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Tuneblom

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[54] **DUAL AMPLITUDE VIBRATION GENERATOR**

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[51] **Int. Cl.** **E01c 19/28**

[58] **Field of Search** ....74/87, 61; 94/50 V, 48; 209/366.5, 367; 259/DIG. 42

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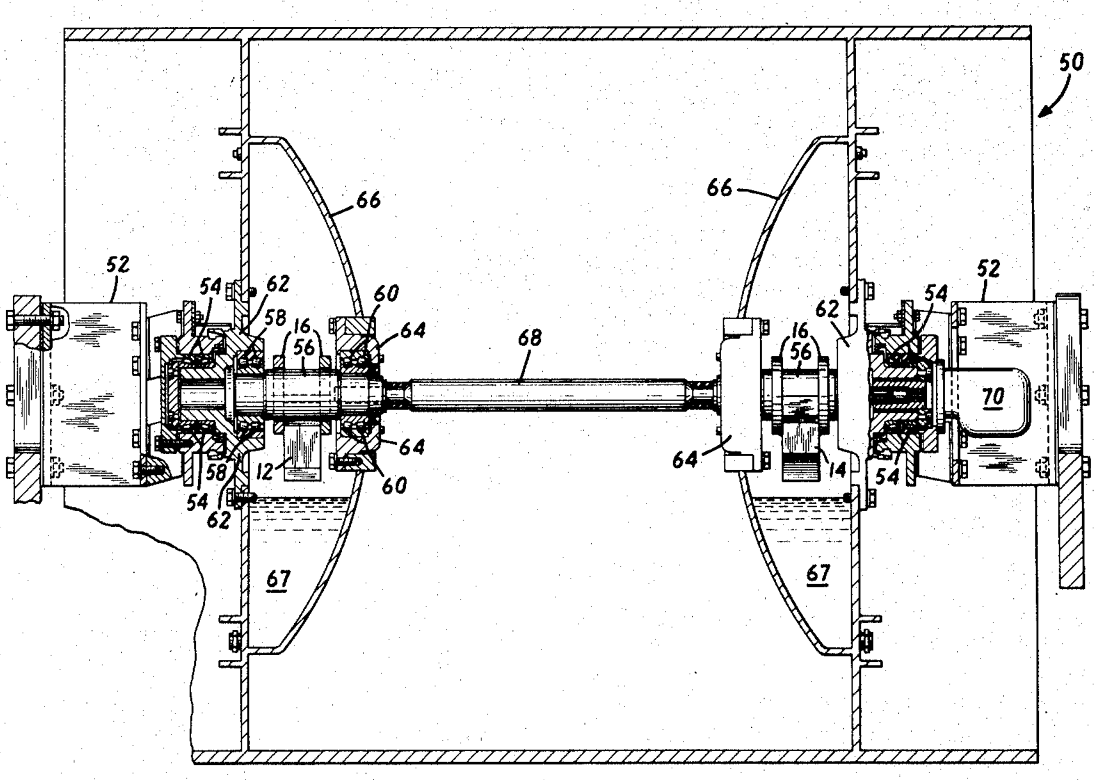
[57] **ABSTRACT**

A dual amplitude vibratory mechanism has a pair of eccentric weights mounted on a shaft in such a way that a different amplitude of vibration can be had simply by reversing rotation of the shaft. One of the weights is attached to the shaft and rotatable with it, while the other weight is mounted on the shaft but freely rotatable relative to it. Each weight has a pair of contact surfaces that cooperate with similar surfaces on the other weight, so that when the shaft rotates one of the surfaces on the fixed weight engages the cooperating surface on the free weight, which results in both weights revolving as a single composite eccentric weight, thereby causing the shaft to vibrate. When the shaft rotation is reversed, the other surface on the fixed weight engages its cooperating surface on the free weight, and the weights revolve in that direction as a single composite eccentric weight. The weights are shaped and dimensioned such that they have a combined center of gravity relative to the shaft when one set of surfaces engage each other that is different from the center of gravity when the other surfaces are in engagement, thereby resulting in a different amplitude of vibration when rotation of the shaft is reversed.

2 Claims, 4 Drawing Figures



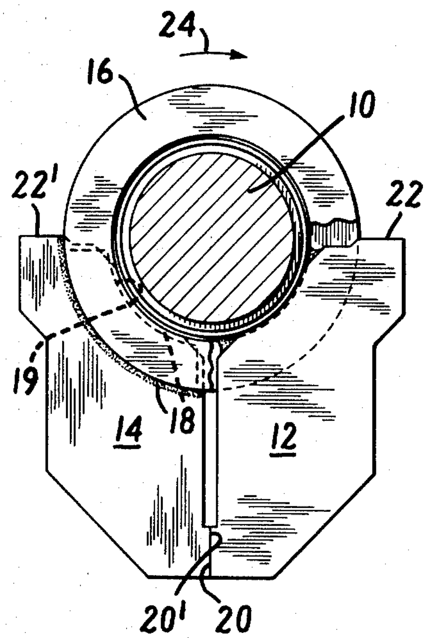


FIG. 1

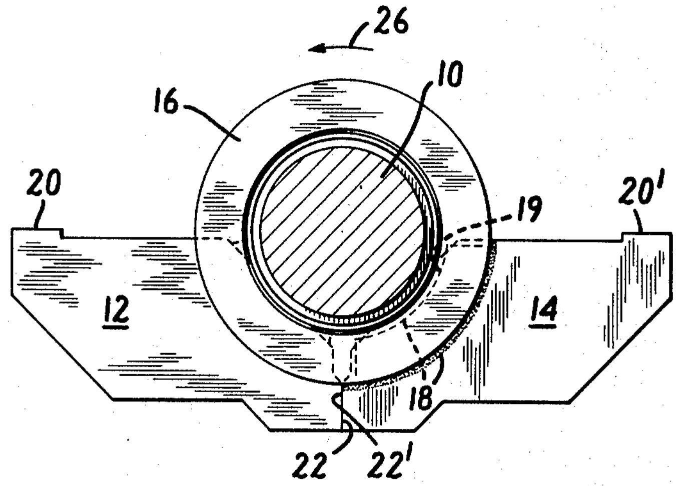


FIG. 2

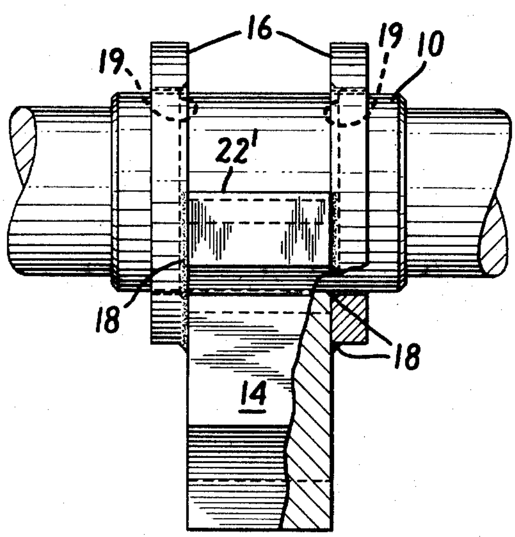


FIG. 3

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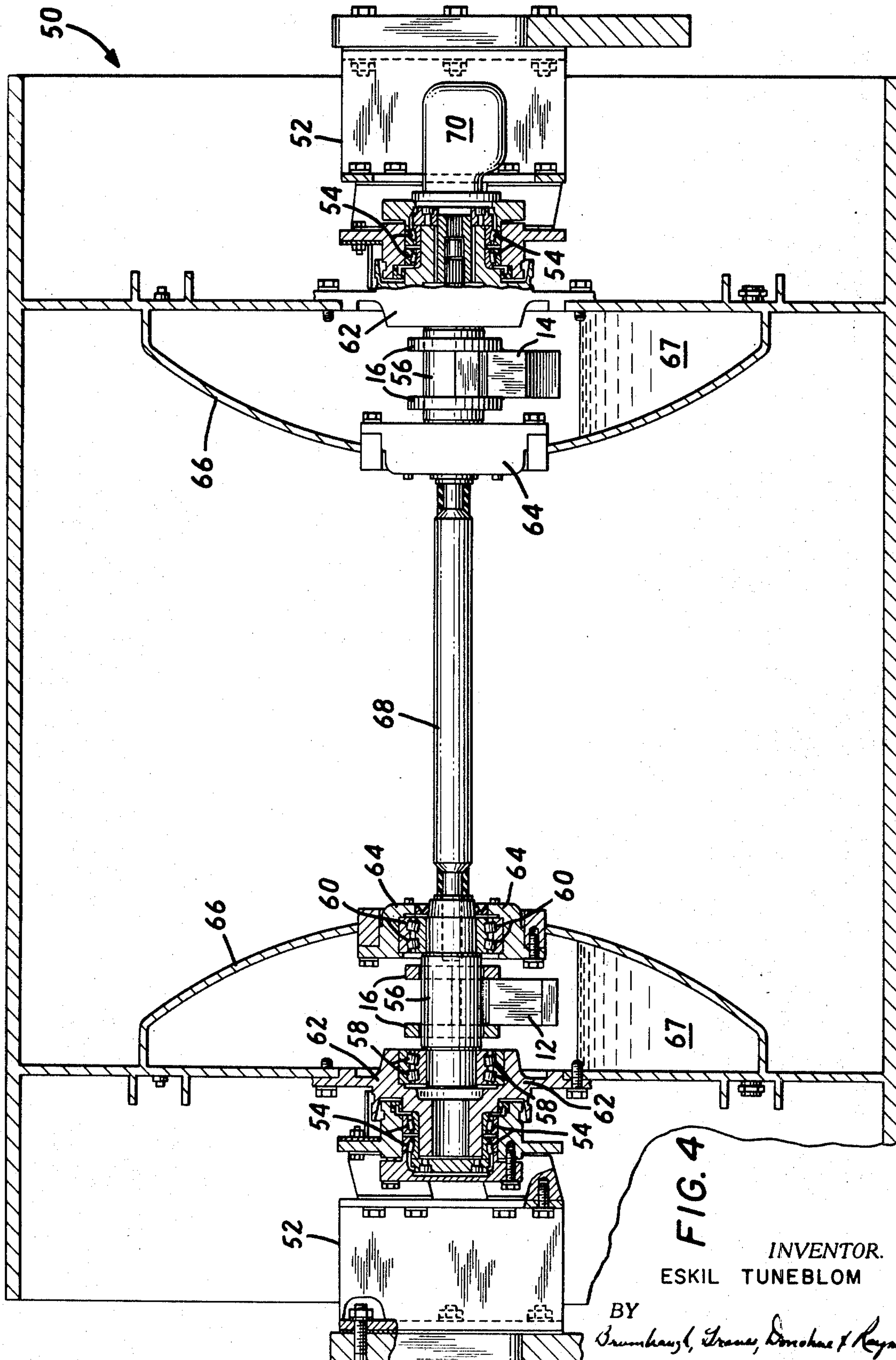

FIG. 4

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DUAL AMPLITUDE VIBRATION GENERATOR

BACKGROUND OF THE INVENTION

This invention relates to a mechanism that generates a vibratory motion through rotation of a shaft, and more particularly to a vibratory mechanism that is capable of producing vibrations of more than one amplitude.

There are many types of machines that utilize a vibratory motion to perform their basic operations. These machines include, among many others, soil and stone compactors for road construction, grinding mills for mineral comminution and shaker screens for separating and sizing particles. It is well known that the use of an eccentric weight in conjunction with a rotating shaft mounted in such a machine will provide the vibratory motion that is needed to enable the machine to function effectively.

However, in most of these machines the vibratory motion is normally limited to a single amplitude. This is disadvantageous in that the conditions under which the machines must operate often change, and a machine that has vibratory motion limited to one amplitude many times cannot perform in the most effective manner and can only be used under one set of operating conditions.

Road construction is one area in which it is economically important to use machines that are capable of vibrating at more than one amplitude. Compactors with rollers producing high amplitude vibrations have been used on earth and granular base materials, the so-called thick lift materials. It is also advantageous to use vibrating rollers to compact bituminous paving mixtures and other thin lift materials to provide substantial savings in construction costs and a road surface of a higher quality, when compared to static rollers which do not vibrate.

However, when working on the thin lift materials, vibrations of a relatively low amplitude produced at a high rotational frequency are needed to avoid a "-bounce back" effect, which causes ripples to form on the surface of bituminous materials such as asphalt and a high degree of surface dispersion in materials such as soil cement. For the thick lift materials, though, a higher amplitude is needed so that the pressure waves caused by the roller will penetrate the material and effectively compact it to the proper density. Thus, ideally a compactor for road construction should have a roller that is capable of vibrating at different amplitudes, so that a single machine is provided with the versatility to compact both the thin lift and thick lift materials. This type of compactor would result in significant economic savings by eliminating the need for a separate machine for each operation.

In known machines, the amplitude of the vibratory motion produced by an eccentric weight can be changed, but this normally requires dismantling at least a portion of the machine and replacing the existing weight with another one having a different center of gravity. In one road roller machine known to the art, an eccentric weight has a number of cavities in which weights can be inserted or removed for changing the center of gravity of the eccentric weight, thereby varying the amplitude of vibration. However, although that machine did not have to be dismantled to change the amplitude of vibration, a mechanical adjustment did have to be made which is time consuming, especially when operating under less than ideal weather conditions.

SUMMARY OF THE INVENTION

There is provided, in accordance with the invention, a mechanism which transmits a vibratory motion through a shaft to a machine, with the mechanism being capable of producing a vibration having a different amplitude, simply by reversing the rotation of the shaft. The mechanism has special applicability with regard to road compacting machines and will be described in conjunction with one, but the mechanism can be effectively used in other vibrating machines.

More specifically, the dual amplitude vibratory mechanism has a shaft on which is mounted a pair of eccentric weights. One of the weights is attached to the shaft and, therefore, rotatable with it. The other weight is mounted on the shaft, for example by means of a pair of rings through which the shaft is passed, so that the weight is freely rotatable relative to it.

Each weight has a pair of contact surfaces, located on opposite sides of the weight relative to its rotational path, that cooperate with similarly placed surfaces on the other weight. The cooperating surfaces are located relative to each other in such a way that when the shaft rotates, the fixed weight revolves and one of its surfaces engages one of the cooperating surfaces on the free weight, thereby causing both weights to revolve as a single composite eccentric weight. When rotation of the shaft is reversed, the fixed weight rotates with the shaft causing the contact surfaces mentioned above to move out of engagement, the fixed weight revolving independently of the free weight through part of a revolution until the other contact surface engages its cooperating surface on the free weight which, in turn, causes the weights to revolve with the shaft as a single composite eccentric weight in the reverse direction.

The weights are shaped and dimensioned such that when one pair of contact surfaces engage each other, the composite eccentric weight formed by the weights has a center of gravity relative to the shaft that is different from the center of gravity of the weights when the other pair of contact surfaces engage each other. Thus, when the shaft rotates in one direction, the revolving eccentric weights generate vibrations that have an amplitude that is different from the vibration amplitude generated when the weights revolve in the reverse direction.

Each end of the shaft is journaled in a machine, such as, for example, a road compactor, and the vibrations are transmitted through the shaft to the machine. A reversible motor attached to the shaft enables its rotation in either direction for selectively changing the amplitude of vibration.

Thus, there is provided in accordance with the invention a dual amplitude vibratory mechanism which is advantageous because the amplitude of vibration of a machine can be changed without having to dismantle the machine and replace an eccentric weight, and even without the need to make a mechanical adjustment on the machine. The change in amplitude can be accomplished simply by reversing the direction of rotation of the shaft on which the eccentric weights are mounted, which is an essential characteristic in affording a machine such as a road compactor great versatility. A machine in which the inventive mechanism has been installed can be used to perform operations that heretofore could only be done economically by more than one machine, thereby eliminating the need to purchase an extra machine.

DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention, reference may be had to the following description of the preferred embodiment, taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a front elevational view of a pair of eccentric weights mounted on a shaft, with a pair of cooperating contact surfaces engaging each other so that the weights form a composite eccentric weight that has a center of gravity which will cause a vibratory motion of a relatively high amplitude;

FIG. **2** is a front elevational view of the weights and shaft shown in FIG. **1**, but with the other pair of cooperating contact surfaces in engagement so that the composite eccentric weight has a center of gravity different from that in FIG. **1** for producing a vibration of a relatively low amplitude;

FIG. **3** is a side elevational view of the eccentric weights shown in their position in FIG. **1**, with a portion of the freely rotatable weight being broken-away to show its attachment to mounting rings;

FIG. **4** is a front sectional view of the roller of a vibratory road compactor in which eccentric weights of the type shown in FIGS. **1–3** have been installed.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to FIGS. **1** and **2**, the dual amplitude vibratory mechanism is shown as having a shaft **10** on which is mounted a pair of eccentric weights **12** and **14**. The shaft **10** can be of any suitable size and shape, depending on the type of machine in which it is to be used. A reversible motor, not shown, is connected to the shaft **10** so that it can be selectively rotated in opposite directions.

The weight **12** is attached to the shaft **10** and, therefore, rotatable with it. In FIGS. **1** and **2**, the weight **12** as shown is welded to the shaft **10**, but any effective means of attachment can be used. The weight **14** is mounted on the shaft **10** in a way that enables it to be freely rotatable relative to the shaft **10**, and to the weight **12** through at least a portion of one revolution. As best shown in FIG. **3**, this can be accomplished by attaching the weight **14** to a pair of rings **16** that are mounted on but not attached to the shaft **10**, on each side of the weight **12**. The weight **14** is preferably welded to the rings **16**, along both its inner and outer edges as shown by the reference numeral **18** in the broken-away portion of FIG. **3**, but as with the weight **12** any suitable means of attachment can be used. A groove **19** is formed along the inner edge of the rings **16** so that the inner weld **18** will not interfere with the free rotational movement of the weight **14** relative to the shaft **10** or the fixed weight **12**. Moreover, by arranging the rings **16** on each side of the fixed weight **12**, the weight **14** is prevented from moving axially along the shaft **10**.

The weight **12** has two contact surfaces **20** and **22** located on opposite sides relative to its rotational path, the surfaces **20** and **22** cooperating with similarly located contact surfaces **20'** and **22'** on the weight **14**.

The weights **12** and **14** are preferably identical in shape, weight and size, although this is not essential, and together they form a single composite eccentric weight. When the contact surfaces **20** and **20'** abut each other as shown in FIG. **1**, the center of gravity of the composite weight is lower relative to the shaft **10**, when compared to the composite weight shown in FIG. **2**, where the contact surfaces **22** and **22'** are shown abutting each other. This is accomplished by the generally rectangular shape of the weights **12** and **14** and their different combined weight distribution when the different pairs of contact surfaces abut each other.

When the shaft **10** turns in the direction indicated by the arrow **24**, as shown in FIG. **1**, the fixed weight **12** rotates with the shaft **10**, and the contact surface **20** engages the contact surface **20'** of the freely rotatable weight **14** so that both the weights **12** and **14** will revolve as a single composite eccentric weight. Such rotation results in the generation of relatively high amplitude vibrations which are transmitted through the shaft **10** to the machine (not shown) in which the shaft **10** is mounted.

To generate vibrations of a lower amplitude, the rotational direction of the shaft **10** is reversed, as indicated by the arrow **26** shown in FIG. **2**. The fixed weight **12** then rotates with the shaft **10** and the contact surface **20** disengages from the contact surface **20'**. The weight **12** revolves independently of the weight **14** until the contact surface **22** engages the contact surface **22'**, which results in the weights **12** and **14** revolving together in this latter direction as the single composite eccentric weight shown in FIG. **2**. The combined weights **12** and **14** now have a center of gravity higher relative to the shaft **10** than when the weights **12** and **14** are combined as shown in FIG. **1**, thereby imparting vibrations of lesser amplitude through the shaft **10** to the machine. In this manner the vibration amplitude of the machine in which the shaft **10** is mounted can be changed simply by reversing the direction of shaft rotation.

As shown in FIGS. **1** and **2**, the contact surfaces **20**, **20'**, **22** and **22'** do not extend the entire length of the side of the respective weights **12** and **14** on which they are located in order to prevent contact of the weights immediately adjacent to the shaft.

Alternatively, double-amplitude vibration as described above can be obtained by mounting the weights **12** and **14** on the shaft **10** in such a way that they are both freely rotatable relative to it, with the reversible motor being connected to one of the weights for revolving them as described above. Moreover, the weights **12** and **14** can be formed of different sizes and shapes and mounted on the shaft **10** relative to each other in various ways, and be within the scope of the invention.

Now, referring to FIG. **4**, one application of the invention is shown where two sets of the eccentric weights **12** and **14** are mounted in a roller **50** of a self-propelled vibratory road compactor. The roller **50** is journaled in a frame **52** of the compactor by means of bearings **54** so that the roller **50** can be rolled along the surface of the roadway at a suitable speed. For imparting a vibratory motion to the roller **50**, each set of eccentric weights **12** and **14** is mounted, as described above, on shaft sections **56** which are journaled in the roller **50** by means of bearings **58** and **60** that are positioned in outer and inner bearing housings **62** and **64**, respectively. Each of the inner bearing housings **62** forms a part of an oil reservoir **66** which is integral with a side wall of the roller **50** and projects inwardly from it, the reservoir **66** containing oil **67** for "oil bath" lubrication of the bearings **58** and **60**.

A drive shaft **68** is splined to each of the shaft sections **56** so that the hydraulic motor **70**, which is coupled to an end of one of the shaft sections **56**, will drive both sets of the eccentric weights **12** and **14**. The motor **70** is reversible, with the hydraulic system to which it is connected having a two-way directional valve (not shown) so that the shafts **56** can be rotated in either direction for vibrating the roller **50** at different amplitudes merely by adjusting the valve.

Although many other configurations of component parts can be provided, the shaft sections **56** are preferable because four sets of bearings, **58** and **60** (two on each of the shafts **56**), carry the load of the weights **12** and **14** and shaft bending is reduced to a minimum. This is important because of the high speed at which the shafts **56** are rotated.

Thus, there is provided in accordance with the invention a dual amplitude vibratory mechanism which can be used effectively in conjunction with machines that employ eccentric weights to produce a vibratory motion, and which can impart a vibratory motion of a different amplitude to the machine by simply reversing the rotation of the shaft on which eccentric weights are mounted. The embodiment of the invention described above is intended to be merely exemplary, and those skilled in the art will be able to make modifications and variations without departing from the spirit and scope of the appended claims, and all such modifications and variations are contemplated as being within the scope of the claims.

I claim:

1. A dual amplitude vibration generator comprising a shaft, first and second eccentric weights, first mounting means attaching the first weight to the shaft so that it is rotatable with the shaft, second mounting means rotatably mounting the second weight on the shaft so that it is rotatable relative to the first weight through at least a portion of one revolution, the second mounting means including a pair of mounting rings to which the second weight is attached, the shaft passing through the rings and one of the rings being disposed on either side of the first weight for preventing the second weight from moving axially along the shaft, and drive means for selectively rotating said first weight in opposite directions, the drive means including a coupling to the shaft, a pair of contact surfaces on each of said weights, one contact surface on the first weight cooperating with and engaging one contact surface on the second weight when said first weight is rotated by the drive means in one direction to rotate both the weights in said one direction, said two weights when rotating in said one direction forming a first composite eccentric weight having a center of gravity at a first distance from the shaft, and the other contact surface on the first weight cooperating with and engaging the other contact surface on the second weight when said first weight is rotated by the drive means in the opposite direction to rotate both the weights in said opposite direction, said two weights when rotating in said opposite direction forming a second composite eccentric weight having a center of gravity at a second distance from the shaft, whereby the amplitude of vibrations generated by rotation of the composite weights can be changed by reversing the direction of rotation of said first weight.

2. In a vibratory compactor of the type that has a roller journaled in a housing, the roller engaging and rolling along a surface to be compacted a shaft mounted in the roller, an eccentric weight means mounted on the shaft, and means for rotating the weight so that a vibratory motion is imparted through the shaft to the roller, the improvement comprising said shaft, said weight means comprising first and second eccentric weights, first mounting means attaching the first weight to the shaft so that it is rotatable with the shaft, second mounting means rotatably mounting the second weight on the shaft so that it is rotatable relative to the first weight through at least a portion of one revolution, the second mounting means including a pair of mounting rings to which the second weight is attached, the shaft passing through the rings and one of the rings being disposed on either side of the first weight for preventing the second weight from moving axially along the shaft, and drive means for selectively rotating said first weight in opposite directions, the drive means including a coupling to the shaft, a pair of contact surfaces on each of said weights, one contact surface on the first weight cooperating with and engaging one contact surface on the second weight when said first weight is rotated by the drive means in one direction to rotate both the weights in said one direction, said two weights when rotating in said one direction forming a first composite eccentric weight having a center of gravity at a first distance from the shaft, and the other contact surface on the first weight cooperating with and engaging the other contact surface on the second weight when said first weight is rotated by the drive means in the opposite direction to rotate both the weights in said opposite direction, said two weights when rotating in said opposite direction forming a second composite eccentric weight having a center of gravity at a second distance from the shaft, whereby the amplitude of vibrations generated by rotation of the composite weights can be changed by reversing the direction of rotation of said first weight.

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