United States Patent

Riesbeck et al.

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[54] APPARATUS FOR VIBRATING A MATERIAL SEPARATOR

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[51] **Int. Cl.**.....**B07b 1/28,** B07b 1/42

[58] **Field of Search**.....209/386, 325, 368, 310, 332, 209/366, 366.5, 367, 331; 310/17; 198/220

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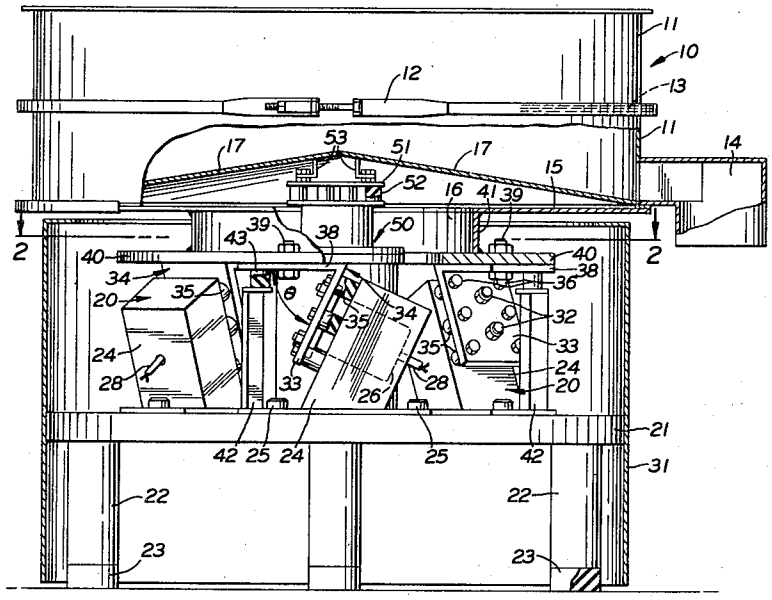
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[57] **ABSTRACT**

An apparatus for vibrating a material separator provides selective horizontal and vertical high frequency vibratory forces to the separator. The amplitude of the forces can be individually controlled while the machine is operating. The precise direction of the horizontal force can be set to obtain the desired pattern of material travel over the screen. Also disclosed is a manner in which the vibratory motion caused by the vertical component force can be utilized to prevent screen blinding.

9 Claims, 6 Drawing Figures



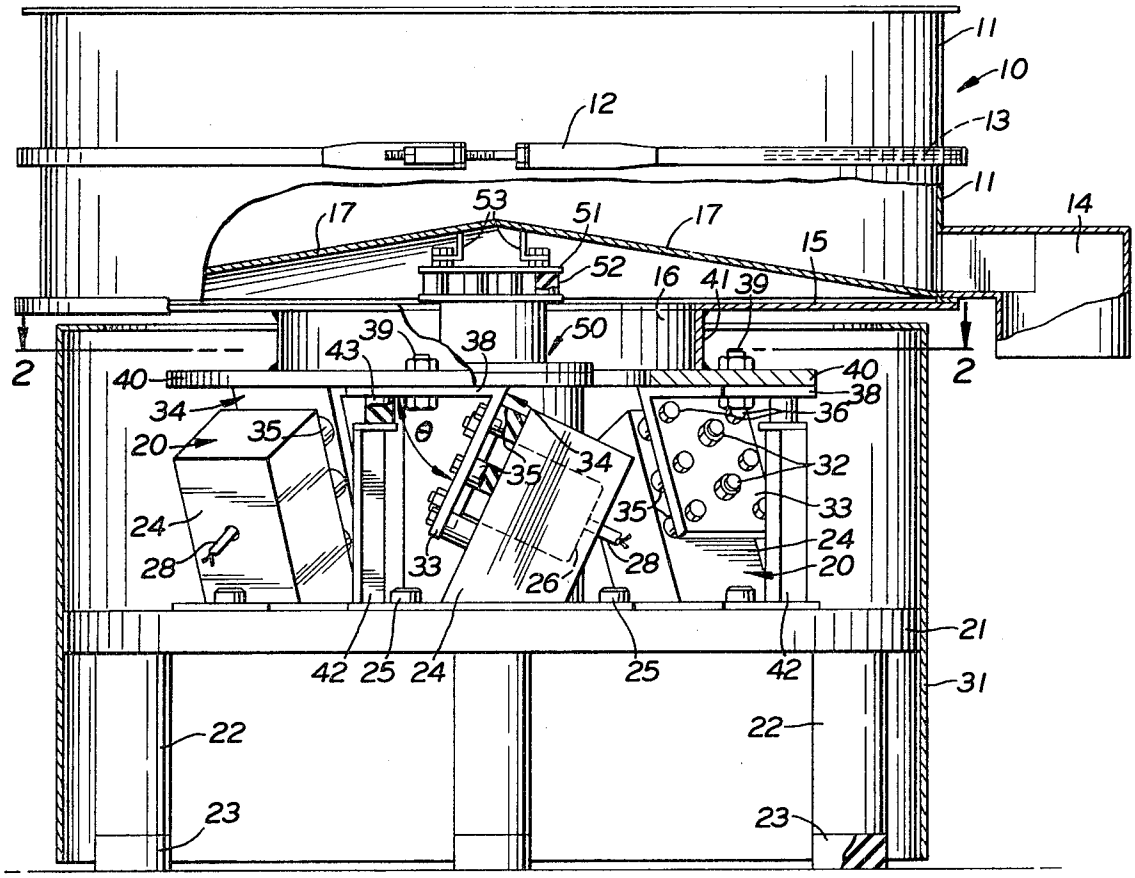


FIG. 1

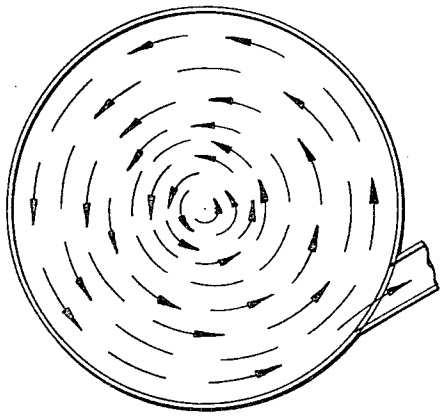


FIG. 3

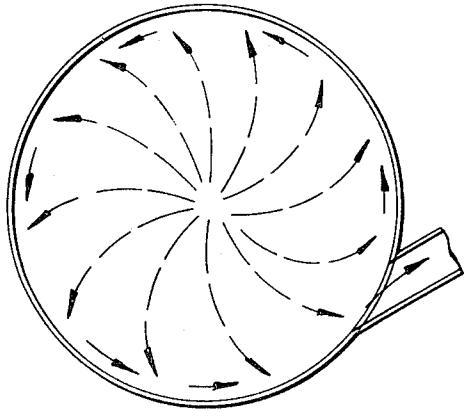


FIG. 4

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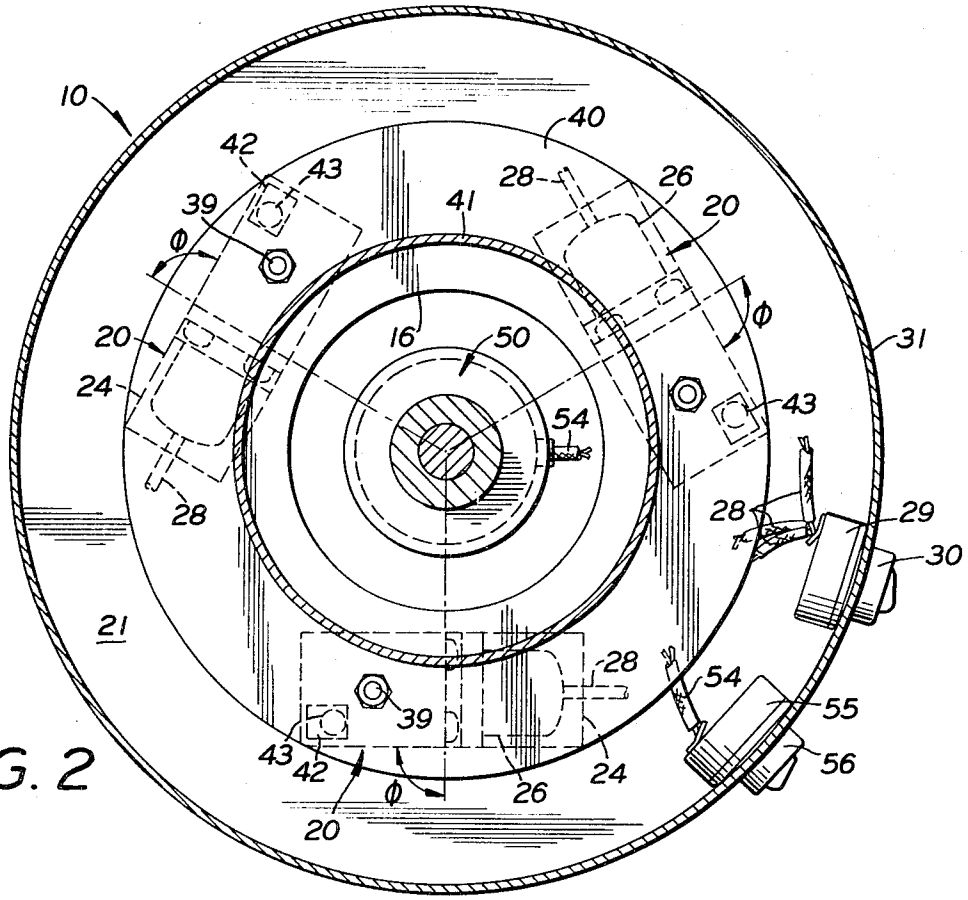


FIG. 2

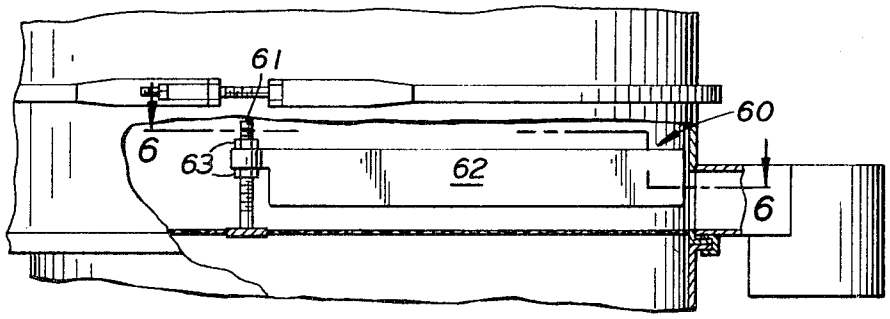


FIG. 5

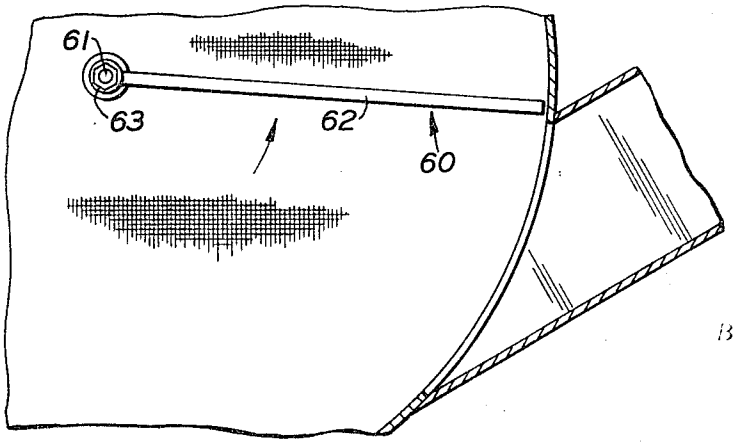


FIG. 6

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APPARATUS FOR VIBRATING A MATERIAL SEPARATOR

BACKGROUND OF THE INVENTION

This invention relates to a device for transmitting vibratory motion to material separators. More specifically, this invention relates to a material separator which is provided with individually controlled horizontal and vertical high frequency vibrations.

Many industries utilize material separators to classify their raw material, their final product or their intermediate product by size. When at least two outputs are desired, such machines consist of a plurality of stacked cylindrical screening sections wherein the material to be separated is continuously fed into the top section to be passed through the plurality of screens, each successive screen having a finer mesh. A rotary shaking force is imparted to the stacked sections to aid in moving the material through the screens and in moving the material radially outward through a chute at the periphery of each screening section to obtain a plurality of products.

There have been numerous designs of motion generating means which have acted to shake the above-described material separators, each, however, having its deficiencies. For example, one type of device utilizes a heavy duty electric motor having eccentric weights at its ends mounted such that one weight will lead the other as the motor turns. Such a device transmits a substantially horizontal and centrifugal low frequency force to the periphery of the screening sections which are floatingly mounted on a plurality of springs. These springs then absorb a portion of the centrifugal force and, in doing so, bounce a vertical component into the system. Such a device therefore gives a somewhat steady oscillating or shaking force to the system. However, the amount of vertical and horizontal force is not independently adjustable nor are the forces readily adjustable in combination, short of dismantling the machine, adjusting or changing the eccentric weights, and/or replacing the springs with other springs of a different elasticity or energy absorbing and transmitting characteristic. Of course, the ability to make adjustments, dependent on the type of material being separated, is a desirable feature. For example, when separating heavy or wet material, it is often necessary to increase only the vertical force to prevent screen blinding. Also, adjustments must be continually made to assure maximum travel of the material on the screen for more efficient operation.

Another type of motion generating device creates its agitating force via the rotation of a drive means in a housing which carries counterbalancing weights at the periphery thereof. A bearing chamber within the rotatable drive member carries a nonrotatable shaft which supports the material separator. The axis of the shaft is eccentrically offset from the axis of the drive member to effect the substantially horizontal low frequency oscillatory forces. Again, a series of spring members transmit an element of vertical motion to the system. Like the above-described device, however, this device does not lend itself to instantaneous adjustment in vibration. While the eccentricity of the stationary shaft with respect to the rotatable shaft can be varied to change the amplitude of the vibrations, the machine must be shut down to effect the adjustment.

Finally, both of the above-described devices will generally provide a somewhat violent force placing undesirable stresses on critical parts and forcing the user to bolt or otherwise affix the machinery to the factory floor.

SUMMARY OF THE INVENTION

It is, therefore, a primary object of the present invention to provide a vibrating apparatus for a material separator in which the horizontal and vertical force components can be individually controlled while the device is operating.

It is another object of the present invention to provide a vibrating apparatus, as above, which will provide longer travel of the material on the screen through selective mounting and adjusting of horizontal and vertical vibrators.

It is still another object of the present invention to provide a vibrating apparatus, as above, which is lightweight, which need not be affixed to the floor of the building, and which does not cause undesirable wear on critical parts.

It is yet another object of the present invention to provide a vibrating apparatus, as above, which is capable of operating at high frequencies.

It is a further object of the present invention to provide a vibrating apparatus, as above, which can be adjusted so that timed or selective vertical force components will prevent blinding of the screens.

These and other objects which will become apparent from the following description are accomplished by the improvements hereinafter described and claimed.

In general, a plurality of high frequency vibrators are mounted below the screening sections of a material separator in such a manner as to provide selective vibrations having horizontal and vertical components to the material separator. In the preferred embodiment, one vibrator is provided to effect solely vertical component forces. Three vibrators are mounted on an angle to provide a component horizontal force and component vertical force. The angle of the mounting of these vibrators may be adjusted not only to increase or decrease the amount of the vertical component, but also to change the direction of the horizontal component. The vertical vibrator and the horizontal vibrators can be individually controlled at an instrument panel.

The vibrators can be accurately controlled so that the material is caused to move on the screen for a greater time, in fact, in theory never reaching the periphery of the screen and the outlets. When such fine control is provided, it is necessary to utilize a wiper blade positioned within a screening section to direct the material to the outlet.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially sectioned partially broken away elevational view of a material separator controlled by the vibrating mechanisms according to the concept of the present invention.

FIG. 2 is a sectional view taken substantially along line 2—2 of FIG. 1.

FIG. 3 is a diagrammatic plan view of a typical pattern of material on a screen when the vibrating mechanisms of the present invention are set in a particular manner.

FIG. 4 is a diagrammatic plan view of another pattern of material on a screen when the vibrating mechanisms of the present invention are set in a particular manner.

FIG. 5 is a partial sectional view of a screening section being vibrated by the mechanism of the present invention and having a wiper device directing material toward an outlet.

FIG. 6 is a sectional view taken substantially along line 6—6 of FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A material separator having a vibrating mechanism according to the concept of the present invention is indicated generally in FIG. 1 by the numeral **10**, as comprising a plurality of axially adjacent substantially horizontal cylindrical sections **11** fastened together by a clamping member **12**. Between each section **11** is a screen mounting assembly **13**, as example of which is shown and described in U.S. Pat. No. 3,463,315 to which reference is made for such details as may be necessary to fully understand this invention. Screen mounting assembly **13** carries a screen which spans the cylindrical section, the mounting assembly and screen also being held in place by the clamping member **12**.

Each section **11** has, at a point along its periphery, a discharge chute **14** through which the classified material is directed. The bottom section **11** is clamped to an annular base plate **15** which has a central aperture **16** therein. The bottom section **11** is further provided with a conical pan member **17** which directs all the material which is capable of passing through the finest screen to chute **14**.

One form of vibrating mechanism according to the present invention is indicated generally by the numeral **20** and is shown as being generally mounted on a base plate **21** which is supported by legs **22** terminating as rubber feet **23** which rest on the floor. As will become evident, rubber feet **23** absorb any vibration which may be transmitted through base plate **21** and legs **22** to prevent movement of the material separator on the floor. However, it has been found that by making plate **21** substantially heavier than the rest of the separator **10**, any undesirable vibrations therein are counterbalanced and the maximum vibratory forces are directed to the screening sections **11** in a manner to be hereinafter described.

A plurality of vibrator housings **24** are attached, as by bolts **25**, to base plate **21**. Within each housing **24** is a vibrating means **26** which is shown herein as an electromagnetic 3600 r.p.m. vibrator of the type described in U.S. Pat. No. 3,404,299 . However, it is evident that any standard high frequency vibrating device could be utilized; for example, an air vibrator could provide the necessary vibratory forces. The amount of vibration for each vibrating means **26** shown herein is controlled through wire **28** by a control means such as a rheostat **29** which is regulated by a knob **30** readily accessible on the outside of a skirt **31** which encloses the vibrating mechanism **20** and its associated members.

Each vibrating means **26** is attached, as by bolts **32**, to one branch **33** of a V-shaped vibrating plate **34**. So that all of the vibrations from the vibration means **26** are transmitted to plate **34**, a plurality of cushioning means **35** are mounted between plate **34** and housing **24** on post members **36**. The other branch **38** of plate **34** is attached by bolts **39** to a horizontal vibrating plate **40** which is, in turn, welded to the base plate or table **15** via frame member **41**. So that the entire weight of the plate **40** (and the members attached thereto) is not resting on the V-shaped plates **34** and exerting a force thereon which would tend to shear bolts **32**, a plurality of posts **42** are provided. Between each post **42** and the plate **40** are cushioning means **43** which are necessary to assure that plate **40** is resiliently mounted to receive all of the vibrations from plates **34**.

It should now be evident that the vibrating means **26** will transmit vibrations to the plates **34** which will, in turn, vibrate plate **40**, frame member **41** and the material separator **10** through base plate **15**. Vibrating means **26** provide, in the above manner, a substantially horizontal vibration component force. However, due to the use of the V-shaped plate **34** having angular branches **33** and **38**, a smaller vertical component force is also provided. The amount of each component force is, of course, dependent on the angle θ formed by branches **33** and **38**. The angle θ is shown in FIG. **1** as being approximately 65° , an angle found sufficient for most uses. However, it is likely that, depending on the material being separated, plates **34** could be provided with angles θ between 40° and 80°, the larger angles providing, of course, the larger horizontal component. Thus while the vibrating means **26** provide primarily horizontal forces, certain secondary vertical forces are created depending on the angle θ selected. Of course, the total composite vibratory action provided by vibrating means **26** is controlled by rheostat **29**.

As shown in FIG. **2**, the primarily horizontal vibrating means **26** can also be oriented along the horizontal plane of the screening sections to effect the desired radially outward forces. Each vibrating means **26** shown is mounted through branch **38** of plate **34** on a tangent to the circle the center of which is defined as the center of each screening section **11**. As such, the angle ϕ is shown as 90°. It should be evident, however, that were plates **34** mounted at angles ϕ less than 90°, the horizontal force would tend to move particles on the screen radially outward. It should also be clear that certain of the plates **34** may be mounted on angles ϕ of less than 90° and others at 90° or more than 90° to effect a wide selective range of particle movements with minimum adjustment.

Mounted substantially at the center of the base plate **21** is a vertical vibrating means indicated generally by the numeral **50** and shown as extending through aperture **16** and vibrating a plate **51** resiliently mounted on cushions **52**. Plate **51** is bolted to brackets **53** extending from below the peak of the conical pan **17**. The vibrating means **50**, like vibrating means **26**, can be of the type shown in U.S. Pat. Nos. 3,404,299 and 3,345,525 or could be an air vibrator, for example. The vibrating means **50** is connected through line **54** to a rheostat **55** which is regulated by control knob **56**. Thus, the amount of pure vertical force transmitted to the material separator **10** is controlled by the adjustment of rheostat **55**, which, of course, is independent of rheostat **29** that regulates the primary horizontal vibrating means **26**.

Through coordination of the four variable factors: the angle θ, the angle ϕ, the setting of rheostat **29**, and the setting of rheostat **55**, it has been found that almost any desired pattern of particle travel can be obtained. While the determination of the angles θ and ϕ are more of a permanent nature, that is, requiring that the machine be stopped and somewhat disassembled to perfect the change, the changing of the rheostats **29** and **55** can be done during operation through control knobs **30** and **56**, respectively. Therefore, it is usual procedure to select the angles θ and ϕ at the beginning of a project according to the material being separated and then create the fine adjustment through rheostats **29** and **55**.

For example, FIG. **3** depicts one typical particle pattern wherein the particles travel in a spiral fashion progressively outward until they go out chute **14**. This configuration could be obtained with the angles θ and ϕ as shown in FIGS. **1** and **2** and with the vertical vibrating means **50** off or at a very low level. The circumferential travel on the screen is caused by the horizontal component forces of vibrating means **26** and the small outward force coming from the vertical component of vibrating means **26** (or a small vibration from vibrating means **50**).

A much faster radially outward pattern such as that shown in FIG. **4** could be obtained by providing a large vertical vibration from vibrating means **50**. Further, such a large vibration from means **50** has been found to provide a cleaning force to the screen to eliminate the harmful blinding thereof and otherwise dislodge particles which may have become lodged within or around the screen. In fact, it is evident that one skilled in the art could adapt the vibrating means **50** into a timed cleaning means whereby a large vertical vibration would be imparted to the screen sections at a certain time interval.

It is, of course, highly desirable in most material separating procedures to maintain the material on the various screens for a maximum amount of time during which the material contacts the screen many times (dependent usually on the r.p.m. of the vibrating unit), thus increasing the efficiency of the system. It has been found, with the apparatus described herein, that the adjustable variables can be set so that the material travels essentially in a circular path with no radially outward component, theoretically never departing through chute **14**. Such a pattern would be much like that shown in FIG. **3** without the slight radially outward travel depicted therein.

In order to assure the continual removal of some of the material traveling in the circular path described above, there can be provided a wiper means indicated generally by the numeral **60** in FIG. **5**. A vertically oriented threaded rod **61** can extend upward through the center of the screens carried by the screening sections **11** and carry thereon a wiper arm **62**. It is evident that the vertical height of arm **62** can be adjusted as desired via nuts **63**. Depending therefore on the distance between the arm **62** and the screen, a certain amount of the material not able to pass through the screen will be diverted to the chute **14**.

It has been found that the vibrator apparatus constructed according to the concept of the present invention as described herein will carry out the aforementioned objectives and substantially improve the material separating art.

We claim:

1. Apparatus for transmitting vibrations to a material separator having at least one substantially horizontal screen-

ing section including a screen spanning said screening section and an outlet at the periphery thereof comprising, at least one plate having a first branch and a second branch angular to said first branch, first vibrating means transmitting a vibratory force to said first branch, said second branch being connected to the material separator so that said first vibrating means transmits a selective horizontal and vertical force to the material separator, the angularity between said branches determining the amount of horizontal and vertical force, second vibrating means selectively transmitting a primarily vertical vibratory force to the material separator, first control means capable of regulating said first vibrating means while said first vibrating means is in operation, and second control means capable of regulating said second vibrating means while said second vibrating means is in operation so that the horizontal and vertical vibratory forces can be independently regulated while the material separator is operating to obtain the desired movement pattern of the material on the screen.

2. Apparatus for transmitting vibrations to a material separator according to claim 1 having orienting means to vary the direction of the horizontal vibrating force transmitted by said first vibrating means along the substantially horizontal plane of the screening section.

3. Apparatus for transmitting vibrations to a material separator according to claim 1 wherein first cushioning means are provided between said first vibrating means and said first branch of said plate.

4. Apparatus for transmitting vibrations to a material separator according to claim 3 wherein second cushioning means are provided between the floor and the material separator.

5. Apparatus for transmitting vibrations to a material separator according to claim 1 having a vibratory plate depending from approximately the center of a screening section of the material separator, said second vibrating means selectively transmitting a primarily vertical vibratory force to said vibratory plate.

6. Apparatus for transmitting vibrations to a material separator according to claim 5 having cushioning means between said vibratory plate and said second vibrating means.

7. Apparatus for transmitting vibrations to a material separator according to claim 1 having a wiper means extending over a screen spanning said screening section and located proximate said peripheral chute to direct the material toward said chute when said vibrating means are adjusted to maintain the material on the screen.

8. Apparatus for transmitting vibrations to a material separator according to claim 7 wherein said wiper means is adjustably maintained on a post means, said post means extending upwardly through said screening sections and having threads thereon to effect the adjustment of said wiper means.

9. Apparatus for transmitting vibrations to a material separator according to claim 1 wherein the said angle between said branches is in the range of 40° to 80°.

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