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C. S. LINCOLN ET AL
LOW HEAD VIBRATING SCREEN

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2 Sheets-Sheet 1

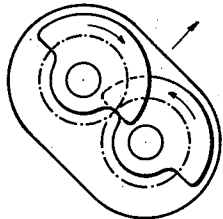
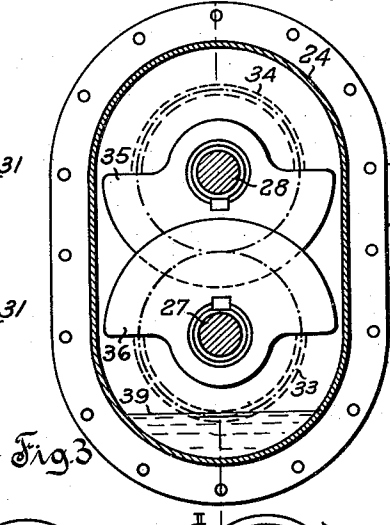
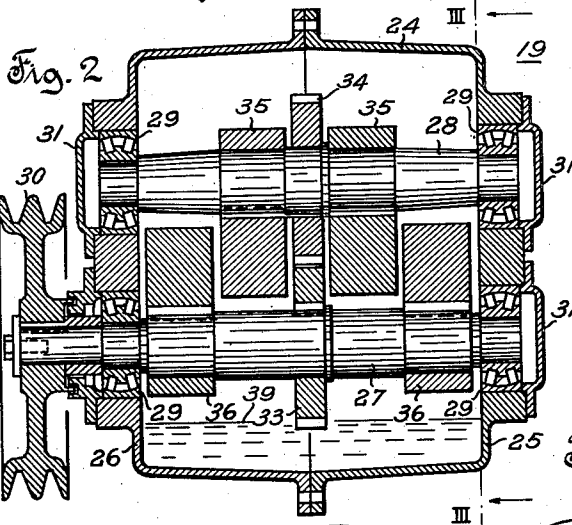
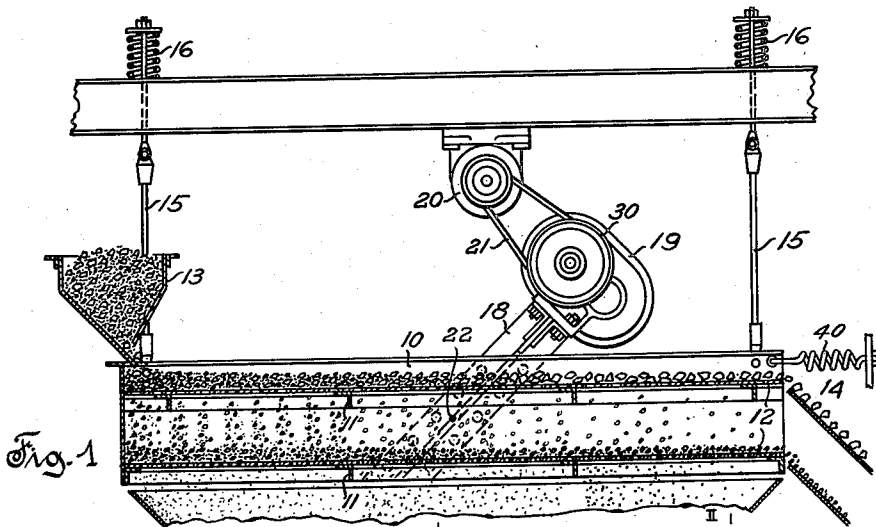


Fig. 4

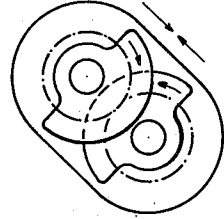


Fig. 5

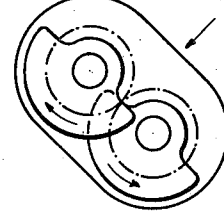


Fig. 6

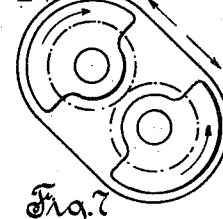


Fig. 7

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2 Sheets-Sheet 2

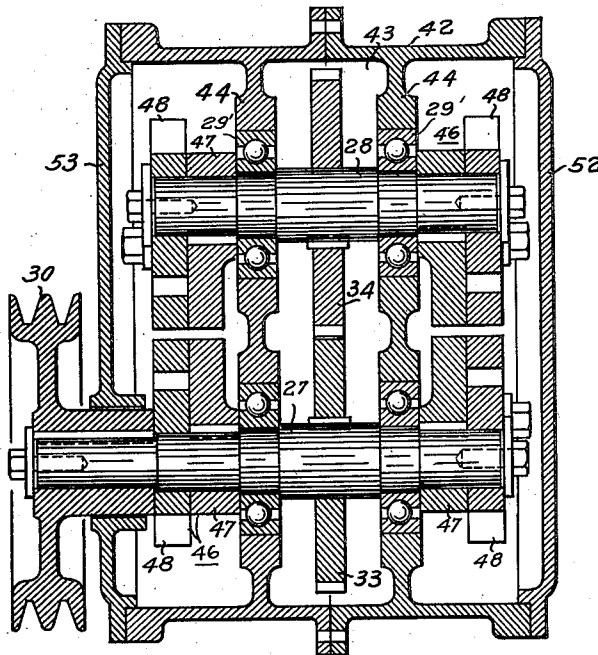


Fig. 8

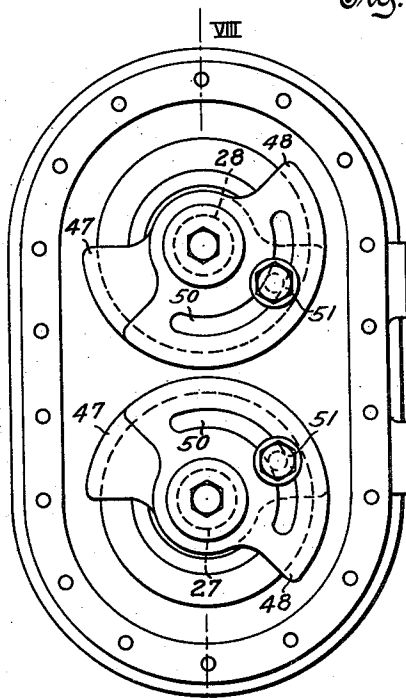


Fig. 9

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LOW HEAD VIBRATING SCREEN

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6 Claims. (Cl. 74-61)

This invention relates to a vibrating screen assembly, and particularly to a vibrating screen adapted for use in a substantially horizontal position. More particularly the invention comprises a screen body freely and yieldingly suspended in a substantially horizontal position and having a vibrator rigidly attached to the screen body and adapted to vibrate the screen in a plane at an acute angle to the plane of the screen body.

An object of this invention is to provide a simple, balanced, self-oiling, rectilinear vibrating mechanism for use in conjunction with vibrating bodies.

A further object of this invention is to provide a centrifugal, rectilinear vibrator, the amplitude of vibration of which is adjustable independently of the frequency thereof.

The invention is illustrated in the following figures, wherein:

Fig. 1 is a cross-sectional elevation of the screen assembly of this invention;

Fig. 2 is a central longitudinal cross-section of the vibrating mechanism taken on the line II—II of Fig. 3;

Fig. 3 is a transverse sectional view of the vibrating mechanism taken along the line III—III of Fig. 2;

Figs. 4, 5, 6, and 7 are diagrammatic views of the vibrating mechanism in four successive positions;

Fig. 8 is a central longitudinal sectional view of a modified form of vibrating mechanism taken along the lines VIII—VIII of Fig. 9; and

Fig. 9 is an end view of the vibrating mechanism of Fig. 8 with the closure plate removed.

It has been the custom in the past to mount vibrating screens at an appreciable angle to the horizontal, in order that the material—especially the oversize—may travel along the length of the screen from the feed end to the discharge end thereof. This method of mounting the screen is subject to two decided disadvantages. In the first place, the inclined position of the screen body requires a considerable space, which is seldom conveniently available in plants where vibrating screens are used; and secondly, when a screen is mounted at an angle to the horizontal, the force of gravity acting on the material in a vertical direction directs the material at an acute angle to the screen surface, so that part of the material, even though comprised of fine particles, is deflected to roll down the screen instead of passing through it.

Horizontal screens, on the other hand, take up

but little space in a vertical direction; and gravity actuates the material in a direction perpendicular to the screen surface, so that all of the fine material can pass through the screen cloth, instead of rolling along the surface.

Horizontal vibrating screens have not been widely used heretofore because there has been no satisfactory means for advancing the material along the screen, to get a continuous screening action. The application of a vibrating force in a plane at an acute angle to the screen surface has made it possible to use a horizontal screen—or even a screen arranged with its discharge end higher than its feed end—and yet obtain a positive movement of the material toward the discharge end of the screen. This is accomplished by reciprocating the screen in a straight line at an acute angle to the horizontal, the direction of reciprocation being upward in the direction of movement of the material and downward in the direction of the feed end. While a rectilinear vibrator is illustrated, it is clear that any mechanism which causes vibration of the screen in a plane which makes an acute angle with the screen would also be effective.

A vibrator designed for applying this reciprocating rectilinear movement to the screen consists essentially of a casing carrying two parallel shafts geared to rotate in opposite directions at the same speed. Each shaft is provided with eccentric weights, the distribution of the weights being symmetrical on each shaft to avoid unbalanced couples between the vibrating mechanism and its mounting. The vibrator is preferably mounted rigidly on the screen body in position to exert its force to the screen body at the center of gravity thereof, the vibrator supports being fixed on the sides of the screen body.

The vibrating screen illustrated comprises a screen body made of frame members and reinforcing members, and carries one or more screen cloths. The screen has a feed hopper and a discharge end, and the fines pass through the screen cloth while the oversize passes over the screen to the discharge end, as is well known to those skilled in the art. The screen is suspended by four cables, which are attached to an overhead support (which may be part of the building in which the screen is housed) through helical springs. These may be either tension or compression springs.

Mounted rigidly on the screen body by means of supports is a vibrator which may be operated by means of a motor, mounted on a

stationary support, which actuates the vibrator through elastic belts 21. The vibrator supports 18 are fixed on the screen frame members 10, to be in line with the force exerted by the vibrator. An angle of 45° between the screen cloth and direction of force exerted by the vibrator, which has been found by test to be the most effective, is shown. The supports 18, which serve not only to support the weight of the vibrator, but also serve to transmit the vibrating force to the screen body, are located in a plane passing substantially through the center of gravity of the screen body, indicated by the numeral 22, so that all parts of the screen frame are reciprocated equally. It will be noted that, while the vibrating mechanism 19 reciprocates rapidly with the screen to which it is rigidly connected, the driving motor 20 is attached to a fixed support, and is not exposed to the hard wear resulting from rapid vibration. A particularly effective means of transmitting power from the fixed motor to the vibrating sheave 30 is by a plurality of V-belts of elastic rubber composition, which are known in the transmission art by the trade name "Texropes".

The construction of the vibrator 19 is best shown in Figs. 2 and 3. The casing 24, of generally cylindrical form, is provided with end walls 25 and 26, which carry parallel shafts 27 and 28 in self-aligning bearings 29. The shaft 27 extends beyond the casing at one end, and carries a sheave 30 fixed thereon. Bearing covers 31 and appropriate packing at the pulley end of shaft 27 serve to seal the casing so that it may contain oil for lubricating the bearings 29. Identical gears 33 and 34 are fixed centrally of shafts 27 and 28, respectively, for mutual engagement, whereby the rotation of sheave 30 serves to rotate shafts 27 and 28 at equal speeds in opposite directions.

Mounted symmetrically on opposite sides of gear 34 are two eccentric weights or masses 35, fixed on shaft 28. Another pair of eccentric weights 36 are fixed on shaft 27 symmetrically with respect to gear 33. These weights 35 and 36 are spaced axially on their respective shafts so as not to interfere with each other during operation of the vibrator. It will be seen that rotation of pulley 30 will cause shafts 27 and 28 and their weights to rotate at the same speeds in opposite directions. The weights 35 and 36 are so fixed on their respective shafts that the resultant of the centrifugal force caused by their rotation will always be along the line perpendicular to the plane passing through the axes of the shafts as explained below.

The particular arrangement of rotating weights shown in Fig. 2 being symmetrical about the transverse center of the casing, no twisting couple results from the rotation of the weights. The operation of the vibrator to produce rectilinear vibration is best illustrated in Figs. 4 to 7, which show diagrammatically the location of the eccentric weight at four successive positions 90° apart in the rotation of the shaft. In the position of the weight shown in Fig. 4, the centrifugal forces due to both weights are in the same direction, namely, upward to the right, and the resultant force exerted on the screen will be in this direction, and equal in magnitude to the sum of these two forces.

One-quarter cycle later the weights will be in the position shown in Fig. 5, the centrifugal force acting on each being opposed by the equal and

opposite centrifugal force acting on the other, the net force acting on the screen being zero.

Fig. 6 shows the position of the weights a half cycle after the position illustrated in Fig. 4. Here the centrifugal forces acting on both weights are again exerted in the same direction, but opposite to the direction in which they act in Fig. 4, thus effecting a return stroke from the movement caused by the force illustrated in Fig. 4.

After another quarter cycle has elapsed, the weights will be in the position shown in Fig. 7, where the centrifugal forces acting on the weights again oppose each other, the net force acting on the screen being zero.

From the above description, wherein the vibrating mechanism is illustrated in its positions of zero and maximum force in both directions, it is clear that the vibrator exerts a force which varies between zero and two maxima in opposite directions, the force being always directed along the same straight line—hereinafter termed rectilinear force. The magnitude of this force has a sinusoidal variation.

Fig. 3 shows at 39 the level of the oil contained in the sealed casing. It will be seen that as the shaft 27 rotates, the weights 36 fixed thereto dip into the oil and distribute it, and serve to lubricate all four bearings. The gear 33 may also dip into the oil.

Since the vibrating mechanism is rigidly mounted on the screen body, the mechanism imparts a sinusoidal rectilinear force to the screen body in a direction approximately 45° with the horizontal. Since the screen body is freely suspended on springs, the movement of the body produces a reaction on the part of the springs, tending to return the body to its position of rest. Thus the four forces acting on the screen, namely, the force of gravity, the rectilinear force of the vibrator, the reactive force of the springs, and the inertia of the screen body and vibrating mechanism, combine to produce a linear pulsating reciprocation of the screen.

It will be noted that as the screen moves upward to the right, it carries its load of material with it. As the screen slows down and reverses its movement, the material continues its upward and onward movement due to its own inertia and then falls back on to the screen cloth as the screen begins its upward movement again. The trajectory of the material constitutes a parabola which starts with a line at 45° to the screen cloth, reaches a maximum height, and then falls downward and is suddenly interrupted in its trajectory by impact with the screen cloth. This impact tends to expedite the separation of the material into fines and oversize, while the 45° trajectory causes a rapid advance of the oversize along the screen to the discharge end.

Because the screen is freely suspended, the reciprocation of the screen is not transmitted to the overhead support. The horizontal position of the screen makes for a maximum separating effect on the material being screened, and also makes it possible to place the screen in locations where little head room is available. The vibration at 45° to the horizontal produces a satisfactorily rapid advance of the material along the screen. In fact it has been found in practice that the screen will advance the material toward the discharge end even when the screen is inclined so that the discharge end is at a higher elevation than the feed end. In other words the screen will convey material "uphill".

It has also been found in practice that the screen here disclosed is unexpectedly effective in eliminating any clogging. All screens, especially when using cloths of large mesh, occasionally become clogged due to pieces of material becoming wedged in the screen. Possibly due to the rapid and positive movement of the screen, aided by the forward advance of the material being screened, pieces of stone or ore which become clogged or wedged within the meshes of the screen cloth are soon thrown up and continue under way. This action is in part due to the sudden deceleration of the screen when, in its upward movement, it receives the impact of the falling material which had been thrown upward on the preceding upward movement of the screen.

If desired, a tension spring 40 may connect the screen body with an adjacent fixed part, in order to provide the necessary tension on the belt 21.

A modified form of vibrator, wherein the magnitude of the resulting rectilinear force is adjustable, is shown in Figs. 8 and 9. In the vibrating mechanism illustrated in Figs. 2 and 3, if it be desired to alter the amplitude of vibration, it is necessary to completely disassemble the mechanism, and substitute weights of a different magnitude for the weights 35 and 36. This is a lengthy and difficult task, involving some provision for taking care of the oil in the casing, and also necessitating the removal and application of weights on the shafts 35 and 36, these weights being usually shrunk on the shaft for increased rigidity.

This difficulty is largely obviated when the vibrating mechanism is constructed in accordance with Figs. 8 and 9. This modification includes a split casing 42, open at both ends, and having a gear case 43 centrally thereof, closed by intermediate walls 44. Parallel shafts 27 and 28 are rotatably mounted in bearings 29 fixed in walls 44, one of the shafts having a sheave 30 thereon. Fixed on shafts 27 and 28 are duplicate gears 33 and 34, respectively, mounted within the gear case 43. The gear case may contain oil (not shown) to lubricate the gears and bearings into which one of the gears may dip. Mounted on each end of each shaft, adjacent to the gear case, are composite eccentric weights 46. Each composite eccentric weight consists of a simple eccentric weight 47 fixed on its shaft, and an adjacent similar eccentric weight 48 angularly adjustable on the same shaft. The adjustable weight 48 is provided with an arcuate slot 50 through which screw 51 is adapted to pass. Screw 51 is inserted into a tapped aperture (not shown) in fixed weight 47.

This construction makes it possible, by loosening screw 51, to move adjustable weight 48 to any angular position with respect to fixed weight 47, within limits. Such relative movement serves to vary the eccentricity of the composite eccentric weight from a maximum when the angular positions of the fixed and adjustable weights coincide, to a minimum of zero when the fixed and adjustable weights are mounted at an angle of 180° apart. It will be observed that in order to maintain a balanced rectilinear system of forces, all adjustable weights on one shaft must be moved in the same direction and mounted at the same angle, and the adjustable weights on one shaft must be moved in an angular direction opposite to that of the movement of the adjustable weights on the other shaft, as is clearly exemplified in Fig. 9.

Removable end plates 52 and 53 close the open casing, for greater cleanliness and safety.

When it is desired to vary the amplitude of vibration caused by this vibrating mechanism, it is only necessary to remove end plates 52 and 53, loosen the screw 51 of each weight, move the adjustable weight 48 to the proper angle with respect to its fixed plate 47, tighten the screw 51, and again attach closures 52 and 53 in place. This is done without disassembling the entire mechanism, and without disturbing the oil contained in gear case 43.

It will be noted that in both modifications of vibrating mechanism, the weights and gears are symmetrically located on their respective shafts, so that there is no unbalanced couple tending to twist the vibrating mechanism on its support. This is an important feature, since the presence of any such twisting couple would soon shake the vibrator loose from its support. These vibrators and screens receive very hard usage in industry and must be very rugged and dependable to survive under the rough treatment received in rock and ore treating plants, cement mills, mines, etc.

While the vibrator has been shown as being applied to a horizontal screen to reciprocate it at an angle to the horizontal, it can obviously be applied to the vibration of screens at any desired angle, or the screen itself may be mounted at any desired angle. Moreover, the vibrator may be used to vibrate apparatus other than screens, such as sieves, hoppers, sifters, tappers, packing and tamping apparatus, etc., and is especially applicable to feeders and conveyors of the reciprocated type.

While a specific construction has been described for purposes of illustration, it is to be understood that the invention is not to be restricted to the exact details shown and described since various modifications within the scope of the claims will occur to persons skilled in the art to which this invention pertains.

It is claimed and desired to secure by Letters Patent:

1. A vibrating mechanism comprising a casing having two intermediate walls forming a gear case, said walls being provided with bearings, two parallel shafts mounted in said bearings, said shafts being provided with meshing gears of equal diameter within said gear case, eccentric weights fixed on each shaft at each side and exterior to the gear case, the weights on each shaft being arranged thereon symmetrically of the gear on said shaft, providing a balanced vibrating mechanism.

2. A vibrating mechanism as defined in claim 1 wherein a body of oil is contained in said gear case, in which at least one of the gears is partly immersed.

3. A vibrating mechanism comprising a housing, two intermediate walls therein forming a gear case, said walls being provided with bearings, two parallel coextensive shafts mounted in said bearings and contained within said housing, a gear fixed centrally on each shaft within said gear case, said gears being of equal diameters and meshing with each other, equal eccentric weights fixed on each end of each shaft within the housing but exteriorly of said gear case, the center of gravity of all the weights on each shaft being located in a single plane passing through the axis of said shaft, and the shafts being so related that when the centers of gravity of the weights on one shaft are at one side of the shaft

in the plane passing through the axes of the two shafts, the centers of gravity of the weights on the other shaft are in the same plane and on the opposite side of said last named shaft.

4. A vibrating mechanism comprising a casing having side walls and end walls, said end walls being provided with bearings, two parallel shafts mounted in said bearings and extending beyond the end walls at both ends, a gear carried by each shaft between the end walls, said gears being of equal diameters and meshing with each other, masses of adjustable eccentricity mounted at each end of each shaft exteriorly of the end walls, and removable end plates mounted on said side walls for encasing said eccentric masses.

5. A vibrating mechanism comprising a casing having end and side walls, two parallel shafts mounted in said end walls, a gear mounted substantially centrally of one of said shafts meshing with a corresponding gear mounted substantially centrally of the other of said shafts, and eccentric weights mounted on each of said shafts symmetrically of the gear thereon.

6. A vibrating mechanism as defined in claim 5 wherein the weights on one of said shafts are axially spaced from the weights on the other of said shafts.

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