Aug. 22, 1967 V. J. MOIR 3,336,848

MATERIAL COMPACTOR

Filed July 6, 1965

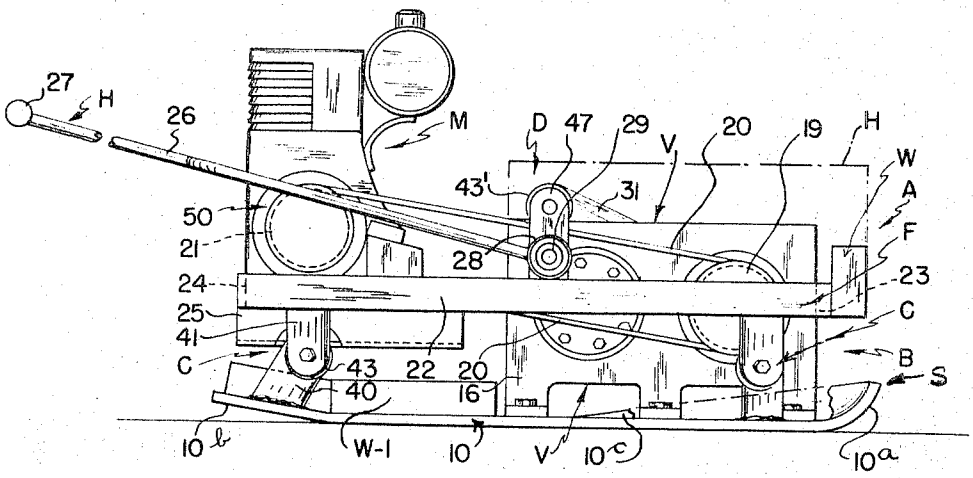


FIG. 1

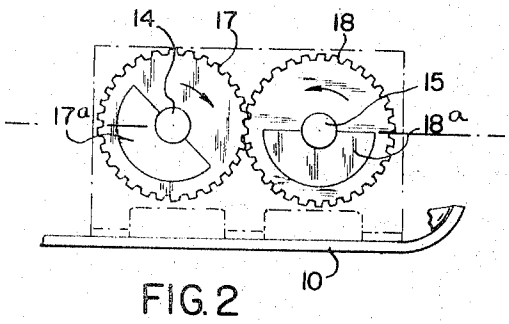


FIG. 2

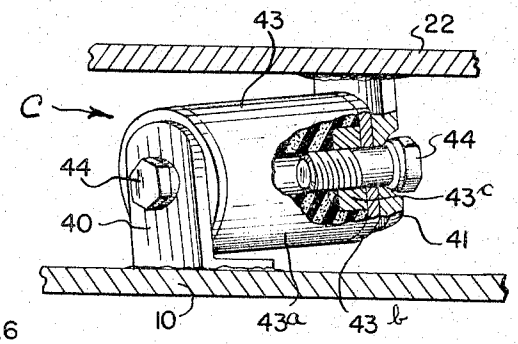


FIG. 3

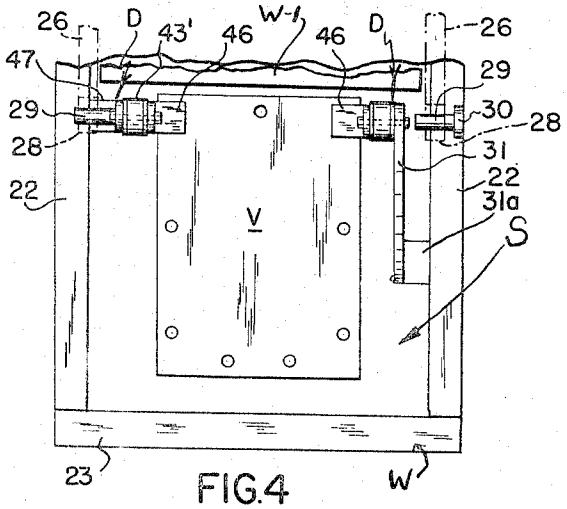


FIG. 4

INVENTOR.
VINCENT J. MOIR
BY
Ely, Golrick & Flynn
ATTORNEYS

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MATERIAL COMPACTOR

Vincent J. Moir, Gates Mills, Ohio, assignor to The International Vibration Company, a corporation of Delaware

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ABSTRACT OF THE DISCLOSURE

Pedestrian-operated directed, self-propelled vibratory impacting material-compacting machine delivering impacting forces downwardly and rearwardly through a slideable flat-bottomed base from a rotationally driven eccentric weight actuator unit on top the base and belt-driven by a gasoline motor supported rearwardly on a frame suspended on and above the base through fore and aft symmetrically paired lateral resilient connectors, a forward loading weight on the frame at least partly counterbalancing the motor; the weight, motor and frame comprising a loading mass with center of gravity above that of base and actuator unit, and lateral stabilizers each provided by a pair of elements projecting respectively from the frame and base to a point above the frame where they are connected by a resilient element.

The present invention relates generally to vibrational material compactors, and more particularly to improvements in self-propelled, single shoe vibrational compactor apparatus adapted for operation and steering by a pedestrian workman.

Material compacting machines or apparatus of a vibrational type are widely known, and long used for tamping, compacting or consolidating earth, stone or gravel, or surfacing material, where a relatively smooth, level, compacted surface is desired, usually as part of a base for road beds, airstrips, or driveways and other areas on which a top surface material is finally placed, although at times merely to insure compact filling of certain areas to minimize subsequent settling even though no particular load is to be later applied over the area. Such equipment has as well been used for the application of asphalt, and at times in certain concrete construction work.

In this class of compacting or tamping equipment, the machine comprises one or more vibrational "shoe" elements comprised of a base or plate adapted to make contact with and to be moved over the top of the area to be compacted, while simultaneously subjected to vibrational forces having a vertical component for presenting a fast tamping action, which together with the mass of the assembly supported on the plate in effect produces at least a ramming compacting action under the shoe. Generally the rapidity of the blows imparted to the material further has the effect of shaking and actually vibrating not only the space immediately underneath the contacted surface but also in space adjacent laterally and in depth, tending to settle loose particles by the very shaking effect itself.

Three broad types of such equipment may be distinguished. A first includes an automotive vehicle, usually a crawler, adapted to move over the area being worked and at one end supporting, usually retractably, one or more vibratory shoe elements each having a vibrational actuator generally comprised of a rotating eccentric mass or masses driven by motor means, either respective motor means on each shoe or through suitable transmission means from a motor on the vehicle. In a second type, the vehicle itself may be supported on track-like elements, for example, on aligned forms at opposite sides of concrete being poured. A third type, with which the present invention is particularly concerned, essentially comprising a single shoe or

material contacting element serving as ground support for the entire apparatus including not only a vibrating actuator, but also a motor means, for example, an internal combustion engine or electric motor; through suitable handle the machine being steered and at times propelled by a pedestrian or operater, but more usually being self-propelled.

The machine of the present invention comprises then a broad base or shoe-plate on which is directly mounted a vibrational actuator, a frame resiliently suspended or connected to the shoe or plate assembly and supporting motor driving means for the vibration unit, and a suitable handle means whereby the entire apparatus may be guided or directed by the pedestrian operator as the machine tends to advance forwardly under suitably directed force components arising from the very operation of the vibrating actuator.

A resilient or spring type suspension is necessary or highly advantageous on two scores. First, a kinematic system appears to be preferable wherein the vibrating actuator is mounted directly on the shoe plate, and there is a further mass in the system resiliently connected to the directly vibrated plate. Further it appears highly preferable that the drive motor for the apparatus, advantageously part of that further mass, particularly where such be an internal combustion engine, be in some degree isolated from being directly subjected to the vibrational forces developed by the actuator.

In prior machines of this type it has been found that even at normal operating speeds or power application the entire apparatus tends to dance from one side to the other, with the result that the machine may have a degree of inefficiency because of the misdirection of impact or virbrational blows, further may tend to produce uneven compacting and uneven top surfaces, and in any event may be difficult or inconvenient to operate.

It has been discovered that in general this untoward behavoir or characteristic is at least in great part a consequence of the resilient suspension or connection between the motor supporting frame and the base or shoe structure in contact with the material being compacted.

In any event, it has been further discovered that by the use of a stabilizing structure in this resilient suspension and as well modifications in the ordinary four-corner suspension between a motor mounting frame and ground-contacting shoe assembly, a marked improvement in compacting performance, ease of steering and manipulation and, in some degree, in mechanical durability is attained.

In brief, by the present invention these advantages are attained by the use of stabilizing connections between the upper frame structure and the lower shoe structure located at each side of the machine vertically above the frame and above the center of gravity of the entire machine, the advantages of which are further enhanced by use of a novel arrangement of a resilient connection at each of the four corners.

It is a general object of the present invention to provide an improved self-propelled single-shoe vibratory compacting apparatus adapted to be manipulated by a pedestrain operator.

A further object of the invention is to provide an apparatus of the type described which is more efficient in operation especially for depth of compaction, is less subject to a dancing or an erratic lateral displacement when in operation, and is more effective in producing a smooth compacted surface.

A still further object is the provision in an apparatus of the type described of a new resilient suspension and stabilizer construction between a motor supporting frame section and a directly vibrated material contacting shoe or base member supporting the entire apparatus in the

course of its normal operation on the surface to be compacted or treated.

Other objects and advantages will appear from the following description and the drawing wherein:

FIG. 1 is a right side elevational view of one form of apparatus embodying the present invention;

FIG. 2 shows schematically certain relations of cooperating rotating eccentric elements in the vibratory actuator;

FIG. 3 is an enlarged detail view, partially broken away, of a suspension means used at each of the four corners of the apparatus and also in stabilizer structures; and

FIGURE 4 is a schematic plan view of the apparatus showing certain positional relation of masses involved.

The apparatus shown in the drawing, as embodying the present invention is comprised of a drive motor mounting upper section A, including as an intermediate member an open rectangular welded frame F, the driving motor M at the rear portion of the frame, here a gasoline engine, and a loading mass or weight W at the front of the frame; a lower section B supporting the upper section through a four-point, four-corner resilient suspension means C, and upwardly extending paired lateral stabilizing means D, respectively; and a handle H whereby the operator guides or steers the entire machine in operation. The lower section B is comprised of a material-contacting base or shoe S to the center front region of which is rigidly secured the housing of a rotary vibratory actuator unit V having an input shaft connected to an output shaft or flywheel of the motor M by suitable flexible drive or transmission means such as V-belts and sheaves, or chain-sprocket drive means.

In shoe S, plate **10** provides a relatively wide flat material contacting area or face supporting the entire apparatus in operation, and has the front end **10***a* upwardly curved and rear slightly upwardly sloped or curved at **10***b*, and preferably includes at least near the front upwardly extending side plates **10***c*, all facilitating movement, guiding and turning of the shoe, without digging into loose material being worked. At the back region of the shoe, another mass or weight W–1 is secured on the plate **10** generally symmetrically disposed about a longitudinal center plane of the apparatus, as are mass W, unit V and other components; W–1 being a partial counterbalance to V relative to a vertical transverse center plane.

The vibratory actuator unit of V is comprised of a housing totally enclosing a rotating eccentric mass system including respective parallel shafts **14**, **15**, each with opposite ends supported in suitable bearings in vertical, opposed parallel housing side walls **16**, the masses provided by what in effect are meshed front and back gear wheels **17**, **18** secured to respective shafts and each including eccentric weight portions **17***a*, **18***a*, with phase or mesh relation as hereinafter described. The shaft axes are in a plane parallel to the contact face of the shoe; and the front shaft **15** projecting from the housing carries a suitable sheave **19** connected by a driving V-belt **20** to a corresponding sheave **21** of the motor.

Eccentric wheels **17***a*, **18***a* are meshed with mass centers about 57° out of phase, e.g., with 50 teeth per wheel, 8 teeth out of phase, in sense that the eccentric mass centers pass on nearest approach downwardly through the plane of the shaft axes with the front one lagging by 57°. The plane of the shafts is parallel to the base plane of the shoe or plate **10**. The vibrator box assembly is symmetrical about its transverse center plane in component location, except for the outside drive sheave thereof.

Heavy parallel side members **22** and transverse front and rear elements **23** and **24** are welded into the rigid, unitary open rectangular frame F, at the top front of which is mounted the loading mass W, here heavy steel or iron blocks welded in place; while the entire motor M is supported at the rear of and extending above the

frame on a flat dropped base plate **25** welded to two members **22** and **24**. In the handle H, the heavy parallel tubular bars **26**, joined by transverse grip bar **27**, have bottom eye formations with resilient, vibration absorbing connections **28** to pivots **29** on the inside and outside faces of respective upward ears or brackets **30** and **47** respectively rigidly centrally secured on each side member **22**.

Each corner connection C (see FIG. 3) includes an inner obliquely upwardly extending ear or bracket **40** welded to the base plate **10**, an outer ear **41** extending downwardly parallel thereto from and welded to a member **22**, and therebetween a resilient unit **43** secured by bolts **44** extending through respective ear apertures and threaded into an end structure of 43. Each unit 43 is comprised of a resilient elastomeric or rubber cylindrical body **43***a* with opposite ends securely bonded to centrally apertured steel disks **43***b*, each here shown with a nut or threaded element **43***c* on its internal face to provide or extend the threaded engagement or purchase for the respective bolts **44**.

The ear elements **40–41** are not only inclined, as shown, to the plane of the base plate **10** and frame F, but further are preferably turned somewhat out of parallelism with respect to the longitudinal center line of the machine; and, moreover so spaced that the elastomeric bodies are axially compressed.

The stabilizing means D centrally located near each side of the apparatus each include a unit **43′**, similar to units **43** as previously described; a short right-angle bracket **46** with a bottom or base leg welded to the removable bolted top of the vibration unit housing and its other upwardly extending vertical leg having its outer face plane parallel to the length of the apparatus; and a second longer bracket, having a lower end welded to a respective frame side member **22** and an inner face extending upward and parallel to the plane of **46**, namely, slanted left bracket **31** having a bottom end **31***a* outwardly flanged and welded to **22**, or upright right bracket **47**, (at right and left of FIG. 4). Again the unit **43′** is bolted between apertured top ends of the corresponding brackets in an axially compressional prestressed condition as described for the units C. The axes of the connecting bolts with the stabilizer units D unstressed in shear would be coaxially transverse to the machine, rather than inclined as in the connectors C, but become parallely off-set under the suspended frame load.

In the elastic bodies a rubber preferably has a 50 Durometer hardness for the corners and about 40 Durometer for the stabilizers.

Preferably, for operator safety and cleanliness and protection of the machine, a suitable housing H, indicated by dashed lines in FIG. 1, covers the front half of the frame extending over the load W and back beyond the stabilizer D and the pivotal connections of the handle.

Conveniently the motor M is an internal combustion engine with shaft transverse to the machine, and is provided with a centrifugal clutch **50** between its output sheave and flywheel. Thus normally the motor may idle at roughly 1000 r.p.m. and with advance of a suitably placed hand throttle, as the engine speeds up to say 1800 r.p.m., the clutch will engage to drive the actuator V. Accordingly impacting vibration of the shoe on the material therebeneath begins, and further the entire apparatus begins to move forward in a self-propelling manner by virtue of certain components of force arising. A typical normal operating speed for actual efficient impacting would, for example, be on the order of 2800 r.p.m. in the engine, representing with the gearing or transmission ratios involved about 2100 r.p.m., therefore 2100 v.p.m. in the actuator and shoe respectively.

Further it may be noted that in a typical machine of this type having a total weight of 870 pounds powered by an 8 horse power Wisconsin engine, a vibrating shoe assembly of about 460 pounds weight and 24 inches wide by 30 inches long, with actual flat contact area between

the front and rear curved toe and heel portions 24 inches by 24 inches, a travel speed range of about 40 to 50 feet per minute was obtained on level loose ground; and with the vertical vibration at the rate of 2100 v.p.m. and a vertical lift in the shoe of 3/8", there was developed a compacting force of approximately 20,000 pounds.

Moreover it was found that even ascending an incline on the order of 20°, this machine would advance despite a very heavy rearward pull by the operator, and could be stopped only with difficulty on such an incline.

In the machine of the drawing, a vertically extended arrangement is avoided, by placing the unit V forward on the shoe, and the engine at the rear of the frame F, to afford the necessary spacing for the flexible drive between motor output and the actuator input shaft. Though the machine as a whole is preferably balanced statically about a transverse plane through **47** and the pivots at **29**, W need not closely counterbalance the motor on the frame in the upper assembly, nor W–**1** the unit V on the shoe in the lower assembly; the weights being chosen, particularly W–**1**, so that at compacting operating speeds on level areas the plate **10** vibrates as a whole vertically without notable rocking or "flopping" of either end, and with the upper assembly appearing to stay nearly motionless in vertical direction. This is conducive both to operator comfort and long engine life.

I claim:

1. A vibratory-impacting, self-propelled material-compacting machine, adapted to be self-supporting on the ground or like surface to be compacted comprising:

a shoe including a member having a flat ground-contacting bottom face and being symmetrical about a vertical longitudinal center plane, a rotationally driven vibratory actuator mounted on the top side of said member and adapted to apply to the shoe repeated upwardly-forwardly directed and downwardly-rearwardly directed forces, an intermediate member mounted on and above said shoe by resilient connection means symmetrically disposed on each side of said centerplane at the front and at the rear of said shoe, a rotary output motor secured to said intermediate member, flexible drive transmission means from the motor output to said actuator, weight means on said intermediate member forming with said frame and motor a loading mass with center of gravity higher than that of said shoe in combination with said actuator unit, and lateral stabilizer means symmetrical with respect to and on opposite sides of said centerplane each comprising a first element rigidly secured to and extending above said intermediate member to a connection point, a second element rigidly secured to said shoe and extending upwardly to said connection point and a resilient element connecting said first and second elements at said connection point.

2. In a machine as described in claim **1**, said resilient connection means between said shoe and intermediate member each comprising an elastomeric element attached to and interposed under precompression between opposed parallel elements rigidly attached to said intermediate member and said shoe, the line of compression being directed obliquely to said centerplane out of parallelism with both the shoe bottom face and a transverse vertical plane.

3. In a machine as described in claim **1**, each said resilient element of said stabilizer means comprising an elastomeric element interposed under precompression between said first and second elements, with the lines of compression substantially co-linear.

4. In a machine as described in claim **3**, said connection points located above the horizontal plane through the center of gravity of the machine.

5. In a machine as described in claim **1**, steering means comprising a handle connected to said intermediate member.

6. In a machine as described in claim **1**, said handle including parallel side legs with inner ends pivotally connected on opposite sides of and near the center of said intermediate member.

7. A vibratory-impacting, material-compacting machine, adapted to be self-supporting on a horizontally extensive area of material to be compacted, and further adapted to compact said material in desired horizontal and inclined portions within said area, comprising:

a shoe including a member having a flat material-contacting bottom face and being generally symmetrical about a longitudinal centerplane and an eccentric rotating mass type vibratory actuator mounted on the top side of said member, said unit adapted to develop rapid vibration of the shoe with vertical components exceeding any horizontal components; an intermediate member mounted on and above said shoe by four-point resilient connection means symmetrically disposed on each side of said centerline at the front and at the rear of said shoe; a rotary output motor secured on and extending above said intermediate member; belt drive means connecting the motor output to an input sheave of said actuator; said intermediate member forming with said motor a loading mass with center of gravity higher than that of the said shoe taken with said actuator unit; and lateral stabilizer means symmetrical with respect to and on opposite sides of said centerplane, each last said means comprising a first element rigidly secured to and extending above said intermediate member to a connetction point, a second element rigidly secured to said shoe and extending upwardly to said connection point and a resilient element interposed between and connecting said elements at said connection point.

8. In a machine as described in claim **7**, said resilient connection means between said shoe and intermediate member each comprising an elastomeric element attached to and interposed under precompression between opposed parallel elements rigidly attached to said intermediate member and said shoe, the line of compression being directed obliquely to said centerplane out of parallelism with both the shoe bottom face and a transverse vertical plane.

9. In a machine as described in claim **8**, each said resilient element of said stabilizer means comprising an elastomeric element interposed under precompression between said first and second elements, with the lines of compression substantially co-linear.

10. In a machine as described in claim **8**, said connection points located above the horizontal plane through the center of gravity of the machine.

11. In a machine as described in claim **7**, the said motor including an operator-set throttle and centrifugal clutch engageable to drive said actuator unit through said belt means upon attainment of a pre-set motor speed above idling speed; and said actuator unit adapted to develop longitudinal horizontal force components applied to said shoe for self-propulsion.

12. A vibratory-impacting material-compacting machine adapted to be self-supporting on a horizontally extensive area of material in desired horizontal and inclined portions within said area, comprising:

a shoe including a member having a flat material-contacting bottom face and being generally symmetrical about a longitudinal centerplane and an eccentric rotating mass type vibratory actuator mounted on the top side of said member toward one end of the machine, said unit adapted to develop rapid vibration of the shoe with vertical components exceeding any horizontal components; an intermediate member mounted on and above said shoe by four-point resilient connection means symmetrically disposed on each side of said centerplane at the front and at the rear of said shoe; a rotary output motor secured

on and extending above said intermediate member at the other end of the machine; flexible drive means connecting the motor output to an input shaft of said actuator; lateral stabilizer means symmetrical with respect to and on opposite sides of said centerplane, each last said means comprising a first element rigidly secured to and extending above said intermediate member to a connection point, a second element rigidly secured to said shoe and extending upwardly to said connection point and a resilient element interposed between and connecting said elements at said connection point; and weight means on the ends of said intermediate member and said shoe respectively opposite said motor and said unit as respective partial counterbalancing means.

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JOCOB L. NACKENOFF, *Primary Examiner.*