April 29, 1941. H. L. CORWIN 2,239,993

VIBRATING SCREEN

Filed April 10, 1939 3 Sheets-Sheet 1

Fig. 1.

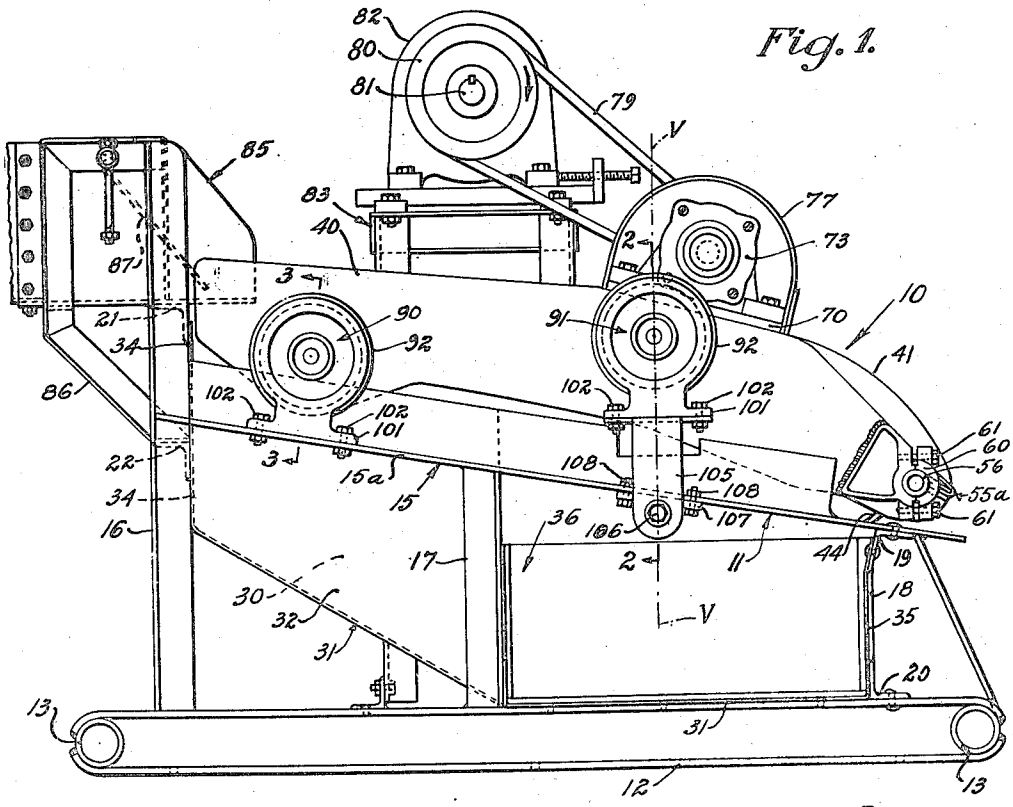
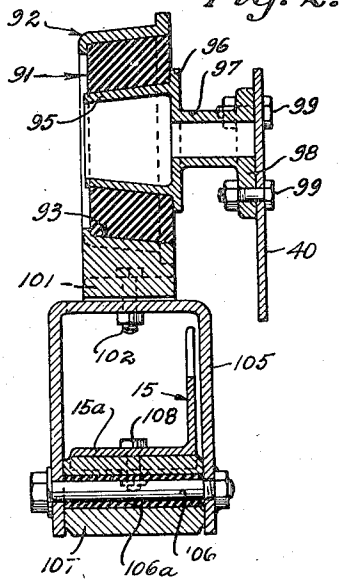


Fig. 2.



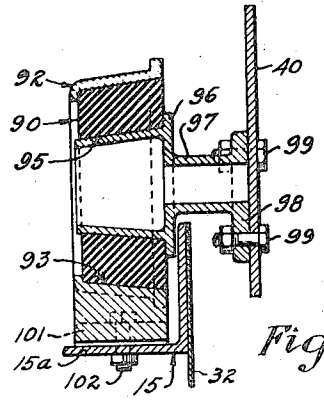


Fig. 3.

Inventor.
Harry Lee Corwin.

Attorney.

April 29, 1941. H. L. CORWIN 2,239,993

VIBRATING SCREEN

Filed April 10, 1939 3 Sheets-Sheet 2

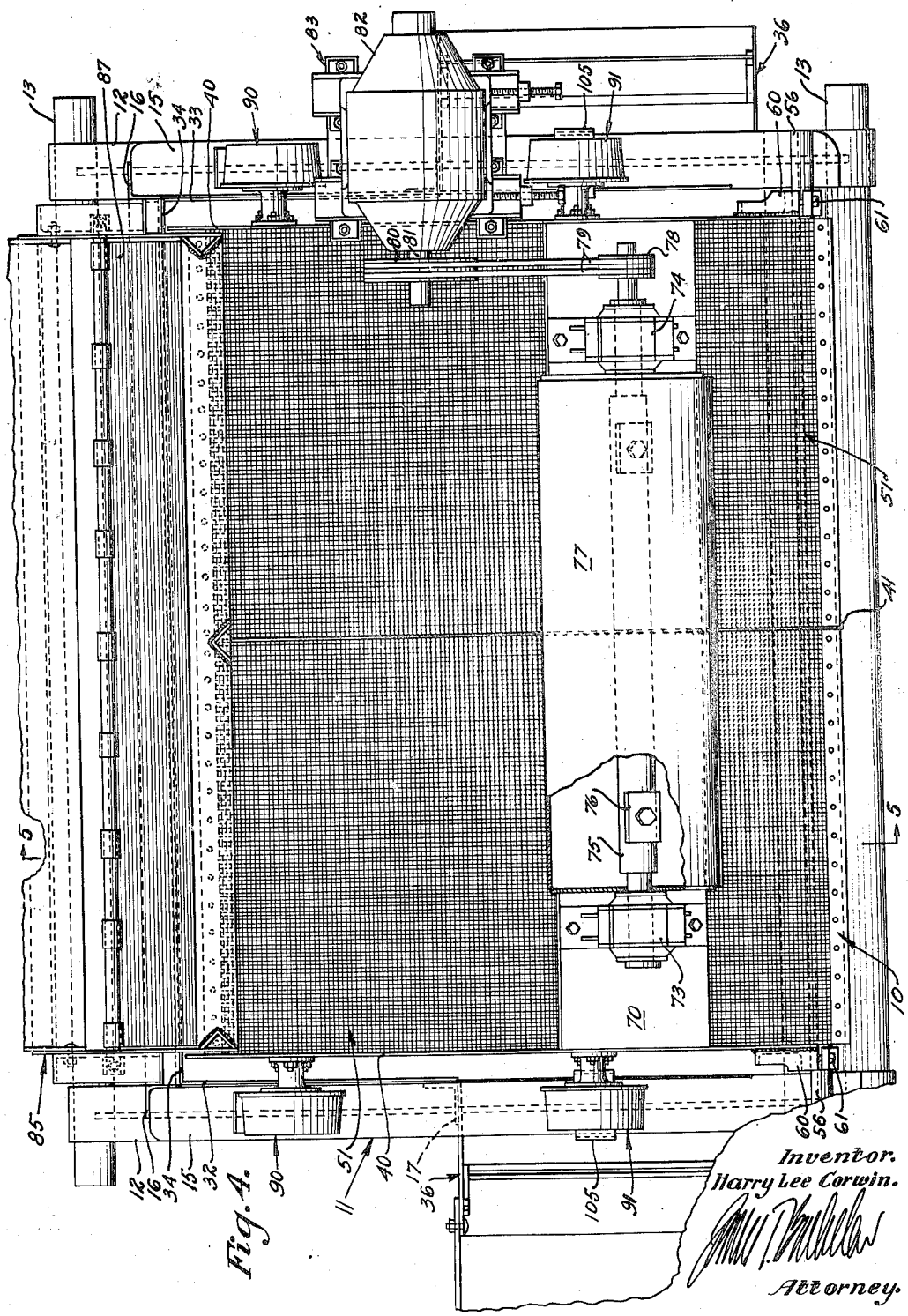


Fig. 4.

Inventor.
Harry Lee Corwin.

Attorney.

April 29, 1941. H. L. CORWIN 2,239,993

VIBRATING SCREEN

Filed April 10, 1939 3 Sheets-Sheet 3

Fig. 5.

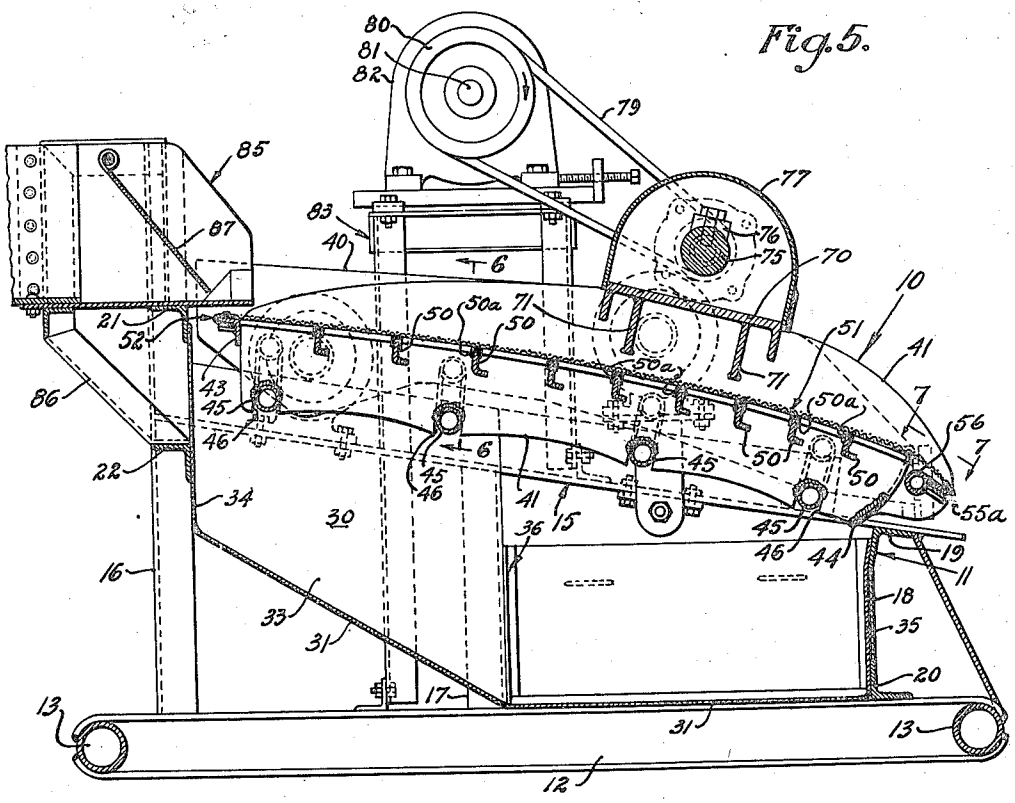


Fig. 8.

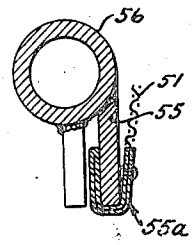
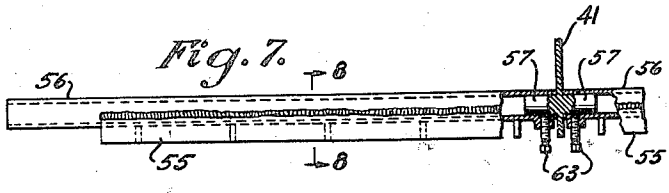


Fig. 7.



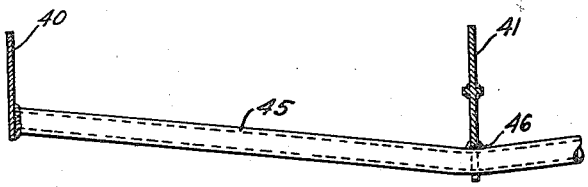


Fig. 6.

Inventor.
Harry Lee Corwin.

Attorney.

Patented Apr. 29, 1941

2,239,993

UNITED STATES PATENT OFFICE

2,239,993

VIBRATING SCREEN

Harry Lee Corwin, Los Angeles, Calif., assignor to Vernon Tool Co. Ltd., Los Angeles, Calif., a corporation of California

Application April 10, 1939, Serial No. 267,042

8 Claims. (Cl. 209—326)

This invention relates generally to vibrating screens, and more particularly to vibrating screens of the type wherein a vibrating screen frame is mounted in resilient supports. The invention is concerned particularly with a type of screen employed in oil field operations to separate "rotary mud" from sand and cuttings, and will be particularly described with that application principally in view, but without implied limitation thereto since the invention is equally adaptable to various other classes of vibratory screens.

The present invention may be regarded as an improvement in a type of screen in which a vibratory screen frame, which carries a rotating eccentric weight, is mounted on resilient supports, such as rubber blocks. In a prior screen of this type, four of such blocks are used near the four corners of a substantially rectangular screen frame, and are mounted directly on a stationary sub-frame. Speaking generally, the greater the speed of rotation of the eccentric weight, the greater, of course, is the vibratory action of the frame and the effectiveness of screening. However, increased speed is accompanied by increased strain on the machine, which is severe at best, and in practice a speed of approximately 3400 R. P. M. is about the maximum consistent with safety to the machine, unless constructed of unduly heavy materials.

A general object of the invention is to provide an improved vibratory screen of the general type mentioned, characterized by increased amplitude of vibratory action without increase in the speed of rotation of the eccentric weight.

A more particular object is to provide an improved mounting for the vibratory screen which will increase the vibratory freedom of the screen and will increase the amplitude of vibration, particularly the vertical component, or component normal to the screen surface.

In accordance with a preferred form of the present invention, the screen frame, with its unbalanced rotating shaft, is mounted on a pair of resilient supports, preferably live rubber blocks, which support the screen frame at points located in a vertical plane passing substantially or approximately through or near the center of gravity of the vibrating screen assembly, this plane lying preferably somewhat to one side of the unbalanced shaft. In the preferred form of the invention, these rubber blocks are carried by upstanding rocker arms, which are pivotally mounted on the sub-frame, in such manner that the screen-frame is supported for free floating movement in a horizontal or longitudinal direction. Another pair of resilient supports, also preferably live rubber blocks, support the screen-frame at points horizontally spaced from the first mentioned blocks, and on the side of the center of gravity opposite to that on which the unbalanced shaft is located, these latter resilient supports being mounted directly on the sub-frame. In result, the flexibility of the screen-frame mounting, and the vibration amplitude of the screening frame, are very materially increased.

It is of course obvious that the slower the machine can be operated, the less will the strain be on bearings and vibrating frame, and the less will be maintenance troubles. One practical embodiment of the particular type of prior art machine referred to has a working speed of between 3000 and 34000 R. P. M., any speed substantially above 3400 R. P. M. placing too great a strain on the mechanism for safety, while the machine is inefficient below 3000 R. P. M. The same machine, but with one pair of the resilient mountings moved to a position in vertical alinement with the center of gravity of the vibratory screen, and also placed on rockers, has its optimum performance within the range of 2600 to 2800 R. P. M.—a material reduction—while at the same time the amplitude of vibration is substantially doubled. Thus the present invention results in substantially greater vibration amplitude at substantially lesser speed, and practical machines constructed in accordance with the invention have demonstrated substantially increased effectiveness of screening.

The invention will be better understood from the following detailed description of a present preferred embodiment thereof, reference for this purpose being had to the accompanying drawings, in which:

Fig. 1 is a side elevation of a machine in accordance with the present invention;

Fig. 2 is a vertical section on line 2—2 of Fig. 1, showing one of the screen-frame mountings;

Fig. 3 is a section taken on line 3—3 of Fig. 1, showing another of the screen-frame mountings;

Fig. 4 is a plan view of the machine;

Fig. 5 is a section taken on line 5—5 of Fig. 4;

Fig. 6 is a section taken as indicated by line 6—6 of Fig. 5;

Fig. 7 is a view taken as indicated by arrows 7—7 on Fig. 5; and

Fig. 8 is a section taken as indicated by line 8—8 of Fig. 7.

In the drawings, which show a typical illustrative embodiment of the invention, numeral 10 designates generally the vibratory screen-frame,

and numeral 11 designates generally a suitable sub-frame or base. The latter includes parallel longitudinally extending skids 12, connected by forward and rearward tubular transverse members 13. At the sides of the machine, directly over skids 12, are inclined angle members 15, which are supported at their rearward or elevated ends by angle members 16 rising from skids 12, at points intermediate of their lengths by angle members 17 rising from skids 12, and at points near their forward ends by a plate 18 welded between the opposed flanges of transverse angle members 19 and 20, which latter are welded to angle members 15 and skids 12, respectively. Transverse, horizontal angle members 21 and 22 extend between and are welded to rearward angles 16 to brace the machine at the rearward end and provide support for certain members later to be mentioned.

Within frame work 11 as described, and below screen frame 10, is a collection chamber 30 for materials passed through the screen, the chamber being defined by bottom wall 31, side walls 32 and 33, rear wall 34, and front wall 35. A discharge trough 36 opens through side wall 32.

The aforementioned screen-frame 10 is comprised of side plates 40 and a central longitudinal partition 41, joined at the rear by transverse angle member 43 welded to members 40 and 41, and at the front by a welded transverse member 44. The screen-frame is further braced by transverse tubular members 45 extending between and welded to side plates 40 and passing through notches 46 in the lower edge of partition 41 (see Figs. 5 and 6).

Arranged transversely of frame 10 on each side of partition 41 is a plurality of transverse screen supporting members 50, of angle section. The upper edges of these members 50 carry rubber moldings or guards 50a which engage and support the wire screen 51, and the members are so disposed as to support screen 51 in a downwardly inclined and curved position, as illustrated in Fig. 5. The rearward edge of screen 51 is hooked to the rearwardly projecting flange of angle member 43, as indicated at 52, while the forward edge of the screen is hooked over a bar 55 welded to a rotatably adjustable tube 56, in the manner clearly indicated at 55a in Fig. 8. In the particular construction illustrated, there are two screen members, one on each side of center partition 41, and each of these is secured to a bar 55 mounted on a rotatable tube 56. The ends of tubes 56 adjacent partition 41 are rotatably mounted on studs 57 welded to partition 41 (see Fig. 7), while the other ends of the tubes are secured and supported by clamps 60 secured in position by screws 61. The ends of the tubes adjacent partition 41 are secured against rotation by means of set screws 63 engageable against studs 57 (see Fig. 7). The screens are tensioned by rotation of tubes 56, which are then secured in tensioning position by setting up screws 61 and 63.

Extending transversely between the upper portions of side plates 40, and at a position preferably approximately two-thirds of the frame length from the rearward or feed end thereof is a channel member 70, which is further braced by transverse members 71, members 70 and 71 being secured rigidly to plates 40 and 41 as by welding. Mounted on the upper side of channel member 70 are bearings 73 and 74 for opposite ends of a rotatable shaft 75. The latter being provided with eccentric weight 76. A guard 77 secured to channel member 70 encloses shaft 75 between bearings 73 and 74. A pulley 78 on shaft 75 is connected by belts 79 to a pulley 80 on the shaft 81 of an electric drive motor 82. This motor 82 is supported by any suitable supporting structure 83 extending upwardly from the sub-frame at one side of vibrating screen-frame 10. Unbalanced shaft 75, mounted as described, is thus located on the upper portion of the screen, and in a position preferably approximately two-thirds of the way from the feed to the discharge end of the screen, though it is to be understood the exact position is subject to some modification. Preferably, however, shaft 75 is so located that it is forwardly of the center of gravity of the screen frame, or in other words, to the right of the center of gravity as viewed in Fig. 1, the vertical plane in which the center of gravity of the screen frame and parts mounted thereon is located being represented by the dot-dash line V.

The materials to be screened are fed to the rearward, upper portion of the screen from a delivery trough generally indicated at 85, the latter being shown in Figs. 1 and 5 to be supported by suitable bracing 86 extending from frame member 22, and also by frame member 21 (see Fig. 5). An adjustable gate 87 spreads the material uniformly over the screen.

There remains for description the resilient mounting of the vibratory screen-frame on sub-frame 11. In the illustrative and preferred embodiment of the invention, this resilient mounting comprises four live rubber blocks, two of which, designated at 90, are rigidly mounted on the sub-frame and support the vibratory screen-frame 10 near or at its upper or feed end, and two of which, designated at 91, are mounted for free-floating movement in a direction longitudinally of the screen-frame, being preferably rocker-mounted on the sub-frame, and support vibratory frame 10 at points in a vertical plane which passes substantially through the center of gravity of the vibratory assembly. The vibratory assembly may be defined as vibratory frame 10 and all parts mounted thereon, including rotating shaft 75 and eccentric weights 76.

In the specific construction here illustrated, rubber blocks 90 and 91 are circular in formation and peripherally engaged by and encased within mounting castings 92. The blocks have bores 93 receiving tubular member 95, preferably slightly conical, mounted on tubular studs 97 furnished with mounting flanges 98 secured, as by bolts 99, to screen frame side plates 40. The inner ends of tubular members 95 have annular flanges 96, which engage and confine the inner surfaces of the rubber blocks.

The mounting castings 92 for blocks 90 have base flanges 101 secured by bolts 102 directly to the horizontal flanges 15a of the aforementioned angle members 15 forming a part of the rigid sub-frame. The mounting castings 92 for blocks 91 are provided with similar base flanges 101 secured as by bolts 102 to the upper portions of upstanding rocker arms 105 (Figs. 1 and 2), the latter being pivotally mounted at their lower ends on studs 106 carried by bearings or supports 107 secured as by screws 108 to the underside of sub-frame flange 15a. Preferably, rubber bushings 106a are used between 106 and 107 (see Fig. 2). As illustrated in Fig. 1, the pivotal mounting axis of rockers 105 is in vertical alinement with the centers or central axis of rubber block 91.

In conformity with what has previously been

said, the center of gravity of screen-frame 10, together with all its appurtenances including the vibrator constituted by the eccentric weighted or unbalanced shaft, is substantially in the same vertical plane with the centers of blocks 91 and the pivot axis of rockers 105, while the unbalanced shaft 75 is offset somewhat forwardly from this plane. The weight of the vibrating assembly is accordingly carried substantially exclusively by rocker-mounted rubber blocks 91. Rubber blocks 90, supporting the vibrating frame at points spaced horizontally from blocks 91, therefore do not bear any substantial part of the weight of the vibratory frame. Accordingly, whereas the lower portions of rubber blocks 91 are normally under substantial compression, blocks 90 are not normally under substantial compression. This condition results in materially increased freedom and capability for vibration of frame 10, when the eccentric weighted shaft is set into rotation. In particular, the positioning of one pair of the resilient supports in approximately the vertical plane of the center of gravity increases the freedom for vertical movement, or for rocking action about the centers of said supports, while the arranging of said supports for free floating horizontal travel, here typically shown as accomplished through use of the described rocker mountings, increases the freedom for horizontal movement. It will be evident that the nearer the points of support of the shaker frame by blocks 91 are to the vertical plane passing through the center of gravity of the shaker frame and unbalanced shaft, the greater will be the proportion of the weight of the shaker frame and unbalanced shaft borne by blocks 91, and therefore the greater will be the freedom for the described vibratory action; however, any approach of blocks 91 toward the center of gravity of the shaker frame and unbalanced shaft, so as to place the load more greatly on blocks 91 than on blocks 90, will increase the freedom for the described vibratory action in accordance with the principles of the present invention, particularly when the blocks 91, or their equivalent, are supported for comparatively free-floating horizontal movement, or movement longitudinal of the shaker frame. At the same time the location of unbalanced shaft at a position offset in a forward direction from the vertical plane which includes the centers of action of the rocker mountings induces a rocking action of the screen frame about said centers. These features greatly free the screen frame for the required vibratory action. This increased freedom may readily be observed when the unbalanced shaft is at rest, simply by manually shaking the frame.

In operation, unbalanced shaft 75 is driven in a right-handed direction, as viewed in Fig. 5, and for a typical embodiment of the invention, the appropriate speed of rotation for optimum screening performance ranges from 2500 to 2800 R. P. M. Under such conditions the entire screen frame is set into high amplitude vibration. A given point on the rearward or feed end of the screen frame describes, typically, a comparatively flat elliptical path, the major axis of which may be vertical, or tilted away from the feed end of the screen to an angle up to approximately 45°, depending somewhat upon the speed of the machine. Typically, the ellipse is vertical at a speed of approximately 2500 R. P. M., and becomes tilted to a 45° angle at about 2600 R. P. M., remaining at the latter angle for speeds greater than 2600 R. P. M. A given point on the other (forward) end portion of the screen frame describes, typically, a somewhat elliptical path, with its major axis approximately vertical, the minor axis of the ellipse being proportionately somewhat greater than for the ellipse at the feed end of the frame. For a typical embodiment of the invention, the elliptical path at the feed end of the frame is of a length of approximately from $\frac{3}{32}$'' to $\frac{5}{32}$'' or greater, depending upon the speed and the individual characteristics of the machine tested, while the horizontal component of vibration depends upon the length and also the inclination of the long axis of the elliptical path with reference to horizontal, as will be readily apparent. The horizontal component is ample under the running conditions described. The elliptical path at the forward end portion of the frame, on the other hand, has, typically, a substantially vertical major axis, and therefore a vertical component of travel, of a length of from $\frac{1}{16}$'' to $\frac{3}{32}$''. The horizontal component at the forward end portion of the frame ranges typically from two-thirds to nearly equal to the vertical component, again depending upon certain factors which are variable in operation and construction.

The machine as described thus provides materially increased amplitude of vibration, in both vertical and horizontal directions, while operating at reduced speed. The effectiveness of the screening action is therefore materially increased, while owing to decreased speed of the machine, wear on the bearings and breakage of parts is materially decreased.

It is to be understood that while I have here shown a typical embodiment of my invention, this is for illustrative purposes only, and that various changes in design, structure and arrangement may be made without departing from the spirit and scope of the invention or of the appended claims.

I claim:

1. A vibratory screen comprising, a vibratory screen frame having a longitudinally extending screen fabric, a vibrator mounted on said screen frame, a stationary frame, a pair of universally resilient supporting elements connected with opposite side portions of said vibratory screen frame at points approximately in a vertical plane that passes through the center of gravity of said screen frame and vibrator, means supporting said supporting elements on said stationary frame for free-floating substantially horizontal movement in a direction longitudinally of the screen frame, said means comprising a pair of substantially vertical rocker arms pivotally mounted on the stationary frame and supporting said supporting elements at their free ends, and another pair of universally resilient supporting elements supported by said stationary frame and connected with said vibratory frame at points horizontally spaced from said center of gravity in a direction longitudinally of the vibratory screen frame.

2. A vibratory screen comprising, a vibratory screen frame having a longitudinally extending screen fabric, a vibrator mounted on said screen frame, a stationary frame, a pair of universally resilient supporting elements connected with opposite side portions of said vibratory screen frame at points approximately in a vertical plane that passes through the center of gravity of said screen frame and vibrator, means supporting said supporting elements on said stationary frame for free-floating substantially horizontal movement in a direction longitudinally of the screen frame, said means comprising a pair of

substantially vertical rocker arms pivotally mounted on the stationary frame and supporting said supporting elements at their free ends, and additional resilient supporting means mounted on said stationary frame and supporting said vibratory screen frame at a position horizontally spaced from said center of gravity and near one end of the screen frame.

3. A vibratory screen comprising, a vibratory screen frame having a longitudinally extending screen fabric, a vibrator mounted on said screen frame, a stationary frame, a pair of universally resilient supporting elements connected with opposite side portions of said vibratory screen frame, means supporting said supporting elements on said stationary frame for free-floating substantially horizontal movement in a direction longitudinally of the screen frame, said means comprising a pair of substantially vertical rocker arms pivotally mounted on the stationary frame and supporting said supporting elements at their free ends, and another pair of universally resilient supporting elements supported by said stationary frame and connected with said vibratory frame at points horizontally spaced from said first mentioned supporting elements in a direction longitudinally of the vibratory screen frame.

4. A vibratory screen comprising, a vibratory screen frame having a longitudinally extending screen fabric, a vibrator mounted on said screen frame, a stationary frame, a pair of universally resilient supporting elements connected with opposite side portions of said vibratory screen frame, means supporting said supporting elements on said stationary frame for free-floating substantially horizontal movement in a direction longitudinally of the screen frame, said means comprising a pair of substantially vertical rocker arms pivotally mounted on the stationary frame and supporting said supporting elements at their free ends, and additional resilient supporting means mounted directly on said stationary frame and connected with said vibratory screen frame at a position horizontally spaced from said universally resilient supporting elements in a direction longitudinally of the vibratory screen frame.

5. A vibratory screen comprising, a screen frame having a feed end and a discharge end and provided with a longitudinally extending screen fabric, an unbalanced shaft rotatably mounted on said screen frame in a transversely extending position, the center of gravity of said screen frame and unbalanced shaft lying in a vertical plane horizontally offset from the center of rotation of said unbalanced shaft, a pair of resilient supports engaging opposite side portions of said screen frame at points located near said vertical plane, upstanding rocker arms carrying said supports at their upper ends and arranged for pivotal action in planes transversely of said unbalanced shaft, and resilient supporting means engaging said screen frame at a point horizontally spaced from said vertical plane and on the side of said vertical plane opposite from said unbalanced shaft.

6. A vibratory screen comprising, a screen frame having a feed end and a discharge end and provided with a longitudinally extending screen fabric, an unbalanced shaft rotatably mounted on said screen frame in a transversely extending position and located approximately two-thirds of the way from the feed end to the discharge end of the screen frame, the center of gravity of said screen frame and unbalanced shaft lying in a vertical plane horizontally offset from the center of rotation of said unbalanced shaft, a pair of universally resilient supporting elements supporting opposite side portions of said screen frame at points located near said vertical frame, a sub-frame, upstanding rocker arms carrying said supporting elements at their upper ends and pivotally mounted on said sub-frame for movement in planes transversely of said unbalanced shaft, and resilient supporting elements mounted on said sub-frame engaging and supporting said screen frame at points horizontally spaced from said vertical plane and on the side of said vertical plane opposite from said unbalanced shaft.

7. A vibratory screen comprising a vibratory screen frame having a longitudinally extending screen fabric, a vibrator mounted on said screen frame, a stationary frame, resilient supports supportingly connected with the vibratory frame at points located approximately in a vertical plane passing through the center of gravity of the screen frame and vibrator, means supporting said resilient supports from the stationary frame and allowing said resilient supports substantially unopposed movement bodily in a direction longitudinal of the screen frame while restricting movement of the resilient supports bodily in a direction normal to the screen frame, and additional resilient supporting means mounted on said stationary frame and supporting said vibratory screen frame at a position horizontally spaced from said center of gravity in a direction longitudinally of the vibratory screen frame.

8. A vibratory screen comprising, a horizontally extending screen frame having a feed end and a discharge end and provided with a longitudinally extending screen fabric, an unbalanced shaft rotatably mounted on said screen frame in a transversely extending position, the center of gravity of said screen frame and unbalanced shaft lying in a transverse vertical plane longitudinally offset from the center of rotation of said unbalanced shaft, a stationary frame, resilient supports supportingly connected with the vibratory frame at points located approximately in said transverse vertical plane, means supporting said resilient supports from the stationary frame and allowing said resilient supports substantially unopposed bodily movement in a direction longitudinally of the screen frame while restricting bodily movement of the resilient supports in a direction normal to the screen frame, and resilient supporting means mounted on said stationary frame engaging said screen frame at points longitudinally spaced from said transverse vertical plane and at that side of said vertical plane which is opposite from said unbalanced shaft.

HARRY LEE CORWIN.