

[54]	HYDRAULIC VIBRATORY COMPACTOR	3,635,132	1/1972	Mellrath et al.	404/133
[75]	Inventor: Bernard A. Century , Cleveland Heights, Ohio	3,749,506	7/1973	Lance	404/133
		3,782,845	1/1974	Briggs et al.	404/133
[73]	Assignee: Allied Steel & Tractor Products, Incorporated , Cleveland, Ohio	<i>Primary Examiner</i> —Mervin Stein <i>Assistant Examiner</i> —Steven Hawkins <i>Attorney, Agent, or Firm</i> —Lyon and Lyon			
[22]	Filed: Feb. 11, 1974				
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Related U.S. Application Data

[63]	Continuation of Ser. No. 194,674, Nov. 1, 1971, abandoned.	
[52]	U.S. Cl.	404/133
[51]	Int. Cl.²	E01C 11/16
[58]	Field of Search	404/133

References Cited

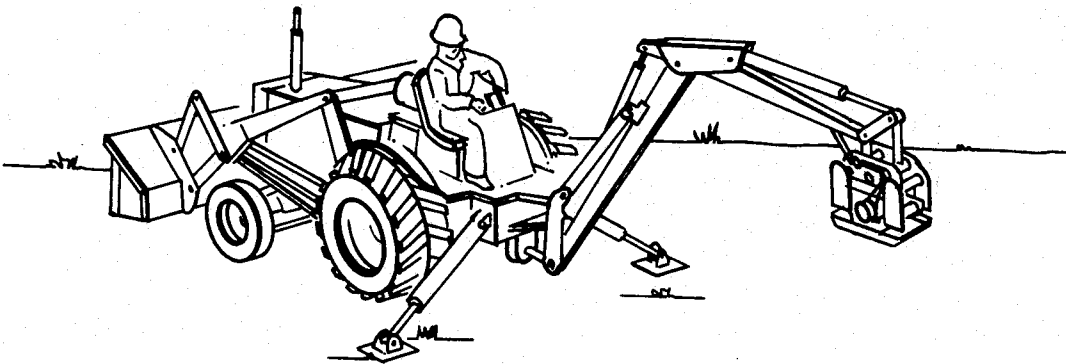
UNITED STATES PATENTS

3,336,848	8/1967	Moir	404/133
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[57] **ABSTRACT**

A hydraulic vibratory compacting device for use with a heavy-duty vehicle. The device is given an oscillatory motion by a rotating eccentric weight. The device is coupled to the heavy-duty vehicle by flexible mounting made from material having a low modulus of elasticity. The mountings are positioned for maximum stability of the compacting device and are able to transmit large bias loads imposed by the heavy-duty vehicle. Stops are also provided to insure employment within the proper operating range.

5 Claims, 6 Drawing Figures



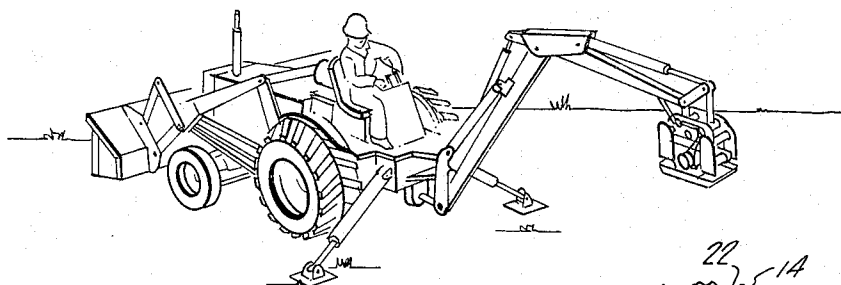


FIG. 1

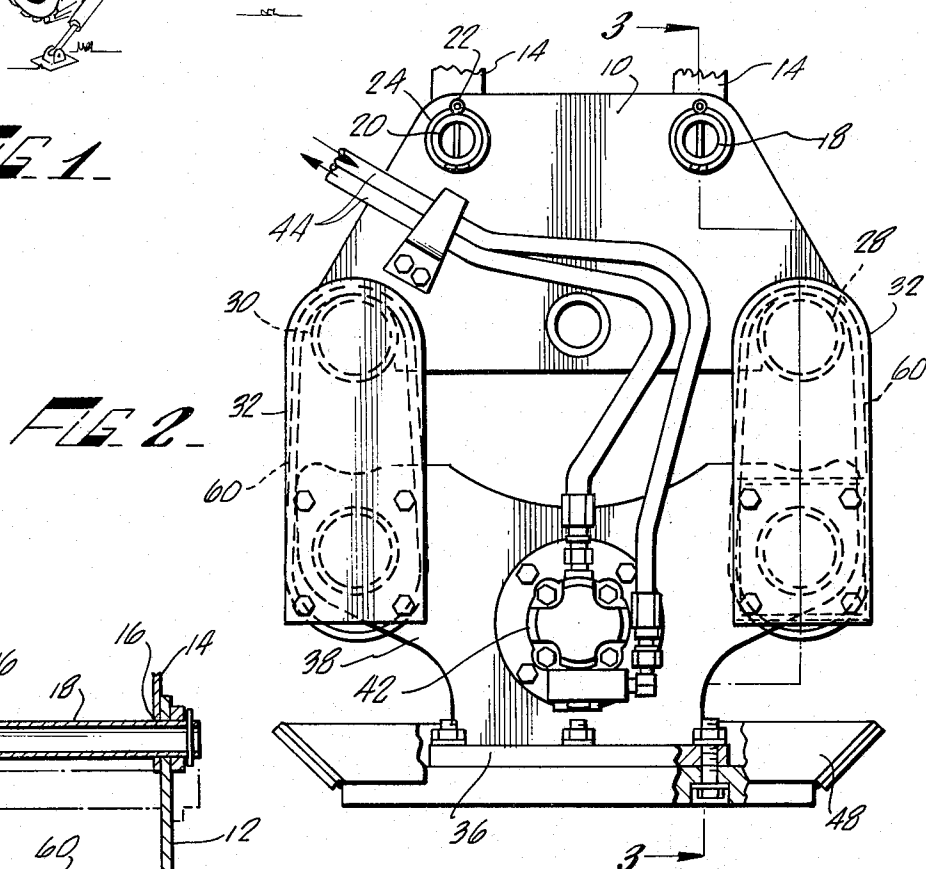


FIG. 2

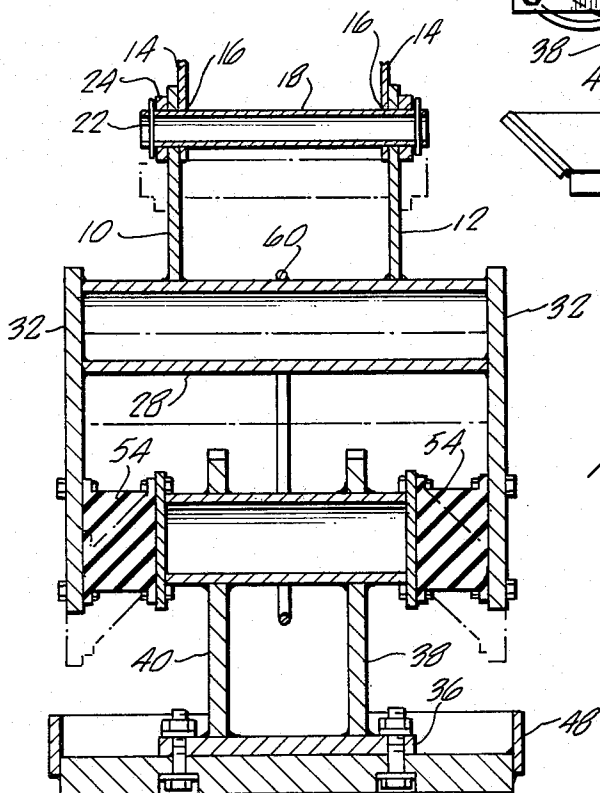


FIG. 3

INVENTOR.
BERNARD A. CENTURY
BY
Lyon & Lyon
ATTORNEYS.

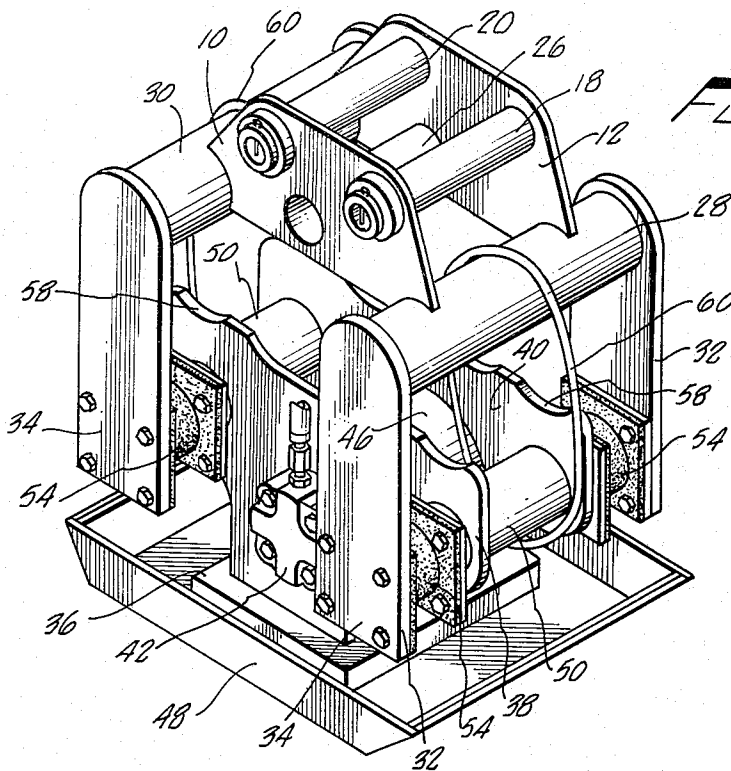


FIG. 4

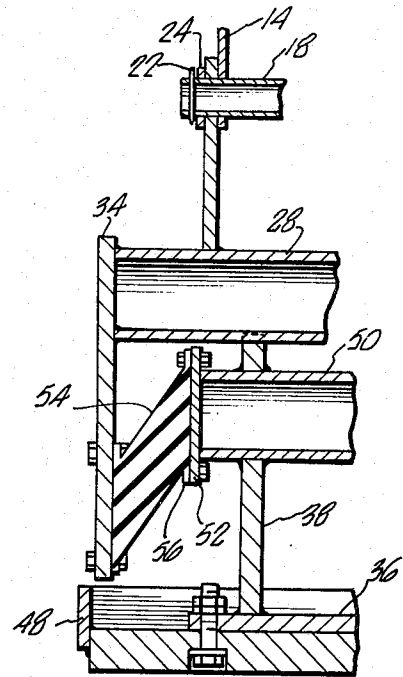


FIG. 5

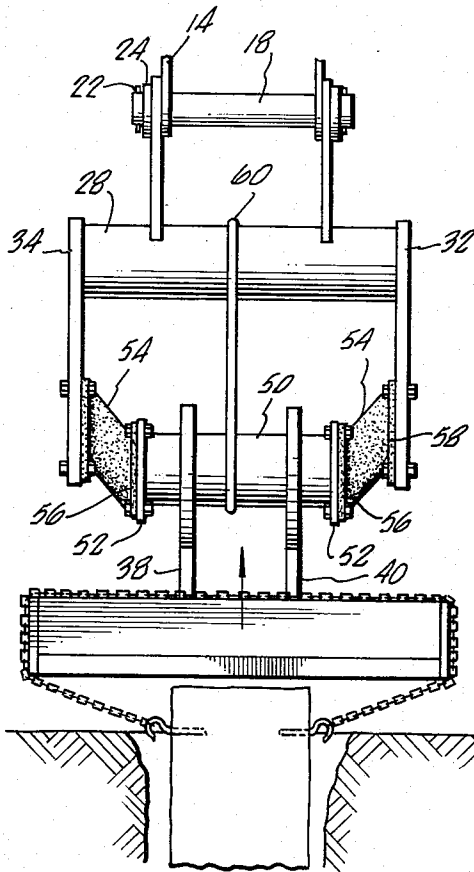


FIG. 6

INVENTOR
BERNARD A. CENTURY
BY
Lyon & Lyon
ATTORNEYS.

HYDRAULIC VIBRATORY COMPACTOR

This is a continuation of application Ser. No. 194,674, filed Nov. 1, 1971 now abandoned.

BACKGROUND OF THE INVENTION

Vibratory compacting devices are presently available for use with heavy-duty vehicles. The common form for such devices includes a body having a rotating eccentric weight which generates a vibratory motion of the body for compacting soil. This vibratory motion may also be used for driving piles and other similar tasks. To achieve maximum results with any given vibrating force, an external bias force must be exerted on the device in the operative direction. To achieve such a bias force, the vibrating body must be physically attached to the supporting heavy-duty vehicle. Thus, it has been found necessary to provide a support structure and a flexible coupling device to act between the heavy-duty vehicle and the vibrating body to transmit the desired bias forces without transmitting the vibratory forces from the body.

To date, the flexible coupling devices which have been employed have had a relatively high spring modulus for the flexible member. This high modulus has been required to overcome the inherent instability of the vibratory compaction body relative to the supporting heavy-duty vehicle. This high spring modulus requirement is of great disadvantage because the resulting assembly readily transmits the vibrational energy to the supporting heavy-duty vehicle. This is undesirable because less energy is then available for compaction and because the vibrations transmitted can have a detrimental effect on the supporting heavy-duty vehicle and its operator.

A major feature promoting instability of the vibrating compaction bodies is that the flexible coupling devices have heretofore been mounted above the compaction body. This puts the coupling device some distance from the impact surface of the compactor which in turn provides an excessive operating moment through which unstabilizing loads at the compaction surface can act. As a result greater torque loads must be overcome at the flexible support coupling and stiffer material configurations must be employed.

The location of the flexible couplings above the vibratory compaction body has also made it impossible in many cases to adequately present excessive loads from distorting the flexible coupling devices beyond their elastic limit. Frequent failure of the coupling devices and the associated waste of replacement time and expense has been a problem. As a result, these devices have demanded a particularly well instructed operator to avoid these excessive loading situations.

SUMMARY OF THE INVENTION

The present invention is an improved vibratory compaction device. The improvements relates to the structural means for supporting the vibratory compaction body. Blocks of material having a comparatively low modulus of elasticity such as soft rubber are mounted on the sides of the vibrating compaction body. A rigid structural unit is attached to all of these flexible blocks and rises in a U-shaped configuration to avoid the vibratory compaction body and provide for rigid attachment to the heavy-duty vehicle above the compaction body. These blocks or flexible mounts are located about rather than above the vibratory compaction body

to provide maximum stability and support. Because the mounts are positioned low and to the outside of the vibratory compaction body, the moment through which unstabilizing forces can act to disturb the vibrating compaction body is reduced thus reducing the requirement for rigid support. Correspondingly the operative moment of the system of mounts is increased which in turn further reduces the requirement for rigid stabilizing restraints. Also by locating the mounts at maximum practical distances from each other about the vibrating compaction body, greater stability is effected for supporting all portions of the compaction body.

This novel mounting configuration, by reducing the rigidity requirements for stabilization, makes possible the use of materials having a low modulus of elasticity. As a result, the amount of vibrational energy lost from the vibratory compaction unit and transmitted to the heavy-duty vehicle is greatly reduced.

An included feature of the present invention is the integral means for stopping the travel of the compaction body to prevent the mountings from exceeding their elastic limit. The structural frame is designed to clear the vibratory compaction body by a specific amount which is dependent upon the displacement associated with the elastic limit of the flexible mounting material. This clearance is reduced by distortion of the flexible mounts until the vibratory compaction body comes in contact with the structural support frame and prevents further displacement which would damage the flexible mounts. If the unit is used in a tension mode to extract posts and the like, the vibratory compaction body will be pulled away from the structural support frame. A cable or chain may easily be employed to prevent excessive displacement of the body from the frame. Because these various stops are rigidly linked to the heavy-duty vehicle, when excessive force is experienced by the device the impact of the compaction body on the stops will be transmitted to the operator as a signal to reduce the forces employed.

In summary, by this invention there is provided an improved means for mounting a vibratory compaction body to a heavy-duty vehicle using flexible material having a comparatively low modulus of elasticity. The novel configuration incorporates means for preventing excessive travel of the vibratory compaction body and also provides for stability control of the unit.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the device mounted on a heavy-duty vehicle.

FIG. 2 is a side view of the device.

FIG. 3 is a sectioned front view taken along line 3—3 of FIG. 2.

FIG. 4 is a perspective view of the device.

FIG. 5 is a sectioned view taken along line 3—3 of FIG. 2 and illustrating the device in maximum displacement.

FIG. 6 is a front view of the device showing its employment in the tension mode.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning now to the drawings, coupling plates 10 and 12 are mutually parallel and spaced to accommodate a standard backhoe coupling 14. A backhoe is most conveniently employed as the mounting heavy-duty vehicle because of its flexibility for placing the device at vari-

ous positions and orientations and for its ability to exert large bias forces in many directions. FIG. 1 illustrates the use of a backhoe as the supporting equipment for the compaction unit. Two holes 16 are placed in each of the coupling plates 10 and 12. These holes 16 are again placed to accommodate the standard backhoe couplings 14. Tie bars 18 and 20 are employed to lock the mounting plate 10 and 12 to the back hoe couplings 14. Pins 22 maintain the tie bars 18 and 20 in position. Collars 24 are welded to plates 10 and 12 for added strength. Pipe 26 is welded to plates 10 and 12 for added strength and rigidity. Pipe 26 also serves as a convenient, centered location for lifting and transporting the device when it is not in use.

Plates 10 and 12 are welded to tubular cross members 28 and 30 which traverse the width of the compaction unit. Plates 10 and 12 must be wide enough that the cross members 28 and 30 will be positioned over the ends of the compaction unit as best shown in FIG. 2. The cross members 28 and 30 are in turn welded to the structural arms 32 which together form a U-shape structural support frame that is clear of the vibratory compaction body and provides four attachment points 34 that are well down on the device and located at the extreme corners. The body of the compaction unit is composed of a base 36 and two parallel side plates 38 and 40. The side plates 38 and 40 are welded or otherwise rigidly attached to the base 36. A hydraulic motor 42 which is driven by the backhoe through lines 44 has a direct drive connection to an eccentric located between the side plates 38 and 40 in the housing 46 shown only in FIG. 4. The motor and eccentric assembly are further detailed in my U.S. Pat. No. 3,561,336. A compaction pan 48 is bolted to the base 36. Two tubular members 50 extend through the parallel side plates 38 and 40 and are welded thereto as part of the structure of the vibratory compaction body. An adapter plate 52 is welded to each end of the tubular members 50.

The adapter plates 52 provide a means for bolting the flexible mounts 54 to the vibrating compaction unit. The flexible mounts 54 extend horizontally in a direction parallel to the axis of rotation of the eccentric in housing 46 and are similarly bolted to the structural arms 32 which form part of the overall structural support frame. The flexible mounts 54 act as springs to isolate the dynamic motions of the vibratory compaction body from the backhoe while providing for the transmission of constant mechanical force exerted by the backhoe on the compaction unit. The mounts 54 each have metallic plates 56 and 58 to which the material having a low modulus of elasticity is bonded. The mounts 54 then form springs which operate in a shearing motion illustrated in FIGS. 3, 5 and 6. The material presently employed for the mounts 54 is rubber. The spring modulus selected for the unit illustrated is 900 pounds/inch per mount or 3,600 pounds/inch for the unit. The optimum spring modulus for any specific embodiment must be empirically determined as it depends upon the weight of the unit, the magnitude of the bias forces required and the speed and weight of the eccentric. To achieve such a low spring modulus and still retain the capability for large total forces around 20,000 pounds, the material used for the mounts 54 must be of a low modulus of elasticity such as is soft natural rubber. Soft natural rubber having a Shore durometer hardness of 50 to 60 is most satisfactory for

mounting material. This gives a shear modulus of elasticity around 90 to 125 pounds/sq. inch. The use of material having a low modulus of elasticity is made possible by a novel positioning of the mounts 54 resulting in a maximum practical stability of the unit. This maximum stability is achieved by positioning the mounts so that the effective moment distance to the mounts from the point of application of an unstabilizing force is no greater than twice the effective moment distance of the restraining mounts responding to the unstabilizing force. This criterion insures a preferred configuration; but where practical considerations require, a greater unstabilizing moment distance can be made acceptable by using stiffer mounting material. This will result in a corresponding loss of vibration isolation. The optimum range may be achieved by insuring that the average of the distances from each mount 54 to the center of the unit is at least one-half the average of the normal distances from each mount 54 to the plane of the base surface of the unit.

To prevent extension of the mounts 54 beyond the elastic limit the parallel side plates 38 and 40 are of sufficient height above the mounts 54 to insure that surfaces 58 will come in contact with the cross members 28 and 30 before the mount 54 are permanently deformed. FIG. 5 shows the unit in maximum deformation with the side plate 38 and 40 in contact with the cross members 28 and 30. If the compaction unit is to be used for extracting posts and the like, the flexible mounts 54 may be similarly protected by a pair of cables 60 of the proper length and encircling the tubular members 28 and 30 on each end of the unit to prevent excessive deformation. FIG. 6 shows the unit in a tension mode.

The present embodiments of this invention are to be considered as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and range of equivalency of the claims therefore are intended to be embraced therein.

I claim:

1. A high force producing vibratory compaction device for mounting on a heavy-duty vehicle adapted to impart variable forces and movements to said device, comprising a structural support frame, means for rigidly coupling said support frame to the heavy-duty vehicle, a body having a generally horizontal compaction pan and means for generating vibratory motion in said body, and means for flexibly mounting said body on said support frame, said structural support frame being positioned above said body and having structural arms extending down the sides of said body, said flexible mounting means comprising at least four blocks of material having a low modulus of elasticity extending approximately horizontally in the unstressed condition between said body and the lower extremities of said structural arms to flexibly couple said structural support frame to said body with a resultant low spring modulus for minimizing the vibrational forces transmitted to the vehicle, said structural arms being laterally positioned at substantially the extremities of said compaction pan and closely approaching said compaction pan upon the application of normal vertical loading forces on said frame by the vehicle, and said blocks being of a size and positioned to deform substantially under said downward vertical loading toward a down-

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wardly stressed condition with the direction of the resilient force imposed on the body by each block being primarily downward and slightly outwardly to intersect the plane of the base surface of said compaction pan at a location close to the adjacent extremity of said pan for maximum stability under all directions of loading.

2. The device of claim 1, wherein the said means for generating vibratory motion in said body comprises an eccentric rotating on a horizontal axis and said four blocks of material all extend on substantially horizontal axes parallel to said axis of rotation of the eccentric.

3. The device of claim 1, wherein the average of the

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distances from each of said plurality of blocks to the center of said body is at least one-half of the average of the normal distances from each of said plurality of blocks to the plane of the base surface of said body.

4. The device of claim 1, wherein said structural support frame includes a plurality of stops to insure that said body is not displaced more than a specified distance relative to said support frame.

5. The device of claim 1, wherein said material having a low modulus of elasticity is soft rubber.

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