

May 2, 1933.

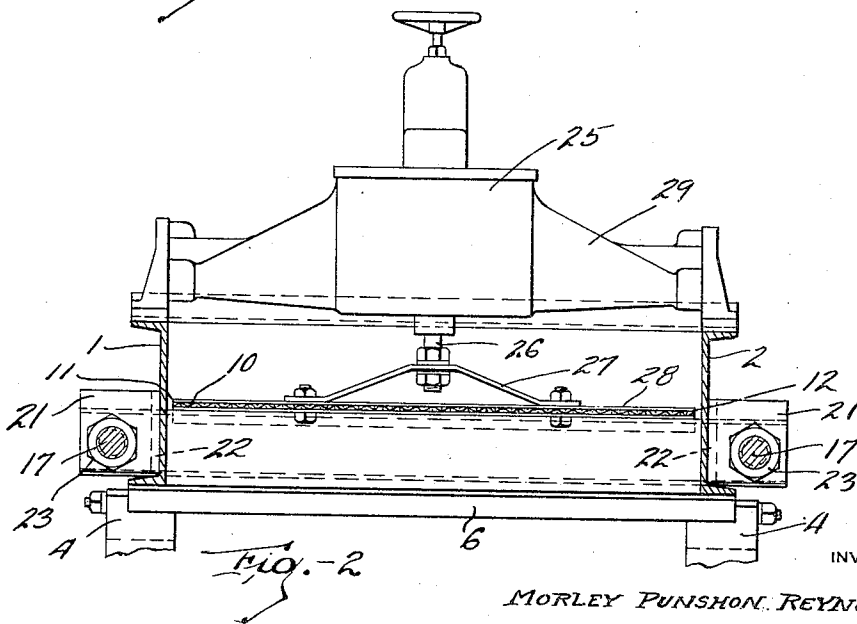
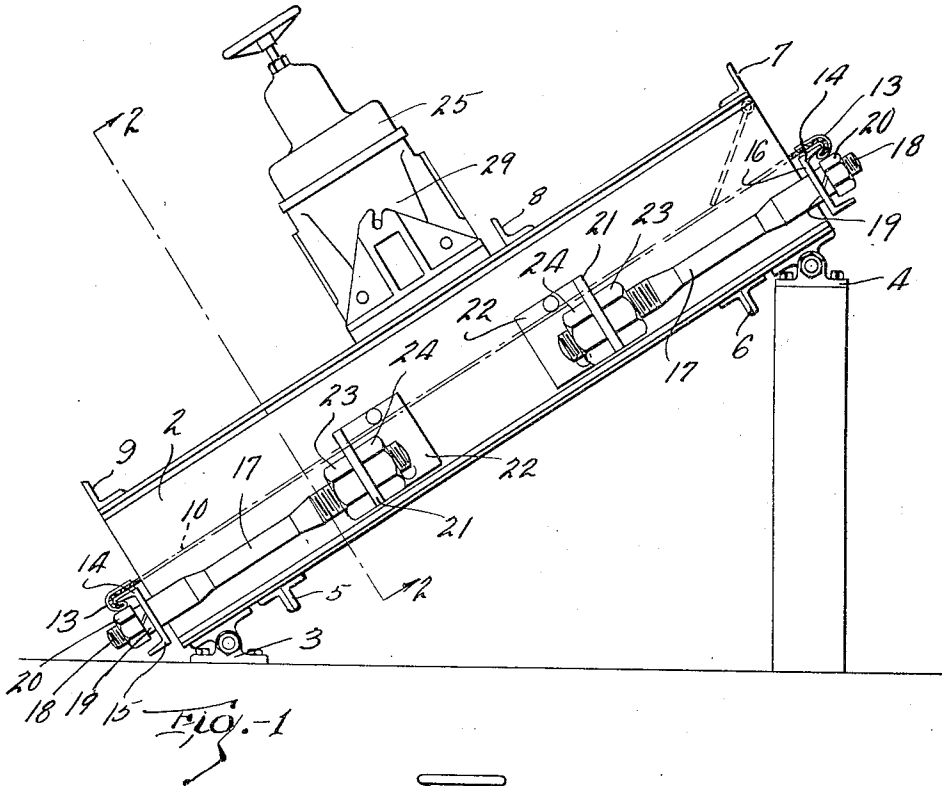
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1,906,336

SCREENING APPARATUS

Filed Oct. 4, 1928

5 Sheets-Sheet 1



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5 Sheets-Sheet 2

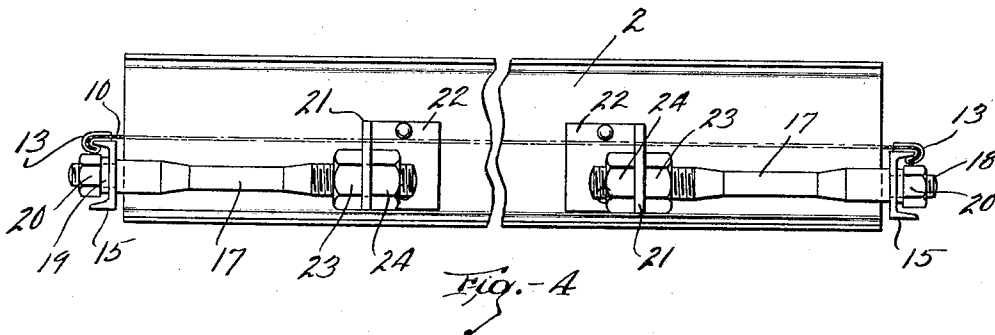
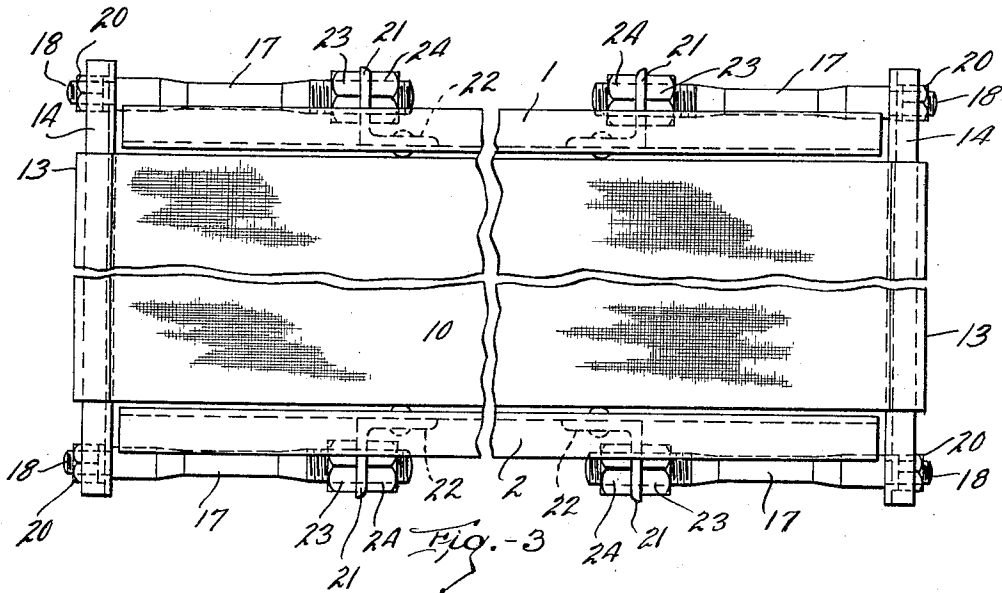


Fig. 5

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5 Sheets-Sheet 3

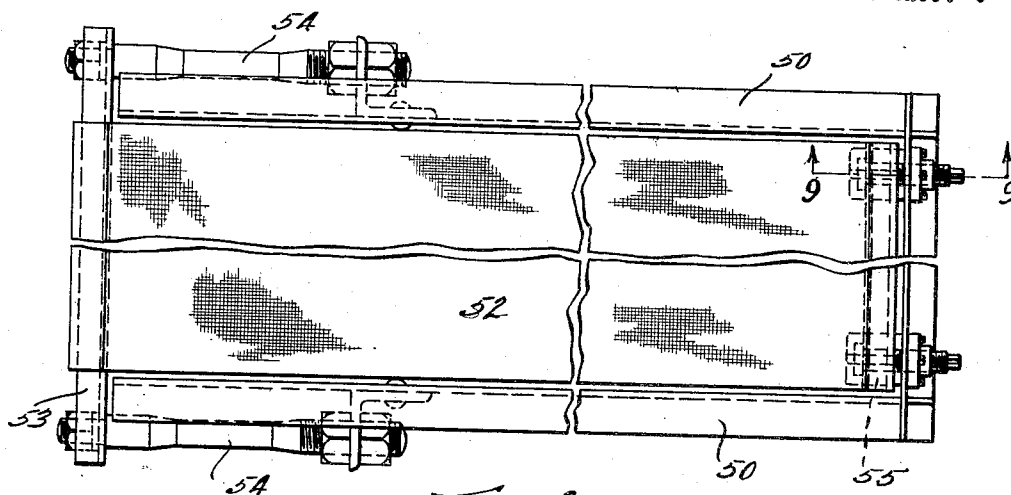


Fig. -6

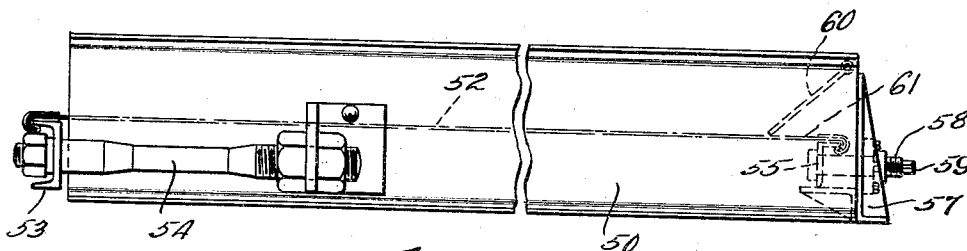


Fig. -7

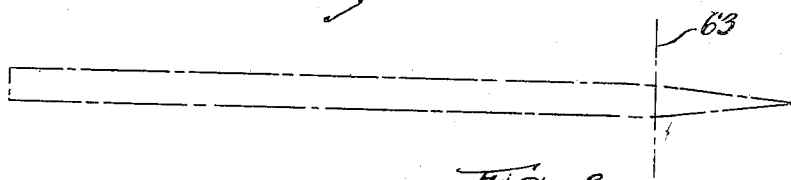


Fig. -8

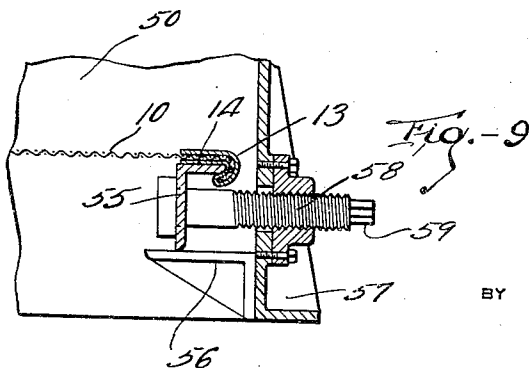


Fig. -9

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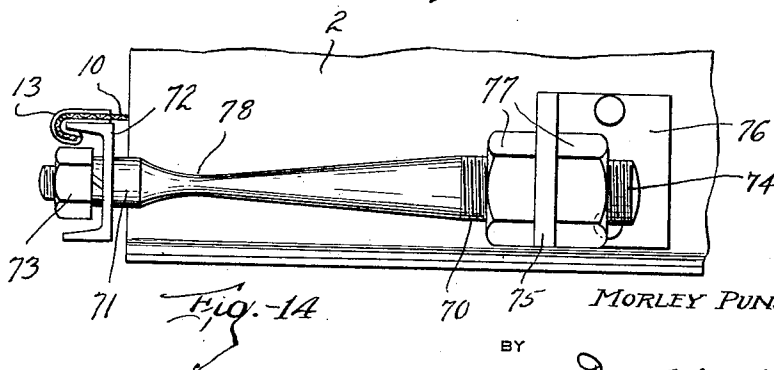
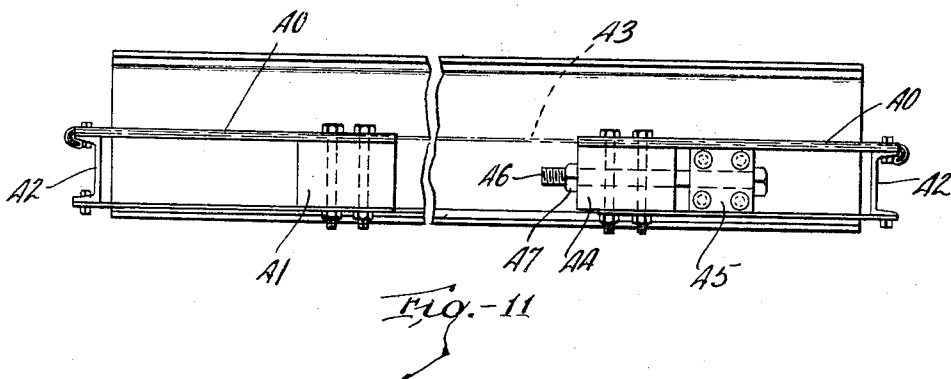
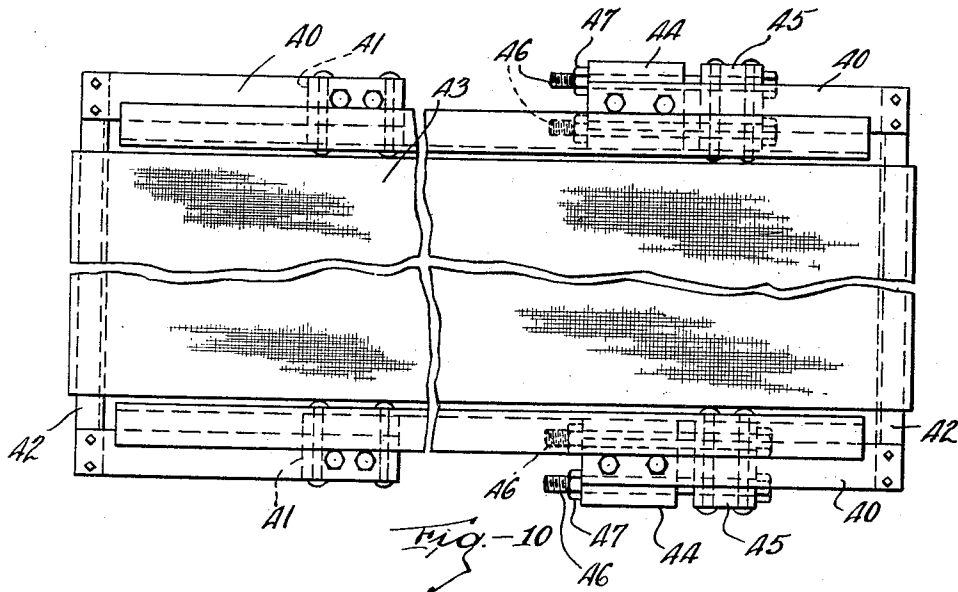
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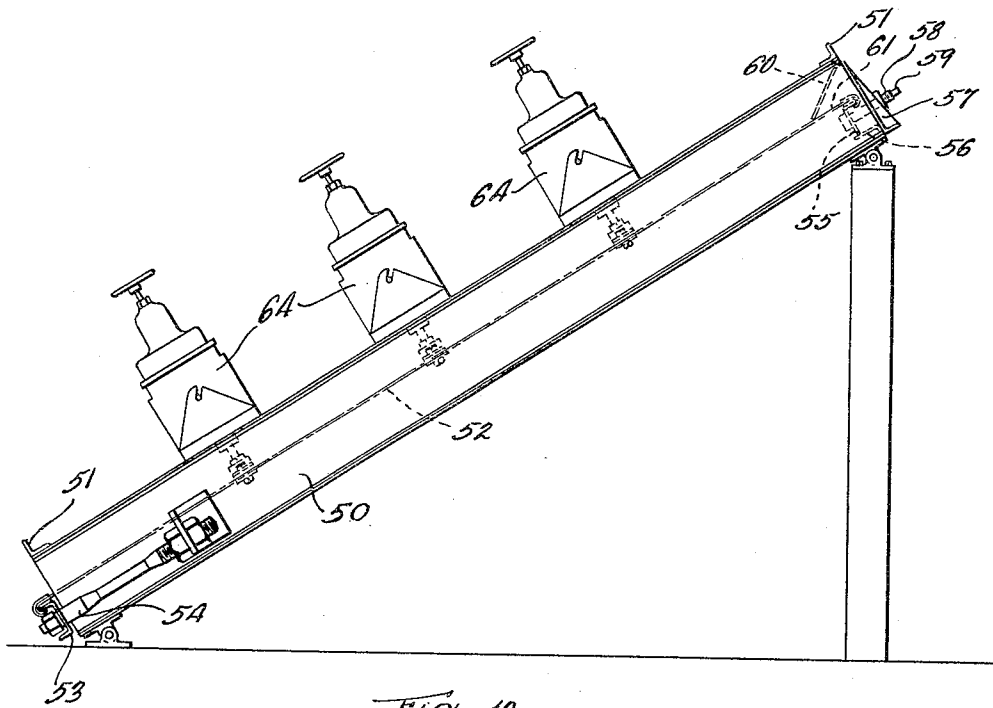


FIG. 12

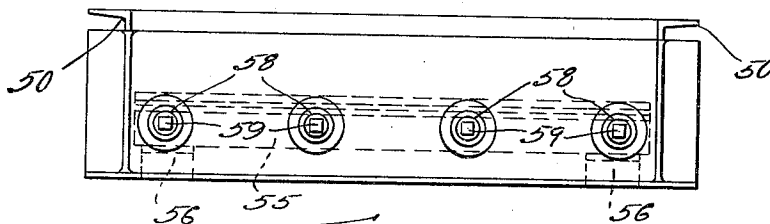


FIG. 13

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UNITED STATES PATENT OFFICE

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SCREENING APPARATUS

Application filed October 4, 1928. Serial No. 310,416.

The present improvements relating, as indicated, to screening apparatus are more particularly directed to an improved machine of this character in which the screen proper is mounted and maintained in a "floating" condition, that is, a condition in which the entire screen area may be maintained in vibration as distinguished from the machines now in general use. In current types of machines where the screen is fastened at two or more edges to rigid members, there is a diminution of the vibration over the area adjacent to the fastened edges and the primary purpose of the present invention is to provide an apparatus in which the entire area of the screen is in a condition permitting it to be given a uniform and effective vibration. A further object of the invention is the provision of a screening apparatus in which the entire screen is so mounted as to make it extremely lively and resilient in order to secure the full benefit of the vibration imparted thereto. 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 various mechanical forms in which the principle of the invention may be used.

In said annexed drawings:—

Fig. 1 is a side elevation of the screening apparatus embodying my improvements; Fig. 2 is a transverse section of the same on the line 2—2, Fig. 1; Fig. 3 is a plan view showing the screen and one means of mounting the same; Fig. 4 is a side elevation of the mechanism of Fig. 3; Fig. 5 is a diagrammatic side elevation illustrating movement of the screen cloth when mounted in the mechanism of Figs. 3 and 4; Fig. 6 is a plan view showing a modification of the means for mounting the screen; Fig. 7 is a side elevation of the mechanism of Fig. 6; Fig. 8 is a diagrammatic side elevation illustrating the movement of the screen cloth when mounted in the mechanism of Figs. 6 and 7;

Fig. 9 is an enlarged detail view showing the mounting of the screen cloth at the right side of Fig. 7; Fig. 10 is a plan view showing another modification of the mechanism for mounting the screen; Fig. 11 is a side elevation of the mechanism of Fig. 10; Fig. 12 is a side elevation more or less diagrammatic in character showing my invention as applied to an inclined screen and using the means for mounting the screen which are shown in Figs. 6 and 7; Fig. 13 is an upper end elevation of the mechanism of Fig. 12; and Fig. 14 is a side elevation of a modification of the supporting arms.

Screening apparatus as used today is of two general types. In one, a section of screen cloth is mounted in a fixed frame, the screen cloth being secured usually at two opposite sides to the frame and vibrations being imparted to the screen by some suitable means, such as a rotated unbalanced weight, an electro-magnetic device, mechanical hammers or the like. In this type of mechanism the amplitude of vibration occurring in the screen is the maximum at the point where the vibration is transmitted to it, usually at or near the center. It is a minimum close to the fastened edges and as a result either a considerable portion of the screen is operating with an amplitude of vibration insufficient for the best screening effect, or the central part must be given an unnecessary large amplitude, which causes the material to be bounced from the screen in that portion in order to produce an approximation of the desired amplitude adjacent to the edges. It will be recognized that in this type of apparatus either condition is a compromise and in neither can the entire area of the screen be given a really effective and uniform vibration.

The other type of screening apparatus which is in general use has the screen secured either on all of the edges or on two opposite edges to a frame, the vibrations then being transmitted, not to the screen but to the frame. This frame is then struck or shaken and in this way the material is moved over and through the screen, although this is not as effective as where the vibration is trans-

mitted directly to the screen cloth as in the machine described above. The advantages of the second type of machine are that there is a more nearly uniform movement of the entire screen than in the first, although the type of movement with respect to the material on the screen is far less effective.

The present improvements are directed to the first of the two types of screening apparatus described above and have been found to provide a very much more effective and uniform amplitude of vibration over a greater portion of the screen area than is possible in former types of machines. My new apparatus is so constructed that it combines the advantages inherent in both of the above types of screening machine without the drawbacks which such machines have had in the past. In the new apparatus the screen cloth is tensioned and vibrated directly and is also so mounted that it is enabled to have a free or floating movement. It thus combines both the direct applications of the vibrations to the screen and also the single advantage of the second type of machine referred to above, namely, the movement of the entire frame in which the screen is mounted.

Referring now to Figs. 1 and 2, there is shown a screening apparatus consisting of spaced parallel inclined members here shown as channels 1 and 2 mounted upon suitable brackets 3 and 4 at their lower and upper ends respectively. These channel members constitute a frame for the screening apparatus and are connected by transverse members 5, 6, 7, 8 and 9 to provide a substantially rectangular casing open at its upper and lower ends for the delivery of material onto the screen which is mounted in the frame and for discharging material from said screen.

The woven wire screen employed in the present apparatus is mounted between the channels 1 and 2 and is secured at two opposite edges only. The secured edges are here shown as the upper and lower edges of a section of screen cloth 10 and it will be understood that for most conditions, these edges are the ones which can best be secured, leaving the other two edges, in this case, the two side edges 11 and 12, perfectly free and clear both of the casing in the form of the channels 1 and 2 and of all other obstructions.

The screen 10 has each of two opposite edges bent over and confined within a curved metallic hook strip 13 which in turn is engaged over the upper surface 14 of the channel or angle 15. The engagement of the screen is the same at each of the two-secured edges, the channel 15 being here shown at the lower end of the screen and a similar channel 16 being shown at the upper end.

The channels 15 and 16 are carried upon the ends of longitudinally extending arms which are shown in Figs. 1 and 2 in the form

of studs 17. These studs are mounted on the outside of the channels 1 and 2 which constitute the frame and are provided with a reduced threaded end portion 18 and a shoulder 19 adjacent this reduced portion against which the angle 15 engages, being secured in this position by means of a nut 20. At their inner ends, the arms 17 are threaded and are engaged in the outwardly projecting flange portions 21 of brackets 22 suitably secured to the sides of the channels 1 and 2, the engagement of the arms with the brackets being effected by means of lock nuts 23 and 24. It will be understood that the arms or studs 17 when fixed by the nuts 23 and 24 are thereafter not movable longitudinally. The movement secured from these studs, and from them transmitted to the screen, is an oscillatory or vibratory movement, and is not a movement of the stud with respect to the bracket in which it is supported.

Suitable means for vibrating the screen are employed, the means here shown consisting of an electro-magnetic vibrator 25 of which the armature 26 is secured to a V-shaped bracket or a strip 27, the lower ends of which are secured to a thin resilient metal strip 28 secured directly to the screen and, as here shown, extending transversely thereof, although this strip may also extend longitudinally. The vibrator as shown in Fig. 1 is formed as a part of a bridge 29 which extends completely across the frame of the machine and is secured at its two ends upon the side channels 1 and 2 in such position that the armature 26 moves in a plane at right angles to the plane of the screen 10. Depending upon the length of the screen between its two fixed ends, there may be one, two, three, or even more electro-magnetic devices or equivalent means for vibrating the screen, each vibrating the screen cloth through a resilient distributing strip, such as the strip 28 already described.

The screen is initially mounted in the frame by loosening one pair of the supporting arms 17, that is, moving one pair of arms toward the center of the frame, thus reducing the distance between the flanges 13 and 14 of the channels 15 and 16 and allowing the hooked edges of the screen to be secured over these flanges. The arms are then adjusted outwardly, that is, longitudinally of the frame to bring the screen into a taut condition, that is, into a tight vibratory condition or as near such a condition as the character of the screen permits, it being understood that where extremely coarse wire or rod is employed in the screen it is impossible to tension such a screen to the same degree as one made of finer wire and in smaller mesh. When so made taut, the other edges of the screen are entirely free and unrestricted by any part of the frame or of the apparatus.

The term "woven wire screen" as here used in the description is intended to include not only screens formed by weaving together longitudinal and transverse wires, but also
5 screens in which wires or rods are either woven or connected in such a way as to form an element provided with a plurality of openings therethrough, and also what are termed "plate screens", that is, elements
10 formed of plates provided with perforations acting to pass material therethrough.

A screen so mounted when vibrated by the electro-magnetic vibrator is perfectly free to move throughout its entire area and the
15 amplitude of the vibration is substantially uniform throughout the screen surface. The amplitude will of course depend upon various conditions such as the type of material passing over the screen, the weight of material, the character of the screen cloth and the type of vibration imparted to it, but
20 regardless of these factors, the amplitude is substantially the same over the entire area and the entire screen surface is then in a free lively floating condition which may be illustrated in the manner shown in Fig. 5, in
25 which the upper and lower dotted lines represent the upper and lower limiting positions of the screen and the intermediate wavy line, the waves imparting to the screen surface from each vibrator whether one or more be used. The action is therefore that of a freely movable sheet combining a bodily movement with a wave or vibratory movement
30 which passes from the point of application of the vibration toward the edges of the screen.

The floating condition of the screen and the uniform amplitude of vibration secured
40 therein are produced by the floating condition of the two pairs of supporting members or arms to which the fastened edges of the screen are secured. The supporting arms 17 while relatively fixed and rigid by reason of
45 their mounting in the brackets 22 are still free to move slightly in a vertical direction and do move under the influence of the vibratory screen and the vibrating strip where used. This slight movement allowed the
50 screen supports, that is, the channels 15 and 16, permits the fastened ends of the screen to float up and down and allows the adjacent screen area to move and to vibrate to substantially the same extent as the central portion of the screen which is a condition not
55 heretofore obtained in any tensioned screen.

It will be apparent that in this screen a very much closer approximation of the ideal screening condition is secured than where
60 two opposite edges are attached to fixed unyielding supports. In this screen, the vibration imparted thereto can be more nearly the exact vibration desired for the mesh of the screen cloth and the load passing over it
65 while an additional advantage is that the

area of screen undergoing vibration is very much increased over that in machines having two fixed supports. The advantages of the present screen produced by the uniform
70 amplitude of vibration given the entire screen area are an increase in tonnage without any increase in the size of the machine, a decreased tendency of the screen to "clog" and a lower screening angle. The screen is
75 now so much more lively that the material can be made to move down over the screen surface with the screen at a lower angle than heretofore which prevents racing of the material over the screen and keeps the material
80 in constant movement, but in a close engagement with the screen surface, thus presenting as many openings for the undersized material to pass through as possible.

Various modifications of the mechanical form in which the invention is embodied may be employed; one such form being shown in
85 Figs. 10 and 11 in which the supporting arms are in the form of resilient elements 40. These elements 40 are in effect springs mounted on suitable brackets 41 on the sides
90 of the channels in the same manner as the supporting arms of the preceding apparatus and extend in substantial alignment in opposite directions towards the ends of the frame where they support transverse angles
95 or channels 42 on which the ends of the screen 43 are mounted. One of the two pairs of springs 40 are adjustable longitudinally of the frame in order to space the screen supporting members and thus tension the screen
100 when applied. This adjustment is secured by mounting the inner ends of one pair of springs 40 on blocks 44 which are supported by fixed brackets 45. These blocks are movable
105 with respect to the brackets by means of bolts 46 mounted in the brackets and passing through the blocks where they are secured by nuts 47.

Further modifications of the apparatus just described are illustrated in Figs. 6 and 7
110 while the purpose and convenience of this modification are illustrated more or less diagrammatically in Figs. 12 and 13. The apparatus previously described is intended principally for the use of relatively heavy
115 stiff screens of relatively coarse mesh in which wire of considerable size and stiffness is employed. It is also limited to some extent by the fact that the mounting and adjustment of the screen cloth is effected through the adjustment of the supporting
120 arms on the two opposite sides of the frame. In cases where screen of less stiffness and of finer mesh is employed and particularly under conditions where space is at a premium
125 and it is impossible to so arrange and mount the machines that access can conveniently be had to both sides of the machine, it is then desirable to employ a modification of the construction so far described in which the screen
130

may be initially tensioned and subsequently adjusted to maintain it in tension from behind the machine, that is from either the lower or upper end and desirably from the upper end which is not in the path of the discharging material. It will be understood that it is impossible to draw a definite line between heavy and light screens as under different conditions either the apparatus previously described or that now to be described may be employed but that in general there is such a distinction and that in the lighter and finer screens, the apparatus now to be described can best be employed, and in many cases must be employed, by reason of the close arrangement of the screening units in a plant which precludes access for adjustment to both sides of each machine.

Referring first to Fig. 12, I have shown diagrammatically an inclined screening apparatus consisting of a casing formed of spaced parallel inclined channels 50 suitably secured together by transverse members 51 in which a woven wire screen 52 is mounted between its upper and lower ends which are secured to tensioning means while the two side edges of the screen are entirely free. The apparatus shown in this figure is one in which a relatively long narrow screen is employed. The screen is mounted at its lower end from a channel 53 secured to supporting arms 54 of the type already described. The upper end of the screen is mounted upon a transversely extending channel or angle 55, (see Figs. 9 and 12) supported upon an angle 56 secured to a transverse end member 57 of the frame and adjusted by means of a plurality of adjusting bolts 58. The bolts 58 pass through the angles 55 and are there fixed by engaging in the threaded portion of a bracket which is secured to the transverse end member of the frame. The adjustment of the member 55 is secured by turning the bolt 58 which is provided with a reduced end 59 for the reception of a suitable operating handle. In this apparatus the screen is initially mounted in position by having its lower end engaging over the angle 53 and its upper end engaged over the angle 55. The various bolts (see Fig. 13) may then be initially adjusted to bring the screen into a true uniform, vibratory condition. The number of bolts employed depends of course upon the width of the screen and to some extent upon the character of the screen cloth.

In the apparatus shown in Fig. 12, the material is then fed onto the screen intermediate its ends instead of substantially at the upper end as in most machines by means of a deflecting plate 60 suitably mounted upon the frame and extending downwardly at an angle to the screen surface. The material is fed first onto this plate 60 and is then fed off from the plate onto the screen, thus reducing the effect of the falling material on the screen

as it now slides gently off from the plate instead of dropping bodily through a number of inches onto the screen. A further advantage of the use of the deflection feed plate is to free the upper portion 61 of the screen of any load, thus allowing this portion of the screen to vibrate very much more freely than if it were under a load and had to lift the load with each vibration. The result of freeing the fixed end of the screen from load is to allow the entire balance of the screen to vibrate through substantially a uniform amplitude in the manner indicated in Fig. 8, in which the dotted line 63 represents the position of the lower end of the feed plate while the upper and lower dotted lines indicate the upper and lower position of the screen under vibration. In a screen of considerably greater length and width, such as that diagrammatically illustrated in Fig. 12, it may be desirable to employ a plurality of electro-magnetic vibrators or similar devices and I have here shown three vibrating units 64, which are substantially equi-distantly spaced and between them divide equally the portion of the screen between the lower end and the effective upper end, that is, the point at which the material discharges onto the screen, neglecting the blanketed portion which receives no load and which is under the feed plate 60. In such an apparatus it is possible, as indicated diagrammatically in Fig. 8, to secure substantially the same uniform amplitude of vibration throughout the screen surface. In this apparatus the term "screen surface" is employed to mean the surface of the screen engaged in operating on the material, neglecting of course the unloaded blanked off portion at the upper end of the screen which is not a matter of material importance, nor is this portion of the screen of any considerable extent.

In the apparatus just described, the tensioning and adjusting of the screen can be effected from behind the machine instead of from the two sides and this is a matter of considerable advantage in locations where the screens are positioned closely adjacent each other or between pillars or other machinery where it is almost impossible to have free access to each side of each machine. In addition to this advantage, the greater sensitivity of the adjustment by reason of the multiplicity of adjusting bolts spaced at close intervals make it possible to secure a greater tension and a more uniform tension across the screen which is of considerable advantage in the use of certain weights of screen.

By the description of the apparatus of Fig. 12 in which a screen of considerable length with respect to its width is shown, it is not intended to imply that the mounting for the screen here shown is necessarily limited to screens of these relative proportions. In Figs. 6 and 7, I have shown plan and side ele-

vations respectively of the mounting more diagrammatically shown in Fig. 12, in which the lower end of the screen is mounted upon oscillatory or vibratory arms and the upper
 5 end to a fixed adjustable support, and it should be understood that this mounting may also be employed in screens in which the length approximates the width.

In Fig. 14 I have shown a modification of one of the supporting arms or studs. In this
 10 form the stud 70 is provided as in the other form with an end shoulder 71 to receive the screen supporting channel or angle 72, which is held in position by a suitable nut 73. The
 15 other end of the stud is provided with a threaded portion 74, which passes through a suitable opening in the flange 75 of a bracket 76, which is secured to the longitudinal side channel of the frame, and the stud is locked
 20 against longitudinal movement in this flange 75 by nuts 77. The chief point of distinction between the studs shown in this figure and the studs previously described is in the inter-
 25 mediate or body portion of the stud, which is here tapered from a maximum diameter at the inner or fixed end to a minimum diameter at the point 78 which is closely adjacent to the enlarged shoulder end of the stud. It
 30 is found that studs so formed give a somewhat better vibratory action than those shown in Figs. 3, 4, 6 and 7 and are less subject to breakage under repeated use.

Other modes of applying the principle of my invention may be employed instead of the
 35 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.

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

1. In a screening apparatus, the combination of a frame, a woven wire screen mounted in an inclined position in said frame, said
 45 screen having one edge fixedly secured therein, means engaging the other opposite edge of said screen, said means being oscillatory about an axis parallel to the fixed edge of said screen and disposed between the secured
 50 edges thereof, and means for vibrating said screen.

2. In a screening apparatus, the combination of a frame, a woven wire screen disposed in an inclined position therein, fixed means in
 55 said frame engaging one edge of said screen, and means engaging the opposite edge of said screen disposed between the secured edges thereof, said last-named means being oscillatory in a plane at right angles to the surface of said screen, and one of said means being
 60 movable in a plane parallel to said screen to permit of tensioning of said screen to a desired tension.

3. In a screening apparatus, the combination of a frame, a woven wire screen disposed

in inclined position therein, means engaging the ends of one set of wires in said screen at one end thereof, and securing the same in position within said frame, and oscillatory tensioning means mounted adjacent the other
 70 end of said screen, said means comprising a transverse member and pivotally mounted supporting means therefor disposed between the secured edges of said screen.

4. In screening apparatus, the combination of a frame, two parallel screen supporting
 75 members, one being fixed to said frame, a woven wire screen engaged over said members, and means for supporting the other of said members comprising resilient arms, each
 80 being attached at one end to said members and at the other end to said frame intermediate the ends of said screen.

5. In screening apparatus, the combination of a frame, two parallel screen supporting
 85 members, one being fixed to said frame, a woven wire screen engaged over said members, and means for tensioning said screen and supporting the other of said members comprising resilient arms interposed between
 90 said member and said frame, said arms being under compression by virtue of tension of said screen.

6. In a screening apparatus, the combination of a frame, a woven wire screen disposed in an inclined position therein, means in said frame engaging one edge of said
 95 screen, and means engaging the opposite edge of said screen, said last-named means disposed between the secured edges of said screen being oscillatory in a plane at right angles to the surface of said screen, and one of said
 100 means being movable in a plane parallel to said screen to permit of tensioning of said screen to a desired tension.

7. In a screening apparatus, the combination of a frame, a woven wire screen mounted in an inclined position therein, and two oscillatory members engaging two opposite edges
 110 of said screen, said members being adjustable in a plane parallel to the plane of said screen to tension the same and being oscillatory in a plane at right angles to the plane of said screen, and said members being pivoted about axes intermediate the ends of said
 115 screen.

8. In screening apparatus, the combination of a frame, spaced brackets mounted thereon, supporting arms oscillatorily mounted on
 120 said brackets and extending in opposite directions therefrom, parallel screen supporting members secured to the ends of said arms, and a woven wire screen engaged with said supporting members and extending between the same, said brackets disposed between the
 125 secured ends of said screen.

9. In screening apparatus, the combination of a frame, aligned supporting arms oscillatorily mounted thereon at their inner ends, screen supporting members carried on the
 130

free ends of said arms, a woven wire screen engaged at two opposite edges upon said supporting members, and means for tensioning said screen.

5 10. In apparatus of the character described, a frame, an oscillatorily mounted transverse member at one end thereof, a second member adjustably mounted at the other
10 end of said frame, a woven wire screen mounted on said two members tensioned therebetween, said members supported by means disposed intermediately of the ends of said
15 screen, a feeding means disposed above said screen and adapted to discharge material onto said screen at a point spaced from said adjustable member, and a plurality of vibrating means equidistantly spaced and connected to said screen for vibrating the same.

20 11. In apparatus of the character described, a frame, two spaced parallel screen supporting bars extending transversely of said frame, means for adjusting one of said bars, oscillatory compression arms mounted
25 at one end on said frame and supporting the other of said bars, and a plurality of vibrating means engaging said screen and adapted to vibrate the same.

30 12. In screening apparatus, the combination of a frame, two parallel screens supporting members, one being adjustably fixed to said frame, a woven wire screen engaged over said members, and leaf spring elements disposed parallel to said screen, supporting the
35 other of said members, and being in compression by virtue of tension of said screen.

40 13. In apparatus of the character described, the combination with a screen cloth and a supporting frame therefor, of means for movably supporting said cloth within said frame comprising a plurality of flexible studs which are longitudinally substantially rigid, each secured at one end to said frame
45 and at their other ends supporting and tensioning said cloth.

Signed by me, this 2nd day of October, 1928.

MORLEY PUNSHON REYNOLDS.

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