

Sept. 21, 1943.

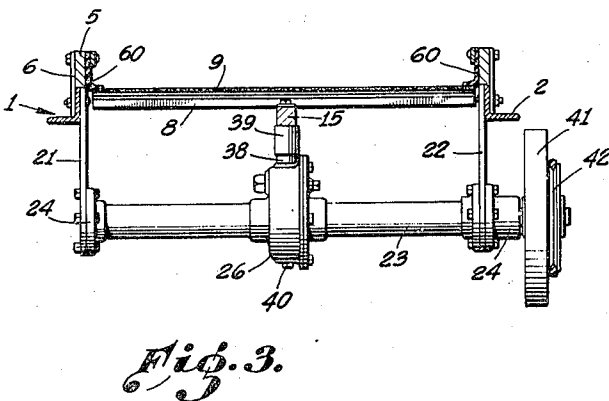
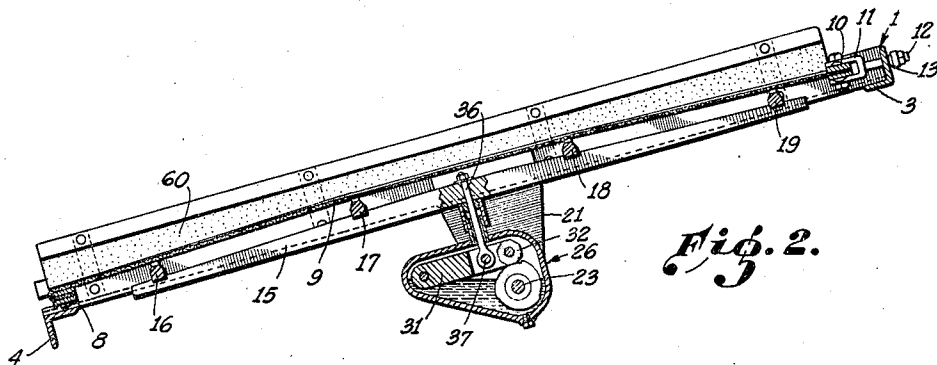
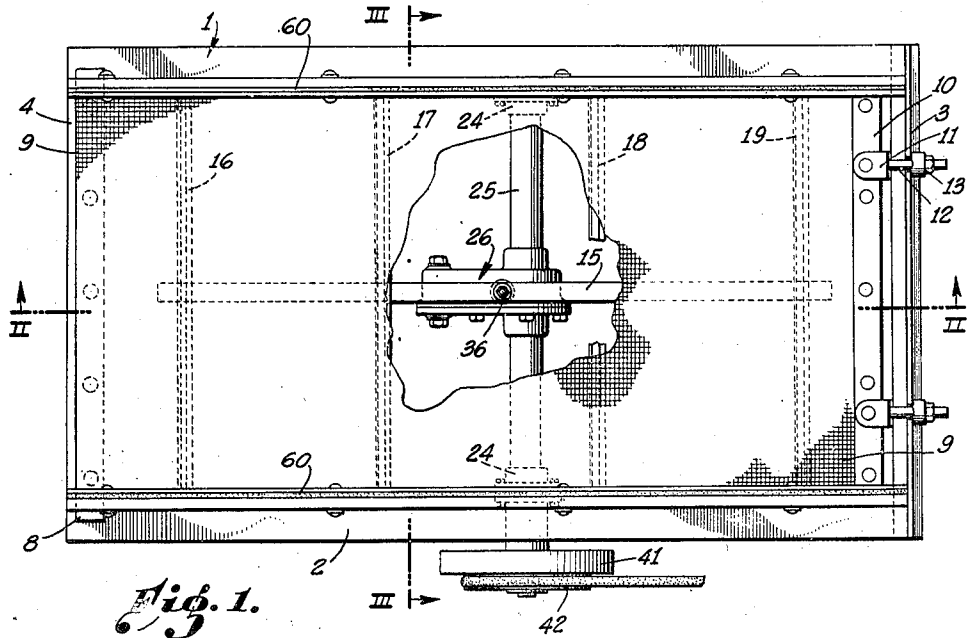
R. A. LEAHY

2,329,773

VIBRATING SCREEN

Filed May 31, 1941

2 Sheets-Sheet 1



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VIBRATING SCREEN

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2 Sheets-Sheet 2

*Fig. 4.*

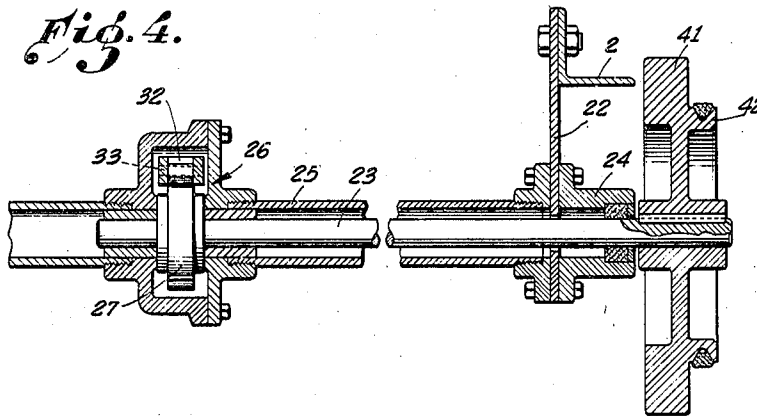


*Fig. 5.*

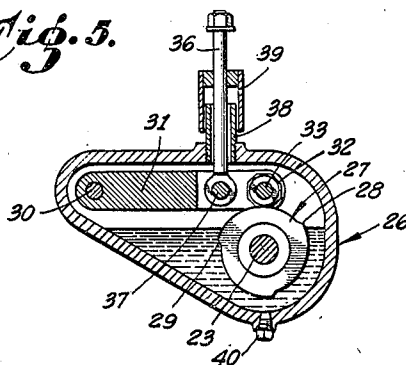


*Fig. 6.*

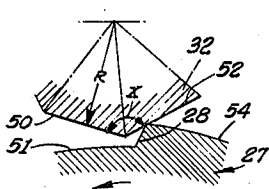
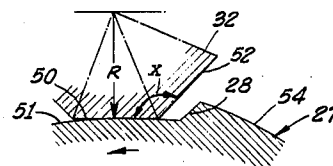


*Fig. 7.*

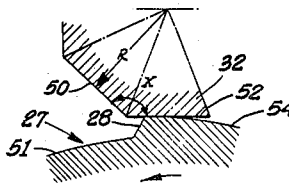


*Fig. 8.*

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## UNITED STATES PATENT OFFICE

2,329,773

## VIBRATING SCREEN

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Application May 31, 1941, Serial No. 396,011

7 Claims. (Cl. 209—310)

This invention pertains to improvements in the art of screening granular or finely divided materials and is particularly directed to improvements in the construction of vibrating screens.

Generally stated, the invention pertains to vibrating screens in which a foraminous member such as a sheet of punched metal or a strip of wire mesh or screen cloth is held within a frame, and vibration is then imparted to the foraminous member. The material to be screened, separated or graded is passed over the screen, the vibration of the screening surface suitably separating the material during its passage over the screen.

Heretofore, screening devices of this general character have been devised. In most cases, the vibrating force is applied to the entire frame which supports the screen cloth. In accordance with the present invention, the vibrating force is applied to the screen cloth alone, thereby more effectively utilizing energy. Moreover, in accordance with the present invention, complete mechanical control of intensity and frequency of the impact vibration is made possible, thereby permitting the apparatus to be readily adapted to the separation or treatment of various materials differing in physical properties. Novel means are provided for distributing vibrations to the foraminous member or screening medium. A simplified means is provided for facilitating the adjustment or change of the screening medium. Among other advantages, it may be stated that the present invention gives rise to an apparatus in which the structural elements are of lower weight, in which the distribution of vibration over the screen surface is more effectively accomplished, in which the life of the screen cloth is increased and a more constant high efficiency is maintained with concurrent long life. The vibratory force or impact is applied in a positive manner so as to produce a forward movement of the particles of material being separated on the screening surface or cloth, this forward movement making it possible to decrease the angle of inclination of the screen and thereby permit the screen to be used in those locations which do not have available the amount of head room or vertical height required by prior screening devices.

Generally stated, the invention contemplates a screen construction in which the screening medium is stretched between the end members of a stationary frame and employs an assembly beneath the screen, this assembly including resilient longitudinal members, the entire assembly be-

ing pressed against the lower surface of the screen, the pliant end portions of the resilient members being deflected downwardly. A vibrator rod is attached to the assembly, the vibrator being connected to a follower arm in sliding contact with a driven cam. The cam and follower are so arranged that a positive impact is periodically delivered through the vibrator rod to the assembly beneath the screen cloth, the resultant forces including a forward element tending to move the material along the screen surface. A flywheel is preferably employed on the driven cam shaft for the purpose of employing its inertia instead of the dead weight of the parts formerly required to concentrate impact vibrations transmitted to vibratory screens.

An object of the present invention, therefore, is to disclose and provide a vibratory screen of improved construction.

Another object is to provide a vibratory screen in which the vibrations are applied to and distributed over the vibrating screen in a more economical and efficient manner.

A further object is to provide means whereby greater life is imparted to a screening medium and means whereby the screening medium may be readily replaced.

Again an object of the invention is to disclose and provide a vibration imparting unit of novel construction, such unit being characterized by low friction losses, long life and the utilization of inertia of a rotating flywheel.

Other objects, advantages, adaptations and modifications of the invention will become apparent to those skilled in the art from the following description of an exemplary form of the invention.

In the appended drawings:

Fig. 1 is a plan view of an exemplary form of the present invention.

Fig. 2 is a longitudinal section taken along the plane II—II of Fig. 1.

Fig. 3 is a transverse section taken along the plane III—III of Fig. 1.

Fig. 4 is an enlarged transverse section of the vibrator unit.

Fig. 5 is an enlarged longitudinal section of the vibrator unit.

Figs. 6, 7 and 8 are enlarged views, partly diagrammatic, showing the relationship of the cam and cam follower of the vibrator unit at different positions.

In the drawings, a relatively rigid frame is shown formed from longitudinally extending side rails 1 and 2 connected by end rails 3 and 4.

Various means for supporting this frame in a desired inclined position may be used, but such means are not shown. The side and end rails may be made either of channel iron, angle iron or the like. The said rails may be built up somewhat as indicated at 5 and 6 in Fig. 3.

One of the end rails may be slotted to receive a bar 8 having a foraminous member, screen cloth or other, screening medium attached thereto. Screen cloth is indicated in the drawings at 9. The other end of the frame may be provided with tensioning means adapted to grasp the opposite end of the screening medium and place the same in tension longitudinally of the frame. For example, the screening medium 9 may be provided with a bar 10 adapted to be engaged by the yoke ends 11 of bolts 12 extending through suitable apertures in the end rail 3 and attached thereto by means of nuts 13. In this manner the entire screening surface may be placed under uniform longitudinal tension within the frame and may be removed therefrom for replacement.

Beneath the screening medium 9 there is placed a relatively light subframe or assembly which, in the form shown in the drawings, comprises a resilient longitudinal member 15 carrying a plurality of transverse members 16, 17, 18 and 19. These transverse members 16-19 may be provided with resilient and narrow bearing strips along their upper surfaces for contact with the bottom of the screening medium 9. Rubber compositions, leather or wood may be used for these bearing strips carried by the tops of the transverse members 16-19.

It may be noted at this time that the upper surfaces of the transverse supporting members 16-19 occupy a plane or planes slightly above a plane passing through the end portions of the foraminous member 9. (See Fig. 2.)

Suitably supported beneath the stationary frame, as for example by means of hangers 21 and 22, is a drive shaft 23 journaled in bearings 24. The drive shaft 23 may be carried within a tubular housing 25 connected to a centrally disposed split housing 26 which may also contain suitable bearings for the shaft 23. Within this split oil-tight housing 26 a cam 27 is mounted upon the shaft 23. The cam 27 may be provided with one or more inclined faces 28 and 29.

Within the housing 26 there is pivoted as at 30 a follower arm 31 carrying a follower 32 at one end. Preferably the end of the follower arm 31 is bifurcated, the follower 32 being held between the spaced end portions of the arm 31 upon a suitable pin or stud bolt 33 so that the follower 32 may rotate. The follower is shown in the drawings as a polygonal element and may be either hexagonal or octagonal in form. An octagonal form is illustrated since this has been found to be the preferred form. The follower rests upon the cam 27. The follower arm 31 is also provided with a vibrator rod 36 pivotally connected to the arm as at 37. The vibrator rod 36 extends upwardly through a port in the housing 26, such port being shown in Fig. 5 as provided with an upstanding pipe section 38 adapted to slidably extend into a sleeve 39 carried by the vibrator rod 36. The upper end of the vibrator rod 36 is connected in any suitable manner to the longitudinally extending resilient subassembly member 15.

The housing 26 may be provided with a suitable drain plug 40. A flywheel 41 may be mounted upon one end of the shaft 23. The shaft 23 may be driven in any suitable manner,

but in the drawings the flywheel 41 is shown provided with an integral pulley 42 adapted to receive a V-shaped belt making a driving connection with a motor not shown.

It will be noted that the subassembly is not connected to the stationary frame of the device in any manner and the only support for the subassembly is the vibrator rod 36, and such subassembly and screening medium in contact therewith is therefore free to vibrate most effectively. By adjusting the locking nuts between the vibrator rod 36 and the resilient longitudinally extending member 15, the desired portions of the subassembly may be raised above a plane extending through the end portions or ends of the screening medium 9. The screen cloth or other screening medium will therefore exert a downward pressure upon the subassembly and the pliant end portions of the resilient longitudinal member 15 (which may be provided with tapered ends) may be deflected downwardly by pressure on the transverse members 16 to 19 exerted by component forces of the longitudinal tension of the screen cloth between the ends of the stationary frame.

By referring to Figs. 6, 7 and 8 the operation of the cam and polygonal follower will become apparent. The cam 27 rotates in the direction of the arrow so as to cause the rising faces 28 and 29 to strike an inclined face of the follower 32 a solid blow. By referring to Fig. 6, for example, it will be seen that the lower face 50 of the follower 32 is sliding along the substantially cylindrical surface 51 of the cam 27. The forward face 52 of the follower 32 is at substantially the same angle as the angle of the face 28 which is approaching the follower. The angle  $x$  should be an acute angle between about  $90^\circ$  and  $30^\circ$ , depending upon the number of faces on the polygonal follower 32. When an octagonal follower is employed, the angle  $x$  should be about  $45^\circ$ . When a hexagonal follower is employed, the angle  $x$  should be about  $60^\circ$ . Expressed differently, it may be stated that the angle  $x$  of the face 28 is supplementary to the internal angle  $y$  between adjacent faces of the follower 32. The face 28 and the face 52 should meet in substantial contact. The height of the face 28 should not exceed the radius of a circle inscribed in a cross section of the follower 32 and preferably should be between 15% and 50% of the radius of such inscribed circle indicated at  $r$ .

After the face 28 strikes the inclined face 52 of the follower 32, the follower 32 will pivot upon the stud bolt 33 as shown in Fig. 7 and simultaneously with such pivoting movement the follower will rise, causing the follower arm 31 to pivot and causing the vibrator rod 36 to move upwardly until the face 52 of the follower begins to slide upon the cam surface 54 of the cam 27 as shown in Fig. 8.

The impact of the rising face 28 of the cam against the face 52 of the follower is transmitted instantaneously to the material upon the screen medium 9, the impact throwing the particles of the material upwardly and forwardly with a force proportional to the masses of the particles. Automatically these impact forces cause the coarsest or heaviest particles to the top of the layer of material, thereby permitting the lighter, finer particles to come into direct contact with the openings of the screening medium 9 on their return to the screening surface. Efficient screening is thus obtained. While the follower 32 is turning (as indicated in Fig. 7), the heavier ma-

terial being screened is still off the rising screen surface. When the follower is sliding along the retreating face or surface 54 of the cam 27, downward movement of material on the screen takes place, followed by a short quiescent period just before the next impact of the two new faces of the succeeding cam tooth and the follower. The time interval for the rise of the screen surface appears to be less than 10% of the cycle of operations.

The various movements described herein are steadied, localized and made more uniform by the inertia of the rapidly revolving flywheel 41. The force of impact between the faces 28 and 57 is controlled to some extent by the speed of the flywheel, and the force of these blows appears to be proportional to the peripheral velocity of the cam. The frequency (expressed as impacts per minute) is the product of the number of cam teeth or rising faces by R. P. M. of the drive shaft 23 and flywheel 41. This applied energy is concentrated more on the screening medium, and is dissipated less in the screen frame and the external supporting structure. This greatly reduces the weight and strength of the structure necessary for supporting the screening apparatus which is generally situated in the upper and less stable part of the plant.

When the apparatus is employed in the screening of materials which have a tendency to adhere to the screen surface due to viscosity (as in damp, clayey material or drilling muds) or due to their weight or size, the intensity of the impact may be increased by reducing the number of cam teeth and increasing the peripheral velocity of the cam. When the apparatus is employed in screening fine, dry material or fine materials in a very large portion of liquid, the intensity of the impacts may be reduced and their frequency increased by reducing the velocity of the cam and increasing the number of cam teeth.

It will be noted that the telescopic connection included in the conduit section 33 and the sleeve 27 forms a labyrinth which prevents the entrance of foreign matter into the oil filled housing. Flaps of flexible material indicated at 60 may be connected to the side rails 5 and 6 and overlie the longitudinal edge portions of the screening medium 9 so as to prevent material being screened from spilling off the sides of the screen.

Although in the drawing a single longitudinal member 15 has been shown, it is to be understood that the subassembly may comprise a plurality of longitudinally extending resilient members 15 connected together by a plurality of transversely extending contact members. In most screens, the vibrator rod 35 is attached to about the midpoint of the subassembly, although on larger screens more than one vibrator rod may be used, each vibrator rod being actuated by its separate follower and cam. When two vibrators are employed they should be synchronized and both vibrator rods connected to a transverse vibrator arm which then is attached to one or more longitudinally extending resilient members. Moreover, two flywheels instead of one may be employed, one flywheel being carried by each end of the shaft 23.

I claim:

1. In a vibrating screen construction, the combination of: a stationary frame; a flexible screen medium provided with end bars; slots in said frame adapted to receive one of said end bars; tensioning means cooperating with the other end

bar for placing the screen medium under tension within the frame; a lightweight subassembly including a longitudinally extending resilient member provided with longitudinally tapered ends and a plurality of longitudinally spaced, transversely extending screen supporting members along said longitudinal resilient member, said transverse member being adapted to contact with the lower surface of the screening medium; means positioned beneath said subassembly for imparting upward impulses to the subassembly, said means including a follower arm pivoted to a stationary support at one end and provided with a polygonal follower carried by the movable end of said arm, a vibrator rod attached to said arm and to said subassembly and adapted to place said transversely extending screen supporting members in pressure contact with the screen medium, a driven cam shaft provided with a flywheel and a cam having an impact face substantially parallel to a face of the follower at the instant of impact and means for driving said cam shaft in a direction to cause impact impulses to produce an upward and forward motion of material on the screen medium supported by the subassembly.

2. In a vibrating screen construction, the combination of: a stationary frame; a flexible screen medium stretched in longitudinal tension between end members of said frame; a lightweight subassembly including a longitudinally extending resilient member provided with longitudinally tapered ends and a plurality of transversely extending screen supporting members attached to the longitudinal member in spaced relation and adapted to contact with the lower surface of the screen medium; means positioned beneath said subassembly for imparting upward impulses to the subassembly, said means including a follower arm pivoted to a stationary support at one end and provided with a polygonal follower carried by the movable end of said arm, a vibrator rod attached to said arm and to said subassembly and adapted to place said transversely extending screen supporting members in pressure contact with the screen medium, a driven cam shaft provided with a flywheel and a cam having an impact face substantially parallel to a face of the follower at the instant of impact and means for driving said cam shaft in a direction to cause impact impulses to produce an upward and forward motion of material on the screen medium supported by the subassembly.

3. In a vibrating screen construction, the combination of: a stationary frame; a flexible screen medium provided with end bars; slots in said frame adapted to receive one of said end bars; tensioning means cooperating with the other end bar for placing the screen medium under tension within the frame; a lightweight subassembly including a longitudinally extending resilient member provided with longitudinally tapered ends and a plurality of spaced, transversely extending screen supporting members adapted to contact with the lower surface of the screen medium; means positioned beneath said subassembly for imparting upward impulses to the subassembly, said means including a follower arm pivoted to a stationary support at one end and provided with a polygonal follower carried by the movable end of said arm, a vibrator rod attached to said arm and to said subassembly and adapted to place said transversely extending screen supporting members in pressure contact with the screen medium, a driven cam shaft pro-

vided with a cam having an impact face substantially parallel to a face of the follower at the instant of impact and means for driving said cam shaft in a direction to cause impact impulses to produce an upward and forward motion of material on the screen medium supported by the subassembly.

4. In a vibrating screen construction, the combination of: a stationary frame; a flexible screen medium stretched in longitudinal tension between end members of said frame; a lightweight subassembly including a longitudinally extending resilient member provided with downwardly deflectable ends and a plurality of spaced, transversely extending screen supporting members adapted to contact with the lower surface of the screen medium; means positioned beneath said subassembly for imparting upward impulses to the subassembly, said means including a follower arm pivoted to a stationary support at one end and provided with a polygonal follower carried by the movable end of said arm, a vibrator rod attached to said arm and to said subassembly and adapted to place said transversely extending screen supporting members in pressure contact with the screen medium, a driven cam shaft provided with a cam having an impact face substantially parallel to a face of the follower at the instant of impact and means for driving said cam shaft in a direction to cause impact impulses to produce an upward and forward motion of material on the screen medium supported by the subassembly.

5. In a vibrating screen construction, the combination of: a stationary frame, a flexible screen medium removably attached by its longitudinal end portions to the frame, tensioning means at one end of said frame and cooperating with said screen medium for placing the screen under tension within the frame; a light weight subassembly including a longitudinally extending resilient member provided with longitudinally tapered ends and a plurality of transversely extending spaced screen supporting members adapted to contact with the lower surface of the screen medium, the upper surface of said screen medium being maintained convex by upwardly directed pressure applied through said supporting members and tapered longitudinal member, said subassembly being unconnected to said frame; and means positioned beneath said subassembly for imparting sharp upward impulses to the sub-

assembly, said means including a vibrator rod attached to said means and to said sub-assembly whereby said screen medium is uniformly vibrated and said vibrations are transmitted to areas adjacent the ends of said screen medium through the tapered end portions of the longitudinal sub-assembly member.

6. In a vibrating screen construction, the combination of: a stationary frame; a flexible screen medium stretched in longitudinal tension between end members of said frame; a light weight subassembly including a longitudinally extending resilient member provided with longitudinally tapered ends, and a plurality of longitudinally spaced transversely extending screen supporting members along said longitudinal member and attached thereto, said transverse members being adapted to contact with the lower surface of the screen medium; means for holding said subassembly in pressure contact with the lower surface of the screen medium to impart a convex upper surface to said screen medium; said subassembly being unconnected to said frame and end members thereof; and means for imparting upward impulses to the sub-assembly whereby substantially uniform vibration is transmitted to all portions of the screen medium through said resilient sub-assembly member.

7. In a vibrating screen construction, the combination of: a stationary frame; a flexible screen medium provided with end bars, slots in said frame adapted to receive one of said end bars; tensioning means cooperating with the other end bar for placing the screen medium under tension in the frame; a light weight sub-assembly including a longitudinally extending resilient member provided with downwardly deflectable end portions, and a plurality of spaced transversely extending screen supporting members positioned beneath the screen; means for holding said subassembly in pressure contact with the lower surface of said screen medium to impart a convex contour to the upper surface of said screen medium; and means positioned beneath the subassembly for imparting upwardly impulses thereto whereby vibrations may be uniformly distributed to said screen medium through the resilient longitudinally extending member, said sub-assembly being unconnected to said frame and end bars of said screen medium.

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