

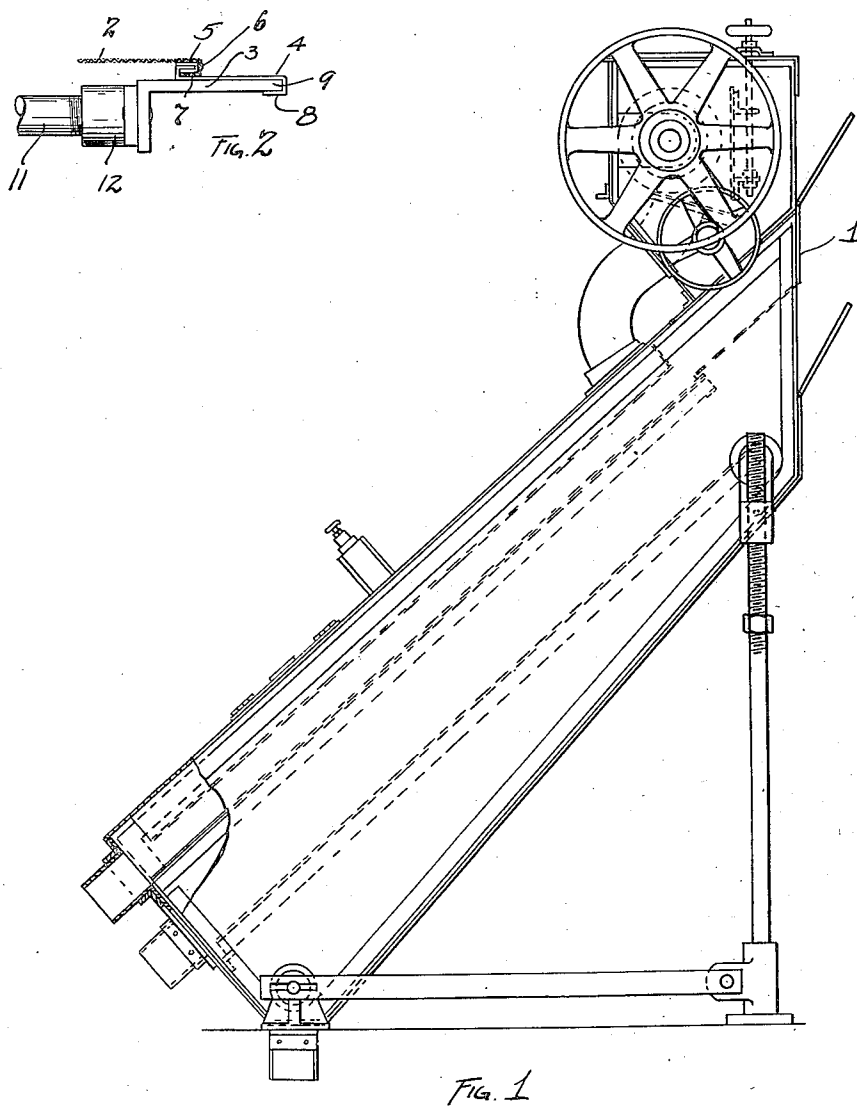
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M. P. REYNOLDS

SCREENING APPARATUS

Original Filed March 28, 1921 3 Sheets-Sheet 1



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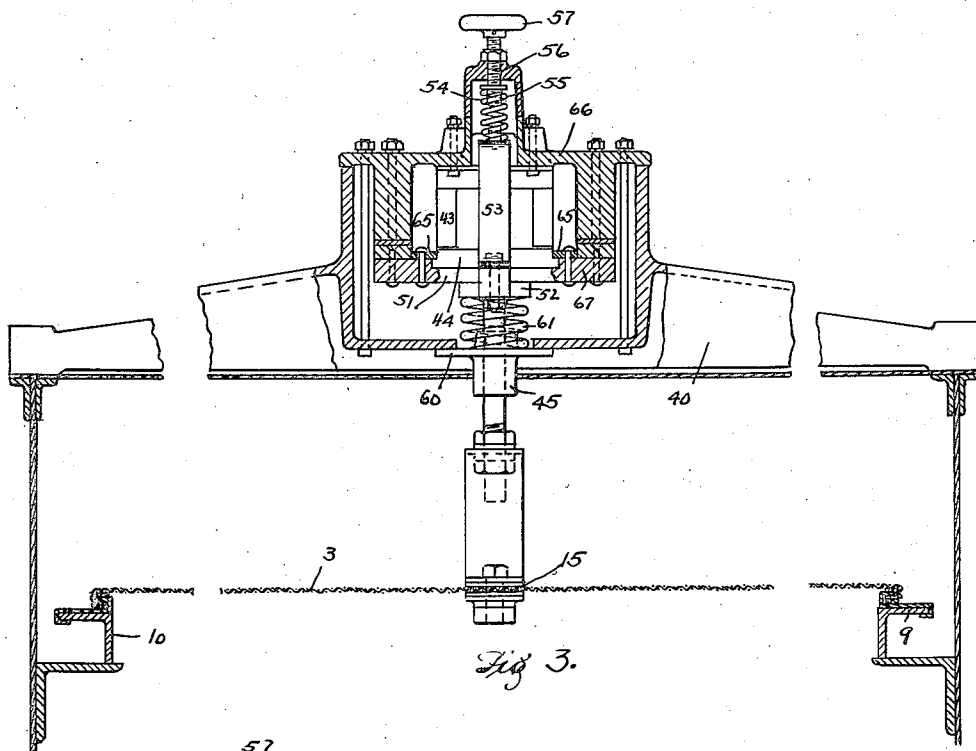


Fig. 3.

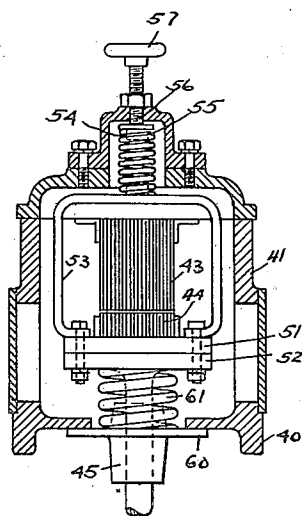


Fig. 4.

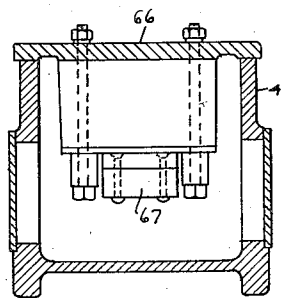


Fig. 5.

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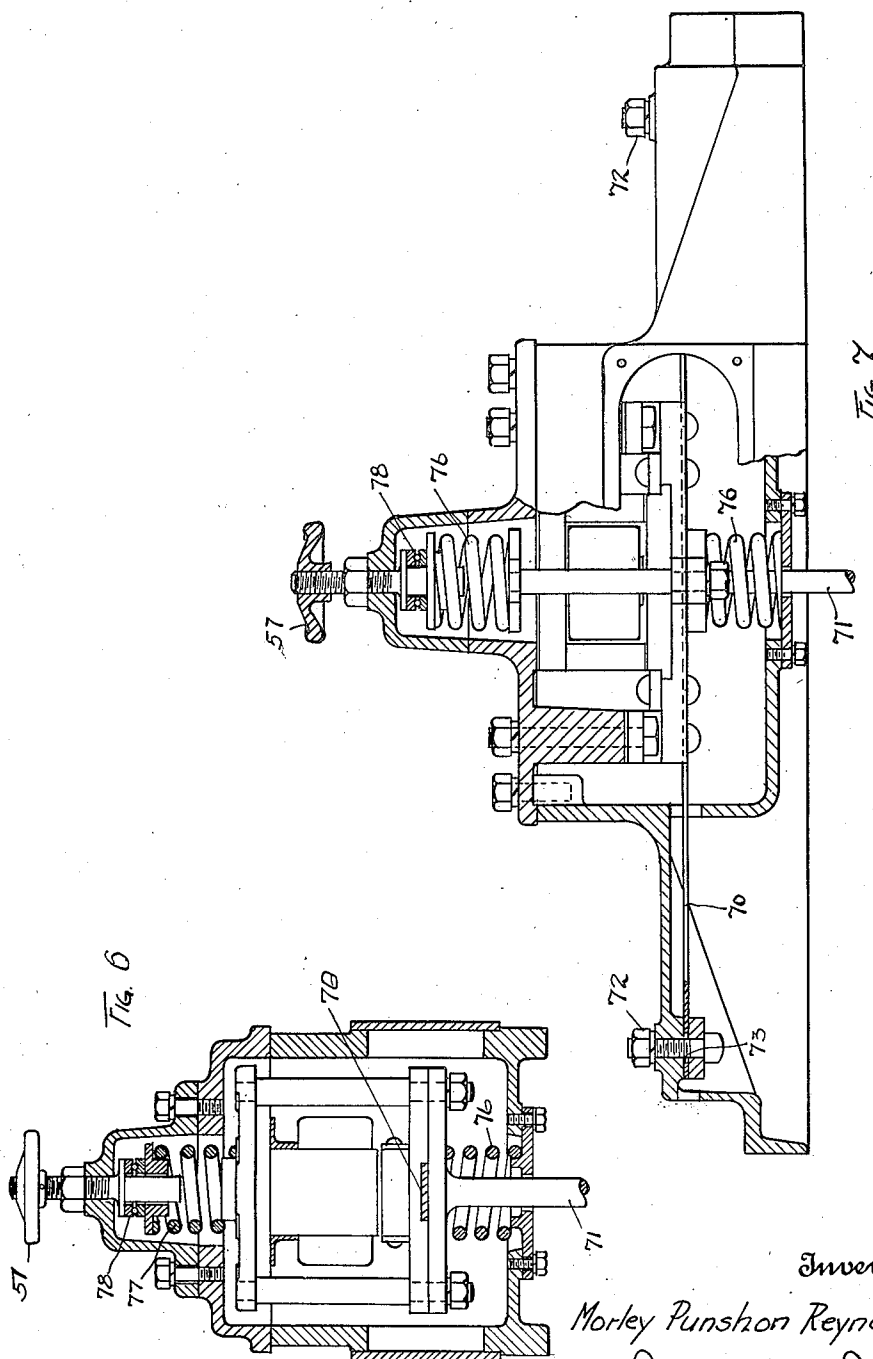
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UNITED STATES PATENT OFFICE.

MORLEY PUNSHON REYNOLDS, OF CLEVELAND HEIGHTS, OHIO, ASSIGNOR TO THE
W. S. TYLER COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

SCREENING APPARATUS.

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To all whom it may concern:

Be it known that I, MORLEY PUNSHON REYNOLDS, a citizen of the United States, and a resident of Cleveland Heights, county of Cuyahoga, and State of Ohio, have invented a new and useful Improvement in Screening Apparatus, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

The present improvements, relating, as indicated, to screening machines, are more particularly directed to an improved means for securing a more effective vibration or movement of a screen surface in order to agitate the material passing thereover and cause the same to continuously classify itself in such a way as to present the smaller particles to the surface of the screen. Another object of the invention is the provision of a simple but effective electro-magnetically operated vibrating mechanism. 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 drawings and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of the various mechanical forms in which the principle of the invention may be used.

In said annexed drawings:—

Fig. 1 is a side elevation of a screening machine constructed to embody my improvements therein; Fig. 2 is a transverse section through the edge of the screen showing the means for holding and tensioning the same; Fig. 3 is a transverse section through the vibrating mechanism and screen; Fig. 4 is a similar view, but showing on an enlarged scale a sectional view of the vibrating mechanism alone; Fig. 5 is a sectional view showing the jarring means; Fig. 6 is a transverse section through a modified type of my vibrating mechanism; and Fig. 7 is a longitudinal section on the line 7—7 in Fig. 6.

Before proceeding to the description of my invention it may be desirable to briefly outline the faults which have heretofore been experienced in vibrating mechanisms. The chief objection in mechanical vibra-

tors has been that the proper speed of vibration could not be applied. It is mechanically possible to strike a screen surface at a sufficiently high rate of speed to secure really good results, but practical structural considerations have limited the rate of speed and character of impulses that produce the most effective screening action. Electrical vibration has been tried heretofore in order to obtain high speed, but without results that have caused actual adoption of an electrical vibrator in any screening apparatus now in use. From my experiments I am convinced that the failure of former electro-magnet devices has been due chiefly to the fundamentally wrong character of vibration produced.

In passing material over a screen, tonnage capacity and close separation are the essential considerations and require constant agitation of the material in such a way as to present new particles to the meshes of the screen, but this must be done so as to cause the smaller undersize particles to contact the screen surface, and not the oversize, that is, the larger particles coming to the top and the smaller particles working down into a position to contact the screen and work through the meshes thereof. This necessary action is caused by an improved apparatus, which provides a really efficient screening action by the associated presence of the mechanical features which I have found essential.

Referring now to Fig. 1, there is shown a screening machine of a well-known type, in which the casing 1 is mounted in inclined position and is provided with an inclined screen surface 2 held in a suitable frame 3 in the casing 1. The other features of the screening machine itself need not be described in detail as the machine in general differs in no way from the usual inclined screening machine except in the features which are hereinafter to be described.

In Fig. 2 I have shown one convenient and efficient means of mounting the screen cloth in the frame in such a way as to maintain the screen cloth at a fixed drumhead tension and in a truly vibratory condition throughout the screening area. This means consists, as shown in Fig. 2, of an S-shaped hook-like strip 4, the inner end 5 of which is re-bent and clamped over the turned-in edge 6 of the screen cloth, which is rein-

forced by a stiffened strip 7 of fabric or similar material. The outer edge 8 of the hook-like strip is in turn fastened over one edge of an angle iron 9, and the two angle irons 9 and 10 at the opposite sides of the frame are connected together and are spaced in any desired relation by means of adjusting bars 11 threaded into right and left-hand threaded sockets 12 in the angle irons 10 on the two sides of the frame. By adjustment of the bars the angle irons may be spread apart and in this way an even uniform tension is put upon the screen surface, and the tension may be increased to such a point that the screen surface is under a vibratory, drum-head tension.

Mounted longitudinally and centrally upon the screen surface is a suitable strip of metal 15. The strip of metal is rigidly fastened, either by bolting or some other suitable means, to the screen surface itself and extends over the entire length of the screen. This metal strip may be termed a distributing strip and its action is to distribute the impulses conveyed to it over the entire screen surface, so it has been found that a very much better screening action can be secured if the vibratory action can be transmitted to all parts of the screen, and such an action cannot be secured on light screen cloth by a single vibratory mechanism unless some such means of distributing the impulses are employed. On heavy screen cloth where the wires are themselves of considerable size, it is perhaps unnecessary to use any additional distributing means, as there the wires themselves are sufficiently rigid to serve as distributing strips for transmitting the vibratory impulses throughout the screening area of the screen cloth.

It is important that the screen cloth be under a vibratory and uniform tension at all points throughout its area and also that the vibratory impulses be transmitted to all parts of the screen by means of a distributing strip, such as I have described, or a similar functioning means. Without these two conditions the action of the vibratory means which I will now describe, is not satisfactory and capable of giving the best results either in the tonnage of material handled or in the accuracy of the separation.

The means for limiting the movement of the armature act to bring to a sudden stop both the armature and screen upon the travel under the influence of the electro-magnet and as this travel is rapid the sudden stoppage of the armature and screen, which is caused by the engagement of the upper and lower striking blocks, jars the screen very sharply. This jar is transmitted to the screen upon movement of the armature and is important, as it overcomes

the main difficulty which has heretofore been found with electro-magnetic vibrators for screening machines. The difficulty in question is that in electro-magnetic machines as used in the past, while an extremely rapid vibration has been given to the screen surface, there has been no striking or jarring action transmitted to the screen to cause the material passing thereover to be agitated sufficiently for the purpose of making the desired separation. In such machines the screening action has been very much hampered by the fact that the material was not properly agitated at each impulse or movement of the screen to bring the larger particles to the top and allow the smaller particles to go to the bottom and work their way through the screen surface. The present means for limiting the range of action of the armature and screen surface serve to impart the necessary jar to the screen and to cause the larger particles or oversize to leave the surface and the smaller particles or undersize to travel closely to the surface of the screen.

A rapid vibration of the screening surface is also necessary to secure the highest efficiency, both in tonnage of material and in closeness of separation at a given mesh. In screening machines employing mechanical means for vibrating the screen, which have almost invariably taken the form of hammers striking against the screen surface or means for jarring the screen surface longitudinally, the rate of vibration has usually been three to six hundred vibrations a minute. This rate of vibration is too slow to secure the best screening action for most uses, and while I am not prepared to specify any exact speed, the best speed in each case will depend upon a number of factors, such as the size and weight of material passing thereover and the condition of material as to moisture. I have found that the best results cannot be secured by vibration of less than 800 vibrations a minute, nor more than 4,000. Tests indicate that the minimum and maximum speeds are approximately as given above. By electro-magnetic means any speed found necessary to the most efficient vibration can be applied, but for most work 1800 impulses has shown the best results.

The working range of the screen between its uppermost and lowermost positions need never be more than about one-fourth of an inch, irrespective of the kind, weight or size of material passing over the screens, and irrespective of the character or size of the screen itself. The amount of travel or working range of the screen should, however, be determined according to the character of material to be screened, and the size and strength of the screen used

when the machine is first installed and tested and it should not be necessary to thereafter use this adjustment so long as the same kind of material and the same character of screen are used.

The adjustment for different kinds of material may be made, of course, while the machine is in operation, but as a matter of practice it need not be, as the best vibratory action of the screen can be easily determined before material is passed over it at all. For determining the point of best vibration, a removable door is mounted in the top of the machine, and to adjust the vibration, the vibratory means are operated before material is passed over the screen, and the operator, by opening this door (not shown), can place his hands upon the screen and can thus adjust the hand wheel 57 until the proper action is secured. It is extremely difficult to describe in words how to determine when the vibration is satisfactory, but in practice it is easily determined by putting the finger tips to the screen.

My improved electro-magnetic vibrating means are shown in Figs. 4 and 5, and consist of a transversely extending bridge 40, upon which is mounted an enclosed housing 41, within which is carried the electro-magnetic field consisting of the coils 43 and movable armature 44. The armature is provided with a downwardly extending stem or boss 45 to an inverted U-shaped bracket 46, which is in turn attached at its two ends to the distributing strip 15 mounted centrally on the screen 2. The action of the electro-magnet is to repeatedly pull the armature member upwardly toward the coil and then release the same, this action being carried out at a speed of approximately 1800 complete movements per minute, which gives 1800 impulses per minute to the screen. The intermittent action of the electro-magnet is secured either by operating upon an alternating current, or on a direct current with a suitable interrupter.

The armature of the electro-magnet is provided with two laterally extending plates 51 and 52, to which is secured an inverted U-shaped support 53, on the upper part of which is mounted a spring 54. The upper end of this spring is mounted about the downwardly projecting portion 55, which is adjusted by means of a hand wheel 57 mounted above the casing 41. The adjusting stem 56 may be operated by the hand wheel 57 to vary the pressure exerted by the spring 54 against the armature 44. By increasing the tension on the spring the force acting to return the armature to its lowest position is increased, and this increased force will drive the screen and armature downward upon the release of

the armature by the electro-magnet. In this way the amplitude of the vibration given to the screen can be varied to suit each existing operating condition, and this is important in order to proportion the vibration to the type of screen and to the kind of material that is being classified.

Mounted between the plate 52, which is attached to the armature, and a plate 60 attached to the bridge 40 is a heavy coiled spring 61. When the machine is initially assembled this heavy coiled spring 61 is placed under a slight compression and is compressed at a distance of perhaps one-eighth inch, or slightly less. The tendency of this spring is to press the armature, and, with it, the spring, upwards and serves to maintain the screen and armature in a given normal position, even under the heaviest working load that may be passed over the screen. In this way this spring 61 also acts to maintain the armature within practical working limits of the magnetic field and thus insures a constant speed of vibration, whereas otherwise an extraordinarily heavy load on the screen might so depress the armature that it might be carried below the effective working limits of the field, and as a result the vibration might cease or become ineffective because the armature was not in a position to be properly acted upon by the field.

The spring is of course so proportioned as to prevent the depression of the armature which would be effected when a heavy load of material were passed over the screen. On the other hand, if an extremely light load of material were passed over the screen the action of the spring 61 would be to hold the armature very close to the field and, if anything, slightly above its normal position. This would tend to decrease the amplitude of vibration, but this can in turn be adjusted by tensioning the upper spring 54 until the downward force exerted by this spring is sufficient to off-set the upward force exerted by the spring 61, in this way making it possible to exactly position the screen and armature under any given set of conditions. The vibrating apparatus and the screen can by this means be maintained in their normal and best operative positions under all conditions, irrespective of the load that is being passed over the screen.

In order to secure an efficient screening action it is essential that the screen be jarred upon each vibration, and this jar should come as the screen is moved upward in order to allow the material to move slightly above the screen which will cause the material to be agitated and to return to the screen with the smaller material adjacent to the screen surface, and in a position to pass through the meshes of it. In order to secure this jarring of the screen upon each upward

movement I have provided a series of striking blocks mounted respectively upon the armature and upon the casing enclosing the entire apparatus. These striking blocks consist of plates 65 supported from the top 66 of the enclosed casing 41 and extending ends or arms 67 on the upper of the two plates 51 and 52 attached to the armature. These plates 65 and 67 are so proportioned and mounted that the plates 67 will strike against the plates 65 before the armature reaches the field, as such contact between armature and field would batter the laminations of both so as to destroy their working value.

The modified type of vibrator which is shown in Figs. 6 and 7 is distinguished from the type already shown and described in Figs. 3, 4 and 5, it being provided with a transversely extending guide strip 70 which is mounted centrally on the armature shaft 71. This guide strip 70 is held against any except slight longitudinal movement at its two ends by means of bolts 72 passing through holes 73 in the spring strip. The holes 73 are made slightly larger than the bolts in order to permit a very slight movement of the guide strip when the same is bent upwardly and downwardly under the action of the armature. The function of this guide strip is to automatically center and guide the armature. The centering and guiding of the armature by means of this guide strip eliminates any binding of the armature which might be caused by the armature contacting against other parts or bearings and also keeps the armature true in its position. The result is that the action of this mechanism is very free and the power necessary to operate it is correspondingly reduced.

A further distinction in this type of vibrator is the construction and mounting of the two springs 76 and 77, which in this form are of the same size although the spring 77 is of wire of slightly smaller diameter making it slightly weaker than the lower spring 76. This upper spring 77 may be adjusted by means of the same hand wheel 57 as is shown on a preceding type and for convenience of adjustment a ball thrust bearing 78 is provided.

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 a screening apparatus, the combination of a woven wire screen tensioned to a uniform vibratory tension, an electro-magnetic means adapted to vibrate said screen

at a high speed, and resilient supporting means for said screen, said means being adapted to maintain said screen within predetermined limits.

2. In a screening apparatus, the combination of a woven wire screen tensioned to a uniform vibratory tension, an electro-magnetic means comprising a stationarily mounted field and a movable armature attached to said screen, and resilient means mounted to normally maintain said armature within the effective working range of said field against the pull of the load of said screen.

3. In a screening apparatus, the combination of a woven wire screen tensioned to a uniform vibratory tension, an electro-magnet mounted above said screen, the armature of said electro-magnet being attached to said screen, a coiled spring mounted to press said armature upward, a second, spring mounted to press said armature downward, and means adapted to vary the pressure exerted by said second spring.

4. In a screening apparatus, the combination of a woven wire screen tensioned to a uniform vibratory tension, an electro-magnet mounted above said screen, the armature of said electro-magnet being attached to said screen, a coiled spring mounted to press said armature upward toward said field, said spring being normally under compression, a second spring mounted to press said armature downward, and means adapted to vary the pressure exerted by said second spring.

5. In a screening apparatus, the combination of a woven wire screen, an electro-magnetic means including an armature attached to said screen, said means being adapted to vibrate said screen at high speed, and means including fixed striking blocks and striking blocks mounted on said armature, said blocks being mounted to contact upon each movement of said armature, thereby jarring said screen.

6. In a screening apparatus, the combination of a woven wire screen tensioned to a uniform vibratory tension, an electro-magnet mounted above said screen, the armature of said electro-magnet being attached to said screen, a spring mounted to press said armature upward toward said field, said spring being normally under compression, a second spring mounted to press said armature downward, and means adapted to increase the pressure exerted by said second spring to a point sufficient to balance the first-named spring and place the armature and screen in resilient balance.

7. In a screening apparatus the combination of a woven wire screen tensioned to a uniform vibratory tension, an electro-magnetic device mounted above said screen, the armature post of said electro-magnetic de-

vice being attached to said screen, and a resilient flexible, metal strip mounted at right-angles to said armature post, said armature being attached to and guided by said strip. 10

8. In the screening apparatus the combination of a woven wire screen tension of a uniform vibratory tension, an electro-magnetic device mounted above said screen, the armature post of said electro-magnetic device being attached to said screen, a flexible metal strip mounted at right angles to said armature post, said strip guiding said armature and being mounted to bend in the direction of movement of said armature. 15

Signed by me, this 26th day of March, 1921.

MORLEY PUNSHON REYNOLDS.