United States Patent

Willis

[15] **3,655,032**

[45] **Apr. 11, 1972**

[54] **VIBRATORY FEEDER**

[72] Inventor: **Grant N. Willis**, Bristol, Conn.

[73] Assignee: **The Arthur G. Russell Company, Incorporated**, Bristol, Conn.

[22] Filed: **May 26, 1970**

[21] Appl. No.: **40,678**

[52] **U.S. Cl.** .... **198/220 BC**

[51] **Int. Cl.** **B65g 27/32**

[58] **Field of Search** .... 198/220 BC, 220 CA, 220 CB, 198/220 CC; 209/365; 267/160

[56] **References Cited**

UNITED STATES PATENTS

2,821,292 1/1958 Spurlin .... 198/220 BC

3,087,603 4/1963 Petrea .... 198/220 CA

Primary Examiner—Richard E. Aegerter

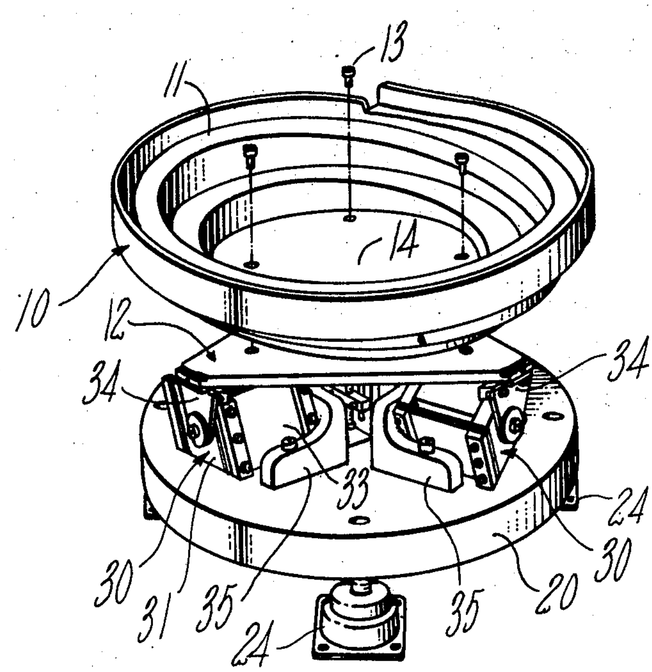
Assistant Examiner—Alfred N. Goodman

Attorney—Prutzman, Hayes, Kalb & Chilton

[57] **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



PATENTED APR 11 1972 3,655,032

SHEET 1 OF 2

FIG. 1

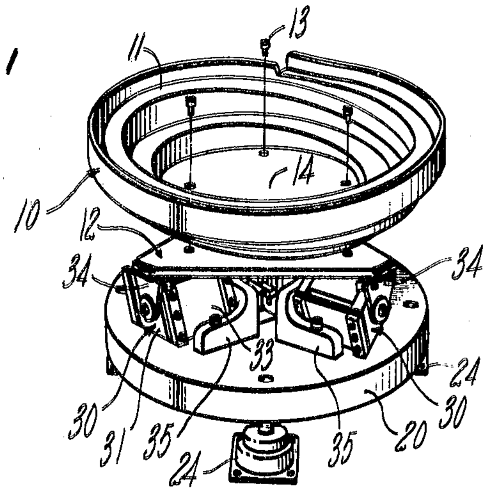
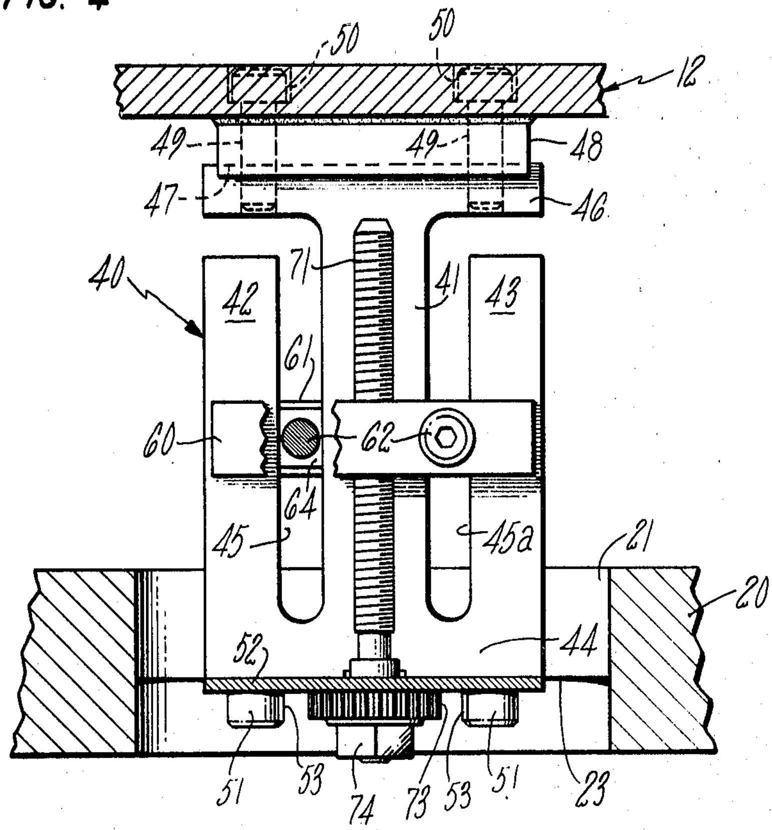


FIG. 4



INVENTOR
GRANT N. WILLIS

BY Prutzman, Hayes, Kalb and Chilton
ATTORNEYS

FIG. 2

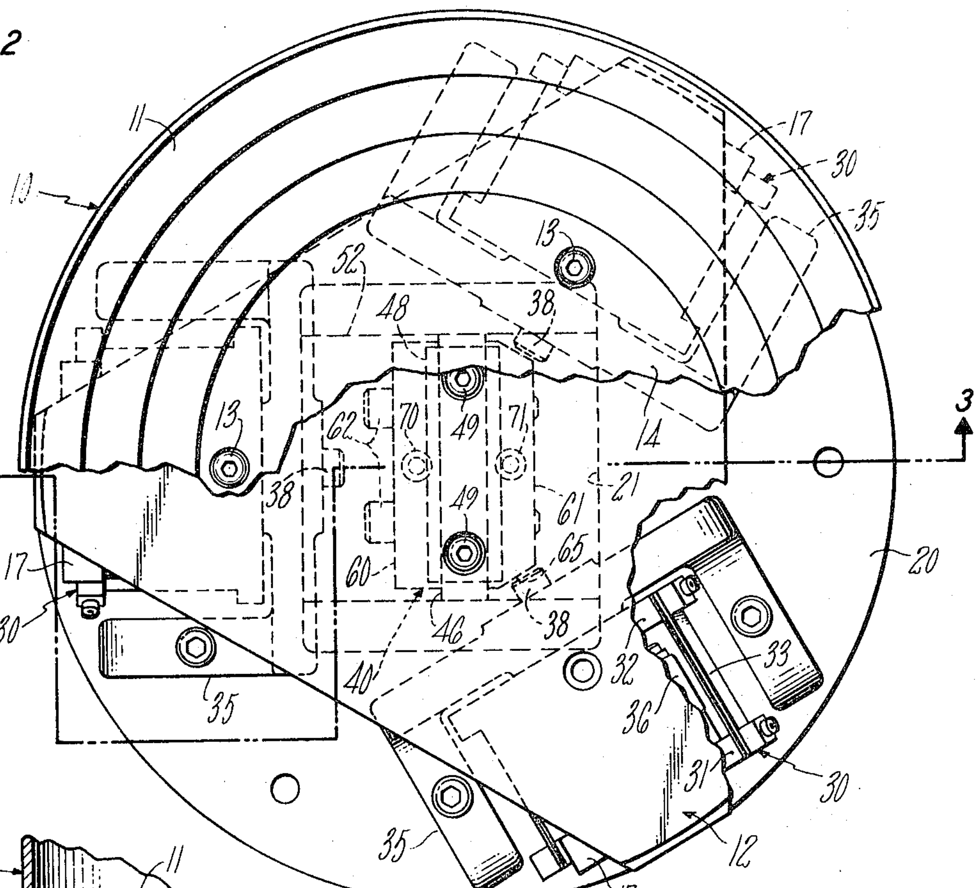
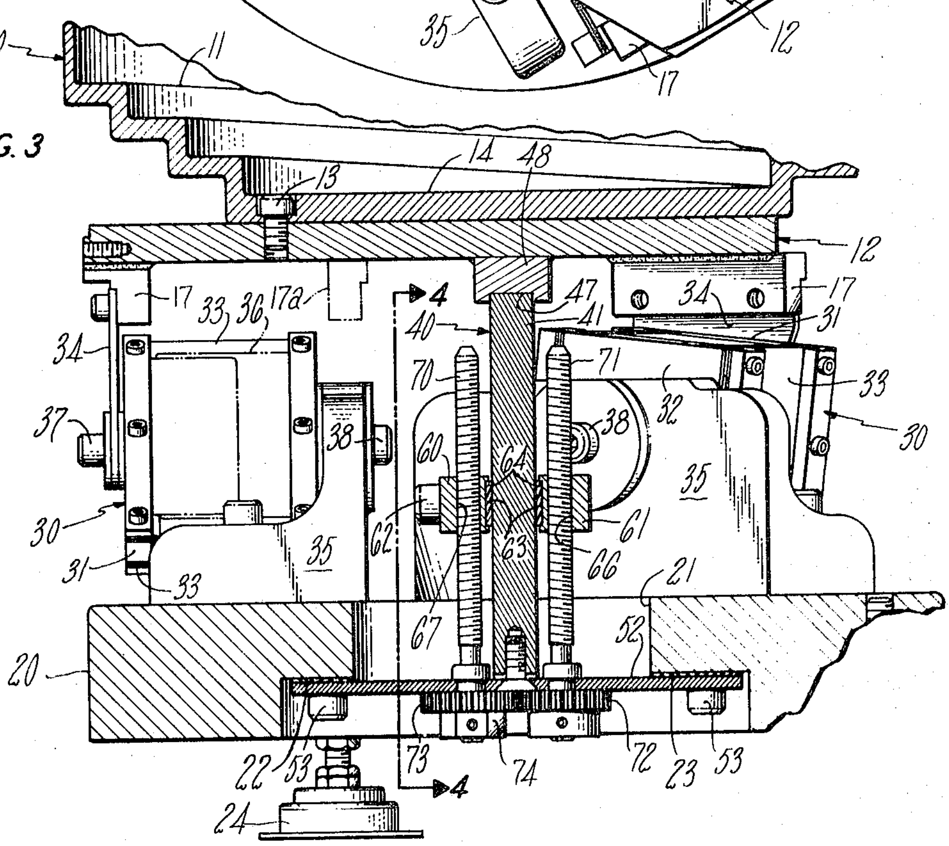


FIG. 3



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 a small 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 construct the mechanism so that the system is in resonance, i.e., 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 feeder 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;

FIG. 2 is an enlarged plan view of the vibratory feeder with a portion of the bowl cut away to show certain of the details of the connecting mechanism;

FIG. 3 is a fragmentary cross-sectional view taken along line 3—3 of FIG. 2; and

FIG. 4 is an enlarged fragmentary cross-sectional view taken along line 4—4 of FIG. 3.

Referring to the drawings in detail, the present invention is shown embodied in a vibratory feeder of generally the same type as that shown in my prior U.S. Pat. No. 3,048,260 granted Aug. 7, 1962. The bowl **10** in the embodiment shown in the drawings is a case aluminum bowl of circular configuration having a combination spiral-helical ramp **11** in its upper surface. As will be understood, the ramp **11** forms the path along which the articles to be fed move in response to vibration of the bowl. The bowl **10** is fastened to a generally triangular mounting plate **12** by means of screws **13** extending through the bottom wall **14** of the bowl **10**. Welded at the underside of the mounting plate **12** and also adjacent the apices thereof are mounting brackets **17**.

The mounting plate **12** and hence the bowl **10** is mounted for vibratory movement on a base **20** which may be a metal casting as disclosed in my prior U.S. Pat. No. 3,048,260 but which in the present embodiment is formed of a single but relatively thick circular steel plate. The base **20** is formed with a rectangular central opening **21** having recessed downwardly facing shoulders **22** and **23** along to opposite edges thereof. The base is provided with a plurality of adjustable feet **24** by means of which the base **20** may be adjustably mounted on a supporting surface.

While various arrangements could be utilized for mounting the bowl **10** on the base **20** and for driving it to produce the desired vibratory movement, the bowl **10** in the preferred embodiment shown in he drawings is mounted and driven by a plurality of combination supporting and vibratory units **30** of the type disclosed and claimed in my prior U.S. Pat. No. 3,048,260, to which reference may be made for further details if desired. The vibratory units **30** comprise end plates **31** and **32** which are arranged to vibrate relative to each other in parallel paths in the plane of the plates, the end plates **31** and **32** being connected together by a plurality of leaf springs **33** clamped thereto. The end plates **31** and **32** extend generally vertically and the springs **33** extend transversely of the base. Vibrating motion is produced by an internal motor (one shown in phantom at **36** in FIG. 3) which may be of the electromagnetic or fluid-powered type. The end plates **31** of the base units **30** are connected to the mounting brackets **17** by spring straps **34** and the end plates **32** are connected to mounting brackets **35** secured to the upper surface of base **20**. Concentric screws **37**, **38** connect the end plates **31** to spring straps **34** and end plates **32** to brackets **35**, respectively, thus permitting the angular or rotated position of the vibratory units **30** to be adjustably selected. It is an advantage of the present invention that the vibratory units **30** may be connected between the bowl **10** and the base **20** with the mounting brackets **17** radially outward from the mounting brackets **35**. However, if desired, the vibratory units **30** could be reversely mounted as shown in my prior U.S. Pat. No. 3,048,260 merely by turning brackets **35** through an angle of 180° and placing the mounting brackets **17** radially inwardly of the mounting plate **12** as indicated in phantom at **17a**. As will be apparent, and as more fully described in my prior U.S. Pat. No. 3,048,260, the helix angle of the bowl vibration is determined by the rotated or angular position of the vibratory units **30** which can be varied to produce various ratios of vertical to horizontal components of vibration and either clockwise or counterclockwise rotation of articles in the bowl, as desired.

In accordance with the present invention, an adjustable torsion bar assembly indicated generally at **40** forms an additional connection and supplementary support between the bowl **10** and the base **20**. As best shown in FIG. 4 the torsion bar assembly **40** comprises a main or center bar **41** and two parallel side bars **42** and **43** which are integrally joined 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 are best formed by milling the L-shaped slots **45, 45***a* 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 3-½ inches wide and 5-¼ inches long.

For mounting purposes, the head portion **46** is engaged in a slot **47** formed in a re-enforcing bar **48** welded to the underside of the mounting plate **12** at the center thereof, and the head portion **46** 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 vertical component movement of the bowl will be accommodated 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 3-½ inches wide and 6-¼ inches long is one which in practice has been found to afford the desired flexibility.

In accordance with 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, 45**a. 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 lefthand thread, whereas the tapped hole **67** in clamp **60** has a righthand thread. Journaled at their lower ends in the supporting plate **52** are two adjusting feed screws **70** and **71** having a righthand thread and a lefthand thread respectively, which are threadably engaged in and extend 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 torsional spring 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 infinitely variable between limits rather than 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 precalculations 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 in a path 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 clamp 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 element and at their other ends to the bowl radially outwardly of the center of the bowl, said spring elements being disposed so that upon flexure of the spring elements, said other ends move in a path inclined to the vertical.

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 adjustably 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.

* * * * *