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APPARATUS FOR SCREENING MATERIALS

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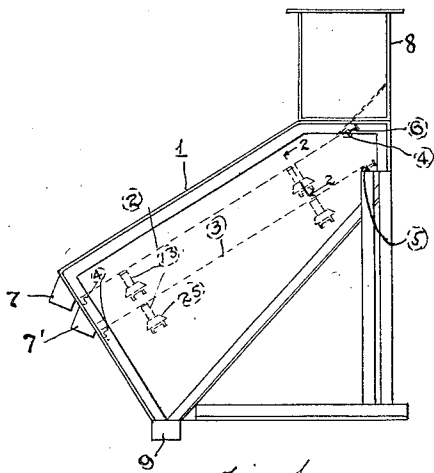


Fig. 1

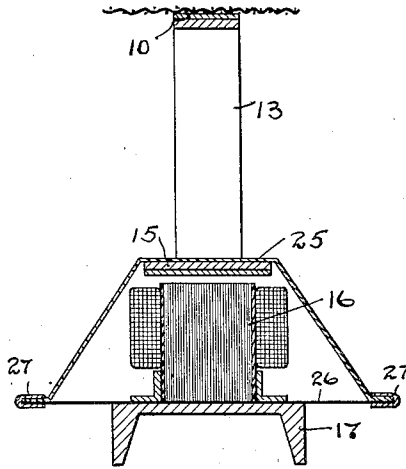


Fig. 4

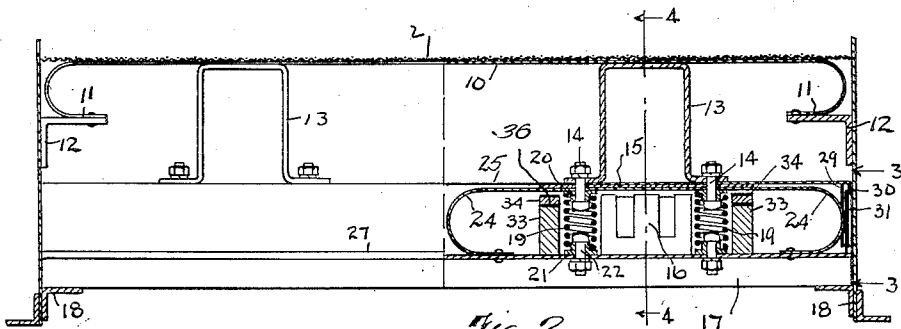


Fig. 2

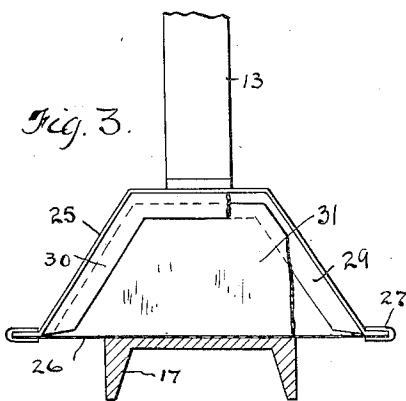


Fig. 3

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APPARATUS FOR SCREENING MATERIALS

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The present invention, relating as indicated to an apparatus for screening materials, is more particularly directed to the screening of certain materials for which present methods and apparatus are not well adapted, that is, such materials for example as coal, heavy ores and the like where the load on the screen from the weight of the material is extremely heavy. A further object of the invention is the provision of an apparatus for screening materials more rapidly and accurately than is possible with present types of machines, and one in which the entire surface of the woven wire screen is in constant and relatively uniform vibration. Another object of the invention is the provision of apparatus adapted to screen material in which the load of the material is neither carried by the means employed for vibrating the screen, nor actually lifted by the action of the vibrating means, thus reducing to a large extent the power required for operating the vibrating mechanism. A still further object of the invention is the provision of a screening apparatus in which the entire area of the screen is open to the flow of material, thus permitting the entire screen surface to be in effective action at all times and reducing the tendency to clog, as is the case where the vibrating mechanism, or some part of it, is mounted in the path of flow of the material. A still further object of the invention is the provision of an apparatus for screening materials in which substantially the entire area of the screen is maintained under a constant and substantially uniform vibration, and one in which the screen surface is rendered more resilient and "live" than is the case in the present types of apparatus. To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims; the annexed drawing and the following description setting forth in detail certain mech-

anism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawing:—

Fig. 1 is a side elevation partially in section of my improved apparatus and adapted to carry out the present method; Fig. 2 is a transverse sectional view through the apparatus of Fig. 1 on the line 2—2 therein; Fig. 3 is a transverse section on the line 3—3, Fig. 2; and Fig. 4 is a similar view on the line 4—4, Fig. 2.

Various types of screening machines which are in most common use today are those employing (1) the vibration of a woven wire screen mounted in a suitable frame or casing by means of an unbalanced weight, the effect of which is transmitted directly to the screen, (2) machines in which the vibratory action of an unbalanced weight is transmitted to a frame in which a woven wire screen is mounted, or the frame is rocked by suitable mechanism, and (3) machines in which a woven wire screen is vibrated by electro-magnetic means, the vibrations being transmitted directly to the screen surface. Of these three methods which are in general use none are well adapted to the screening of certain materials such as heavy ores, coal and the like, in which the load on the screen is heavy, as in the case of the first two types of machines named above a heavy load is moving down the screen in a series of jumps which detracts materially from both the speed and the accuracy of the separation, while in the latter type of machine the screening action can be maintained, but only by means of extremely heavy electro-magnetic apparatus, which has the serious disadvantage of very great weight and its necessary position, since this mechanism must be placed above the screen, in which event connecting members impede the flow of the material, and if placed below the screen its great size

makes it extremely difficult to house properly and to move for adjustment or repair. In addition to these disadvantages all of the above methods and apparatus fail to vibrate the screen uniformly over the entire surface, there being in every case a certain portion of the screen which is vibrated through a considerably greater amplitude than other portions, and this quite apparently affects the accuracy and efficiency of the separation, and also in some cases affects the uniformity of flow over the screen surface.

The present method and apparatus have been found to operate very much more satisfactorily and efficiently on the types of materials referred to than any of the other methods now in general use, and accomplish this by a substantially uniform vibration imparted to all portions of the screen surface and a vibration which has the same amplitude throughout the screening area. Briefly stated, the invention consists in imparting to a screen surface a multiplicity of short extremely rapid vibrations accompanied by simultaneous stops or jars and distributed over substantially the entire area of the surface so that not only is the entire area in motion, but the entire area is jarred uniformly, the motion being through very much shorter amplitudes than in other apparatus, but the amplitude being the same for approximately the entire screening area. In the present types of apparatus where the screen is engaged by the vibrating means at either one, or at the most two, points it is obvious that the same amplitude of vibration which is imparted to the screen at these points cannot be maintained undiminished all over the screen surface, and therefore in order to provide a vibration of sufficient amplitude for the average effective area of the screen surface, an amplitude which is really greater than necessary must be imparted to the screen at the point where the vibrating mechanism acts. The mechanisms now in general use impart a vibration to the screen in many cases by lifting the screen and the load during each vibration, and if the screen is lifted at certain points through an amplitude greater than is really necessary a very much greater amount of work is being done than should be, and consequently the power supplied to the machine is to a very large extent wasted, and what is more serious the vibration imparted to the screen surface is neither uniform nor to the exact proper amplitude over the greater portion of the screen surface.

Referring now to the drawing, in Fig. 1 I have shown a frame or casing 1, in which are mounted two parallel spaced woven wire screens 2 and 3. Each of these screens is mounted at two opposite edges, and in the view shown at its upper and lower edges in an angled plate 4, which acts to grip all of

the wires of the screen extending at right angles to such plate. This plate 4, or hook strip as it may be termed, is then engaged over a supporting angle 5 of the frame, and suitable means, such for example as screws 6, secured to one of the angles 5, are employed for drawing this angle away from the other, and thus placing the screen under uniform vibratory tension. A sufficient number of the tensioning screws 6 may be provided so that the screen can be effectively tensioned across its entire width and all of the wires of the series extending at right angles to the strips 4 being placed under the same uniform vibratory tension.

The screens 2 and 3 as thus mounted in the frame or casing 1 are supplied with material through a feeding conduit 8, the material to be fed onto the upper screen 2, and such material as passes through this screen being in turn passed onto the screen 3, the oversize from the two screens being discharged through conduits 7 and 7', respectively, and the undersize being collected in the lower part of the casing and discharged through a conduit 9. It will be understood that while I have illustrated an apparatus in which two screens are employed, my method may equally well be applied to a single screen surface, or if desired more than two screens may be used under certain conditions.

In the following description only one of the two screens shown in Fig. 1 will be described, it being understood that the same means for supporting, mounting and vibrating the screen may be employed on each of the screens where more than one is used. The screen is supported at intervals along its length by means of resilient strips 10 of suitable material, such as spring steel, the ends of these supporting strips being rebent, as shown at 11, and secured to suitable brackets 12 mounted on the side of the casing 4.

Many times a screen is forced to support an extremely heavy load of material and in such cases the screen, regardless of how taut it may be sags slightly. If the screen is vibrated by mechanism which actually lifts the screen the load also must be lifted, requiring a very large amount of power in many cases and deadening to a large extent the vibrating action. By supporting a screen on a plurality of resilient supports, such as those just described, the load of material is supported by these supports rather than by the screen alone and the latter is therefore maintained more nearly in its true or free plane even under load, and is furthermore rendered very much more lively than would otherwise be the case.

The means for vibrating the screen surface are secured to the lower side of the strips 10, and one form of such mechanism is shown in Fig. 2 and consists of an inverted U-shaped bracket 13, which is secured by means of

bolts 14 to an armature member 15 in the form of a short flat plate, or if desirable a laminated field can be attached to the plate, which is controlled and actuated by means of an electro-magnet 16 mounted upon a supporting shelf in the form of a channel member 17 extending transversely of the casing and supported at its two ends upon suitable brackets 18 secured to the casing. Springs 19, interposed between washers 20 mounted about the lower ends of the bolts 14 and other washers 21 mounted about the inner ends of corresponding bolts 22 normally maintain the armature and the screen actuating brackets 13 in the position shown, and are of sufficient strength to materially assist the other resilient members in the mechanism in supporting the dead-weight load of the material on the screen. The other resilient members in the mechanism are of course the supporting strip 10 and other similar strips 24 which are secured to the lower side of the armature 15 and extend downwardly, and have their ends supported upon, the channel member 17, as shown in Fig. 2.

The entire electro-magnetic mechanism just described is completely housed within a chamber formed of an inverted U-shaped channel 25 and a thin wafer-like diaphragm 26, which is of the same width as the open side of the channel and has its edges secured to the edges of the channel by means of U-shaped clamping strips 27. The channel element 25 is substantially rigid and is interposed between the brackets 13 and the armature strips 15 and moves as a unit with these elements during the operation of the mechanism. The diaphragm 26 is merely a sealing element and is of sufficient flexibility so that the edges overhanging the channel 17 will bend or flex up and down with the movements of the casing proper. At the ends the channel is provided with downwardly extending flanges 29 and 30 which are spaced apart a sufficient distance to enable them to slidably fit over a plate 31 projecting upwardly from the channel 17, thus allowing for movement between the enclosed casing and the supporting channel, but at the same time substantially closing the ends of the casing against the entrance of any material, and providing a pump which will tend to force air out between the interengaging flanges, carrying with it any material which may tend to work in between these flanges and substantially sealing the operating elements from the entrance to the casing of any material which is passing through the screen.

In Fig. 1 I have shown two banks of vibrating mechanism, each bank constituting two electro-magnetic vibrators, although it will be understood that more individual vibrating mechanisms may be employed in carrying out the present method, the number being properly proportioned to the total area

of the screen and the type and weight of the material which is being passed thereover. The four separate vibrating mechanisms which are here shown are each directly engaged with a certain portion of the screen and act to impart vibration individually to these certain areas of the screen surface. In this way substantially the entire surface is placed under vibration and a series of waves are imparted to the screen surface, keeping the entire surface in constant movement and maintaining a substantially uniform movement throughout the screen. For each impulse or vibration to the screen there is also imparted a single sudden jar or stop which is effected by the posts 33 mounted on the channel 17, on which are removable jarring blocks 34, the height of which may be adjusted by removing one or more of the shims 36 interposed between the supports and the striking blocks. These blocks are engaged by the armature, or rather by the supporting spring strips 24, upon each downward movement of the screen and armature and bring the spring to a sudden jarring stop, this jarring being of course imparted to the entire area of the screen which is influenced by the particular electro-magnet carrying the stop.

My improved method and apparatus present the following important advantages over those now in general use. The entire surface of the screen is unobstructed and free to the unimpeded flow of material. The screen is resiliently supported and thus rendered free and lively even under severe loads of material. Vibration of the required amplitude for any given type of screen is imparted to substantially the entire surface of the screen, and the mechanism for imparting vibration is completely enclosed and disposed beneath the screen. The vibrating means is not mechanically connected to the screen, but is merely in contact with the resilient supports therefor, and thus is not required to carry a portion of the load, but is free to impart an extremely rapid and sharp jarring or whipping action to all portions of the screen surface. The vibrating apparatus are disposed in banks which, together with the resilient supporting means, extend transversely of the screen surface and parallel to the supporting ends, while the other ends or sides are unsupported and thus entirely free for vibration, and in this way waves of vibration are spread throughout the screening surface with a minimum of restriction or dampening. These waves extend lengthwise of the screen, assist the flow of the material and also extend throughout the entire width, and are only dampened or reduced from the end portions of the screen which are closely adjacent to the supported top and bottom edges.

My improved method has been found to be extremely effective, particularly in the

screening of coarse materials, such as coal, stone and the like, which have never been satisfactorily handled in any of the types of apparatus in common use.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. In apparatus of the character described, the combination of a frame, a woven wire screen mounted therein and tensioned along two opposite edges to a uniform vibratory tension, an enclosed casing disposed beneath said screen and having its top secured thereto, and means in said casing for vibrating the top thereof and also said screen.

2. In apparatus of the character described, the combination of a frame, a woven wire screen mounted therein and tensioned along two opposite edges to a uniform vibratory tension, a supporting member disposed parallel to and beneath said screen, a casing mounted on said support but movable toward and away from said supporting member, said casing being in engagement with said screen, and means mounted within said casing, said means being adapted to rapidly vibrate said casing and said screen.

3. In apparatus of the character described, the combination of a frame, a woven wire screen mounted in an inclined position therein and tensioned along its top and bottom edges to a uniform vibratory tension, resilient means directly supporting said screen, and a plurality of separate vibrating means disposed beneath said screen in engagement with said resilient supporting means and adapted to separately actuate certain portions of said screen surface.

4. In apparatus of the character described, the combination of a frame, a woven wire screen mounted in an inclined position therein and tensioned along its top and bottom edges to a uniform vibratory tension, a plurality of transversely extending resilient supports mounted beneath said screen and engaging with the under surface thereof, and a plurality of separate vibrating means, each disposed beneath said screen and adapted to vibrate the same through one of said resilient supports.

5. In apparatus of the character described, the combination of a frame, a woven wire screen mounted in an inclined position therein and tensioned along its top and bottom edges to a uniform vibratory tension, a plurality of transversely extending resilient supports mounted beneath said screen and engaging with the under surface thereof, and a plurality of separate vibrating means, each disposed

beneath said screen and adapted to contact and vibrate one of said resilient supports.

6. In apparatus of the character described, the combination of a frame, a woven wire screen mounted in an inclined position therein and tensioned along its top and bottom edges to a uniform vibratory tension, a plurality of transversely extending resilient supports mounted beneath said screen and engaging with the under surface thereof, and a plurality of separate vibrating means disposed beneath said screen, each of said means comprising a plurality of individual electro-magnetic vibrating devices adapted to contact and actuate a portion of each of said resilient supports.

7. In an apparatus of the character described, the combination of a frame, a woven wire screen mounted in an inclined position therein and tensioned along its top and bottom edges to a uniform vibratory tension, a plurality of resilient supports mounted beneath said screen and engaging with the under surface thereof, and a plurality of separate vibrating means each disposed beneath said screen and adapted to vibrate the same through one of said resilient supports.

8. In an apparatus of the character described, the combination of a frame, a woven wire screen mounted in an inclined position therein and tensioned along its top and bottom edges to a uniform vibratory tension, a resilient support mounted beneath said screen and engaging with the under surface thereof, and vibrating mechanism disposed beneath said screen and adapted to vibrate the same through said resilient support.

9. In an apparatus of the character described, the combination of a frame, a woven wire screen mounted in an inclined position therein and tensioned along its top and bottom edges to a uniform vibratory tension, a plurality of resilient supports mounted beneath said screen and engaging with the under surface thereof, and vibrating mechanism contacting with said supports at various points and adapted to vibrate the screen over its entire surface.

10. In an apparatus of the character described, the combination of a frame, a woven wire screen mounted in an inclined position therein, and tensioned to a uniform vibratory tension, resilient supporting means engaging the under surface of said screen and vibratory means disposed beneath said screen and adapted to vibrate the same through said resilient support.

Signed by me, this 28th day of April, 1927.
MORLEY PUNSHON REYNOLDS.