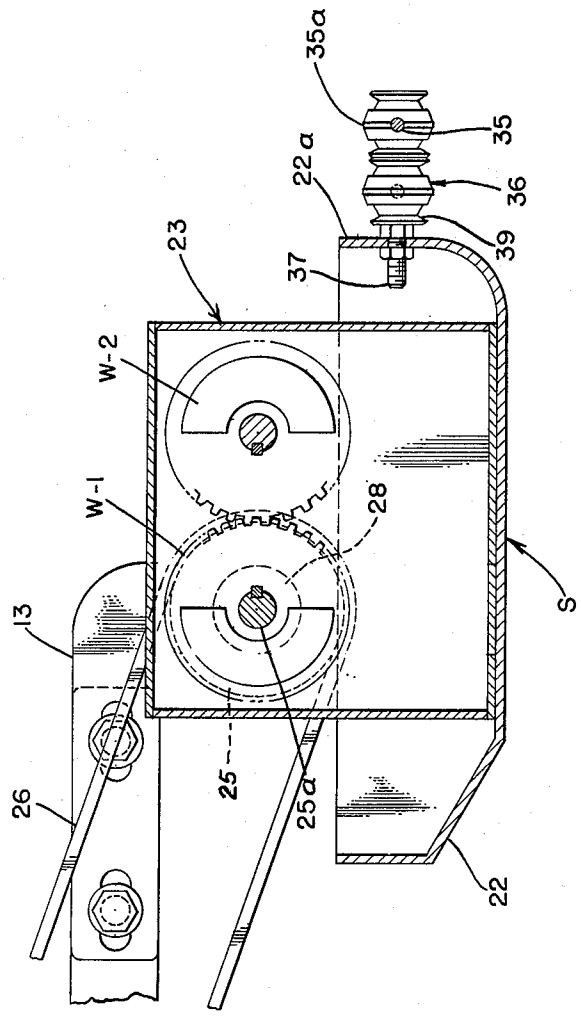


FIG. 4

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2,958,268

ROAD WORKING MACHINE WITH TAMPING SHOE STABILIZING MEANS

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4 Claims. (Cl. 94—48)

The present invention relates to material compacting road working machines, and more particularly to an improvement in that type of compacting machine wherein a plurality of individually actuated adjacent vibrating tamping shoes are each mounted to a vehicle frame by individual suspension means.

Now well known are road working machines for compacting loose material such as earth, sand, gravel, coarse aggregate or other particulate material by forces rapidly repeatedly applied in a vibratory compacting action. In a type of machine which has been eminently successful, there is provided a vehicle suitable for travel from one work location to another and also for working traverse of an area to be compacted, and mounted on the vehicle a transverse array of separately suspended heavy tamping shoes individually actuated to develop compacting forces on the underlying material by a generally vertically directed shoe oscillation at a rate in the typical range of 1800 to 3000 vibrations per minute.

A machine of this character with advantageous shoe mounting or suspension structure is described in my copending application S.N. 607,514, wherein each individual shoe is so suspended that a major flat bottom area of a shoe has a nominal horizontal operative disposition; that is, horizontal when in contact with a horizontal area underlying the machine, but is adapted to cant laterally as well as fore and aft for a more effective force application in traversing unevenly spread or disposed material.

The shoes in machine of this character, by lateral sway or displacement, would often collide with attendant damage and wearing of the shoe structures and impairment of compacting efficiency; and to this end flexible sway restraining means have previously been proposed, extending between each pair of adjacent shoes to limit lateral excursion, and so in fact diminishing collisions throughout the array as a whole, though at times permitting adjacent shoes to come into undesirable contact. Moreover even with such sway restraining means, where there is used a belt drive from vehicle frame to individual shoe actuating units, practical belt maintenance problems are present since even the diminished lateral shoe excursion still required a degree of belt tautness—resulting in premature failure—to keep the belts in proper disposition.

It has now been found that by use of a type of restraining means including a tie rod extending between adjacent shoes and a torsionally resilient pivotal end anchor structure therefor at the corresponding shoes, not only is there completely avoided undesirable collision between adjacent shoes, but surprisingly an increase in compaction efficiency is attained. Thus, for example, a machine including the present invention as hereinafter disclosed by standard Proctor density tests has been observed to produce, at a single traverse of sandy granular material, a Proctor test value exceeding by five to eight points that achieved by a like machine with a chain sway restricting structure. Since such increase in density of

compaction, in many conditions of operations, represents the certain attainment of a job specification density of compaction by at least one less number of passes of the work area than would otherwise be required, the great advantage is obvious. This seems to result from a general shoe stabilization in an entire array of shoes. Further it has been found that with the present invention as hereinafter described, shoe actuating unit drive belt tension, where belt drive is used, may be lower than when the stabilizing means is absent, accordingly prolonging belt life without imparting other maintenance problems.

The general object of the present invention is then the provision of a shoe stabilizing structure in a vibratory tamping type road working compaction machine having an array of individually mounted and actuated shoes. Another object is the provision in a machine of the general character described of a shoe stabilizing structure not only minimizing shoe wearing and damaging collisions, but also providing an increased compaction efficiency. A further object is to prolong drive belt life in machines of the character described wherein individual shoes are driven by belts from the vehicle frame. Other objects and advantages of the invention will appear from the following description and the drawings wherein:

Fig. 1 is a front view of a road working machine involving the present invention;

Fig. 2 is a detail view in partial axial section of a shoe stabilizing tie rod connection taken substantially as indicated by line 2—2 in Fig. 1;

Fig. 3 is a resilient bushing included in Fig. 2; and

Fig. 4 is a vertical section through a tamping shoe taken substantially as indicated by the line 4—4 in Fig. 1.

In Fig. 1 of the drawings a machine embodying the present invention is seen as comprised of a crawler type vehicle V of known type powered by an engine E for vehicular propulsion and travel as well as for other operative functions, and a transverse array T of identical individually suspended and actuated material vibrating and compacting shoe units S.

The shoe units with their immediately associated auxiliary mechanism are supported by a rigid framework extending across the front of the vehicle and including a lower transverse beam member **10**, along which are spaced the vertical frame uprights **11** for supporting rotatably a shoe lift shaft **12** at their upper ends. For a generally vertically directed vibratory tamping or oscillating motion when in operative ground contact and also for swinging to and from an upwardly and rearwardly retracted travel or inoperative position, each shoe unit is supported by a pair of like spaced parallel arm assemblies **13** pivotally connected to the front of beam member **10** by brackets **14** with aligned horizontal pivot axes. For each shoe unit, there is a lift chain **15** with one end secured near the center of the unit (here at the top of an actuator housing) and the other end wound about a corresponding sheave **16** aligned therewith and fixed to shaft **12**.

Shoe lift power means, provided on the vehicle for rotating shaft **12** in both directions to raise and lower the shoes, may be such as the hydraulic cylinder means extending longitudinally of the vehicle for drawing or releasing a chain **18** passing over sheave **19** to a central sheave **20** on shaft **12**, about which said chain is wound in sense reverse to chains **15**, such as is fully described in my copending application Serial No. 607,423, now United States Patent 2,893,299.

In each shoe unit S there is a welded steel metal base member **22** having a major flat bottom tamping portion generally horizontally disposed when in normal average ground contacting position, but which slopes or curves upwardly toward the front into a generally vertical front

plate 22*a* and at the rear slopes gradually upwardly; and also having generally parallel vertical side plates.

Generally centrally located within the confines of the base member 22 there is rigidly centrally mounted a vibrating actuating assembly 23 for imparting a rapid generally vertically directed oscillatory movement to the shoe as a whole, that is directed generally perpendicularly to the flat bottom. For this purpose the unit may have (see Fig. 4) as internal operative mechanism a pair of meshed off-balance or eccentrically weighted gear wheels W–1, W–2 with axes transverse to the said arms and parallel to the said pivot axes, so phased or meshed with respect to their mass-centers or eccentric weights as to develop a maximum vertical force component in the shoe unit at normal operating position.

The assembly 23 includes for one of the said wheels a drive shaft 25*a* carrying external V-belt pulley means 25 connected by V-belts 26 to the output bottom pulley of a vertical gear box unit 27 secured to the forward face of beam 10. For each shoe the axes of pivot brackets 14 and of the output pulley of 27 are fixedly aligned. The axis of pulley 25 is aligned with the transverse upper axes of front arm pivot connections 28 when the latter are in normal alignment, i.e., with the shoe in normal operative horizontal ground contacting position. Aligned input shaft elements of the several gear boxes 27 are connected by drive shaft elements to form in effect a common transverse intermediate drive shaft means 29, driven in turn under shoe operating conditions by an operator clutch controlled power take-off pulley means 31 at the engine, through V-belt pulley means 32 to pulleys 33 on shaft 29. Generally, the actuating assemblies 23, and the power transmission means thereto from engine E may be, and in the disclosed structure are, such as disclosed in my copending application Serial No. 607,423, now Patent 2,893,299.

The specific disclosed arm mounting structure of each shoe unit is generally similar to that described in my copending application Serial No. 607,514 insofar as the shock absorbing character of the bracket structure 13, the belt-tightening adjustable arm length, and the universal or two-fold pivotal type front arm connections to the shoe are concerned, wherein the lower longitudinal axes are parallel. Such structure has the advantage of permitting a degree of operative lateral tilting accommodation of the shoe tamping surface disposition to the surface contour of the ground being traversed.

Of great consequence, in a machine of this character, is a shoe stabilizing means of this invention whereby each pair of adjacent shoes is linked together by means including a tie rod with opposite ends secured to a shoe by a torsionally resiliently restricted pivot structure having a horizontal pivot axis lying in a vertical longitudinal center plane of the shoe, at either or both front or rear parts of the shoe base, or mounted on some intermediate part of the shoe.

Since a front-mounted tie rod by itself has been found quite effective as well as structurally convenient, such is represented in the drawings as the form of the shoe stabilizing structure. It includes the horizontal transverse tie rod 35 extending between each pair of adjacent shoe units to which it is secured by a respective resilient pivotal connection assembly or anchor 36 (see Fig. 2) mounted centrally of the integral front plate 22*a* of the corresponding shoe unit. At the ends of the tie rod are like oriented enlargements or eyes 35*a*, each provided on each side with an inward taper or conical surface 35*b*. At mid-width of each shoe there is secured a stud bolt or the like 37 projecting forwardly from the shoe front plate 22*a* to have a normally horizontally longitudinally disposed axis when the shoe is in operative positions; that is, the axis of 37 is generally parallel to the bottom of the shoe, the stud being shown in the drawings as extending through the plate and secured by the two nuts 37*a*, 37*b*. To the stud is secured an end of a tie rod by means

including a pair of interposed resilient bushings 38 inserted in the eye 35*a* from opposite sides and having external tapers matching those of the eye, a pair of dished washers 39 with convex sides disposed toward adjacent respective bushings, and means for applying an axial compressive force to said bushings, whereby in consequence of the tapers, circumferential frictional forces arise between the bushings and both tie rod eyes and studs.

It is to be observed in Fig. 1 that a single stud 37 on any but the end shoes serves to anchor two tie rods extending in opposite directions to adjacent shoe units. Hence detail Fig. 2 represents such double anchor assembly; wherein for each tie rod the relation of its associated eye bushings 38, washers 39, shank of stud 37, and the bushing compressing action exerted by washers 39, is identical.

Considering in Fig. 2 the outermost (top) tie rod eye and the immediately associated elements, each bushing has a conical or tapered surface matching or mating the corresponding tapered internal surface of the rod eye. Such taper relations allow development of compression required for frictional engagement while minimizing tendency to displacement of the bushings. Taking the lower washer 39 of the top assembly as a fixed or reaction element, as it is in the final double assembly, with its uppermost washer 39, and bolt 40 projecting therethrough into endwise threaded engagement with stud 37, there is formed a means for axially compressing the associated bushings 38, and thereby bringing the latter into functional engagement with eye 35*a* and stud 37, as a resilient torsional connection therebetween or ultimately between eye and shoe.

In like fashion, the inner (lowermost) eye and its associated elements are engaged with stud 37, therefore the shoe, by virtue of the compressive force exerted between its corresponding first washer 39, fixed by abutment upon the stud securing means at plate 22*a*, and outer second washer 39 to which axial force is applied by the adjacent washer of the superimposed eye and, therefore, ultimately by bolt 40 with associated lock washer. At the end shoes, of course, since only one tie rod eye is there anchored, the assembly is simply that comprised by the top half of Fig. 2, with the lowermost washer thereof abutting on a stud securing nut at 22*a* as at the bottom of Fig. 2.

The dimensions of the elements in a single or double anchor assembly are so chosen that when bolt 40 is tightened down to bring the underlying washer into firm abutment with the end of the stud, the several washers remain spaced from the adjacent tie rod eyes while developing the axial compression required for frictional engagement of the bushings with the stud and eyes.

In machines where the individual shoe actuating units are driven by belts from pulleys fixed on the vehicle frame, it has been found particularly advantageous to locate the axis of the anchor stud 37 as low as possible on overall shoe structure as in the specific machine of the drawings, for purposes of attaining a discovered further increase in belt life beyond the improved belt life achieved by restraining lateral excursions of the individual shoes, and therefore of the plane of pulleys 25 relative to their respective drive pulleys 26.

I claim:

1. A road working machine comprising: a crawler type vehicle, a plurality of individually actuated and suspended material compacting shoes mounted in transverse array across one end of the vehicle, vibrating means carried by said shoes to deliver rapidly repeated generally perpendicularly directed forces on underlying material, and shoe stabilizing means extending between each pair of adjacent shoes; said stabilizing means including a tie rod provided with like-oriented eye formations at its respective ends, and resiliently pivotal anchor means securing each end of the rod to a respective shoe of an adjacent

pair; each said anchor means having a horizontal stud secured on the respective shoe in a longitudinal vertical plane of the corresponding shoe, rubber-like bushing means on the stud and in the eye of the tie rod secured thereby and means on the stud for axially compressing said bushing means for a frictional, resilient connection between stud and tie rod end.

2. In a material compacting road working machine including a crawler type automotive vehicle and a plurality of individually actuated and suspended material compacting shoes mounted in traverse array across one end of the vehicle, vibrating means carried by said shoes to deliver rapidly repeated generally perpendicularly directed forces on underlying material, shoe stabilizing means extending between each pair of adjacent shoes and comprising: a tie rod, and resiliently pivotal anchor means securing each end of the rod to a respective shoe of an adjacent pair; each said anchor means having a horizontal stud disposed in a longitudinal vertical generally central plane of the corresponding shoe, rubber-like bushing means coaxially interposed between a respective tie rod end aperture and the stud, and means axially compressing said bushing means to distort the same radially into frictional contact with the said stud and the respective tie rod as a torsionally resilient connection between the tie rod and shoe.

3. In a material compacting road working machine including a crawler type automotive vehicle and a plurality of individually actuated and suspended material compacting shoes mounted in traverse array across one end of the vehicle, vibrating means carried by said shoes to deliver rapidly repeated generally perpendicularly directed forces on underlying material, shoe stabilizing means extending between each pair of adjacent shoes and comprising: a tie rod and resiliently pivotal anchor means securing each end of the rod to a respective shoe of an adjacent pair; each said anchor means including an eye formation upon a respective tie rod end, a horizontal stud disposed in a longitudinal vertical generally central plane of the corresponding shoe, rubber-like bushing means on

said stud and in said one eye formation, and means axially compressing the said bushing means to distort the same radially into contact with the corresponding stud and eye formation whereby a torsionally resilient engagement is provided between the tie rod and stud.

4. In a material compacting road working machine including a crawler type automotive vehicle, a plurality of individually actuated and suspended material compacting shoes mounted in traverse array across one end of the vehicle, and vibrating means carried by said shoes to deliver rapidly repeated generally perpendicularly directed forces on underlying material, shoe stabilizing means extending between each pair of adjacent shoes and comprising: a tie rod, and resiliently pivotal anchor means securing each end of the rod to a respective shoe of an adjacent pair; each said anchor means including an eye formation rigid with the tie rod and having conical female surfaces tapering inwardly from each side thereof, a horizontal stud secured on and in a longitudinal vertical generally central plane of the corresponding shoe, a pair of rubber-like resilient bushings inserted in the eye formation from each side thereof and having complementary male conical surfaces, a pair of dished washers on the stud with convex sides bearing axially against an outer end of a respective bushing, one of said washers being axially fixed, and means threadably engaged with the stud bearing on the other washer for axial compression of the bushings into a frictional, torsionally resilient engagement means between eye and stud.

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