

May 22, 1962

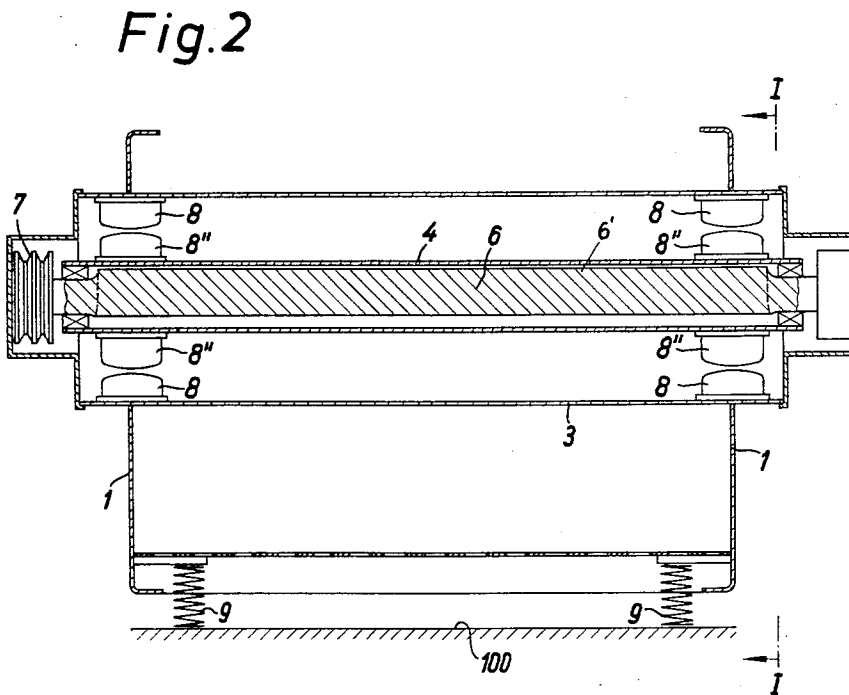
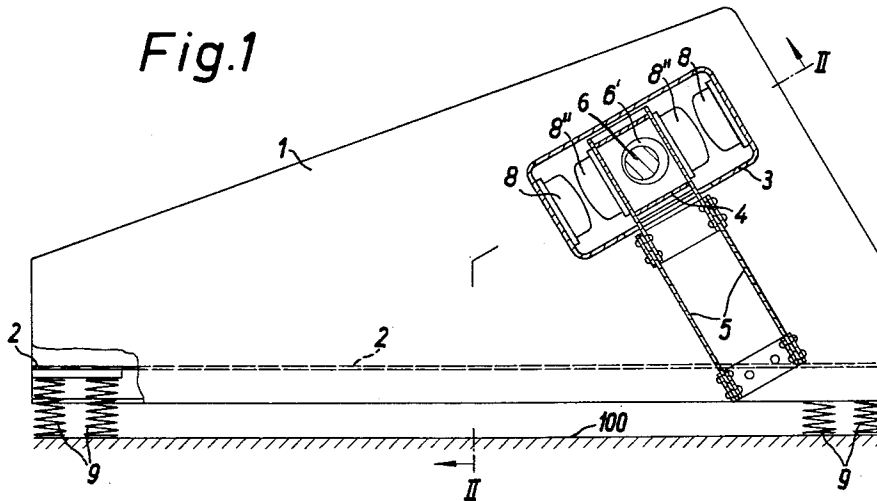
J. E. BRÜDERLEIN ET AL

3,035,699

RESONANT OSCILLATORY APPARATUS

Filed April 20, 1959

3 Sheets-Sheet 1



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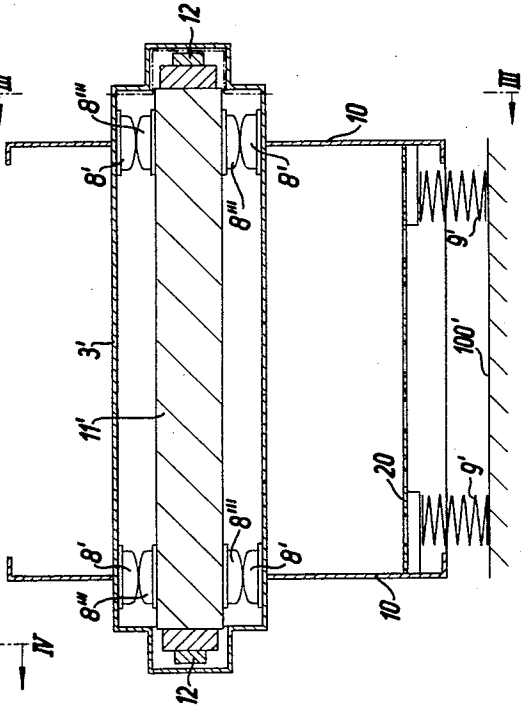
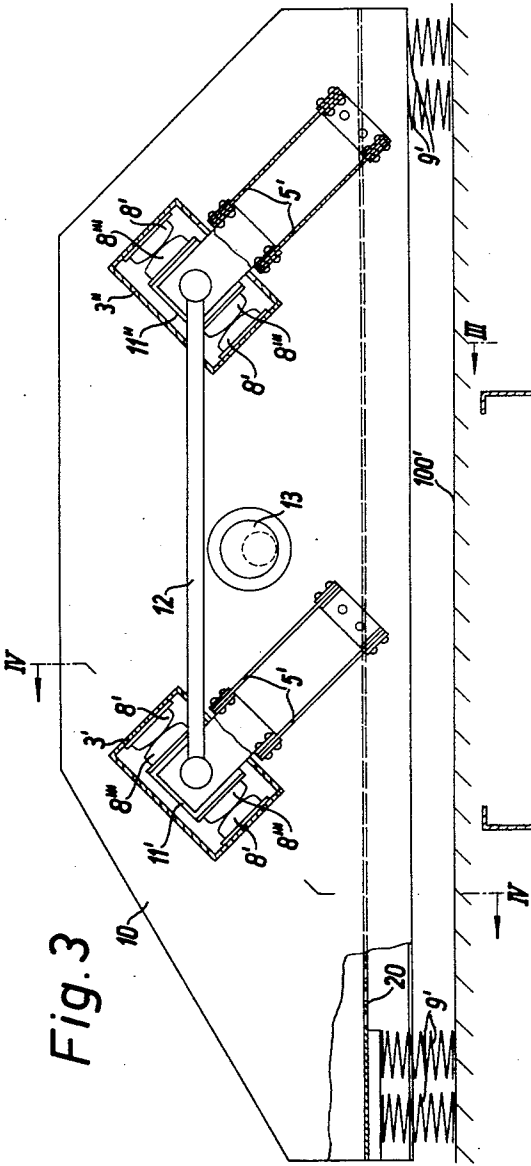
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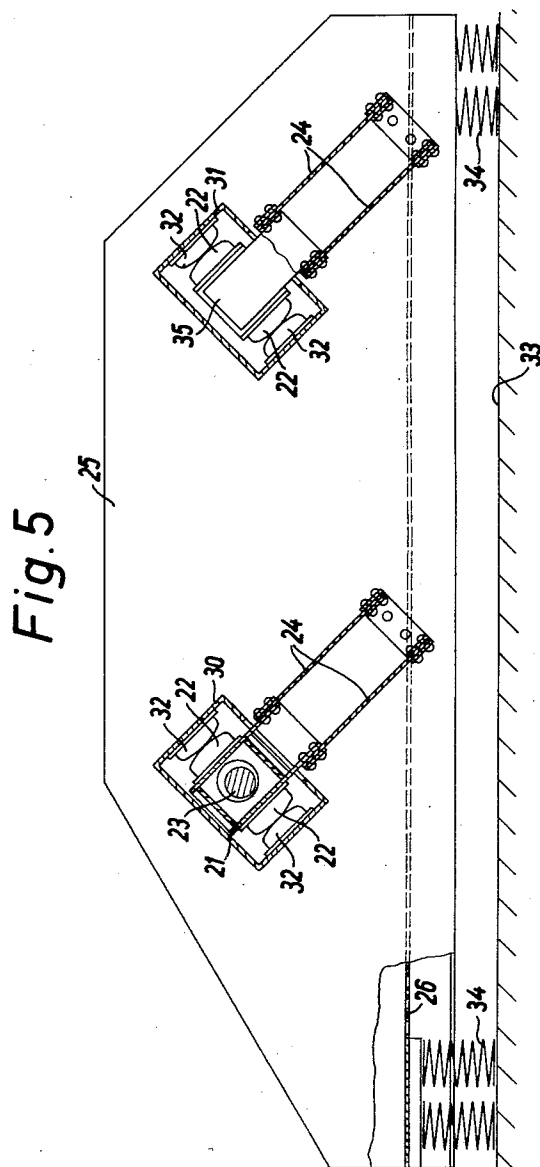
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RESONANT OSCILLATORY APPARATUS

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Filed Apr. 20, 1959, Ser. No. 807,522

Claims priority, application Germany Apr. 24, 1958
13 Claims. (Cl. 209—339)

The present invention relates to resonant oscillatory apparatus and, more particularly, to a vibrating screen device comprising two masses oscillating in opposite directions, said masses being connected to one another by means of springs and being energized by unbalanced forces.

Oscillating apparatus of this kind have been known as so-called vibrating conveyors. In these devices, the ratio of the operating oscillating mass to the counter-oscillating mass is selected to be between 2:1 and 3:1.

It is an object of the present invention to improve the design of these known oscillating apparatus, such as vibrating screens in such a manner, that the entire apparatus will become substantially lighter and less expensive than the known resonant vibrating screens having a counter-oscillating mass which is three to four times heavier than the operating mass or screening box. The term "operating mass," as used throughout the instant specification and claims, will thus be understood to refer to the working mass, namely, the screen box which carries out the oscillations to which the material being screened is subjected, whereas the term "counter-oscillating mass" refers to the mass which carries out oscillations opposed to those carried out by the "operating mass."

It is another object of the invention to provide the counter-oscillating mass in the interior of a hollow transverse member serving to reinforce the rectangular frame structure of the operating oscillating mass or screening box by connecting its side walls.

It is another object of the invention to avoid bending stresses in the hollow transverse member and in the side walls of the operating oscillating body, due to the connecting springs, by providing the latter in such a manner, that their lines of symmetry lie in the planes of the side walls of the oscillating body or vibrating screen.

It is a further object of the invention to operatively connect the counter-oscillating mass with the operating oscillating mass, suitably being two to three times heavier, by means of springs, whereby the counter-oscillating mass includes a rotatable unbalanced weight suitably energized by a motor. In such apparatus, linear oscillations rather than circular oscillations are obtained, because the counter-oscillating mass can be displaced with respect to the heavier operating oscillating mass only transversely with respect to the direction of the springs rather than in their direction.

The operating oscillating frequency is suitably selected in the order between 800 to 3,000 oscillations per minute, whereby in spite of the relatively small amplitude of the operating oscillating mass accelerations of a magnitude large enough for the screening operation are obtained, the lighter counter-oscillating mass having the larger amplitudes.

The size of the device according to the invention is limited if only one counter-oscillating mass is provided in a single hollow transverse member, because a larger operating oscillating mass requires a correspondingly larger counter-oscillating mass and the latter, in turn, requires heavier springs, the design, arrangement and operation of which is difficult in case of larger dimensions.

It is an additional object of the invention to provide a

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counter-oscillating mass in each of several similar or like hollow transverse members, said counter-oscillating masses being energized by the operating oscillating mass via respective springs. In order to avoid in this case pitching motions of the operating oscillating mass, the various hollow transverse members with the respective counter-oscillating masses are suitably arranged and designed in such a manner, that the resultant of the forces of all of the counter-oscillating masses intersects the center of gravity of the operating oscillating mass.

In the apparatus hereinafter described, only one of the counter-oscillating masses is directly energized by a suitable motor, i.e., the remaining counter-oscillating masses are energized by the operating oscillating mass, so that the remaining masses oscillate in a phase opposite to that of this operating mass and, therefore, oscillate in phase with the first or directly driven counter-oscillating mass. In order to prevent a possible occurrence of phase shifts in case of inaccuracies in the adjustment or load distribution, the several counter-oscillating masses are suitably rigidly interconnected in the oscillating direction by means of coupling rods.

It is further possible to provide energization of the system by unbalanced forces in such a manner than an unbalanced weight acts directly on the vibrating screening box rather than on the counter-oscillating mass.

Still further objects and the entire scope of applicability of the present invention will become apparent from the detailed description given hereinafter; it should be understood, however, that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

In the drawings:

FIGURE 1 illustrates a cross section through a resonant vibrating screen apparatus according to the present invention taken along the line I—I of FIGURE 2 and looking in the direction of the arrows.

FIGURE 2 is a longitudinal section through the apparatus of FIGURE 1 along the line II—II and looking in the direction of the arrows;

FIGURE 3 shows another embodiment of a resonant vibrating screen apparatus according to the invention in cross section taken along the line III—III of FIGURE 4 and looking in the direction of the arrows.

FIGURE 4 is a longitudinal section through the apparatus of FIGURE 3 along the line IV—IV and looking in the direction of the arrows.

FIGURE 5 discloses a resonant vibrating system, wherein one of the counter-oscillating masses is directly driven and the remaining counter-oscillating masses are actuated by the operating mass of the system.

In the first embodiment of the invention, shown in FIGURES 1 and 2, a vibrating screening box comprises two substantially triangular side walls 1, between which a screen 2 is mounted as a bottom piece, and between which a hollow member 3 supporting buffer elements 8 and of substantially rectangular cross section is secured so as to join the two side walls 1 and to reinforce them with respect to one another. The member 3 extends through rectangular cutouts provided in the side walls 1 and is welded or otherwise secured thereto at these cutouts. The side walls 1, screen member 2 and hollow member 3 together with its associated buffer elements 8 constitute what is hereinafter referred to as the operating mass. Another hollow member 4 of substantially square cross section is provided within the first hollow and rectangular member 3 and is connected to the side walls 1 of the screening box by means of leaf springs 5 attached to the outer sides of the walls 1 of this screening box. This

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hollow square-shaped member 4 encloses a shaft 6 rotatably mounted therein, the shaft having an imbalance portion 6' so that the shaft as a whole is designed as an eccentric unbalanced mass which forms together with this member 4, a pulley 7 and buffer elements 8'' the counter-oscillating mass. The shaft 6 is driven by means of an electromotor (not shown) via a V-belt pulley 7 mounted on one end of this shaft 6. The oscillations produced thereby are transmitted as linear oscillations to each of the side walls 1 of the screening box by means of two pairs of juxtapositioned members 8 and 8'' in the form of buffers made of elastic material, such as rubber, each pair being disposed in the chambers to both sides of the centrally arranged hollow square member 4 within the hollow rectangular member 3 in such a manner, that the lines of symmetry through these buffer springs 8 and 8'' pass through the planes of the side walls 1 of the screening box. The entire apparatus is supported on the ground 100 by means of helical springs 9 serving to dampen the oscillations or vibrations.

In the second embodiment of the present invention, illustrated in the FIGURES 3 and 4, a screening box comprises two substantially trapezoid side walls 10, a screen 20, inserted therebetween as a bottom, and two hollow transverse members 3' and 3'' of rectangular cross section also interconnecting the two side walls 10 and reinforcing the same in principally the same manner as in the embodiment of FIGURES 1 and 2.

A counter-oscillating mass or body 11' and 11'' is provided within each of these hollow rectangular transverse members 3' and 3'', said counter-oscillating masses having a substantially square-shaped solid cross section and being connected to the two side walls 10 of the screening box by means of leaf springs 5' secured to the outer sides of these walls 10. Pairs of springs or buffers in the form of resilient or rubber pieces 8' and 8''' are provided between the operating mass and each counter-oscillating mass in the direction of relative displacement of the two masses permitted due to this design, whereby these pairs of buffers 8' and 8''' are arranged between each hollow rectangular member 3' and 3'' and the respective inner square-shaped members 11' and 11'', similarly to the arrangement of the members 3 and 4 in FIGURES 1 and 2. These two square-shaped members 11' and 11'', constituting the counter-oscillating masses, are rigidly interconnected by means of coupling bars 12 mounted on their two ends. The entire apparatus is supported on the ground 100' by means of helical springs 9' to dampen the vibrations.

An eccentric of unbalanced rotating weight 13 acts directly on each of the side walls 1 of the screening box. The displacements or vibrations of the side walls 1 energized thereby are transmitted to the counter-oscillating masses 11' and 11'' by means of the buffers 8', whereby, due to the rigid connection by means of the coupling bars 12, the counter-oscillating masses, i.e., the square-shaped members 11' and 11'', carry out linear oscillations in the same phase, which is displaced 180° with respect to that of the operating oscillating mass, i.e., the screening box.

In FIGURE 5, a further modification of a resonant oscillatory system is shown, wherein at least two counter-oscillating masses are provided. The counter-oscillating mass appearing on the left-hand side of the drawing is similar in construction to the counter-oscillating mass previously described with reference to FIGURES 1 and 2 and is provided with a substantially square-shaped hollow member 21 which supports the buffer elements 22. Interiorly of the hollow member 21, there is disposed a rotatable shaft 23 which is constructed in the form of an eccentric unbalanced mass and is driven by a suitable electric motor (not shown). This counter-oscillating mass is secured by means of the spring members 24 to the operating mass, the latter of which is defined by the side walls 25, screen 26 and a pair of substantially rec-

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tangular hollow members 30 and 31 provided with buffer elements 32. The entire system is supported on the ground 33 and dampened by means of the helical springs 34. As a result of the oscillatory motion of the operating mass, the remaining counter-oscillating mass 35 is actuated. The counter-oscillating mass 35 appearing at the right-hand side of the system disclosed in FIGURE 5 is similar in construction to the counter-oscillating mass described in FIGURES 3 and 4, and is secured by means of springs 24 to the side walls 25 of the screening device. The counter-oscillating mass 35 which is actuated by the operating mass will thus be out of phase with the operating mass and in phase with the motor-actuated counter-oscillating mass.

We claim:

1. A resonant oscillatory apparatus comprising a frame structure to be vibrated, said structure being resiliently mounted on a relatively stationary base and having side walls spaced with respect to one another, at least one hollow transverse member interconnecting said side walls and reinforcing said structure, a counter-oscillating mass in said hollow transverse member oscillating in the opposite direction to said frame structure, when subjected to vibratory action, said counter-oscillating mass including elastic means in said hollow transverse member between the latter and said counter-oscillating mass for transmitting the oscillations.

2. An apparatus according to claim 1, wherein said elastic means are arranged in said hollow transverse member with respect to said side walls in such a manner that the lines of symmetry through said elastic means pass in the respective planes of said side walls.

3. An apparatus according to claim 1, wherein spring means are mounted on said frame structure to suspend said counter-oscillating mass in said hollow transverse member.

4. An apparatus according to claim 1, wherein an unbalanced rotating weight is associated with said frame structure to oscillate the same.

5. An apparatus according to claim 4, wherein said unbalanced weight is secured to a shaft rotatably mounted in said frame structure.

6. An apparatus according to claim 1, wherein said frame structure is at least twice as heavy as said counter-oscillating mass.

7. An apparatus according to claim 1, wherein said frame structure is at least three times as heavy as said counter-oscillating mass.

8. An apparatus according to claim 1, wherein a plurality of similar hollow transverse members are provided to interconnect said side walls and wherein a separate counter-oscillating mass is suspended in each of said members, said counter-oscillating mass being adapted to be energized by said frame structure via said elastic means.

9. An apparatus according to claim 8, wherein said counter-oscillating masses are arranged in said hollow transverse members and said hollow transverse members are arranged with respect to said frame structure in such a manner that the resultant of the forces of all of the counter-oscillating masses intersects the center of gravity of said frame structure.

10. An apparatus according to claim 9, wherein means are provided to rigidly interconnect all of said counter-oscillating masses.

11. An apparatus according to claim 10, wherein said rigid interconnecting means comprise separate bars on both sides of said counter-oscillating masses, said bars joining the respective ends of said counter-oscillating masses.

12. An apparatus according to claim 1, wherein said frame structure includes a vibrating screen forming a bottom piece inserted between and secured to said side walls.

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13. A resonant oscillatory apparatus according to claim 1, wherein a plurality of similar hollow transverse members are provided to interconnect said side walls, a separate counter-oscillating mass in registry with each of said hollow transverse members, drive means for at least one of said counter-oscillating masses for imparting vibrational motion thereto, the remaining counter-oscillating masses being actuated in response to vibrations of said frame structure by said drive means.

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