

March 3, 1970

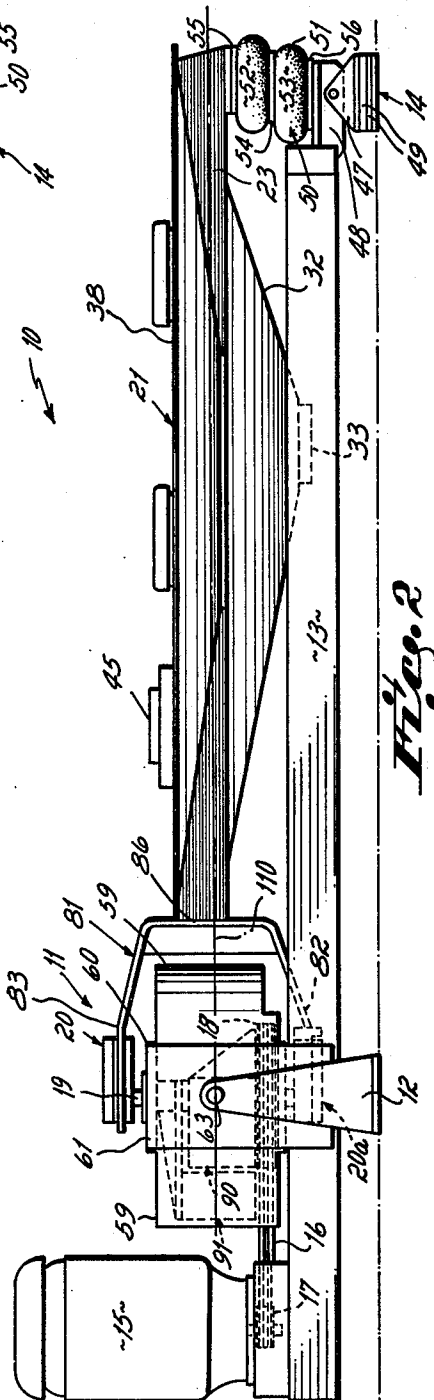
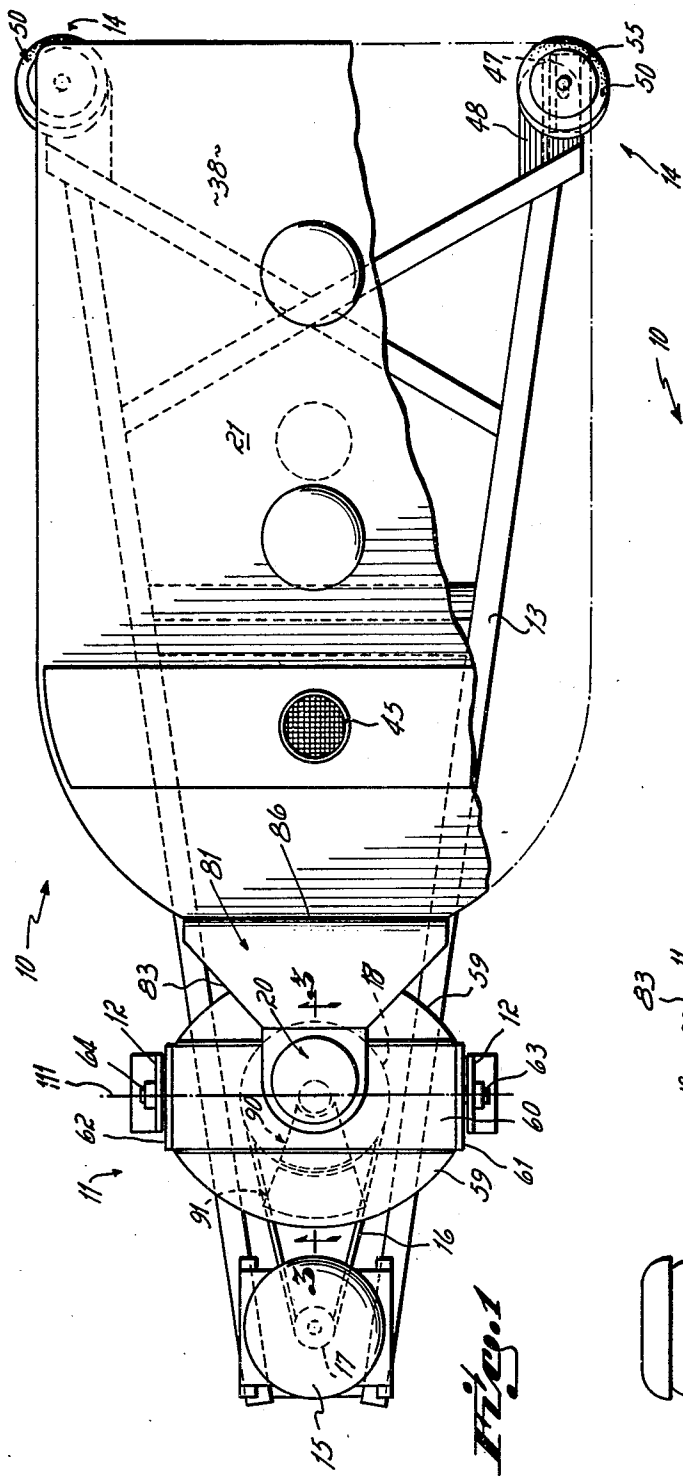
E. W. CHILDS ETAL

3,498,456

BALANCED GYRATORY SIFTER

Filed June 17, 1968

4 Sheets-Sheet 1



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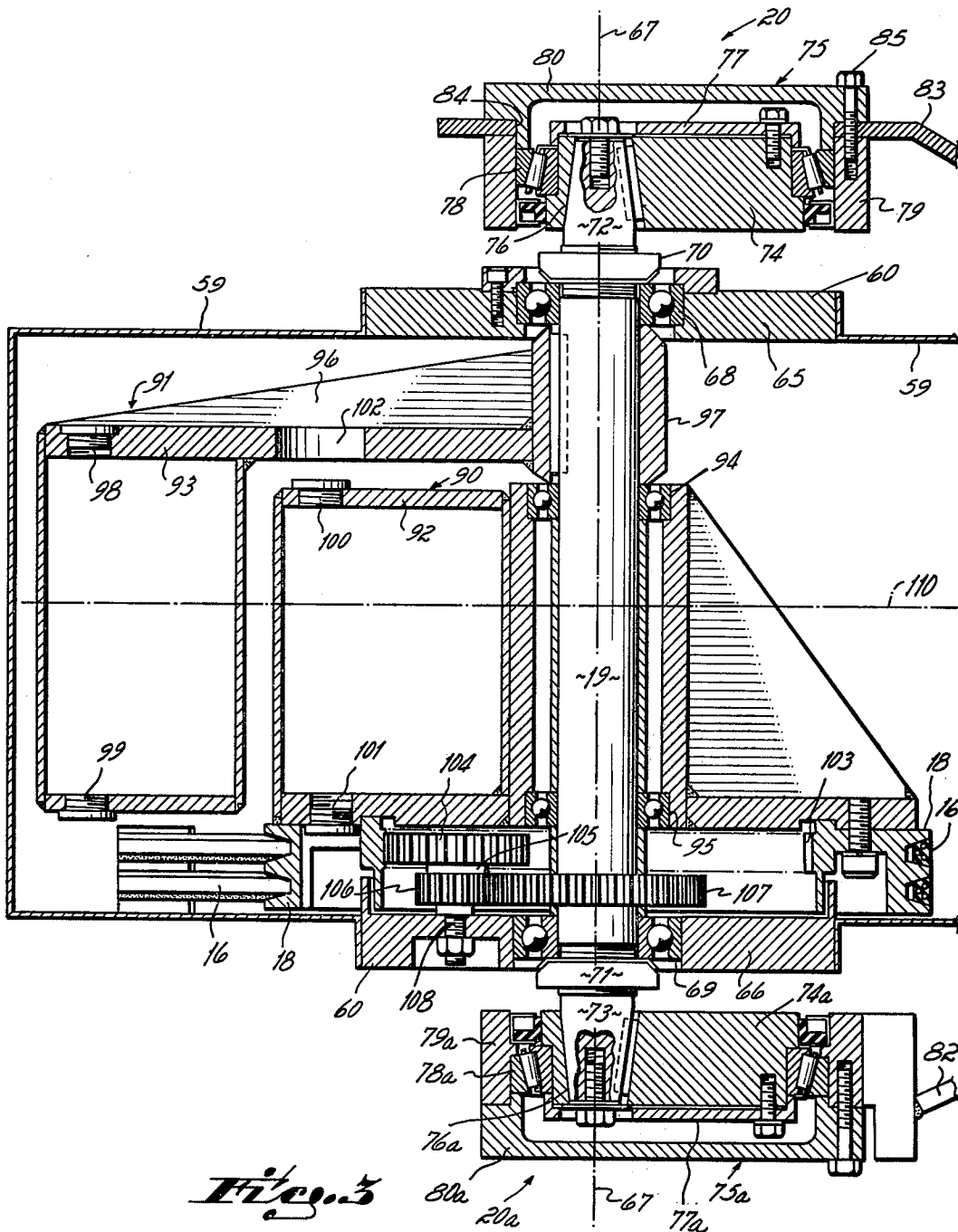


Fig. 3

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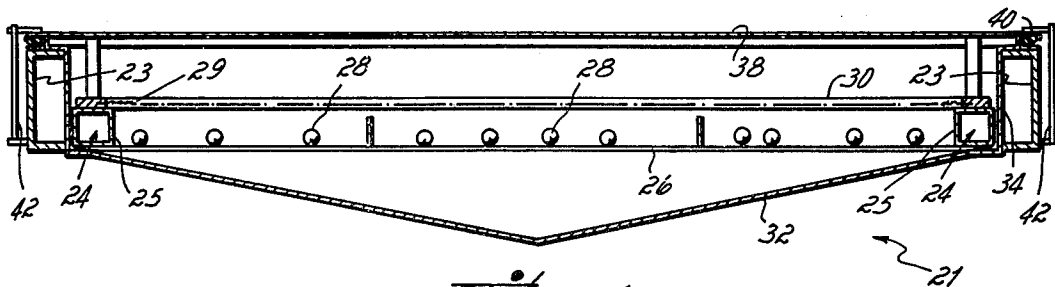


Fig. 4

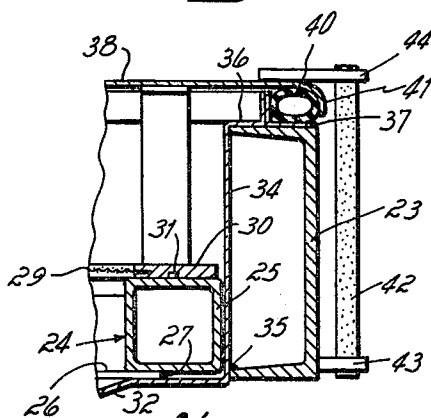


Fig. 5

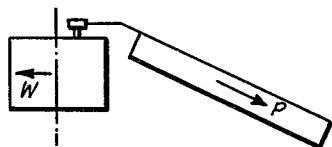


Fig. 6

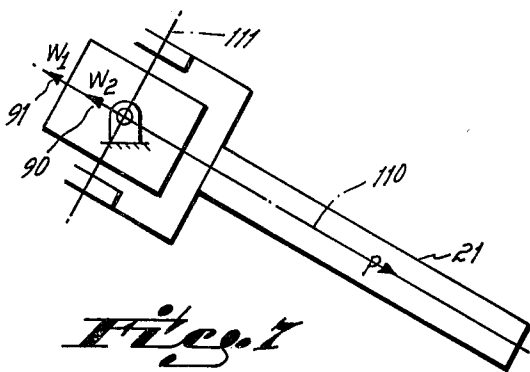


Fig. 7

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4 Sheets-Sheet 4

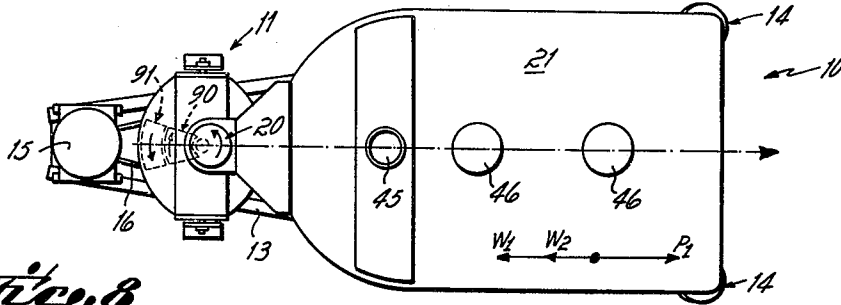


Fig. 8

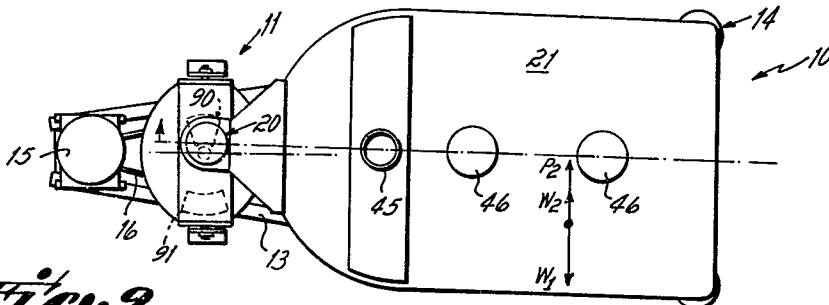


Fig. 9

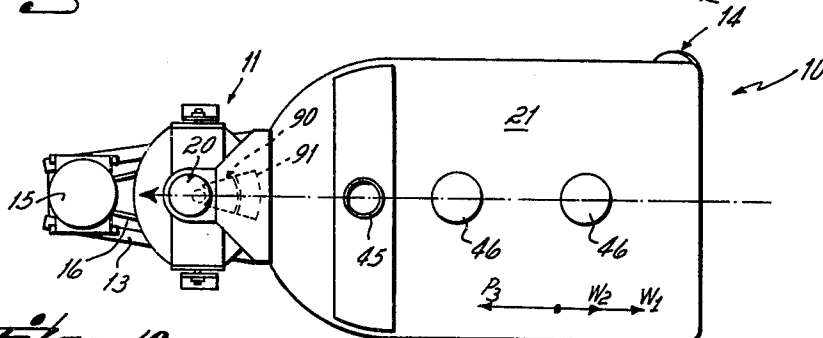


Fig. 10

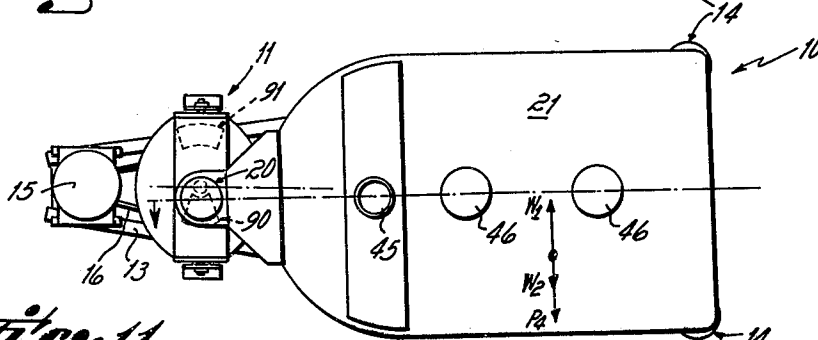


Fig. 11

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BALANCED GYRATORY SIFTER

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Int. Cl. B07b 1/34

U.S. Cl. 209—325

16 Claims

ABSTRACT OF THE DISCLOSURE

A gyratory sifter including a generally horizontal screen and an eccentric drive mechanism for imparting a gyratory motion to the head end of the screen. The tail end is mounted for reciprocal movement upon a pair of resilient mounts. A pair of weights rotate in opposite directions about the center of gyration of the screen and are so positioned that they counterbalance both the gyratory movement of the head end of the screen and the reciprocal movement of the tail end.

This invention relates to sifters and is particularly directed to a novel balancing mechanism for balancing forces at the head end of a gyratory type sifter.

Gyratory sifters are used in many applications for sifting products as variable as sugar, flour, sand and other powdery materials. These sifters conventionally include a large, generally rectangular screen supported in a generally horizontal plane, but sloping downwardly slightly from the head end to the tail end. An eccentric drive mechanism is provided for imparting a gyratory motion to the head end of the sifter. The tail end undergoes an oscillatory movement, and in the past, either a complex slide bearing and stabilizing mechanism or a resilient mount has been provided to support this end of the sifter. In the past, the head end was balanced by a rotating weight which was located 180° out of phase with the eccentricity of the drive mechanism for the screen. This rotating weight arrangement substantially reduced the vibration which would have otherwise been imparted to the frame of the machine and the floor to which it was secured. In fact, it reduced it to about 25% of what it would have been in the absence of the weight. However, 25% of the vibration was still objectionable.

The present invention is predicated upon the concept of better balancing the gyratory movement of the head end of the sifter and the reciprocal movement of the tail end of the sifter so as to effect a substantial reduction in the vibration imparted to the frame or to the floor of the building in which the sifter is mounted. Specifically, this novel balancing mechanism reduces the imbalance to as little as 2% of what it would be in the absence of any counterbalancing mechanism. Expressed another way, this invention effects a ten-fold improvement in the amount of vibration imparted to the frame of the machine or to the floor of the building over that which has heretofore been considered objectionable but acceptable for lack of any better or more practicable solution.

Specifically, the invention of this application is predicated upon the concept of mounting the reciprocating and gyrating pan in a common plane of movement with the plane of movement of a pair of contra-rotating weights. The weights rotate in opposite directions at the same angular rate of rotation and about the same axis as the eccentric for driving the pan. When the reciprocating tail end of the pan is at one extreme end of its movement, both weights are aligned about 108° out of phase with the pan-driving eccentric. After 90° of rotation of the eccentric and of the weights, the weights counterbalance

2

each other and the gyrating end of the pan. After 90° more of rotation, the weights are once again aligned and 180° out of phase with the eccentric and the attached pan.

The present concept of utilizing contra-rotating weights located in a common plane with the tilted pan is completely different from the concept of balancing a crank-shaft in that this application requires the balancing of both a gyratory and a reciprocating movement. Consequently, the use of the contra-rotating weights has been determined empirically to be a far better solution than a single fixed weight counterbalance.

A further important concept of the present invention is to locate the sloping pan in a common plane of movement with the weights. Heretofore, the pan has always been attached to an eccentric on one end of a shaft about which the weight rotated, but the weight was located near the middle of the shaft. Consequently, there was a resultant force couple operating in these two different planes which created a resultant imbalance. We have determined that if the pan is connected to the drive shaft at two points located equidistantly from the plane of movement of the counterweights, and that if the pan is then moved in a common plane of movement with the counterweights, this force couple imbalance can be eliminated with a resulting reduction in the vibration imparted to the frame of the machine or to the floor of the building in which the machine is mounted.

The primary advantage of this invention over prior art gyratory sifters is that it effects approximately a ten-fold reduction in the unbalance forces created by the gyratory and reciprocating movement of the pan. This improvement substantially reduces the amount of vibration damping material required in the frame of the machine or the vibration damping characteristics required in the floor of the building in which the machine is mounted. In other words, a relatively thin wood floor may now serve as a base for the machine where heretofore, a heavy concrete flooring was required; and where heretofore, heavy anchors were required to anchor the machine to the floor, such anchors may now be eliminated.

These and other objects and advantages of this invention will be more readily apparent from the following description of the drawings in which:

FIGURE 1 is a top plan view of a gyratory sifter incorporating the invention of this application,

FIGURE 2 is a side elevational view of the sifter,

FIGURE 3 is a cross sectional view through the gyratory head of the machine taken on line 3—3 of FIGURE 1,

FIGURE 4 is a cross sectional view through the pan of the machine taken along line 4—4 of FIGURE 1,

FIGURE 5 is an enlarged sectional view of the screen, frame and cover, the view corresponding to the right-hand portion of FIGURE 4,

FIGURE 6 is a diagrammatic illustration of the prior art practice of mounting a single weight in a different plane of movement than the plane of movement of the pan,

FIGURE 7 is a diagrammatic illustration of the common plane of movement of the pan and of the dual contra-rotated weights as embodied in the sifter illustrated in FIGURES 1 through 5, and

FIGURES 8 through 11 are partially diagrammatic top plan views of the sifter of FIGURE 1 illustrating the relative movements of the contra-rotated balancing weights and of the pan driving eccentric.

The overall construction of a gyratory sifter constructed in accordance with the principles of the present invention is shown in FIGURES 1 and 2. As there shown, the

sifter 10 comprises a drive head assembly 11 mounted upon the supports 12 at the head end of the sifter. A generally A-shaped frame 13 is supported at one end from the head 11 and at the opposite or tail end upon a pair of shimmed support pads 14. An electric motor 15 is mounted on the head end of the frame 13 and is drivingly connected with the head 11 by means of belts 16. These belts 16 pass over a drive pulley 17 carried by the shaft of motor 15 and around a large pulley 18 mounted on a shaft 19.

Shaft 19 carries a pair of upper and lower eccentric drive assemblies 20, 20a which are secured to a main sifter box or pan assembly 21, as explained more fully hereinafter. It will be understood that rotation of the pulley 18 and attached shaft 19 will effect gyratory movement of the main sifter pan assembly 21.

Sifter pan assembly 21 comprises longitudinal side members 23 preferably formed of angle irons. These longitudinal side frame members are adapted to support a sieve frame 24. The sieve frame 24 is a generally rectangular framework formed of tubular members 25. These members carry a transverse ball support screen 26 which extends across the lower portion of the sifter assembly, the screen being joined to tubular member 25 in any suitable way, such as by welding at 27. Ball support screen 26 is a coarse mesh screen effective to support a plurality of rubber balls 28 mounted above the screen.

The upper wall of the tubular frame carries a transverse extending screen cloth 29. The screen cloth is mounted in any suitable way in a peripheral clamping member 30, which member is in turn secured to the upper edge of tubular frame member 25 by means of pins 31 which fit into aligned openings formed in clamping member 30.

The sifter also comprises a bottom pan member 32, effective to receive the sifted material, and a discharge port 33. As is best shown in FIGURES 4 and 5, bottom pan 32 includes upper side wall portions 34 which extend upwardly around tubular sieve frame 24. These upper wall sections are welded to longitudinal frame members 23 as at 35 and include an upper peripheral flange 36 which overlies the upper surface of frame member 23 and is welded thereto as at 37.

A suitable cover member 38 is placed over the sifter assembly. A tubular gasket 40 is compressed between an arcuate flange 41 of the cover member and flange 36 of the pan. The cover member is held in position in any suitable manner, such as by means of resilient bands 42, the ends of which engage pins 43 extending outwardly from the lower portion of side frame members 23. Bands 42 pass over pins 44 carried by the cover member so that the tension in these bands holds the cover member down tightly in place, gasket 40 being compressed sufficiently to provide an effective seal. Cover member 38 is provided with an intake port 45 and inspection ports 46, the inspection ports being illustrated in a covered or closed condition.

The tail end mount 14 comprises two support legs or brackets 47. These brackets 47 are pinned to flanges 48 of the frame 13 and are adapted to be supported upon a floor or other supporting structure. Shims 49 may be inserted between the bottoms of the brackets 47 and the floor to change the angle of inclination of the screen.

The tail end of the sifter pan assembly 21 is supported upon the frame 13 for oscillatory movement by a pair of pneumatic air mounts 50. These air mounts 50 comprise a reinforced rubber tube 51 configured in upper and lower convolutions 52 and 53 by means of a girdle hoop 54. The upper and lower ends of the air mounts are enclosed by metal caps 55 and 56. The caps extend across and enclose the ends of the rubber tube 51 and are secured to the tail end of the sifter pan assembly and the flanges 48 of the A-frame 13 respectively. These air mounts may be partially filled with liquid such as water as described in Patent No. 3,347,374, assigned to the assignee of this application.

Those portions of the fixture thus far described constitute no portion of the present invention and it is contemplated that other forms of screens, screen mounts and oscillatory tail end mounts may be substituted for those heretofore described.

The novelty of this application resides in the mechanism for effecting gyratory movement of the sifter screen and pan assembly 21 and the mechanism for balancing the gyratory and reciprocatory forces of the assembly. This mechanism all resides in the head 11 of the machine and is enclosed within a housing or cover 59. As may be seen most clearly in FIGURES 1, 2 and 3, the housing 59 is fixedly supported upon a hollow rectangular frame or box 60, the front and rear sides 61, 62 of which are pivotally supported by trunnions 63, 64 respectively. The trunnions are in turn pivotally mounted within the vertical uprights or legs 12.

As may be seen most clearly in FIGURES 2 and 3, the upper and lower walls 65, 66 of the pivotally mounted rectangular frame 60 rotatably support the drive shaft 19 for rotation about a generally vertical axis 67. This shaft 19 is mounted within ball bearings 68, 69 and is secured against vertical movement within the frame 60 by a pair of nuts 70, 71 threaded over threaded sections of the shaft 19.

The eccentric assemblies 20, 20a for effecting the gyratory movement of the head end of the sifter pan and screen assembly 21 are drivingly keyed to tapered ends 72, 73 of the shaft 19. These assemblies 20, 20a comprise central hubs 74, 74a and outer two-piece assemblies or wheels 75, 75a which are rotatable about the hubs. Tapered eccentric apertures 76, 76a of the hubs 74, 74a are received over the tapered ends 72, 73 of the shaft 19. Caps 77, 77a are bolted to the hubs 74, 74a and have depending flanges engageable with the inner races of tapered bearings 78, 78a. The outer races of these bearings support and carry outer wheels 79, 79a and wheel caps 80, 80a of the cap assemblies 75, 75a.

The forward end of the sifter assembly 21 is attached to the eccentrics 20, 20a by a generally U-shaped bracket 81. A lower leg 82 of this bracket 81 is welded to the wheel 75a of the eccentric assembly 20a and the upper leg 83 has an annular section 84 fitted over the hub 20 and secured thereto between the two sections 79, 80 of the wheel 75 by bolts 85.

A web section 86 of the bracket 81 is welded or otherwise fixedly secured to the forward end of the sifter pan assembly so that gyratory movement of the eccentrics 20, 20a results in a corresponding gyratory movement of the forward end of the pan.

To balance the forces which result from gyratory movement of the head end of the pan and reciprocating movement of the tail end, a pair of weights are mounted for rotation about the axis 67. These weights 90, 91 consist of a pair of generally arcuate shaped cannisters 92, 93, one 93 of which is keyed to the shaft 19 and is mounted 180° out of phase with the eccentric 20 and the other of which is not keyed to the shaft 19 but is rotatable about it upon a pair of ball bearings 94, 95.

As may be seen most clearly in FIGURE 3, the cannister 93 is suspended from an overhanging arm 96, the end of which terminates in a sleeve 97 drivingly keyed to the shaft 19. The cannister 93 has a pair of upper and lower plugs 98, 99 threaded therein. These plugs facilitate insertion and removal of lead shot weights or of melted lead.

The other cannister 92 is mounted inside of the cannister 93 and beneath the arm 96. It also has a pair of plugs 100, 101 threaded in the upper and lower walls thereof which facilitate insertion of counterbalancing weights such as lead shot or melted lead. An aperture 102 is preferably formed in the overhanging arm 96 of the weight 91 so as to enable weights to be poured into the cannister 92 when the arm 96 is located over the plug 100.

5

Rotational drive to the inner weight 90 is effected through the drive belt 16 from the drive motor 15. This belt 16 is operative to drive the pulley 18 bolted to the underside of the weight 90.

The pulley 18 is generally annular in shape and has gear teeth 103 formed on its inner surface. These teeth 103 drive a spur gear 104 mounted for rotation interiorly of the pulley upon a sleeve 105. This sleeve 105 also carries a second pinion gear 106 keyed thereto and operative to drive another spur gear 107 keyed to the shaft 19. The sleeve 105 is rotatably journaled upon a stub shaft 108 which is fixedly mounted in the bottom wall 66 of the rectangular frame 60.

As a result of this geared drive to the shaft 19, the weight 91 and the eccentrics 20, 20a are driven in rotation by the shaft 19 in rotational direction opposite to the direction in which the pulley 18 and the attached weight 90 rotate about the common axis 67. The amount of weight contained in each of arcuate cannisters 92, 93 is determined empirically and is adjusted so that the net effect of the weights is to counterbalance the combined gyratory-reciprocatory movement of the screen assembly 21 as well as to counterbalance the imbalance of the two weights.

Referring now to FIGURES 8-11, there is illustrated diagrammatically and vectorially the manner in which these weights counterbalance the movement of the pan. Referring first to FIGURE 8, it will be seen that the eccentrics 20, 20a are mounted for rotation in the same direction but 180° out of phase with the rotation of the weight 91. The weight 90 is also 180° out of phase with the eccentrics 20, 20a but is mounted for rotation in an opposite direction. Consequently, when the resultant force generated by the reciprocating movement of the pan 21 tends to pull the shaft 19 to the right with a force P_1 , this force is balanced by the combination of the two forces W_1 , W_2 , generated by the weights 90, 91 about the same shaft 19. Thus, there is no net imbalance transmitted through the shaft 19 to the frame 13 of the sifter.

After 90° of rotation of the eccentrics 20, 20a and of the weight 91 in the same counterclockwise direction as viewed in FIGURE 9, the weight 91 is 180° out of phase with the weight 90 and the pan vector P_2 . At this time the vector W_1 of weight 91 exactly balances the combined vectors W_2 and P_2 of the weight 90 and pan 21.

When the eccentrics 20, 20a have rotated 180° (from the starting position illustrated in FIGURE 8 to the position illustrated in FIGURE 10), the weights 90, 91 are both 180° out of phase with the eccentrics and once again, the combined vectors W_1 , W_2 , of the weights balance the vector P_3 of the pan.

When the eccentrics have rotated through 270°, the two weights 90, 91 are 180° out of phase and the vector W_1 of weight 91 exactly counterbalances the combined vectors W_2 and P_4 of weight 90 and pan 21. Consequently, the contra-rotating weights not only partially balance each other but cooperate to balance the force generated by the pan in its gyrating-reciprocating movement.

Referring to FIGURE 7, it will be seen that the centers of gravity of the weights 90 and 91 are in a common horizontal plane 110 with the center of gravity of the screen assembly 21 so that the vectors P and W_1 , W_2 all operate in the same horizontal plane of the axis 111 of the trunnions 63, 64. Consequently, even when the slope of the pan is varied by varying the number of shims 49 beneath the base bracket 47 at the tail end of the pan, the vectors always continue to operate in the same common plane and thus counterbalance each other in that plane. This is in contrast to the prior art practice of having a single weight mounted for rotation about the axis of rotation of the eccentric and having its center of gravity rotating in a different plane from the plane in which the pan reciprocates. This prior art practice is illustrated in FIGURE 6 and necessarily generated a resultant force

6

which imparted a vibratory movement to the frame of the machine and the floor of the building in which the machine was mounted.

In operation material to be sifted is introduced through inlet port 45 above screen 29. Motor 15 rotates pulley 18 through belt drive 16. Eccentrics 20, 20a carried by the shaft 19 impart a gyratory motion to the head end of the sifter assembly. This gyratory motion may be of the order of four cycles per second. A large portion of the material being treated passes downwardly through the screen cloth 29 and through the coarse belt retaining screen 26 and drops into the pan 32. The sifting screen 29 slopes downwardly toward the tail end of the sifter. The tailings are discharged through a conventional discharge port (not shown) disposed at the tail end of the sifter. Clogging of the upper screen 29 is prevented by the rebound action of rubber balls 28 which bounce upwardly against the under-surface of screen 29 to keep that screen in a state of vertical vibration.

It has been determined that the motion or vibration transmitted to the base frame in a sifter provided with (a) dual contra-rotating weights located in a common plane with the plane of movement of the center of gravity of the pan and (b) the pan supported by dual supports at opposite ends of the shaft, the axis of which is the center of rotation of the gyratory movement, is reduced approximately ten-fold from the displacement or vibration in a machine of the type shown in Frei Patent No. 3,437,374.

We claim:

1. A sifter construction comprising a screen assembly including a screen cloth, said sifter assembly having a head end and a tail end, means for imparting a gyrating motion in a generally horizontal plane to said head, and means supporting said tail end for oscillatory movement, the improvement wherein said means for imparting a gyrating motion to said head comprises a shaft having a longitudinal axis located in a generally vertical plane, an eccentric mounted upon said shaft, means connecting said screen assembly to said eccentric so that rotational movement of said eccentric effects gyratory movement of the head end of said screen assembly, and dual counterweights mounted for rotation about said shaft, said dual counterweights being rotatable in opposite directions about the axis of said shaft, both of said weights having a center of gravity movable in a common horizontal plane.

2. The sifter of claim 1 wherein at least one of said counterweights is always 180° out of phase with said eccentric.

3. The sifter of claim 1 wherein the center of gravity of said screen assembly is movable in the same horizontal plane of movement as said centers of gravity of said weights.

4. A sifter construction comprising a screen assembly including a screen cloth, said screen assembly having a head end and a tail end, means for imparting a gyrating motion in a generally horizontal plane to said head, and means supporting said tail end for oscillatory movement, the improvement wherein said means for imparting a gyrating motion to said head comprises a vertical shaft and a pair of eccentrics located at opposite ends of said shaft, bracket means interconnecting said eccentrics to said screen assembly, and counterbalance means rotatable upon said shaft.

5. The sifter construction of claim 4 wherein said counterbalance means comprises at least two weights rotatably mounted upon said shaft, and means for simultaneously rotating said weights in opposite directions about said shaft.

6. The sifter construction of claim 5 wherein the centers of gravity of both of said weights are movable in a common horizontal plane.

7. The sifter construction of claim 6 wherein the cen-

ter of gravity of said screen assembly is movable in a common horizontal plane with the plane of movement of the centers of gravity of said weights.

8. A sifter construction comprising a screen assembly including a screen cloth, said screen assembly having a head end and a tail end, means for imparting a gyrating motion to said head, and means supporting said tail end for oscillatory movement, the improvement wherein said means for imparting a gyrating motion to said head comprises a vertical shaft and a pair of eccentrics located at opposite ends of said shaft, means interconnecting said eccentrics to said screen assembly, counterbalance means rotatable upon said shaft, said counterbalance means and said screen assembly having centers of gravity movable in a common horizontal plane, said eccentrics being equidistantly spaced from said horizontal plane.

9. The sifter construction of claim 8 wherein said counterbalance means comprises at least two weights rotatably mounted upon said shaft, and means for simultaneously rotating said weights in opposite directions about said shaft.

10. A sifter construction comprising a body mounted for pivotal movement about a generally horizontal axis, a shaft rotatably mounted within said body for rotation about a generally vertical axis, a generally horizontal screen assembly including a screen cloth, said screen assembly having a head end and a tail end, means supporting said tail end of said screen assembly for oscillatory movement, means for imparting a gyratory motion in a generally horizontal plane to said head end of said screen assembly, said last named means comprising a pair of eccentrics drivingly keyed to opposite ends of said shaft and bracket means interconnecting both of said eccentrics to said head end of said screen assembly, and counterbalance means keyed to and rotatable with said shaft.

11. The sifter construction of claim 10 wherein said counterbalance means includes a pair of weights rotatably mounted upon said shaft for rotation about the axis of said shaft and means for simultaneously rotating said weights in opposite directions about said shaft.

12. The sifter construction of claim 11 wherein the centers of gravity of both of said weights are movable in a common horizontal plane.

13. The sifter construction of claim 12 wherein the center of gravity of said screen assembly is movable in a common horizontal plane with the plane of movement of the centers of gravity of said weights.

14. A sifter construction comprising a body mounted for pivotal movement about a generally horizontal axis, a shaft rotatably mounted within said body for rotation about a generally vertical axis, a generally horizontal screen assembly including a screen cloth, said screen assembly having a head end and a tail end, means supporting said tail end of said screen assembly for oscillatory movement, means for imparting a gyratory motion to said head end of said screen assembly, said last named means comprising a pair of eccentrics drivingly keyed to opposite ends of said shaft and bracket means interconnecting both of said eccentrics to said head end of said screen assembly, said screen assembly having a center of gravity movable in a horizontal plane, said eccentrics being equidistantly spaced from said horizontal plane, and counterbalance means keyed to and rotatable with said shaft.

15. The sifter construction of claim 14 wherein said counterbalance means includes a pair of weights rotatably mounted upon said shaft for rotation about the axis of said shaft and means for simultaneously rotating said weights in opposite directions about said shaft.

16. The sifter construction of claim 15 wherein the centers of gravity of both of said weights are movable in said horizontal plane.

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HARRY B. THORNTON, Primary Examiner

ROBERT HALPER, Assistant Examiner

U.S. Cl. X.R.

74—87; 209—332, 366.5

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,498,456 Dated March 3, 1970

Inventor(s) Elmer W. Childs and Robert M. Broomall

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 70, change "108°" to --180°--.

Column 2, line 49, change "fo" to --of--.

SIGNED AND
SEALED

JUL 14 1970

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents