

Jan. 5, 1932.

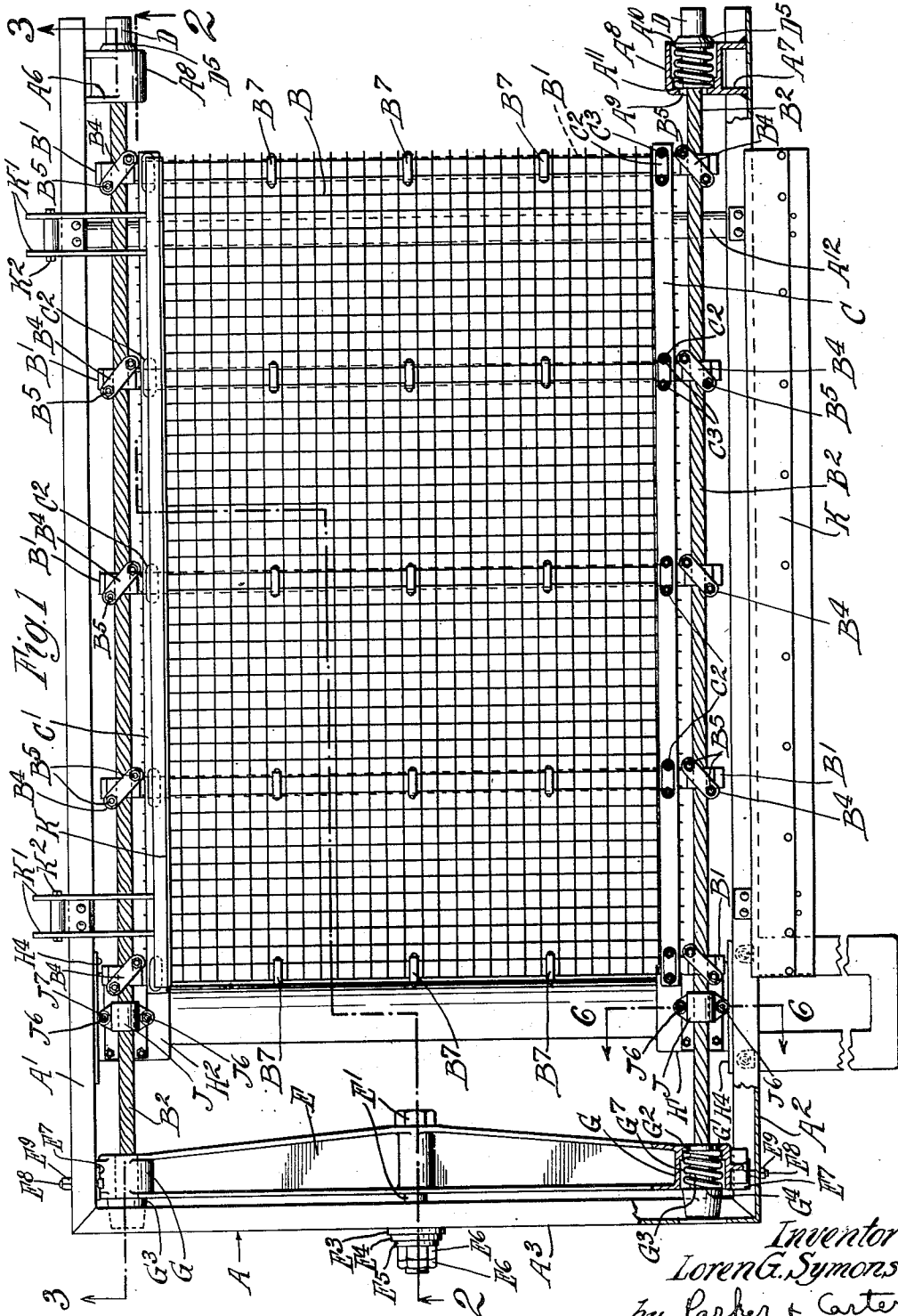
L. G. SYMONS

1,839,610

SCREEN

Filed Nov. 13, 1929

3 Sheets-Sheet 1



Jan. 5, 1932.

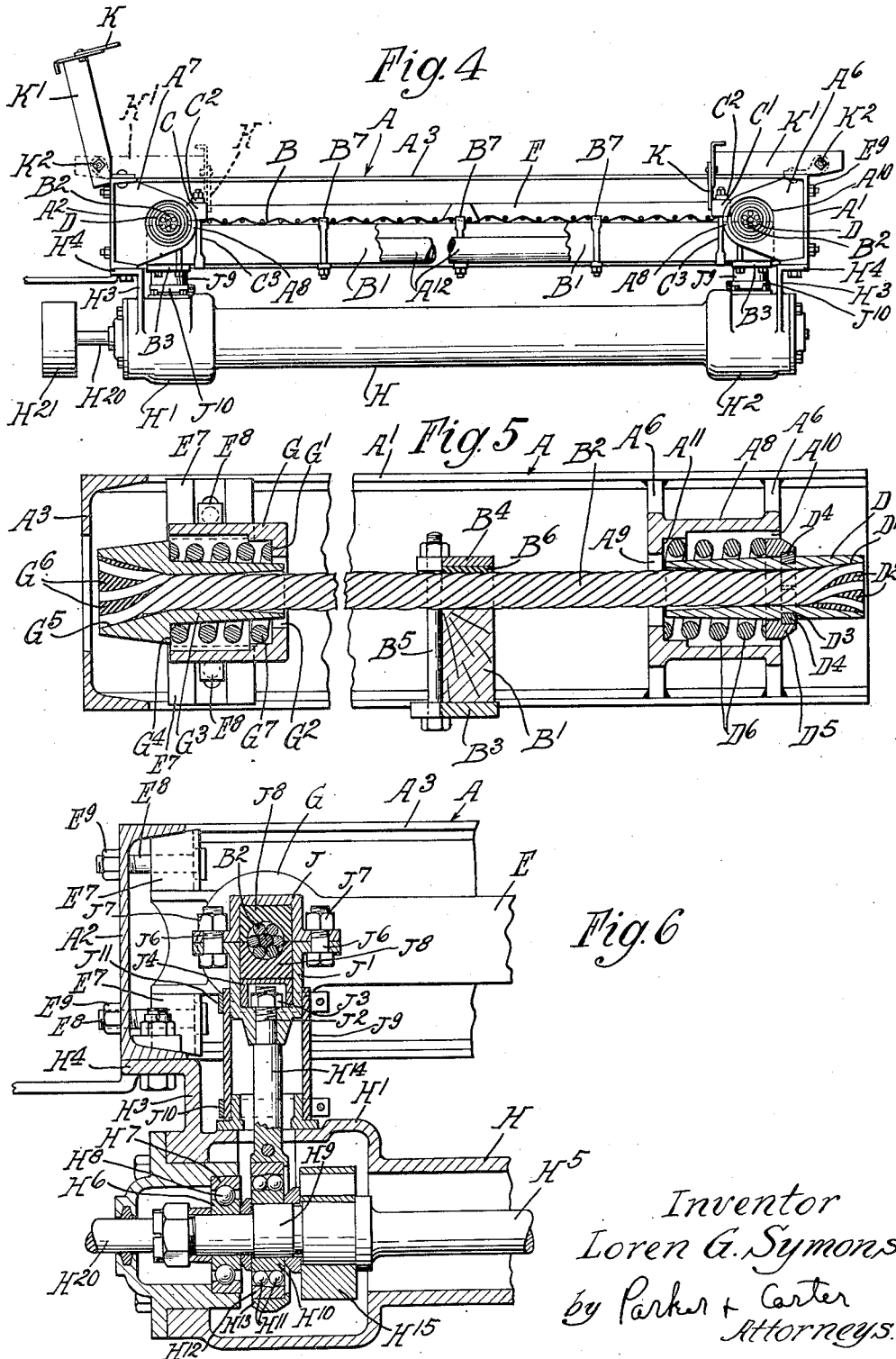
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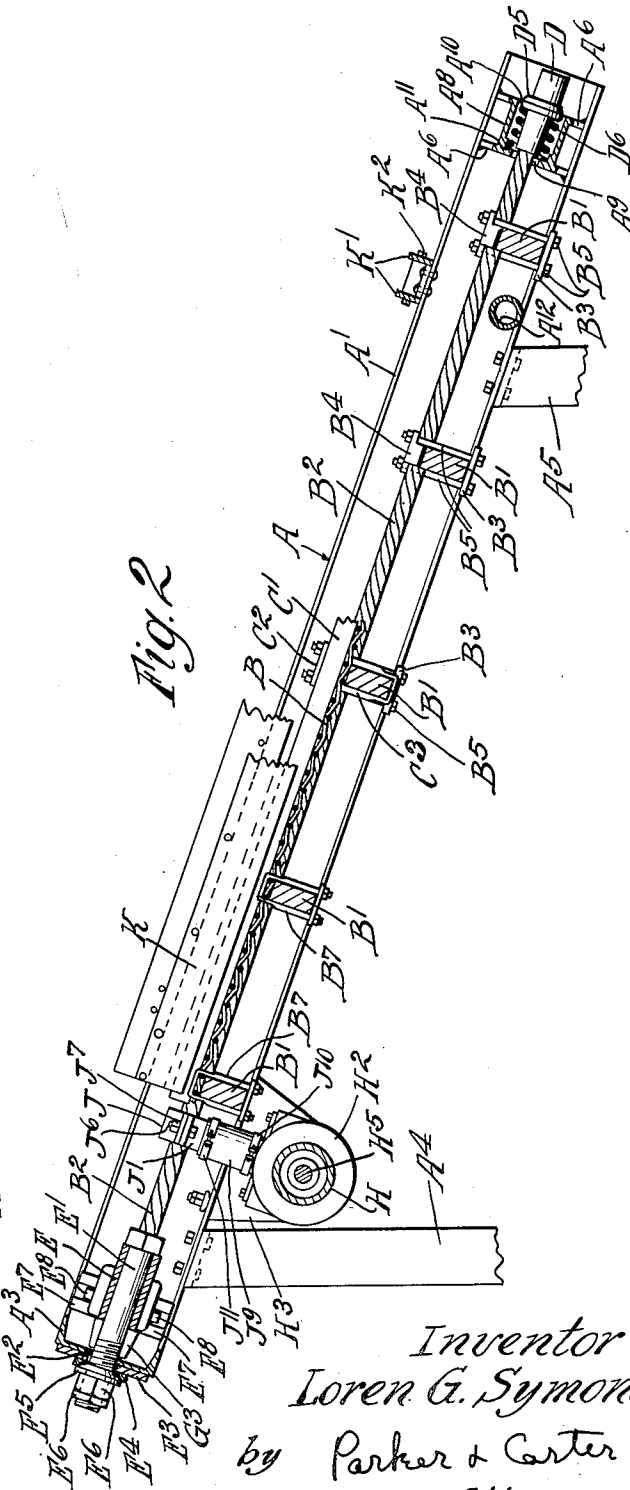
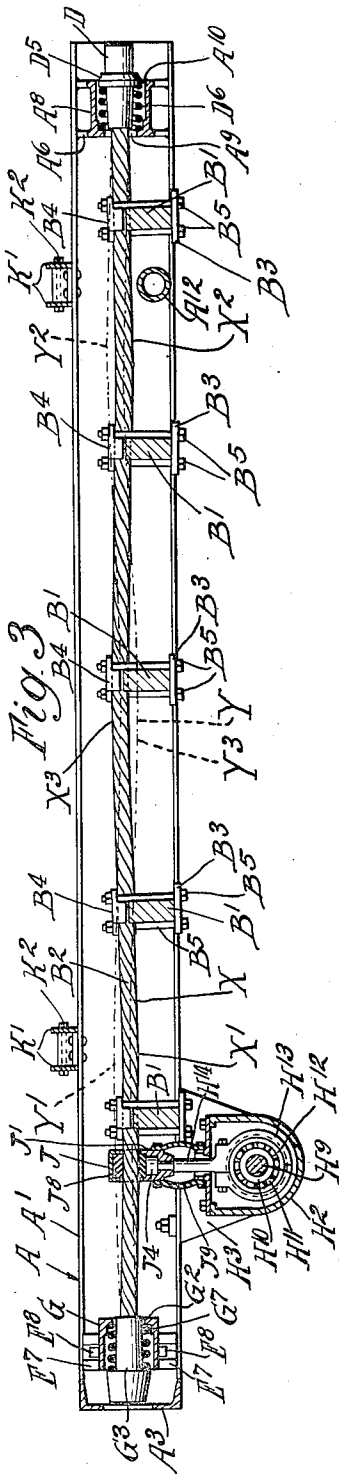
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3 Sheets-Sheet 3



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SCREEN

Application filed November 13, 1929. Serial No. 406,780.

My invention relates to an improvement in screens and relates particularly to an improved vibratory screen. One object of the invention is the provision of a screen which shall be flexible from end to end. Another object is the provision of a screen structure to which may be imparted a wave-like vibration, the waves of the vibration passing from end to end of the screen. Another object is the provision of tensional, flexible supporting members for a screen, which supporting members flex with the screen. Another object is the provision of means for constraining the screen to vibration in unison with its tensional supporting means. Another object is the provision of a screen having a wave-like vibration of constant or relatively constant amplitude throughout the effective area of the screen. Other objects will appear from time to time in the course of the specification and claims.

I illustrate my invention more or less diagrammatically in the accompanying drawings, wherein—

- Figure 1 is a plan view;
- Figure 2 is a section on the line 2—2 of Figure 1;
- Figure 3 is a section on the line 3—3 of Figure 1;
- Figure 4 is an end elevation;
- Figure 5 is a detail; and
- Figure 6 is a section on the line 6—6 of Figure 1.

Like parts are indicated by like symbols throughout the specification and drawings.

Referring to the drawings, A generally indicates any suitable frame member, of which I show the side channel members $A^1 A^2$ which may be connected as by the transverse end member A^3 . In order to support the frame and screen at any desired angle I may employ supports $A^4 A^5$ of unequal height. $A^6 A^7$ are brackets welded to the ends of the channels $A^1 A^2$, each bracket including a generally cylindrical portion A^8 with a restricted aperture A^9 , facing the opposite end of the screen and an enlarged aperture A^{10} . A^{11} indicates a circumferential ledge or seat the purpose of which will later appear. A^{12}

is a transverse brace or tube welded to the side channels $A^1 A^2$.

B generally indicates any suitable screening member, herein shown as of mesh. It is mounted upon a plurality of transverse members B^1 , which may be relatively rigid and may for example be of wood, and which extend from side to side of the screen. These members B^1 are secured to longitudinal cables $B^2 B^2$, extending along each side of the screen and being herein shown as of greater length than the screen and extending beyond the screen at each end thereof. The members B^1 may be secured in relation to the cables or flexible tensional members B^2 , as by the lower clamp members B^3 , the upper clamp members B^4 and the securing bolts B^5 . B^6 indicates any suitable cushion or more or less flexible member which may be interposed between the clamp B^4 and the cable, in order to prevent a metal to metal contact, in case a metal cable is employed. B^7 indicates any suitable clamps, spaced along the members B^1 , whereby the mesh may be secured to the said transverse members at sufficiently frequent intervals to insure that the entire structure vibrates virtually as a unit, and to constrain the mesh to downward vibration or movement with the supporting structure. Thus any whipping or free movement of the mesh is prevented and the entire structure can be vibrated as a unit.

Positioned along the opposite edges of the screen are the flexible material guiding walls indicated as $C C^1$. They are preferably of material which will flex with the screening and with the flexible members B^2 . I may for example employ strips of rubber. These strips may be clamped in place, as by clamping elements C^2 and U-bolts C^3 which may pass about the members B^1 .

Whereas I do not wish to be limited, except so far as I limit myself in the claims, to any specific cable structure, I illustrate the members B^2 as metal cables, formed of a plurality of metal strands or wires. In order to support these cables within the above described frame and to maintain them under tension I provide an enlarged head at each end of each cable. Referring for example to

Figure 5 I illustrate one end of the cable as passing through the cylindrical member A⁸.

About the end of the cable I illustrate a sleeve D the outer end of which is outwardly tapered as at D¹, to provide an expansion of its bore to a diameter greater than the normal diameter of the cable B². The end of the cable may be more or less frayed out, as shown in Figure 5 and metal or any other suitable packing or expanding medium D² may be employed, to provide an expansion or enlargement of the cable end which will prevent it from drawing through the sleeve D. Zinc is a satisfactory metal to be employed as an expanding filler for the cable end. In order to prevent the necessity of placing zinc in the cable in the field I may provide the sleeve D, which is channeled as at D³, with a pair of outwardly projecting half rings D⁴ which may be put in place after the full ring D⁵ has been slipped about the cable. D⁶ indicates a spring compressed between the ledge A¹¹ and the ring D⁵, and tending to maintain the cable under constant tension.

In order to maintain both cables under a uniform tension, and to compensate for what would otherwise be differences in tension I provide a transverse yoke E. This yoke may be secured to the end frame member A³, as by the pin or bolt E¹ which passes through an aperture E² in the frame. Surrounding the end of the member or bolt E¹, where it passes through the aperture is any suitable washer E³ having associated therewith a more or less spherical surfaced bearing member E⁴ opposed to a spherical surface member E⁵ about the bolt E¹. E⁶ E⁶ are any suitable adjusting and locking nuts, whereby the tension on the entire structure may be varied. It will be understood that the proportion of the parts is such that the yoke E may tilt somewhat about its point of support, this movement being permitted by the size of the aperture E² and the spherical formation of the opposed engaging members E⁴ and E⁵. Preferably I constrain the yoke E to horizontal position, or rather, to a position normal to the plane of the frame. I may therefore provide blocks E⁷ opposed to the ends of the transverse yoke E, the bolts and nuts E⁸ E⁹ being provided to take up the slack and to prevent any up and down movement of the yoke due to the vibration of the cables.

Formed in each end of the yoke is a socket G with a ledge G¹ and an aperture G² through which may pass the end of the cable B². G³ indicates a sleeve about the cable, with the abutment ledge G⁴ and the enlarged central aperture G⁵ to receive the unravelled end of the cable, with its filler G⁶, for example of zinc. Compressed between the ledges or abutments G¹ and G⁴ is the spring G⁷. As shown in Figure 5 it will be seen that each end of the cable is yieldingly mounted, the two springs D⁶ and G⁷ serving to put the

cable under any desired tension, this tension being equalized by the yoke E.

In order to impart vibration to the cables I provide the vibratory structure below described. A transverse housing H, with terminal enlargements H¹ H² is positioned beneath and mounted upon the frame. I may employ for example the supporting webs H³ with their flanges H⁴, which may be bolted to the longitudinal frame members A¹ A². Mounted for rotation within the housing H is any suitable shaft or rotary member H⁵. It may be provided at each end with an inner ball race H⁶ fixed on the shaft, an outer ball race H⁷, and the intervening ball bearings H⁸. Figure 6 generally illustrates an eccentric at one end of the shaft H⁵ and it will be understood that a corresponding eccentric and actuating structure is associated with the opposite end. Referring again to Figure 6 H⁹ indicates a cylindrical eccentric member surrounded by the inner ball race H¹⁰, the ball bearings H¹¹ and the outer race H¹². The outer race is mounted in the eye of a vibration transmitting link which includes the annular member H¹³ and the shaft or stem H¹⁴ extending upwardly therefrom. H¹⁵ is any suitable counterweight associated with the shaft H⁵.

In order to transmit movement of the element H¹⁴ to the cables B² I provide a clamping structure which includes the upper clamp element J and the lower clamp element J¹. The lower element J¹ may be secured to the connector H¹⁴, as by the screwthreaded bolt portion J² and the nut J³. J⁴ is a spacer about said nut. The clamp elements J J¹ may be secured together as by the bolts J⁶ and the nuts J⁷. J⁸ J⁸ are yielding pads associated with the clamp member, one engaging the upper and the other the lower side of the cable B². These pads serve to prevent a metal to metal contact and to more or less cushion the connection between the connector H¹⁴ and the cable, thus limiting wear.

In order to prevent the access of dust to the working parts and to reduce the lubricating problem I provide a flexible connection between the above described clamp structure and the enlarged housing portion H¹. This may take the form of a flexible member J⁹, herein shown as tubular the ends of which may be clamped into dust proof engagement with the housing portion H¹ and the clamp structure J¹ respectively, as by the rings J¹⁰ J¹¹.

I may provide any suitable means for rotating the shaft H⁵ and as an illustration of a practical method I illustrate the shaft extension H²⁰ with the pulley H²¹ thereupon.

In order further to constrain the material passing over the screen to longitudinal travel along the screen, and to prevent it from escaping from the edge of the screen I provide, in addition to the flexible walls C¹ the inner

guiding walls generally indicated as K. These may be of sheet or strip metal and are shown, as in Figure 4, as terminating somewhat above the mesh, and as being positioned within the flexible walls C C'. The flexible walls C C' bridge the gap between the normally fixed members K, and prevent any friction or damaging or wearing contact between the members K and the mesh. The members K may be mounted upon brackets K¹ pivoted as at K² to the longitudinal frame members A¹ or A², whereby the members K may be rotated out of vertical alignment with the mesh, as shown at the left of Figure 4. This is advantageous, as giving full contact to the mesh, and as permitting the mesh to be lifted into and out of place, in setting up the screen.

It will be realized that whereas I have described and shown a practical and operative device, nevertheless many changes might be made in the size, shape, number and disposition of parts without departing from the spirit of my invention. I therefore wish my description and drawings to be taken as in a broad sense illustrative and diagrammatic rather than as limiting me to my specific showing. In particular I wish it to be understood that mere variations in proportion or location of parts do not depart from my invention. Where in certain of the claims I describe cables as extending from end to end of a screen member it will be understood that such claims are to be interpreted sufficiently broadly to cover a screen in which the distance between the cables exceeds the length of the screen.

The use and operation of my invention are as follows:

I provide herein a screen member to which may be imparted a wave-like vibration. In practice I find it desirable and adding highly to the efficiency of the screen that the amplitude of vibration be as nearly as possible uniform throughout substantially all points on the effective screening area. I impart the desired vibration to my screen by supporting the mesh B upon flexible supporting members, for example the cables B², which extend along opposite edges of the screen and which not only flexibly support the screen, permitting it to flex freely, but are themselves the intermediary between the vibration imparting mechanism and the screen, and transmit to the screen the vibration which they receive. In order to cause the screen to vibrate completely in unison with the members B² I mount the screen upon the relatively rigid transverse members B¹, and clamp the screen to these members B¹ at a number of spaced points. The result is a screen which will flex transversely of its ends but which will not flex longitudinally. Hence I may impart to the screen a uni-directional wave-like vibration, and the crests and troughs of

the waves of this vibration will extend from side to side of the screen, with equal amplitude, and will move longitudinally along the screen, unimpeded by any stiffening or hampering frame or other supporting means. The nature of this wave-like vibration which is imparted to the cables B², and through them to the screen, is illustrated somewhat diagrammatically in Figure 3. The position of the cable at one instant is indicated in full line as at X. The position of the cable at another limit of its vibration is indicated in dotted line as at Y. Note that the cable indicates the wave-like formation and travel of the vibration, with the wave troughs X¹ X² and the wave crest X³, or the wave crests Y¹ Y² and the wave trough Y³. Thus each point along the screen is vertically vibrated through a vibration of substantially uniform amplitude, while the individual waves of this vibration travel in definite sequence from end to end of the supporting members and screen.

As an effective means of imparting the desired vibration to the cables B² I provide the eccentric structure shown in detail in Figure 6. Its effect, broadly stated, is the vertical reciprocation or oscillation of the upper end of the member H¹⁴. The lower end, the eye H¹³, is constrained to a circular oscillation by its position about the rotated eccentric H⁹. But this movement is translated, so far as relates to the point of connection of the clamping structure with the cable, to a vertical reciprocation or oscillation. This oscillation or vibration is imparted to each cable B² in unison and it is imparted to the cables, adjacent their upper ends, and adjacent the upper ends of the screen. The point of application shown in Figures 2 and 3 is a convenient one. It will be understood that I might apply the vibrations elsewhere along the length of the flexible members B². In any case, the vertical oscillation of the upper end of each of the cables imparts to the cable the characteristic wave-like vibration diagrammatically shown in Figure 3, and this wave-like vibration is fully imparted to the entire surface of the screening mesh through the members B¹ and the clamps. Although the oscillating mechanism is mounted on the frame, it is in cushioning engagement with the cables, through the pads J⁸. The cables themselves, being yieldingly mounted at each end, cannot transmit their vibrations to the frame. In practice, although the screen is undergoing a rapid and ample vibration, the frame does not vibrate and will not vibrate even though it may be supported loosely on the floor of a plant. The rotation of the shaft H⁵ imparts no vibration to the frame, because the shaft is provided with proper counterweights. No vibration is imparted to the housing portion H¹, because its sole connection with the vibrated cables is through the flexible housing J⁹, which of course trans-

mits no shock or vibration. It is therefore possible to employ a light, open screen frame and to employ light and simple supporting means therefor. The frame is freed from wire or vibratory distortion.

The movement of the cable resembles that of the body of a snake when crawling, the wave-like vibration, however, being in a generally vertical plane. It is true that the cable could be vibrated slowly enough to cause it to vibrate as a violin string, which would give a pronounced movement in the center of the screen, with the amplitude of vibration diminishing from the center toward both ends. But in practice in the structure shown herein, a somewhat more rapid rate of vibration causes the travel of waves lengthwise along the cable and all parts of the screen cloth supported on the cable will be given an upward movement along the full length of the cloth, with every wave set up, and a downward movement, the upward and downward movements corresponding to the difference between the crests and troughs of the waves which travel along the screen. The mechanism is actuated at such speed that the waves follow each other in rapid succession, the crests and troughs extending transversely across the screen from edge to edge, and follow each other lengthwise along the screen. As earlier stated, the screen reproduces the vibratory movement of the cables in a downward as well as in an upward direction, the transverse members B¹ and their clamps rendering this the necessary result of the vibration of the cables.

The material is held on the screen by means of the rubber or flexible strips C C¹ which are fastened securely along each edge of the cushion and which vibrate freely with the cushion and with the cables B². The additional stationary sides fit inside the rubber strips but are positioned far enough from the screen cloth to prevent contact or wear. The result is a saving in power and a decrease in the amount of vibration transmitted to the supporting frame. The hinging of the stationary sides permits the screen cloth to be removed with a minimum of work.

The tensional mounting of the cables is an important and probably a necessary element in the production of the wave-like movement of the cables, as when the movement is set up in the cables it has a tendency to shorten the distance from one end of the cable to the other. The springs G⁷ and D⁶ take care of this variation in length, and permit the cable to take this wave movement without adding any undue strain due to the increase in tension. These springs also prevent any tendency to throw back a wave in the opposite direction, and each wave, as it reaches the end of the cable, is killed through the flexibility of the springs. This is important, since if a return wave were set up, it would kill

the next initial wave travelling in the opposite direction at the point where they meet.

While it may be preferable to employ a spring connection between each end of each cable and the frame and yoke respectively, as shown in Figure 1, I find it desirable under some circumstances to eliminate one of the springs and to eliminate the yielding connection for one end of each cable. For example I may omit the spring D⁶ and let the abutment D⁵ engage the abutment A¹¹. Or any other suitable abutment means may be employed for maintaining the end of the cables B² connected to the frame. In such case the springs at the upper end of the cable, the springs G⁷, may be employed to take care of the shortening and lengthening of the distance, to permit the wave-like vibration to take place, but the solid connection of the opposite end of the cable may produce a much stronger vibration throughout the lower portion of the screen cloth than would otherwise be produced. In the accompanying claims it will be understood that I do not wish to limit myself to the employment of a yielding connection for each end of the cable unless I specifically so limit myself by the language of the claims. Also I do not wish to be limited, when employing a single yielding connection, to the position of that connection specifically at any given end of the cable, except so far as I specifically so limit myself. In practice a very satisfactory arrangement is to connect the cables yieldingly to the yoke E and unyieldingly, at their opposite ends, to the frame. My tests have indicated that the yielding connection at the vibration transmitting end of the cable, namely between cable and yoke, is effective in preventing return vibration or return waves of vibration along the cable.

In connection with the wave-like vibration the transverse yoke or equalizer E is of great importance, as unless the tension of one cable is almost exactly the same as the tension of the other, there will be a marked difference in the length and height of the waves produced by the eccentric action. The result of the use of the yoke is not only to equalize the tension of the cables, but to equalize the rate and amplitude of vibration throughout the width of the screen. In its action the screen suggests the dusting of a carpet by holding a strip at its two corners and moving it up and down, to cause waves of vibration to travel from end to end of the carpet. In this connection will be understood the importance of providing a screen which is transversely flexible but longitudinally inflexible. I mean a screen which will flex to permit transverse waves of vibration to move from end to end of the screen, but will not flex to permit waves of vibration to move laterally across the screen. In this sense the

screen is flexible transversely, but is held against longitudinal flexure.

I claim:

1. In a screen, a screen member and a cable extending from end to end thereof and means for maintaining said cable under substantial tension, the screen member being supported upon the cable and being mounted for movement in unison with it, and means for imparting to said cable a wave-like vibration, the crests of the waves of such vibration travelling from end to end of the screen.

2. In a screen, a screen member and a cable extending from end to end thereof and means for maintaining said cable under substantial tension, the screen member being supported upon the cable and being mounted for movement in unison with it, and means for imparting to said cable a wave-like vibration, the crests of the waves of such vibration travelling from end to end of the screen, including an eccentric, means for rotating it, and an actuating connection between the eccentric and the cable.

3. In a screen, a screen member, a plurality of cables extending from end to end thereof and means for maintaining said cable under substantial tension and means for imparting a wave-like vibration to said cables, the screen member being supported upon said cables and being constrained to movement therewith throughout substantially its entire effective area.

4. The structure of claim 3 characterized by means for varying the tension upon said cables.

5. The structure of claim 3 characterized by means for maintaining said cables under tension, and means for equalizing the tension upon said cables.

6. The structure of claim 3 characterized by transverse connections between said cables, the screen member being supported upon and held against movement in relation to said transverse connections.

7. In a screen, a normally fixed base, a screen member and means for supporting it upon said base, said means including a plurality of flexible vibratory actuating members, upon which the screen member is mounted, means for maintaining said members under tension, means for equalizing the tension upon said members, including a yoke to which said members are secured, said yoke being pivoted upon said base, and means for imparting to said flexible members a generally wave-like vibration.

8. In a screen, a screen member, a plurality of flexible vibratory members upon which the screen member is mounted, means for imparting vibration to said vibratory members, transverse connections between said vibratory members adapted to prevent flexure of the screen member along axes parallel with said members and means for constraining

the screen member to vibration with said vibratory members and transverse connections, throughout substantially the entire effective area of the screen member, a plurality of clamps adapted to pass through the mesh of the screening member, means for securing them to said transverse connections, and yielding elements, associated with said clamps, adapted for engagement with the screening member.

9. In a screen, a screen member, a plurality of cables upon which the screen member is mounted, means for imparting vibration to said cables, transverse screen supporting connections between said cables and means for securing them to said cables, including clamps extending about said cables and transverse connections, and yielding elements interposed between said cables and the clamps.

10. In a screen, a screen member, a flexible cable upon which said member is supported, means for imparting vibration to said cable and means for maintaining said cable under tension, said tensioning means including a collar about said cable and an enlargement of the end of the cable, adapted to prevent the passage of the cable through the collar.

11. The structure of claim 10 characterized by a cable abutment and a yielding member interposed between said collar and said abutment.

12. The structure of claim 10 characterized in that said collar is flared to a diameter somewhat greater than the normal diameter of the cable, the cable being partially unwound, and being provided with a filling or enlargement at said unwound portion, of sufficient diameter to conform generally to the enlarged diameter of the collar.

13. In a screen, a frame, a yoke pivoted to said frame, intermediate the ends of the yoke, a plurality of flexible cables, each of said cables being secured at one end to said yoke and at the other end to the frame, a screen mounted upon said cables, and means for vibrating said cables.

14. In a screen, a frame, a yoke pivotally secured to said frame, intermediate the ends of the yoke, a plurality of flexible screen supporting members, each of said members being secured at one end to the yoke and at the other to the frame, a screen mounted upon said members, means for vibrating the members, and means for holding said yoke in parallelism with the general horizontal plane of the screen.

15. In a screen, a flexible screen member and means for imparting to it a generally uni-directional wave-like vibration, and means for preventing return or reverse waves of said vibration, including a supporting frame for said screen, means adjacent one end of the screen for imparting vibration to the screen, and a yielding connection between

said supporting frame and the opposite end of the screen.

16. In a screen, a supporting frame, flexible cables mounted on said frame, a screen
5 mounted upon said cables, and means for maintaining said cables under tension including an abutment for each said cable, associated with the frame, an abutment mounted
10 upon the cable and a spring adapted to be compressed between said abutments, one of said abutments including a plurality of removable segmental flange elements.

17. In a screen, a screen member and flexible supporting cables therefor, means for
15 maintaining said cables under tension, and means for equalizing said tension, said tensioning and equalizing means including a transverse yoke and a yielding connection between said yoke and each of said cables, and
20 means for imparting vibration to said cables.

18. In a screen, a screen member and flexible supporting cables therefor, means for
maintaining said cables under tension, and
25 means for equalizing said tension, said tensioning and equalizing means including a transverse yoke and a yielding connection between said yoke and each of said cables, and
means for imparting vibration to said cables,
30 said means including an actuating connection with each said cable adjacent its flexible connection with the yoke.

Signed at Hollywood, county of Los Angeles and State of California, this 23rd day of October, 1929.

35 LOREN G. SYMONS.

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