

Aug. 31, 1926.

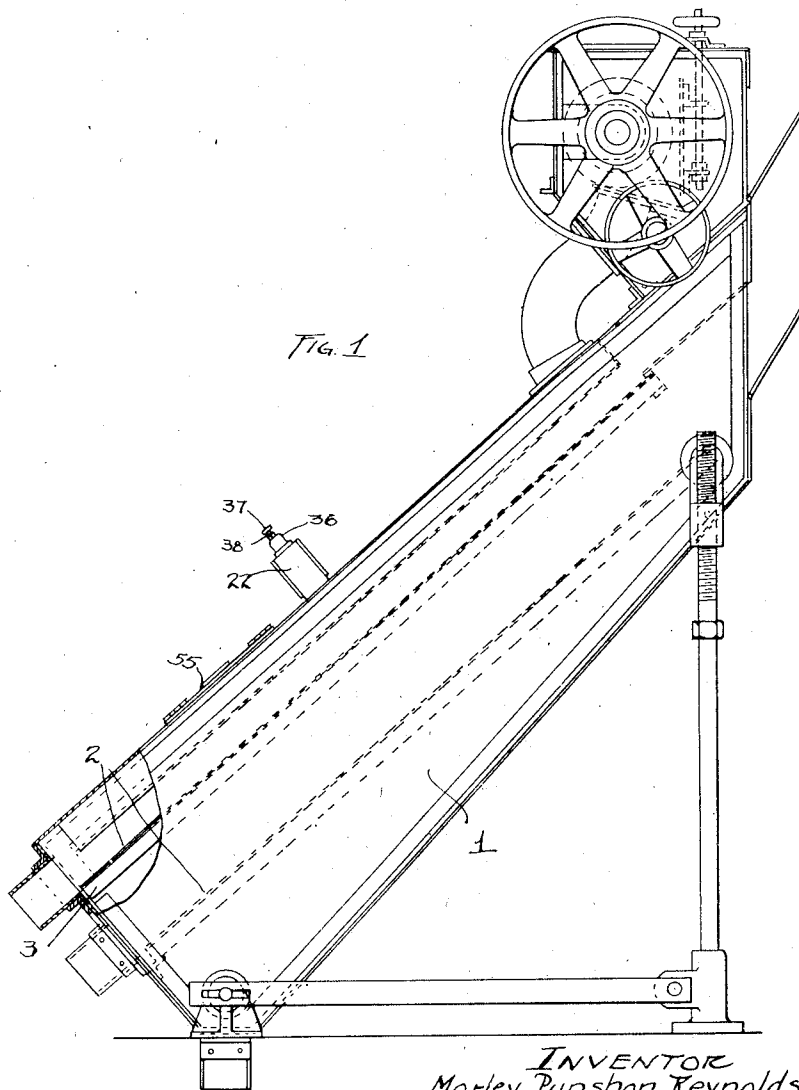
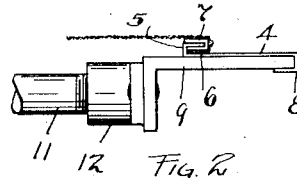
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APPARATUS FOR SCREENING MATERIALS

Filed March 29, 1919

4 Sheets-Sheet 1



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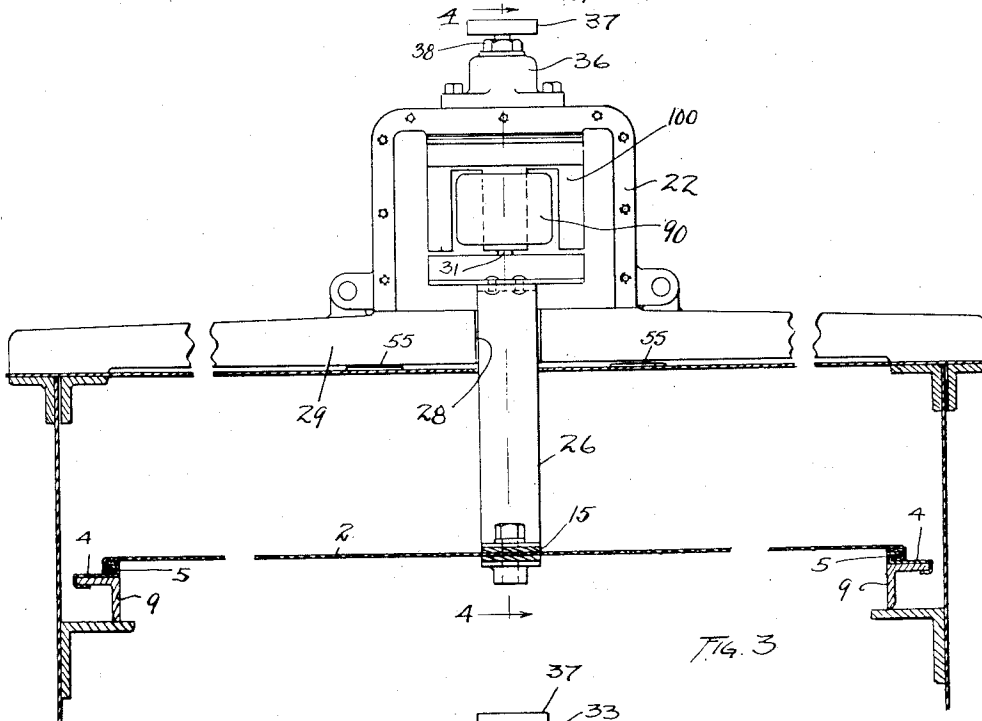


Fig. 3

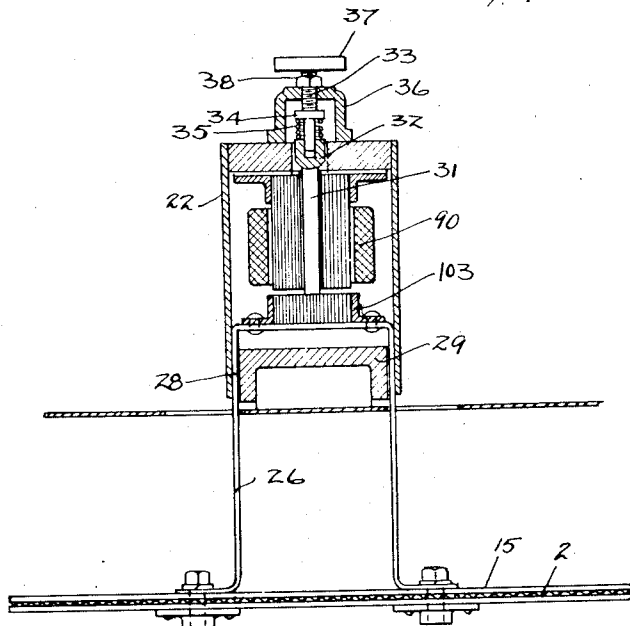


Fig. 4

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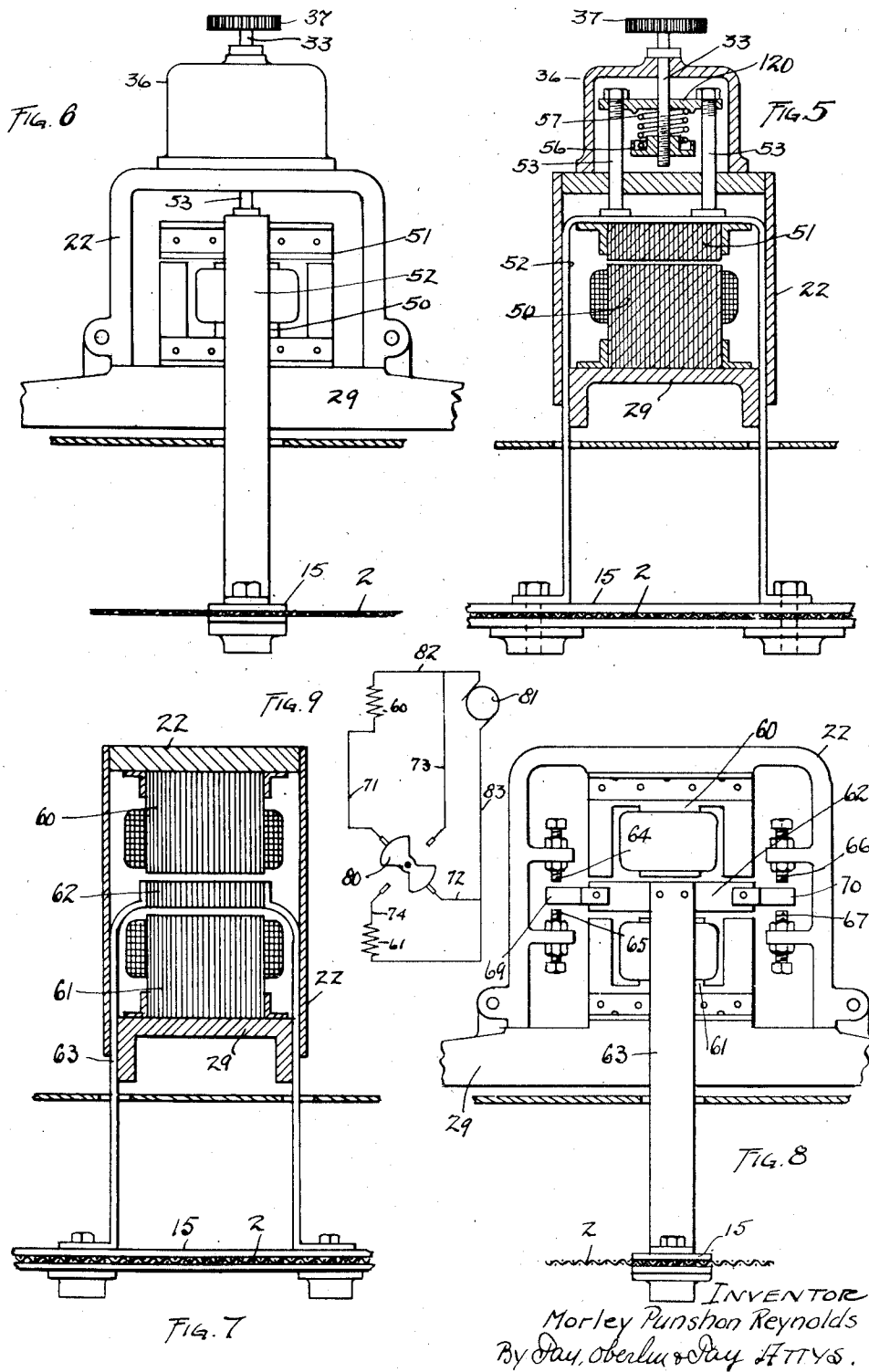
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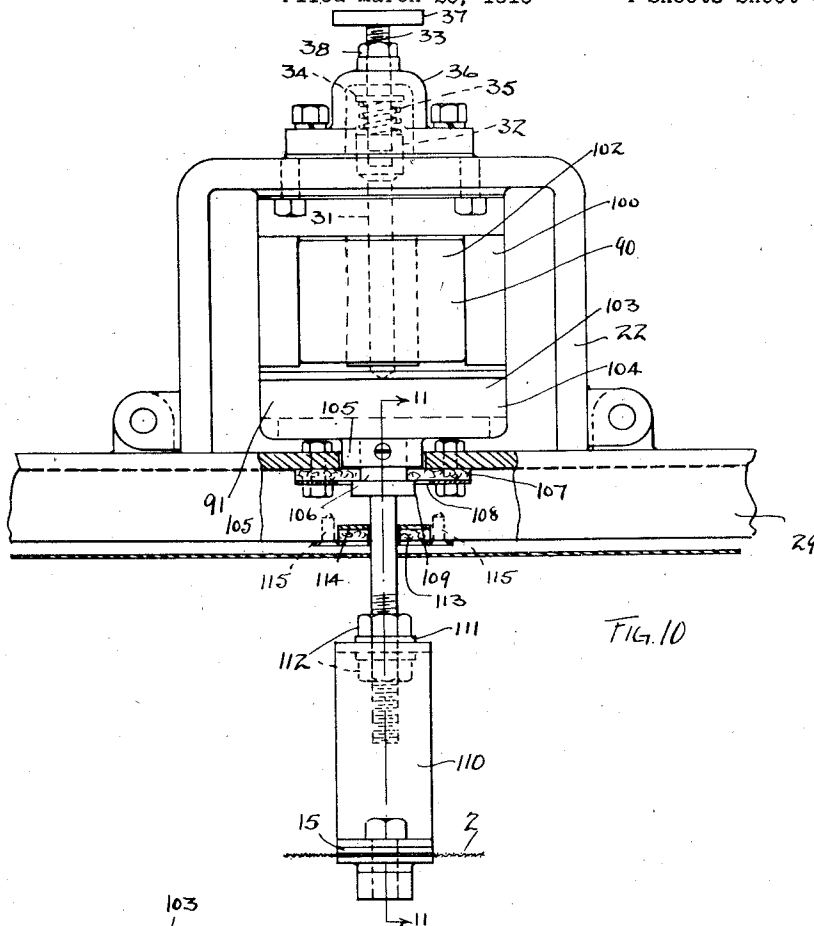


FIG. 10

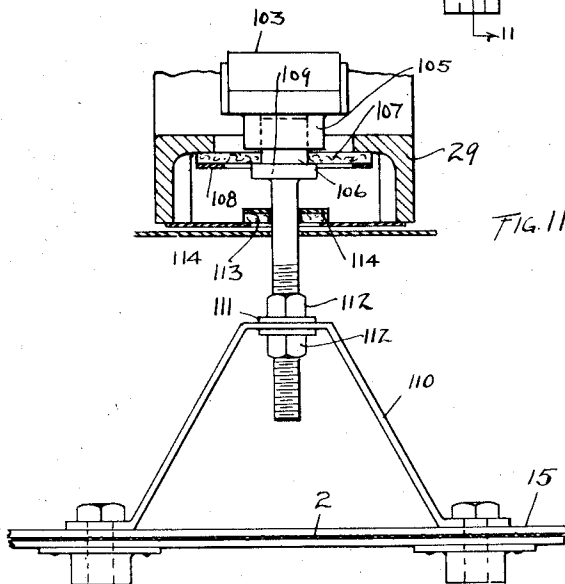


FIG. 11

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APPARATUS FOR SCREENING MATERIALS.

Application filed March 29, 1919. Serial No. 285,953.

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 longitudinal section through the screen and frame; Fig. 3 is a transverse section through the vibrating mechanism; Fig. 4 is a section on the line 4—4, Fig. 3; Fig. 5 is a transverse section showing a modification of the vibrating means; Fig. 6 is a side elevation of the same; Figs. 7 and 8 are views corresponding to Figs. 5 and 6 showing still another modification of the vibrating means; Fig. 9 is a diagrammatic view showing the connections for the electro-magnet of Figs. 7 and 8; Fig. 10 is a longitudinal section through my preferred form of vibrating mechanism; and Fig. 11 is a section on the line 11—11, Fig. 10.

Before proceeding to the description of my invention it may be desirable to briefly outline the faults which have heretofore been experienced in vibrating mechanism. The chief objection in mechanical vibrators 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-magnetic devices has been due chiefly to the fundamentally wrong character of vibration produced.

In passing material over a screen, tonnage and accuracy 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 reinforced 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 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, drumhead 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, as 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 armature against the surface of the core, 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 there- over 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 accuracy of separation. 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 of wire and size of opening in the screen surface, and 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 4000. Tests indicate that the minimum and maximum speeds are approximately as given above. By electromagnetic means any speed found necessary to the most efficient vibration can be applied.

The working range of the screen between its uppermost and lowermost positions need never be more than about one-eighth of an inch, irrespective of the kind, weight or size of material passing over the screen, 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 ma-

terial 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 easily be 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 the door 55, can place his hands upon the screen and can thus adjust the hand wheel 37 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 electromagnetic means are shown in various forms in Figs. 3, 4, 5, 6, 7, 8, 9, 10 and 11, and the form which I have found to give the best results is that shown in Figs. 10 and 11. In this latter form the electromagnetic means are mounted in a casing 22, open at its bottom and supported upon a bridge 29, extending across the frame of the machine. The coils of the magnet are mounted in the casing while the armature 25 is mounted on a casting 104. Formed as a part of the casting 104 is an extending socket 105, in which is removably attached a rod 106, having a threaded upper end for convenient insertion in, and removal from, this socket 105. This post or rod 106 passes through an opening in a bridge 29 and is snugly fitted in an opening in a leather diaphragm 107 which is bolted on the under side of the bridge to entirely close the opening therethrough. A light plate 108 is mounted below and around the outer edge of the diaphragm. The rod 106 has a flange 109 mounted against the diaphragm. In this way the rod is securely fastened to the diaphragm, and as a very slight movement of the armature is required, as will be more fully explained hereafter, the diaphragm has sufficient flexibility to move with armature and rod 106.

Mounted on the distributing strip 15 on the screen is an inverted U-shaped bracket 110, which is provided with an opening in its upper or flattened portion, into which the rod 106 passes, where it is adjustably secured by means of washers 111 and lock nuts 112. The adjustment of the rod 106 in the bracket is necessary in many cases to make up for the variations in the position of the bracket caused by the different thicknesses of screen which are used, and by this means a very wide latitude for adjustment is provided.

Mounted on a plate on the bridge 29 is a second strip of leather, which is covered by a plate 114, both the plate and strip being then secured by means of screws 115 to

the cover plate. This strip and the plate are not attached to the rod 106 and do not move with it, but merely have openings through which the rod 106 passes and serve as a guide for the reciprocation of this member.

Mounted in an extension 36 on top of the casing is an adjustable rod 33 which may be adjusted by means of a hand wheel 37 externally of this casing and may be locked in that position by means of a lock nut 38. This adjusting member 33 is provided with a flange 34, against which is mounted a spring 35 pressing upon a socket 32 on the upper end of a rod 31 which passes down through the center of the electromagnet into contact with the upper face of the armature 103. This adjusting rod serves to determine the working range of the armature and of the screen, and may be adjusted to increase or decrease the amplitude of vibration of the screen surface. By increasing the tension on the spring 35 the force, acting to return the armature to its lowest position and also of course the screen, is increased, and this increased force will drive the screen and armature downward upon the release of the armature by the electro-magnet.

The electro-magnet is operated by any suitable kind of intermittent or pulsating current in order to alternately energize and de-energize the electro-magnet and alternately attract the armature and screen.

In Figs. 3 and 4 I have shown a slightly modified type of vibrating means, in which a bracket 26 is attached to the distributing strip 15 as in the previously described form and is then carried upwardly on either side of the bridge 29 in slots 28 which are formed therein and directly attached to the armature 103.

In Figs. 5 and 6 I have shown still another modification of the electro-magnet, in which the armature is pulled downwardly instead of upwardly as in the preceding forms, an armature 51 being mounted above the electro-magnet 50, and being connected to the screen or distributing strip in the same manner as in Figs. 3 and 4. In this form two rods 53 are attached to the upper side of the armature and carry at their upper ends a plate 120 against which is positioned a spring 57. This spring 57 is held between the plate and a socket 56 which is carried on the adjusting rod 33, which may be adjusted by the external hand wheel 37, as previously described.

In the vibrating means illustrated in the figures already described it is intended that a sharp jar shall be given to the screen upon its reaching its limited movement in one direction, which in the case of the vibrators of Figs. 9, 10, 3 and 4 is its upward position, and in the case of the vibrator of Figs. 5 and

6 its lowermost position. To secure this jarring action, which is necessary to secure a proper and efficient screening action, I cause the armature to be brought directly into contact with the core of the electro-magnet, as this forms the most convenient method of securing this sharp jar without additional mechanism. It will be recognized of course that other means for securing a sharp jar can readily be provided, and in Figs. 7 and 8 I have shown such a means.

In Figs. 7 and 8 I have shown a double-acting electromagnet consisting of spaced electromagnets 60 and 61, operating to reciprocate an armature 62, which is mounted between the electromagnets and attached to the vibrating strip 15 on the screen by means of a bracket 63. In this form the armature is floated between the electromagnets and need not contact either of them as the armature is provided with lateral extensions or lugs 69 and 70 moving between adjustable stops 64 and 65, and 66 and 67, which are carried in suitable extensions of the housing 22. By convenient adjustment of these stops 64, 65, 66 and 67 the range of action of the armature can be accurately set and the armature can be jarred upon each upward and downward movement, that jar of course being transmitted directly to the screen surface through the bracket 63 and the distributing strip 15.

In Fig. 9 I have shown the circuit connections for this double electromagnet. In this circuit diagram there is shown a suitable source of current 81, such as a generator, from which extends lines 82 and 83 to the coils 60 and 61, respectively. From these coils extend lines or contacts 71 and 74. Other lines 72 and 73 are connected to the lines 83 and 82, respectively, and all of the connections 71, 72, 73 and 74 are arranged to be contacted by a rotating switch or commutator 80, which may be operated by any suitable means. The rotation of this switch 80 alternately connects the coil 60 with the source of current supply and then the coil 61, and causes an alternate energizing of the coils 60 and 61.

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 screening apparatus, the combination of a screen tensioned to a uniform drum-head tension, means adapted to vibrate the same at high speed, means adapted to bring the screen to a jarring stop upon each vibratory impulse thereof, and a distributing member mounted directly on the screen and

extending from side to side thereof, said member being adapted to distribute the jar caused by such stop throughout such screen.

2. In screening apparatus, the combination of a screen tensioned to a uniform drum-head tension, means adapted to vibrate the same at high speed, means adapted to bring the screen to a jarring stop upon each vibratory impulse thereof, and a longitudinally disposed distributing strip mounted directly on said screen and adapted to distribute the jar caused by such stop throughout such screen.

3. A vibrating apparatus for screens comprising an electro-magnet adjacent to a screen, an armature mounted directly on said screen, means adapted to operate said electro-magnet intermittently and at a high rate of speed, and stop means mounted to be engaged by said armature upon movement thereof.

4. A vibrating apparatus for screens comprising an electro-magnet mounted centrally and directly adjacent to a screen, an armature mounted on said screen, means adapted to operate said electro-magnet intermittently and at a high rate of speed to move said armature in one direction only, and means adapted to assist in returning said armature to its initial position.

5. A vibrating apparatus for screens comprising an electro-magnet mounted adjacent to a screen, an armature mounted centrally and directly on said screen, means adapted to operate said electro-magnet intermittently and at a high rate of speed to move said armature in one direction only, and resilient means adapted to assist in returning to initial position said armature and said screen.

6. A vibrating apparatus for screens comprising an electro-magnet mounted centrally and directly adjacent to a screen, an armature mounted on said screen, means adapted to operate said electro-magnet intermittently and at a high rate of speed to move said armature in one direction only, resilient means adapted to assist in returning to initial position said armature and said screen, and means for varying the pressure exerted by said resilient means.

7. A vibrating apparatus for screens comprising an electro-magnet mounted centrally and directly adjacent to a screen, an armature mounted on said screen, means adapted to operate said electro-magnet intermittently and at a high rate of speed, and said electro-magnet being adapted to actuate said armature and screen away from material passing thereover.

8. A vibrating apparatus for screens comprising a casing open at one side, an electro-magnet mounted in said casing, an armature also mounted in said casing, a flexible diaphragm closing the open side of said casing, said armature being attached to said dia-

phragm, and means also mounted on said diaphragm and adapted to rigidly connect the same with a screen.

9. The combination with a screen having
5 a bracket mounted thereon, of a vibrating device comprising a casing open at one side, an electromagnet mounted in said casing, a flexible diaphragm closing the open side of

said casing, said armature being attached to said diaphragm, and means also mounted on
10 said diaphragm and rigidly connected to said armature, said means being adjustably attached to said bracket on said screen.

Signed by me, this 19th day of March, 1919.

MORLEY PUNSHON REYNOLDS.