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VIBRATING MECHANISM AND UNBALANCING ROTOR

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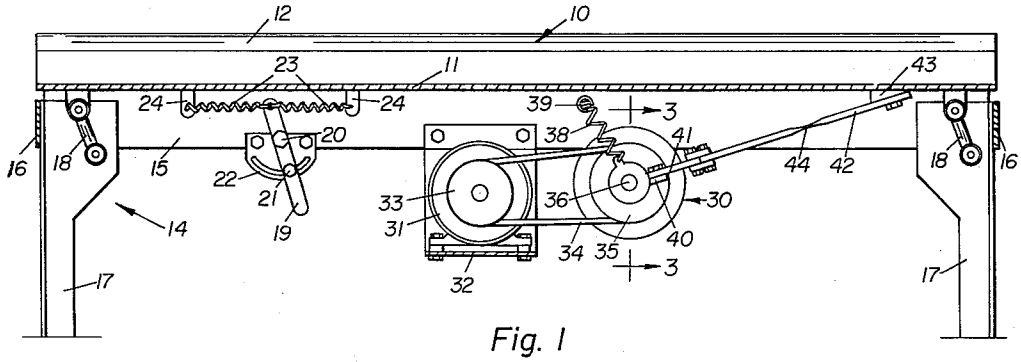


Fig. 1

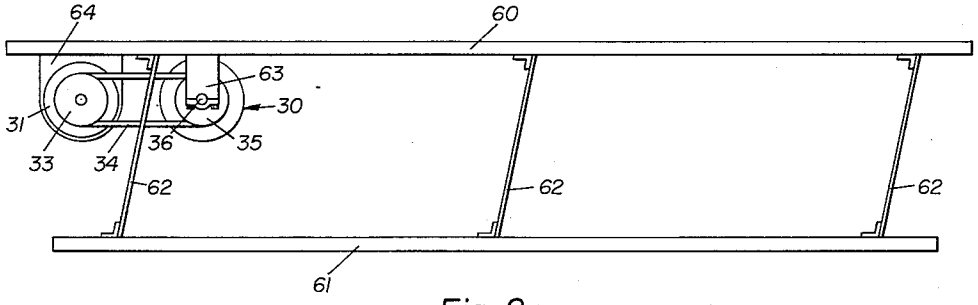


Fig. 2

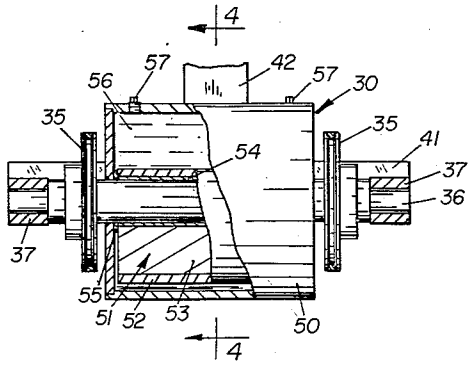


Fig. 3

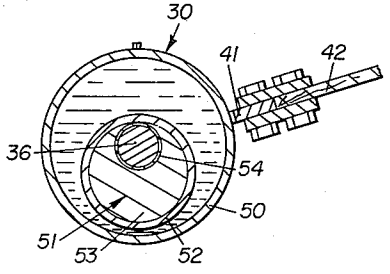


Fig. 4

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VIBRATING MECHANISM AND UNBALANCING ROTOR

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Our present invention comprises an improvement in vibrating conveyors and the like, and means for imparting oscillating motion to such devices. The present invention comprises an improvement in vibrating conveyors such as disclosed and claimed in our Patent No. 2,899,044, issued August 11, 1959, in our co-pending application Serial No. 56,394, filed September 16, 1960, now Patent No. 3,080,961, and in our application Serial No. 97,814, filed concurrently herewith. The present invention also comprises an improvement in means for imparting oscillating motion to a vibrating conveyor which may be of any type other than those disclosed in the above-identified patent and applications.

A principal object of the present invention is to provide means for imparting oscillating motion to a feeding element which includes a rotor assembly, the assembly comprising a cylindrical drum and an eccentric weight mounted therein, in which motion is imparted to the eccentric weight only at speeds above a critical speed. The art prior to our Patent No. 2,899,044, concerning devices in which oscillation motion is imparted by means of a rotor device, depended upon the operation of an eccentric weight gyrating about a fixed axis at any speed which could be imparted to a rotary device by its driving motor. The device to which the rotor is attached has a critical mass with respect to the speed and mass of the rotating eccentric weight, with the result that as the rotor increases in speed from rest, or decreases in speed from its operating speed down to rest, excessive vibrations are imparted to the whole structure while the speed passes through a critical speed. Such excessive vibrations tend to tear the equipment apart, cause the equipment to jump about and displace itself, impart excessive vibrations to surrounding structures, and produce considerable disconcerting noise. The invention disclosed in our above-identified patent reduces the excessive vibrations by providing a weight which remains concentric with the axis of rotation of the rotor until a speed is reached above the critical speed of the equipment while approaching the operating speed, and thereafter becomes eccentric with respect to said axis, and vice versa. The eccentric weight in such apparatus is maintained in balance by spring means plus static friction, with the result that the exact speed at which eccentricity is achieved varies, and the operation of the equipment is not as smooth as could be desired. The device of the present invention is much simpler in construction than the device of the patent and provides smooth, dependable operation with a minimum of variance of the speed at which the weight becomes eccentric, and eliminates springs which tend to change characteristics with continued use.

The smooth operating characteristics of the unbalancing rotor embodied in our present invention enable the use of this type of mechanism in connection with suitable vibrating conveyors or other device without requiring massive foundations to hold them in position. The present invention is particularly useful in conveying means upon which fruit and the like are inspected and sorted while being conveyed from one point to another, the action of the conveying means being such as to cause the fruit, or other discrete materials being conveyed, to spread out for inspection of each individual fruit or particle of material, and the action being particularly soft so that delicate materials such as cherries and berries are not bruised or damaged while being conveyed.

The present invention permits the use of a conveying element having an upwardly facing surface mounted for oscillating motion in a feeding manner without special mounting means or massive bases.

The term "feeding element" as used herein means a device upon which discrete materials may be supported in a substantially horizontal plane, or in a plane inclined so as to feed material downwardly or upwardly to a considerable extent. The feeding element may be so mounted as to permit the feeding action thereof to be reversed, as disclosed in the above-identified patent and applications. The term "feeding element" as used herein also includes a device having solid surfaces for transportation of material alone, or foraminous surfaces for sifting materials of lesser dimension from materials of larger dimensions while feeding the larger dimensioned material onward.

While the principal use at present is in vibratory conveyors, the unbalanced rotor of the present invention may be employed to impart oscillating motion to any element so as to cause motion of discrete materials adjacent thereto, such as a bin for causing flow of materials within the bin toward an exit chute, or any other element as yet not envisioned to which such oscillating motion should be imparted.

The objects and advantages of the present invention will be more readily apparent from inspection of the accompanying drawings, taken in connection with the following specification, wherein like numerals refer to like parts throughout, in which:

FIG. 1 is a longitudinal section through a conveying table representative of those conveying tables disclosed and claimed in the above-identified patent and applications, in which the unbalancing rotor is flexibly connected to a driving motor and to the conveying element;

FIG. 2 is a side elevation of a conveying table representative of prior art devices of the character in which the unbalancing rotor and its driving motor are both rigidly mounted on the conveying element;

FIG. 3 is a vertical section, on an enlarged scale, through the unbalancing rotor of the present invention, taken substantially along line 3—3 of FIG. 1; and

FIG. 4 is a vertical section taken substantially along line 4—4 of FIG. 3.

Referring to FIGS. 1, 3 and 4, a preferred type of vibrating conveyor having the present invention associated therewith is disclosed. The machine comprises an elongated conveying element 10 consisting of a sheet metal trough having a horizontal bottom wall 11 and vertical side walls 12, the bottom wall 11 providing an upwardly facing surface upon which discrete materials may be supported. The conveying element is mounted upon a frame 14 comprising side bars 15, end bars 16 and supporting legs 17 which rest upon a floor or other

surface without attachment thereto. A plurality of upright links 18 are pivotally connected at their lower ends to the relatively fixed frame and at their upper ends to the feeding element 10. The links may be positioned at acute angles to either side of the vertical or vertically, depending upon the inclination of a lever 19 pivotally connected to the frame at 20 and adapted to be held in adjusted position by a bolt and nut clamping device 21 in cooperation with an arcuately slotted plate 22. The upper end of the lever 19 is connected to an opposed pair of horizontally disposed helical springs 23, the outer ends of which are connected to lugs 24 depending from the conveying element. When the lever 19 is positioned as illustrated in FIG. 1, oscillating motion applied to the conveying element 10 will impart a component of feeding motion parallel to the supporting surface, with the material being fed from left to right. If the lever 19, and consequently the links 18, are vertical there will be no feeding movement of the material, and if they are shifted to an opposite inclination the feeding motion will be from right to left. The rate of feeding movement will depend upon the degree of inclination of the links 18 and the speed of revolution and extent of oscillation of the unbalanced rotor attached to the feeding element.

As disclosed and claimed in our above-identified patent, an unbalancing rotor 30 is resiliently suspended beneath the conveying element and is driven by a motor 31 mounted upon a shelf 32 extending transversely and fastened to the side rails 15 of the fixed frame. The motor is double-ended and drives a pair of drive pulleys 33 from which a pair of belts 34 extend to a pair of driven pulleys 35 on opposite ends of an axle 36 extending parallel to the feeding surface and transversely with respect to the direction of the feeding component of the oscillating motion imparted to the feeding element. The axle is mounted in a pair of journals 37, each of which is resiliently supported, partially by a helical spring 38 extending from the journal to a rod 39 extending transversely of the fixed frame. Each journal has a lug 40 thereon to which is fastened one arm of a yoke 41 extending around the rotor 30. A connecting rod 42 extends longitudinally from the yoke 41 in the direction of feeding motion, the opposite end thereof being fixed to a bracket 43 on the feeding element. The connecting rod is preferably an elongated member which is rigid longitudinally, but which is provided with a flexible intermediate portion 44 permitting vertical flexing of the connecting rod toward and away from the feeding surface.

In accordance with the present invention, the unbalancing rotor comprises a cylindrical drum 50 fixed to the axle 36 concentrically therewith so as to be rotated about an axis of rotation coinciding with the axis of the axle 36 and so as to be at least approximately dynamically balanced about such axis. A weight 51 is freely suspended within the drum. The weight preferably comprises a cylindrical weight, which may be readily fabricated by filling a section 52 of cylindrical tube with a cast metal filler 53. A bushing 54 is eccentrically mounted within the weight, being held therein by the cast metal filler. The axis of the bushing is parallel to the longitudinal axis of the cylindrical weight and offset therefrom a distance less than the radius of the cylindrical weight. The bushing receives the axle 36 and the axle is freely rotatable therein. The weight is of slightly less length than the interior length of the drum 50 and washers 55 are preferably provided to hold the ends of the weight spaced from the end walls of the drum. A fluid 56 fills the remainder of the space within the drum, the drum being provided with an aligned pair of screw plugs 57 which may be removed so that the fluid may be poured into the drum through one of the openings for one of the plugs while air escapes from the other. The fluid is preferably a lubricating oil or other fluid such as the hydraulic fluid used in brake and servo-motor systems, preferably one which maintains nearly constant viscosity under normal temperature ranges.

The speed of rotation at which the weight rotates with the drum depends upon the viscosity of the fluid and the mass of the weight 51 and the eccentricity as well as the space between the weight and the inside of the drum 50. The greater the mass of the weight and its eccentricity and the greater the space between the weight and the drum and the less the viscosity of the fluid the greater the speed above which the weight will rotate with the drum. By varying the above factors the speed at which the weight picks up and rotates with the drum when the speed of the drum is increasing as well as the speed at which the weight ceases to rotate with the drum when the speed of the drum is decreasing can be varied within a considerable range of drum speeds.

The operation of the device is as follows: Upon starting the motor the drum 50 will be revolved about its longitudinal axis in direct proportion to the speed of the motor as determined by the pulley ratios. The device is constructed so that the suspended weight 51 will remain in vertical suspension until after the speed of the rotor exceeds the critical speed which has been determined for the assembly. As a specific example, in a device which has a critical speed below 200 r.p.m. the weight can remain in vertical suspension until the speed of the rotor of the drum 50 exceeds 200 r.p.m. At this speed the friction of the oil upon the inner surface of the drum will be sufficient to cause the weight to revolve with the drum, the weight gyrating about the axis of revolution of the drum and imparting oscillatory motion thereto and to the attached feeding element 10. When the motor slows down so that the rotation of the device decreases the weight will crease to rotate when the speed of the axle passes below such critical speed.

It is to be appreciated that the weight may be of other shapes and types, so long as an eccentric weight capable of freely gyrating about the axis of revolution of the drum is provided. However, the cylindrical shape disclosed is preferable for ease of manufacture and smoothness of operation. The bushing 54 is preferably equal in length to the length of the weight so that the axle 36 is stiffened and thereby held against flexing which might disrupt the assembly.

FIG. 2 discloses a conveying element such as an inspection and sorting table, vibratory screen or other element 60 supported upon a relatively fixed frame 61 by means of a plurality of upright, flexible supporting legs 62 so inclined as to cause feeding of material from left to right. An unbalancing rotor 30, as previously described, is mounted directly on the element 60 by means of journal member 63 rigidly secured to the feeding element and supporting the axle 36 of the rotor. The axle 36 is driven by pulleys 33 and 35, belts 34 and a double-ended motor 31 as previously described. The motor in this instance is mounted in a support 64 directly connected to the element 60. In this case the extent of feeding motion depends upon the characteristics of the supporting legs 62 and the combined mass of the feeding element, the motor and the unbalancing rotor, as well as the speed of the unbalancing rotor. Because of the ability to design an unbalancing rotor in which unbalancing will be achieved only after the speed of rotation has exceeded a critical speed, less vibration will be imparted to the fixed frame 61 and to the floor or supporting table upon which it rests while the rotor is passing through the critical speed.

It is to be appreciated that the unbalancing rotor and its driving means may be mounted in various fashions other than as illustrated. For example, they may be mounted above the conveying element. As a further example, the motor may be mounted upon a separate base and the unbalancing rotor driven through flexible drive means of other character. Also, the device may be used to impart oscillating motion to the walls of feed bins or any other element to which vibration is to be imparted. In

any event excessive vibration due to an unbalanced rotor passing through a critical speed is avoided.

It is to be appreciated that means may be provided to change the rate of rotation of the unbalanced rotor, such as disclosed in our above-identified patent.

Having illustrated and described a preferred embodiment of the invention, it is to be appreciated that the same permits of modifications in arrangement and detail. All such modifications as come within the true spirit and scope of the following claims are considered to be a part of our invention.

We claim:

1. A vibrating mechanism comprising an element supported for oscillating motion, a cylindrical drum, journal means mounting said drum for rotation about its longitudinal axis, with said axis extending horizontally and transversely with respect to the direction of said oscillating motion, means connecting said journal means to said element, means for rotating said drum, a weight freely suspended within said drum for revolution about an axis coinciding with the longitudinal axis of said drum, and a liquid filling the remainder of the space within said drum.

2. A vibrating mechanism comprising an element supported for oscillating motion, a cylindrical drum, journal means mounting said drum for rotation about its longitudinal axis, with said axis extending transversely with respect to the direction of said oscillating motion, means connecing said journal means to said element, means for rotating said drum, a cylindrical weight freely suspended within said drum for revolution about an axis coinciding with the longitudinal axis of said drum, the longitudinal axis of said weight being parallel to the longitudinal axis of said drum and being eccentrically spaced therefrom by a distance less than the radius of said weight, and a liquid filling the remainder of the space within said drum.

3. A vibrating mechanism comprising a movable element, a relatively fixed frame, means mounting said element on said frame for oscillating motion with respect to said frame, a motor mounted on said frame, a cylindrical drum, journal means mounting said drum for rotation about its longitudinal axis, resilient means mounting said journal means on said frame for limited movement toward and away from said element, longitudinally rigid, vertically flexible connecting rod means fixed to said journal means at one end, extending therefrom in the direction of said oscillating motion, and fixed to said element at its other end, flexible drive means drivingly connecting said motor to said drum, a weight freely suspended within said drum for revolution about an axis coinciding with the longitudinal axis of said drum, and a liquid filling the remainder of the space within said drum.

4. A vibrating mechanism comprising a relatively fixed frame, an element mounted on said frame for oscillating motion with respect to said frame, a motor mounted on said frame, a cylindrical drum, journal means mounting said drum for rotation about its longitudinal axis, with said axis extending horizontally and transversely with respect to the direction of said oscillating motion, resilient means mounting said journal means on said frame for limited movement toward and away from said element, longitudinally rigid, vertically flexible connecting rod means fixed to said journal means at one end, extending therefrom in the direction of said oscillating motion, and fixed to said element at its other end, flexible drive means drivingly connecting said motor to said drum, a cylindrical weight freely suspended within said drum for revolution about an axis coinciding with the longitudinal axis of said drum, the longitudinal axis of said weight being parallel to the longitudinal axis of said drum and being eccentrically spaced therefrom by a distance less than the radius of said weight, and a liquid filling the remainder of the space within said drum.

5. A vibrating mechanism comprising an element, a relatively fixed frame, means mounting said element on said frame for oscillating motion with respect to said frame, a motor mounted on said element, a cylindrical drum, journal means mounting said drum for rotation about its longitudinal axis, means mounting said journal means on said element, driving means connecting said motor to said drum for rotating said drum, a weight freely suspended within said drum for revolution about an axis coinciding with the longitudinal axis of said drum, and a liquid filling the remainder of the space within said drum.

6. A vibrating mechanism comprising an element having an upwardly facing surface, a relatively fixed frame, means mounting said element on said frame for oscillating motion with respect to said frame, said motion having a component in a direction parallel to said surface, a motor mounted on said element, a cylindrical drum, journal means mounting said drum for rotation about its longitudinal axis, with said axis extending horizontally and transversely with respect to the direction of said oscillating motion, means mounting said journal means on said element, driving means connecting said motor to said drum for rotating said drum, a cylindrical weight freely suspended within said drum for revolution about an axis coinciding with the longitudinal axis of said drum, the longitudinal axis of said weight being parallel to the longitudinal axis of said drum and being eccentrically spaced therefrom by a distance less than the radius of said weight, and a liquid filling the remainder of the space within said drum.

7. Means for imparting oscillating feeding motion to an element comprising a cylindrical drum, means for revolving said drum about its longitudinal axis, a weight freely suspended within said drum for revolution about an axis coinciding with the longitudinal axis of said drum, and a liquid filling the remainder of the space within said drum.

8. Means for imparting oscillating feeding motion to an element comprising a cylindrical drum, means for revolving said drum about its longitudinal axis, a cylindrical weight freely suspended within said drum for revolution about an axis coinciding with the longitudinal axis of said drum, the longitudinal axis of said weight being parallel to the longitudinal axis of said drum and being eccentrically spaced therefrom by a distance less than the radius of said weight, and a liquid filling the remainder of the space within said drum.

9. Means for imparting oscillating feeding motion to an element comprising an axle, means for revolving said axle about its longitudinal axis, a cylindrical drum concentrically fixed to said axle, a weight freely suspended from said axle within said drum for revolution about an axis coinciding with the longitudinal axis of said axle, and a liquid filling the remainder of the space within said drum.

10. Means for imparting oscillating feeding motion to an element comprising an axle, means for revolving said axle about its longitudinal axis, a cylindrical drum concentrically fixed to said axis, a cylindrical weight freely suspended from said axle within said drum for revolution about an axis coinciding with the longitudinal axis of said axle, a cylindrical bushing mounted within said weight, extending from end to end thereof and journaling said weight on said axle, the longitudinal axes of said weight and of said bushing being parallel and spaced apart from each other, and a liquid filling the remainder of the space within said drum.

11. A vibrating mechanism comprising

a hollow cylindrical chamber rotatable about the longitudinal axis thereof,

means for rotating the chamber on said axis,

a paddle-like weight member mounted in the chamber eccentrically on said axis for free rotation on said axis,

and a hydraulic fluid in the chamber for drivingly coupling the weight member to the chamber.

12. A vibrating mechanism comprising

a weight member eccentrically mounted for free rotation on a predetermined axis and having an impeller surface portion eccentric to said axis,

a cylindrical chamber concentrically mounted for rotation on said aixs with the inner wall of the chamber spaced a predetermined distance from the closest portion of the impeller surface portion,

means for rotating the chamber on said axis,

and a hydraulic fluid in the chamber for drivingly coupling the impeller surface portion to the chamber.

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