VIBRATORY FEEDER

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ABSTRACT

A vibratory feeder of the bowl type in which the support system for the bowl includes a torsion bar extending vertically upwardly from a base and attached to the underside of the bowl at its axis. The torsion bar may be formed with two integral arms extending parallel to the main bar and provided with a vertically adjustable clamp for varying the stiffness of the torsion bar for tuning purposes.

20 Claims, 4 Drawing Figures
VIBRATORY FEEDER

This invention relates to vibratory feeders and is particularly applicable to vibratory feeders of the bowl type wherein the bowl is formed with a helical ramp on which the parts to be fed travel in response to vibration or oscillation of the bowl.

As is well known in the art, the feeding of parts or other material along the helical ramp of a bowl is accomplished by reciprocating the bowl through an angle of rotation and at the same time giving the bowl an upward component of movement while it is turned in one direction and a downward component movement during the reverse direction of rotation. Various mechanical arrangements are available for supporting the bowl for such movement and the bowl may be driven mechanically or by electromagnetic or fluid-powered means. The most common arrangement is to support the bowl at its periphery on inclined springs and to drive the bowl in one direction by one or more electromagnets energized by a pulsating electric current.

A principal problem encountered in such prior art vibratory feeders is that in order to attain efficient operation and optimum performance, it is necessary to control the mechanism so that the system is in resonance so that the natural frequency of vibration of the bowl is reasonably close to that of the motor means which, in the case of an electromagnetic motor operated from a conventional alternating power source, usually is 60 Hertz or multiples thereof. The effect of proper tuning is readily apparent because of the marked decrease in power which is required to vibrate the bowl, or conversely, if the power remains the same, by the marked increase in amplitude of vibration which occurs. In order to permit some degree of tuning and also to maintain the working stresses below the endurance limit of the spring material, it has been the common practice to use, instead of a single spring, a plurality of short and thin leaf springs clamped together. By varying the number of springs or by substituting springs of different spring rating, which in itself is a tedious operation and usually requires the services of a skilled mechanic, some measure of resonance can be obtained. However, more precise tuning usually requires the attachment of weights to the periphery of the bowl, which are added or removed as required to attain the desired natural frequency. Even by the use of such expedients, it is found that some sizes or weights of bowls cannot be accommodated within reasonable space limitations and also that overstressing of the spring plates frequently occurs resulting in early failure of the spring plates requiring them to be replaced.

Accordingly, it is an aim of the present invention to provide a novel supplementary support system for a vibratory bowl feeder which eliminates the critical nature of the primary spring support system, permitting the use of fewer and lighter spring plates and avoiding overstressing which might cause early failure. Included in this aim is the provision of such a novel supplementary support system which is adjustable for tuning purposes thus making it unnecessary to rely on the prior art expedient of varying the number or ratings of the spring plates, or adjustment by means of tuning weights attached to the bowl, and also to provide for tuning which requires a minimum of skill and which can be facilitated if desired, by adjustment while the bowl is in operation. A further aim is to provide such a novel supplementary support system which is of simple design and easy and economical to fabricate and assemble on the feeder, but which at the same time is rugged and reliable in operation affording a long service life.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

A better understanding of the invention will be obtained from the following detailed description and the accompanying drawings of an illustrative application of the invention.

In the drawings:

FIG. 1 is a partially exploded perspective view of a vibratory feeder in which the mechanism of the present invention has been embodied and showing the mounting of a conventional cast bowl with a combination spiral-helical ramp;
together by the base portion 44. The center bar 41 is T-shaped in configuration to provide an outwardly extending mounting head portion 46. In fact, the three bars best formed by milling the L-shaped slots 45, 45a in a single rectangular metal plate. While the dimensions of the torsion bar assembly 40 may be varied depending upon the particular installation, a specific example of such an assembly having general use is one formed by milling three-eighths inch slots in a five-eighths inch steel plate which is 3-1/4 inches wide and 5-1/4 inches long.

For mounting purposes, the base portion 44 is securely connected thereto by screws 49 whose heads are recessed in openings 50 in the mounting plate 12. The base of the torsion bar 40 is connected by screws 51 to a generally rectangular supporting plate 52 which is secured at its opposite ends by screws 53 to the shoulders 22 and 23 adjacent the central opening 21 of the base. Inasmuch as the upper end of the torsion bar 40 is fixed to the mounting plate 12 and the base portion is securely fixed to the plate 52, it will be appreciated that the vibratory motion and particularly the circular horizontal component thereof will result in a twisting or torsion of the main or center bar 41. Also, inasmuch as the supporting plate 52 is a metal plate having inherent resiliency, the vibratory motion of the bowl will be modulated by vertical flexing of the support plate 52. While it is not intended to limit the invention to any specific dimensions, it may be mentioned by way of specific example, that a one-eighth inch steel plate approximately 3-1/4 inches wide and 6-1/4 inches long is one which in practice has been found to afford the desired flexibility.

In order to achieve the invention, in order to permit adjustment of the torsional force of the torsion bar assembly 40, thus permitting tuning of the mechanism, there is provided a pair of clamps 60 and 61 extending across opposite sides of the torsion bar assembly 40 and clamped thereto by screws 62 which are accommodated in the slots 45, 45a. The clamps 60 and 61 are recessed at their inner surfaces as indicated at 63, in order to receive shoes or spacers 64, preferably formed of low friction plastic material such as that sold under the trademark "Celcon". The clamps 60 and 61 are almost identical except that clamp 61 is formed with beveled corners 65 to avoid interference with the brackets 35 and is provided with a tapped hole 66 having a left hand thread, whereas the tapped hole 67 in clamp 60 has a right hand thread. Journalled at their lower ends in the supporting plate 52 are two adjusting feed screws 71 and 71a which have a right hand thread and a left hand thread respectively, which are threadably engaged in and extended through the tapped holes 67 and 66 in the clamps 60 and 61 respectively. Fixed on the bottom end of the adjusting feed screw 71 is a gear 72 which meshes with a gear 73 fixed on the bottom end of adjusting feed screw 70. The hub 74 of the gear 73 is milled to form a hexagonal head for receiving a turning tool such as a wrench.

As will be apparent, the mechanism just described permits the clamps 60 and 61 to be moved upwardly and downwardly as desired while the clamps remain in engagement with the center bar 41 and the two sides bars 42 and 43. It has been found that although the two clamps 60 and 61 are held together with a strong force by the screws 62, nonetheless, the mechanical advantage provided by the feed screws 70, 71 is such that the clamps 60 and 61 can be readily adjusted upwardly and downwardly by a reasonable force applied to the hub 74 by means of a conventional wrench. Also because of the clearance space provided between the base 20 and the support surface as a result of the adjustable feet 24, there is ample room for the operator to engage the hub 74 with a turning wrench and adjust the torsion bar 40 without disassembly of any of the apparatus and, in fact, such adjustment can be done while the equipment is in operation, thus permitting the operator to observe the functioning of the apparatus during the tuning operation.

As will be appreciated, the portion of the center bar 41 and side bars 42 and 43 below the clamps 60 and 61 will function substantially as a single unitary structure while above the clamps 60 and 61 only the center bar 41 is in torsion. Accordingly, as the clamps 60 and 61 are raised, the torsion bar assembly 40 is increased in stiffness and conversely, when clamps 60 and 61 are lowered, the torsion bar assembly 40 is rendered more flexible. Thus, by turning the feed screws 70, 71 and adjusting the clamps 60, 61 upwardly or downwardly, as desired, the time for the tuning or changing rate of the torsion bar assembly 40 can be readily adjusted.

Since the torsion bar assembly 40 is connected at opposite ends to the bowl 10 and the base 20, it operates in torsion to absorb and release energy as the bowl is vibrated and its spring rate becomes a major factor in determining the natural frequency of the feeder. As a result, the number and rate of the leaf springs 33 utilized in the vibratory units 30 is rendered relatively unimportant, and thus lighter leaf springs 33 and a fewer number may be used. Also, because the design of the adjustable torsion bar assembly 40 is such that a wide range of spring rates may be attained, a much wider range of bowl weights may be accommodated within usual space limits and relatively lighter base weights are possible while still permitting accurate tuning. Also, it will be noted, since tuning of the assembly is infinite in nature, the bowl movement is incremental as in the tuning of the prior art devices, tuning is rendered more precise and does not require the use of such expedients for final tuning as adding or removing weights from the bowl. Furthermore, because the torsion bar assembly 40 may be adjusted simply by turning the feed screws 70, 71 and this can be done while the feeder is in operation, only ordinary skill is required to tune the feeder, since the effect of the adjustment can be directly observed by observing the operation of the feeder while the adjusting is taking place, and no calculations or cut and try methods are required.

As will be apparent to persons skilled in the art, various modifications, adaptations and variations of the foregoing specific disclosure can be made without departing from the foregoing specific disclosure can be made without departing from the teachings of the present invention.

I claim:
1. A vibratory feeder having a material conveying vibratory element including a bowl, a base element, and means connected between the vibratory element and the base element for reciprocating the vibratory element into any of movement having a horizontal and a vertical component, wherein the improvement comprises vertically extending torsion bar means located centrally of the bowl, first connecting means securing the upper end of the torsion bar means to the vibratory element and second connecting means securing the lower end of the torsion bar means to the base element to cause relative rotation of said ends in response to reciprocal movement of the vibratory element, at least one of said connecting means being yieldable in a vertical direction to accommodate the vertical component of movement of said vibratory element.
2. A vibratory feeder as set forth in claim 1 wherein the torsion bar means is provided with means for varying the effective torsional spring rate of the torsion bar means.
3. A vibratory feeder as set forth in claim 1 wherein the torsion bar means comprises a plurality of parallel bars connected together at one end, and a clamp extending across the bars intermediate their ends, said clamp being adjustably mounted for selective positioning lengthwise of the bars.
4. A vibratory feeder as set forth in claim 1 wherein the connecting means providing a yieldable connection is a flexible plate connected to one of said elements and the torsion bar means is mounted on said plate.
5. A vibratory feeder as set forth in claim 3 wherein a feed screw is threadably engaged with the clamp for moving the one of said elements along the lengthwise of the bars.
6. A vibratory feeder as set forth in claim 1 wherein the means for reciprocating the bowl comprises a plurality of spring elements connected at their one ends to the base ele-
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7. A vibratory feeder as set forth in claim 6, wherein the spring elements are connected by means to selectively vary the horizontal and vertical components of vibratory movement of the bowl.

8. A vibratory feeder as set forth in claim 1 wherein the means for reciprocating the bowl comprises a plurality of supporting and vibrating units angularly spaced around the bowl, each of said units comprising a pair of parallel mounting plates, leaf springs secured to and extending between the mounting plates to permit relative oscillatory movement of the plates in generally parallel paths, and motor means within the unit for oscillating the plates.

9. A vibratory feeder as set forth in claim 8, wherein the mounting plates are mounted on concentric screws permitting angular adjustment to vary the horizontal and vertical components of vibratory movement of the bowl.

10. A vibratory feeder as set forth in claim 1 wherein the torsion bar means comprises a first bar connected at opposite ends to the bowl and base element, and at least one additional bar parallel to the first bar having one free end and having its other end connected to one end of the first bar, and a clamp extending across the bars adjustable mounted for selective positioning lengthwise of the bars.

11. A vibratory feeder as set forth in claim 1 wherein the torsion bar means comprises a center bar having means at opposite ends for connection to the bowl and base element, and a pair of parallel bars on opposite sides of the center bar and integrally joined to the center bar at one end, and clamping means extending across all of the bars, said clamping means being adjustable vertically of the bars.

12. A vibratory feeder as set forth in claim 11, wherein feed screw means is threadably engaged with the clamping means for adjusting the clamping means vertically of the bars.

13. A vibratory feeder as set forth in claim 11, wherein the torsion bar means is a single rectangular steel plate having L-shaped slots forming a center bar with an elongated head portion and a pair of side bars integrally joined to the center bar at its end opposite from the elongated head portion.

14. A vibratory feeder as set forth in claim 4, wherein the torsion bar means comprises a first bar connected at its upper end to the bowl, at least one additional bar parallel to the first bar, said bars being mounted at their lower ends on a flexible plate, said plate being attached to the base element, and clamping means extending across the bars and adjustably mounted for selective positioning vertically of the bars.

15. A vibratory feeder as set forth in claim 14, wherein a feed screw is provided for adjusting the clamping means vertically of the bars, said feed screw being journaled in the flexible plate and being threadably engaged with the clamping means.

16. A vibratory feeder as set forth in claim 14, wherein the clamping means comprises a pair of clamps engaging opposite surfaces of the bars, and a pair of feed screws are threadably engaged, respectively, with the clamps, the feed screws being journaled in the flexible plate and being geared together at their lower ends.

17. A vibratory feeder as set forth in claim 16, in which the lower end of one of the feed screws is formed with an extension for engagement by a wrenching tool.

18. A vibratory feeder as set forth in claim 16, wherein the pair of clamps engaging the bars are provided with a surface of low-friction plastic material for sliding engagement with the bars.

19. For use in a vibratory feeder, a torsion bar assembly comprising a center bar and two parallel bars on opposite sides thereof and integrally joined at one end to the center bar, fastening means at opposite ends of the center bar for connecting the same to the feeder, and clamping means extending across the bars intermediate the fastening means and being adjustable lengthwise of the bars.

20. A torsion bar assembly as set forth in claim 19, wherein the integrally joined ends of the bars are mounted on a flexible plate and wherein feed screw means is journaled at one end in the flexible plate and threadably engages the clamping means.