March 15, 1966 K. M. ALLEN ETAL 3,240,322

ECCENTRIC PULLEY DRIVES

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FIG. 1

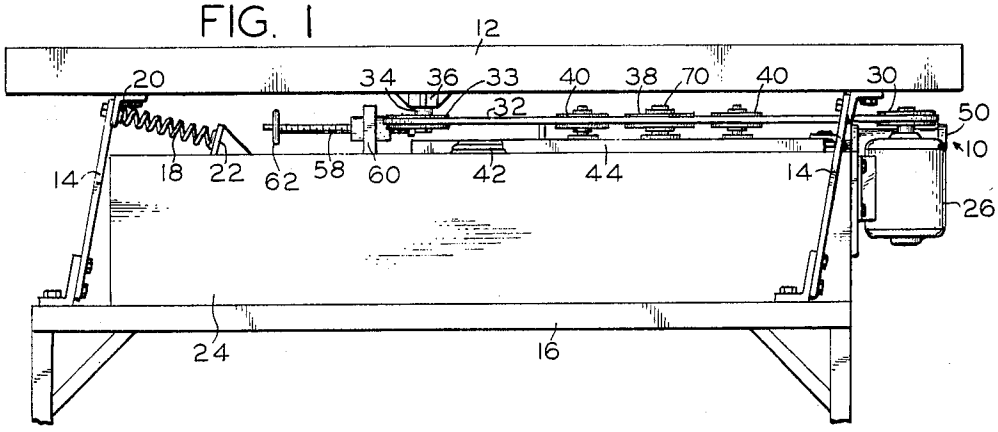


FIG. 2

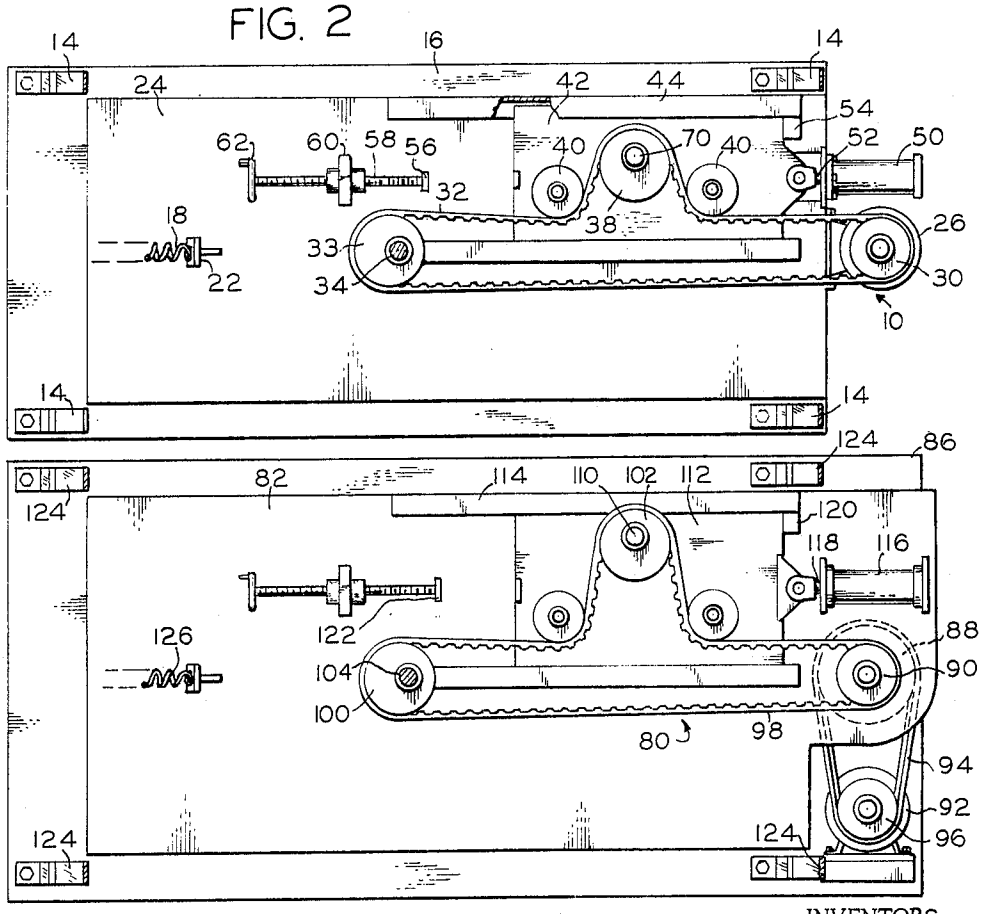


FIG. 4

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FIG. 3

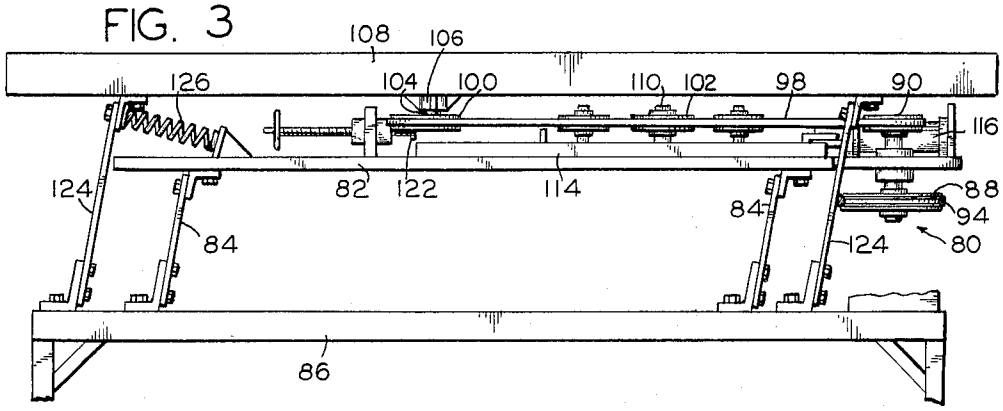


FIG. 5

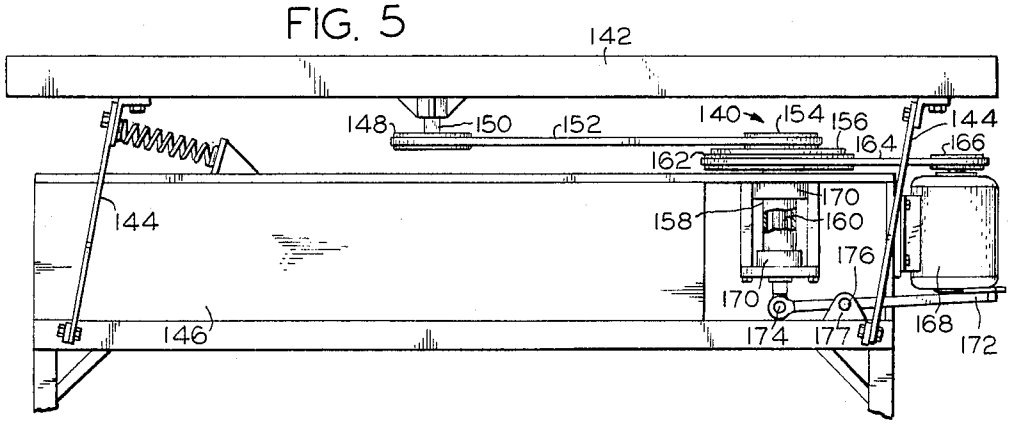
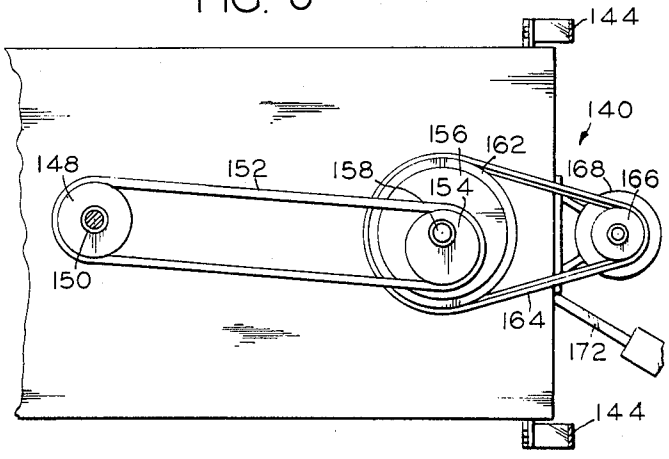


FIG. 6



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ECCENTRIC PULLEY DRIVES

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This invention relates to eccentric pulley drives, and more particularly to adjustable eccentric pulley drives for vibrator conveyors.

An object of the invention is to provide eccentric pulley drives.

Another object of the invention is to provide eccentric pulley drives for vibrator conveyors.

A further object of the invention is to provide adjustable eccentric pulley drives for vibrator conveyors adjustable between no movement of the conveyors and maximum movement of the conveyors.

Yet another object of the invention is to provide an eccentric pulley drive for a vibrator conveyor in which the drive damps vibrations from a conveyor bed of the conveyor to a base thereof.

Still another object of the invention is to provide an eccentric pulley drive having a simple, rugged clutch mechanism.

The invention provides eccentric pulley drives each having a pair of pulleys of which at least one pulley is eccentrically mounted. The pulleys are drivingly connected by a belt, and one of the pulleys is driven and is mounted on a fixed axis of rotation and the other pulley is mounted on a movable axis and is driven by the belt and drivingly coupled to a member to be moved back and forth. In an eccentric pulley drive forming one specific embodiment of the invention, a toothed centric pulley mounted on a base of a conveyor is driven to drive a toothed belt which travels around a first toothed eccentric pulley mounted on a conveyor bed movable relative to the base, and the effective distance between the pulleys is varied by a second toothed eccentric pulley of the same size as that of the first toothed eccentric pulley which is mounted on a slide adjustable along a guideway to vary the phase relationship between the eccentric pulleys. In an eccentric pulley drive forming an alternate embodiment of the invention, a conveyor bed and a frame are mounted by separate, resilient mounting systems on a base and are urged in opposite directions with an adjustable, eccentric pulley drive device mounted on the frame, except for a driven pulley which is mounted on the conveyor bed, so that the frame tends to damp out vibrations which otherwise would be imparted to the base. In an eccentric pulley drive forming another embodiment of the invention, an eccentric driven pulley carried by a movable conveyor bed is selectively driven by a drive pulley mounted on a shaft movable by an actuator between a drive position holding a clutch plate keyed to the shaft in engagement with a continuously driven flywheel and a rest position in which the clutch plate and the flywheel are disengaged.

A complete understanding of the invention may be obtained from the following detailed description of eccentric pulley drives forming specific embodiments thereof, when read in conjunction with the appended drawings, in which:

FIG. 1 is a fragmentary, side elevation view of an eccentric pulley drive forming one embodiment of the invention;

FIG. 2 is a horizontal sectional view of the eccentric pulley drive of FIG. 1;

FIG. 3 is a fragmentary, side elevation view of an eccentric pulley drive forming an alternate embodiment of the invention;

FIG. 4 is a horizontal sectional view of the eccentric pulley drive of FIG. 3;

FIG. 5 is a fragmentary, side elevation view of an eccentric pulley drive forming an alternate embodiment of the invention; and

FIG. 6 is a horizontal section view of the eccentric pulley drive of FIG. 5.

Referring now in detail to FIGS. 1 and 2 of the drawings, an eccentric pulley drive 10 serves to vibrate a conveyor trough or bed 12 mounted by resilient struts 14 on a base 16. The trough 12, struts and base form a parallelogram permitting oscillation of the trough relative to the base to the right and left, as viewed in FIG. 1, but preventing any substantial horizontal movement of the trough that is transverse to the trough. Movement of the trough downwardly and to the right as viewed in FIG. 1 is resisted by a compression spring 18 seated between brackets 20 and 22 fixed respectively to the bottom of the conveyor trough and the top of a mounting frame 24 fixed to the base. The drive 10 includes an electric motor 26 fixed to the frame and driving a toothed, centric drive pulley 30, a toothed or timer belt 32, a toothed, eccentric driven pulley 33 carried by shaft 34 journaled in bearing 36 fixed to the bottom of the conveyor trough and a toothed, eccentric pulley 38. The pulley 38 and guide or pinch rollers 40 are mounted on slide 42. The rollers 40 are so spaced as to cause the belt to engage about one-half of the periphery of the pulley 38. The diameters or sizes of the pulleys 33 and 38 are equal and the eccentricities of the pulleys 33 and 38 also are equal.

The slide 42 is mounted in a guideway 44 on the frame 24 and extends parallel to the plane defined by the axes of rotation of the pulleys 30 and 33. A fluid pressure cylinder 50 fixed to the frame 24 is adapted through a piston member 52 to hold the slide 42 either in a stop position abutting fixed stop 54 or a drive position abutting adjustable stop 56. The stop 56 is carried by adjustment screw 58 threaded through internally threaded mounting member 60 fixed to the frame 24. A handwheel 62 keyed to the adjustment screw may be turned manually to move the stop 56 toward or away from the fixed stop 54 to vary the position of the slide when the slide is held against the stop 56 by the cylinder 50. When the slide is held against the stop 54, the eccentric pulley 38 is out of phase with the eccentric pulley 33, and when the slide is held against the stop 56, the pulley 38 is at least partially in phase with the pulley 33 to an extent determined by the position of adjustment of the adjustment screw 58 relative to the mounting member 60. The screw 58 provides an infinitely variable adjustment of the phase relationship of the pulleys 33 and 38 between a condition in which the revolutions of the pulleys are almost 180° out of phase and a condition in which the revolutions of the pulleys 33 and 38 are fully in phase. When the pulleys 33 are 180° out of the phase, the low side of the pulley 38 extends directly up, as viewed in FIG. 2, from shaft 70 mounting the pulley 38 whenever the high side of the pulley 33 extends directly to the left of the shaft 34 When the pulleys 33 and 38 are fully in phase, the high side of the pulley 38 extends directly up from the shaft 70 whenever the high side of the pulley 33 extends directly to the left of the shaft 34.

In the operation of the eccentric pulley drive 10 to oscillate the conveyor trough 12, the motor 26 is energized to drive the pulley 30, belt 32 and pulleys 33 and 38. Assuming the cylinder 50 has fluid under pressure supplied to its lefthand end, as viewed in FIG. 2, to hold the slide 42 against the fixed stop 54, the revolutions of the eccentric pulleys 33 and 38 are 180° out of phase so that whenever slack is imparted to the belt 32 by the pulley 38, the slack is canceled or taken up by the pulley

33 which is urged continuously to the left by action of the spring 18, and whenever the eccentric pulley 38 takes up more of the belt, the low portion of the eccentric pulley 33 is in engagement with the belt so as to give up the same amount of the belt that is taken up by the pulley 38. Hence, no movement of the shaft 34 and the conveyor trough to the right or left, as viewed in FIGS. 1 and 2, occurs. The drive 10 is in its rest or non-feeding condition at this time.

To cause the conveyor trough 12 to advance material therealong to the left as viewed in FIG. 1, fluid is exhausted from the lefthand end of the cylinder 50 and is supplied under pressure to the righthand end of the cylinder 50 to move the slide 42 to the left into engagement with the stop 56 and hold the slide 42 continuously against the stop 56. The movement of the slide moves the eccentric pulley 38 along the toothed belt 32 to change the phase relationship of the eccentric pulleys 33 and 38 to an extent determined by the setting of the stop 56. Assuming that the stop 56 is in its extreme lefthand position, the pulley 38 is fully in phase with the pulley 33 and the pulley 38 takes up a maximum amount of the belt 32 when the high portion of the pulley 33 extends directly to the left of the shaft 34 At this time the shaft 34 and conveyor trough 12 are in their extreme righthand positions relative to the pulley 30 and base 24. As further rotation of the pulley 30 occurs, the pulley 38 gives up the belt to permit the pulley 33 and the conveyor trough to be moved to the left by the action of the spring 18. Additively, the high portion or lobe of the pulley 33 moves away from its extreme lefthand position to give up a portion of the belt 32 to cause further movement to the left of the conveyor trough and shaft 34 The extreme lefthand positions of the conveyor trough and the shaft 34 occur when the lowest portion of the pulley 38 extends directly upwardly as viewed in FIG 2 and the lowest portion of the pulley 33 extends directly to the left.

To decrease the throw of the conveyor trough 12, the handwheel 62 is turned to move the slide 42 to the right. This moves the pulley 38 to the right to lessen the in phase relationship of the pulleys 33 and 38 so that their throws are only partially additive. Thus, the throw of the conveyor trough can be adjusted from maximum to zero.

An eccentric pulley drive 80 (FIGS. 3 and 4) forming an alternate embodiment of the invention includes a floating frame 82 carried by resilient struts 84 mounted on base 86 and forming a parallelogram with the frame and base. A flywheel 88 and centric pulley 90 aligned therewith and keyed thereto are mounted on the frame and are rotated by a motor 92 mounted on the base and a belt 94 driven by pulley 96 of the motor. The pulley 90 drives toothed or timer belt 98 to revolve eccentric pulleys 100 and 102 respectively mounted on a shaft 104 journaled by bearing 106 fixed to the bottom of conveyor trough or bed 108 and shaft 110 carried by slide 112. The slide 112 is slidable along guideway 114 mounted on the frame 82 by cylinder 116 fixed to the frame 82 and piston member 118 connected to the slide 112. A fixed stop 120 and an adjustable stop 122 limit the extreme positions of the slide 112. Resilient struts 124 mount the conveyor trough 108 for oscillation relative to the base 86, and a compression spring 126 urges the conveyor trough 108 and frame in opposite directions. The struts 84 and 124 are wide relative to the thicknesses thereof and all face in the same direction so that, while permitting oscillation of the trough to the right and left as viewed in FIG. 3, substantial movement of the trough in a horizontal direction transverse to the longitudinal axis of the trough is prevented.

The operation of the conveyor shown in FIGS. 3 and 4 is substantially the same as that of the conveyor of FIGS. 1 and 2 except that, in the conveyor of FIGS. 3 and 4, the entire drive 80, except for motor 92 and pulley 100, is mounted floatingly on the base 86 by the struts 84. This mounting of the drive causes the drive to damp out vibrations which would otherwise be transmitted from the frame 82 to the base 86. Preferably the vibrating system including the frame 82 is caused to have a resonant frequency different from that of the vibrating system including the conveyor trough 108.

An eccentric pulley drive 140 (FIGS. 5 and 6) for a conveyor having a trough or bed 142 mounted by parallel, resilient struts 144 on base 146 includes an untoothed driven centric pulley 148 mounted on shaft 150 carried by the conveyor trough. The pulley 148 is driven by an untoothed belt 152 driven by an untoothed, eccentric, drive pulley 154. The pulley 154 and clutch plate 156 are keyed to and fixed against movement along a drive shaft 160. The drive shaft is journaled for rotation in hollow shaft 158 on which is keyed a flywheel 162 driven by belt 164, pulley 166 and electric motor 168. The hollow shaft 158 is journaled in radial-and-thrust bearings 170 carried by the base 146. When a lever 172 of a manually operable actuator mounted on a fixed pin 176 carried by bracket 177 on the base is pivoted clockwise as viewed in FIG. 5 by an operator of the conveyor, a loose pin connection 174 between the lever and the lower end of the shaft 160 moves the shaft 160, pulley 154 and clutch plate 156 upwardly to move the clutch plate out of engagement with the flywheel 162. This stops the driving of the pulley 154. When the lever 172 is released, gravity moves the shaft 160, pulley 154 and clutch plate 156 downwardly and the clutch plate drivingly engages the flywheel 162. The eccentric drive pulley 154 then drives the pulley 148.

While the above eccentric drives have been illustrated as driving straight conveyor troughs, the drives obviously are well adapted to drive many other devices, such as, for example, helical conveyors, the driven pulley being coupled to the helical conveyor trough in the latter instance to oscillate the trough. Also, while handwheel adjustments of the pulleys 38 and 100 are disclosed herein, it is obvious that other adjusting devices can be used successfully. For example, follow up valves or other types of servo systems may be employed to control the positions of the pulleys 38 and 100. The above described eccentric pulley drives are quiet in operation and are simple, inexpensive and durable in construction.

It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of the invention. Numerous other arrangements may be readily devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. In combination,
a movable member to be driven,
a driven pulley mounted on a movable axis of rotation and drivingly coupled to the movable member,
a drive pulley mounted on a fixed axis of rotation,
and belt means trained about and coupling the drive and driven pulleys,
one of the pulleys being mounted eccentrically on the axis of rotation thereof.

2. In an eccentric pulley drive,
a drive pulley rotated at a uniform rate of speed,
a driven pulley,
a member to be driven mounting the driven pulley eccentrically,
belt means drivingly interconnecting the pulleys, whereby the driven pulley is rotated at a predetermined rate of speed,
and guide means for lengthening and shortening the portion of the path of the belt means between the pulleys in synchronism with said predetermined rate of speed.

3. In combination,
a driven pulley,
a driven member mounting the driven pulley eccentrically,
means mounting the driven member movably,
a drive pulley,

belt means coursing on the pulleys for revolving the driven pulley,
means for rotating the drive pulley at a rate of speed such as to rotate the driven pulley at a predetermined rate of speed,
means urging the driven pulley away from the drive pulley and maintaining the belt means taut,
deflector means for lengthening and shortening the path of the belt means between the pulleys periodically at said predetermined rate of speed,
and means for varying the throw of the deflector means to vary the movement of the driven pulley and driven member.

4. In combination,
a driven member,
a toothed driven pulley having a predetermined diameter and mounted eccentrically on the driven member,
a toothed drive pulley,
a timing belt coursing on the drive and driven pulleys,
means urging the driven member in a direction tending to move the driven pulley away from the drive pulley to maintain the belt in a taut condition,
a third toothed pulley of the same diameter as the driven pulley,
a pair of guide members guiding the belt at least partially around the third pulley,
mounting means mounting the third pulley eccentrically,
and means for moving the mounting means relative to the drive and driven pulleys to adjust the phase relationship between the driven pulley and the third pulley.

5. In combination,
a pair of pulleys,
first mounting means mounting one of the pulleys on a fixed axis of rotation,
second mounting means mounting the other pulley on a second axis of rotation and movable toward and away from said one pulley,
means urging the second mounting means away from the first mounting means,
an endless belt trained about and drivingly connecting the pulleys,
and means for rotating one of the pulleys to drive the other pulley through the belt.

6. In combination,
a pair of toothed pulleys,
first mounting means mounting one of the pulleys on a fixed axis of rotation,
second mounting means mounting the other pulley eccentrically on a second axis of rotation and movable toward and away from said one pulley,
means urging the second mounting means away from the first mounting means,
an endless toothed belt drivingly connecting the pulleys,
and means for rotating one of the pulleys to drive the other pulley through the toothed belt.

7. In combination,
a first toothed pulley mounted for rotation on a centered first axis of rotation,
a second toothed pulley of a predetermined size mounted for rotation on a second axis of rotation eccentric thereto and parallel to the first axis of rotation,
fixed means mounting one of the first and second pulleys,
movable means carrying the other of the first and second toothed pulleys and urged away from said one of the first and second pulleys,
a toothed belt mounted on the pulleys and drivingly interconnecting the pulleys,
a third toothed pulley of said predetermined size mounted for rotation on a third axis of rotation eccentric thereto and positioned laterally from the first and second pulleys,
guide means guiding the belt partially around the third pulley,

means for adjusting the third toothed pulley relative to the first and second toothed pulleys to change the phase relationship between the second and third pulleys,
and means for driving one of the pulleys.

8. In combination,
a first toothed pulley mounted for rotation on a centered first axis of rotation,
means mounting the first toothed pulley on a fixed axis of rotation,
a second toothed pulley of a predetermined size mounted for rotation on a second axis of rotation eccentric thereto and parallel to the first axis of rotation,
movable means carrying the second toothed pulley and urged away from the second toothed pulley,
a toothed belt mounted on the pulleys and drivingly interconnecting the pulleys,
a third toothed pulley of said predetermined size mounted for rotation on a third axis of rotation eccentric thereto and positioned laterally from the first and second pulleys,
guide means guiding the belt partially around the third pulley,
means for adjusting the third toothed pulley relative to the first and second toothed pulleys to change the phase relationship between the second and third pulleys, and
means for driving one of the pulleys.

9. In combination,
base means,
a toothed drive pulley mounted on the base means on a fixed, centered axis of rotation,
means for rotating the drive pulley,
a toothed driven pulley of a predetermined size mounted for movement toward and away from the drive pulley on an axis of rotation eccentric to the driven pulley,
means urging the driven pulley away from the drive pulley,
a slide mounted on the base means for adjustment relative to the drive and driven pulleys,
a third toothed pulley of said predetermined size mounted on the slide on an axis of rotation eccentric of the third pulley,
a toothed belt engaging all the pulleys, and
a pair of guide pulleys guiding the belt around a substantial portion of the third pulley.

10. In a vibrator conveyor,
a fixed base,
a toothed drive pulley mounted on the base on a fixed axis of rotation centered relative to the drive pulley,
a conveyor bed mounted movably on the base,
a toothed driven pulley of a predetermined size movable relative to the base and mounted for rotation on an axis eccentric to the driven pulley,
means drivingly coupling the driven pulley to the conveyor bed,
a toothed belt drivingly connecting the drive and driven pulleys,
a slide mounted slidably on the base,
means for adjusting the slide on the base, and
a third toothed pulley of said predetermined size mounted on the slide on an axis of rotation eccentric thereto and engaging the toothed belt.

11. In a vibrator conveyor,
a conveyor trough,
a base,
a plurality of parallel struts mounting the conveyor trough in a position spaced above the base for reciprocation relative to the base,
a toothed drive pulley mounted on the base between the base and the conveyor trough and rotatable on a first axis of rotation fixed relative to the base and centered relative to the drive pulley,
a toothed driven pulley of a predetermined size mounted

on the bottom of the conveyor trough for rotation on a second axis which is eccentric to the drive pulley, fixed relative to the conveyor trough and parallel to the first axis of rotation,

a guideway on the base extending parallel to a line extending between the first and second axes of rotation,

a slide slidable along the guideway,

a third toothed pulley of said predetermined size mounted on the slide on a third axis of rotation eccentric to the third pulley, fixed relative to the slide and parallel to the first and second axes of rotation,

a toothed belt engaging the pulleys,

a pair of rollers carried by the slide for guiding the belt around a substantial portion of the third pulley, and

means for adjusting the slide along the guideway.

12. In a vibrator conveyor,

a base,

a conveyor bed,

spring means mounting the conveyor bed movably on the base,

a frame,

spring means mounting the frame movably on the base,

spring means urging the conveyor bed and the frame in opposite directions,

a first pulley mounted on the conveyor bed,

a second pulley mounted on the frame,

motor means mounted on the frame for rotating the second pulley,

at least one of the pulleys being mounted eccentrically, and

a belt trained about and drivingly interconnecting the pulleys.

13. In a vibrator conveyor,

a base,

a conveyor bed,

spring means mounting the conveyor bed movably on the base,

a frame,

spring means mounting the frame movably on the base,

spring means urging the conveyor bed and the frame in opposite directions,

a first pulley mounted on the conveyor bed,

a second pulley mounted on the frame,

motor means mounted on the frame for rotating the second pulley,

at least one of the first and second pulleys being mounted for rotation on an axis eccentric thereto,

a belt drivingly interconnecting the pulleys,

a subframe mounted adjustably on the frame,

and a third pulley mounted on the subframe for rotation on an axis eccentric to the third pulley.

14. In a vibrator conveyor,

a base,

a conveyor bed,

spring means mounting the conveyor bed movably on the base,

a frame,

spring means mounting the frame movably on the base,

spring means urging the conveyor bed and the frame in opposite directions,

a first pulley of a predetermined size mounted on the conveyor bed on an axis of rotation eccentric to the first pulley,

a second pulley mounted on the frame on an axis of rotation centered relative thereto,

motor means mounted on the frame for rotating the second pulley,

a subframe mounted adjustably on the frame,

a third pulley of said predetermined size mounted on the subframe for rotation on an axis eccentric to the third pulley,

and a belt drivingly interconnecting the pulleys.

15. In combination,

a movable member to be driven,

a first pulley mounted rotatably on the movable member,

a second pulley,

a flywheel having an axial bore therethrough,

means for rotating the flywheel continuously,

a clutch plate adapted to engage the flywheel,

a shaft keyed to the second pulley and the clutch plate and slidable along and rotatable in the axial bore,

one of the pulleys being mounted eccentrically,

and an actuator for moving the shaft along the bore between a first position in which the clutch plate is out of engagement with the flywheel and a second position in which the clutch plate is drivingly engaged with the flywheel.

16. In combination,

a driving clutch member having a hollow shaft extending vertically downwardly therefrom,

a second shaft extending vertically through the hollow shaft and the driving clutch member and slidable along the hollow shaft and rotatable therein,

a driven clutch member fixed to the second shaft in a position above and opposing the driving clutch member,

a first pulley keyed to the second shaft,

a second pulley movable toward and away from the first pulley,

one of the pulleys being rotatable on an axis of rotation eccentric thereto,

a belt drivingly interconnecting the pulleys,

a member driven by movement of the second pulley toward and away from the first pulley,

and actuator means for selectively lifting the second shaft to an upper position in which the clutch members are out of engagement and permitting the driven clutch member to move by gravity into engagement with the driving clutch member.

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