May 9, 1939. G. A. OVERSTROM 2,157,562

SCREEN APPARATUS

Filed Dec. 20, 1935 3 Sheets-Sheet 1

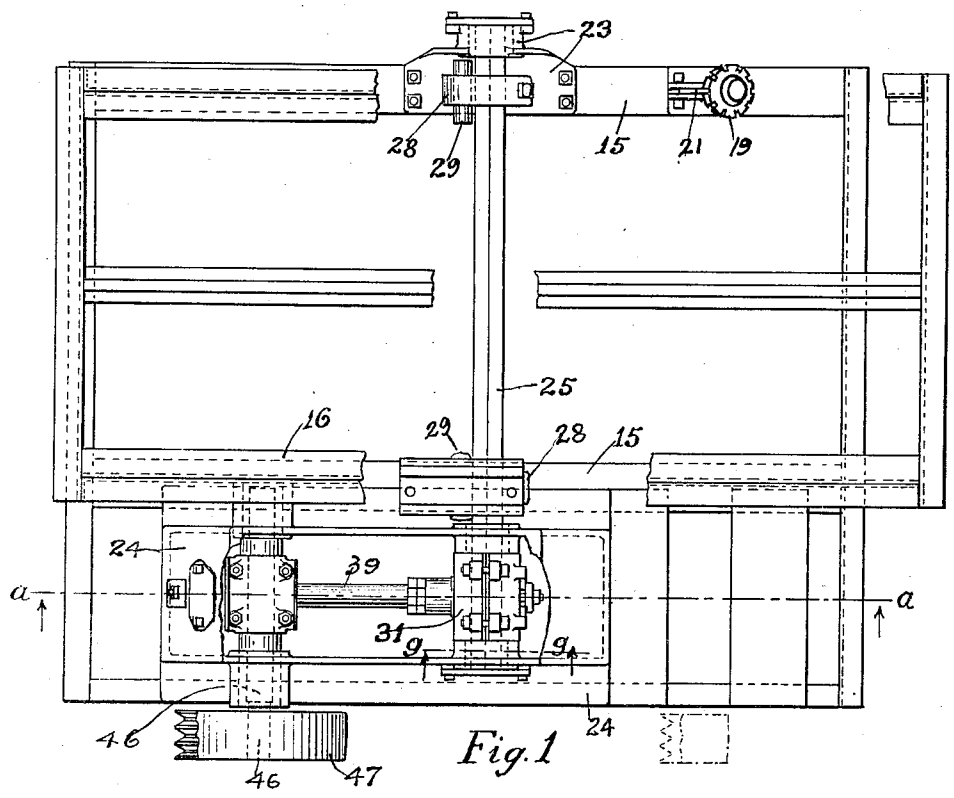

Fig. 1

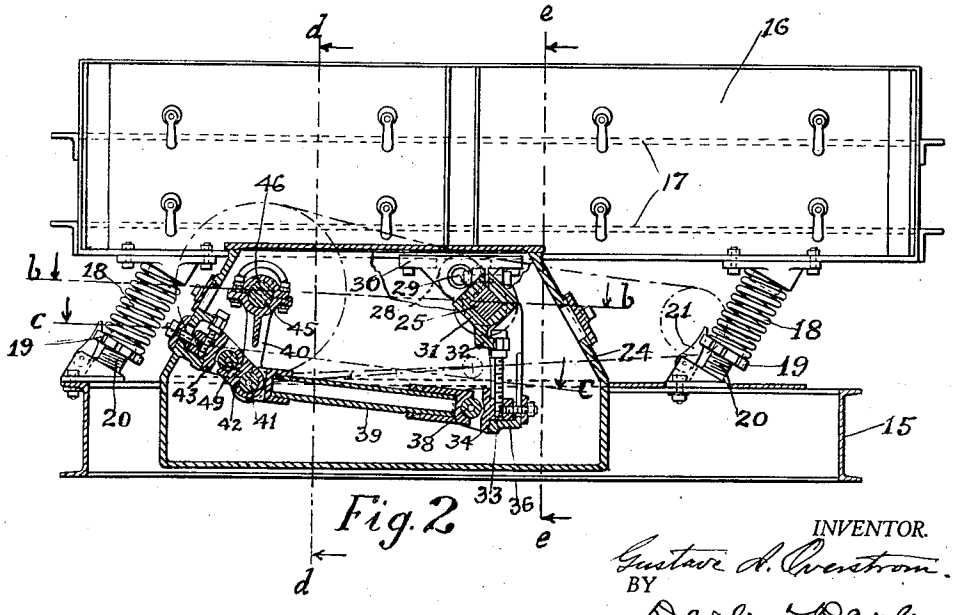

Fig. 2

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Fig 3

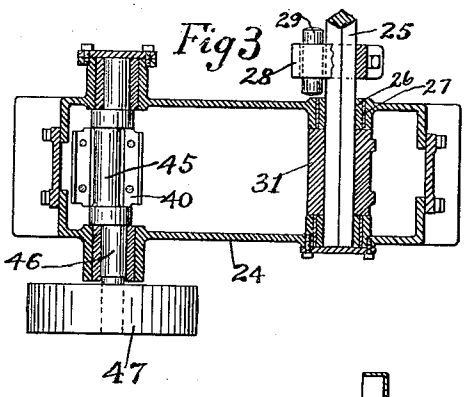


Fig. 4

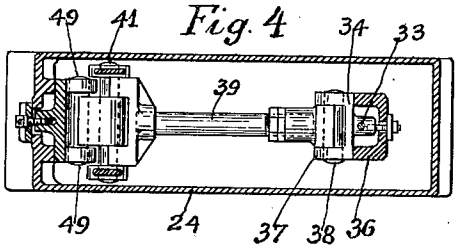


Fig. 5

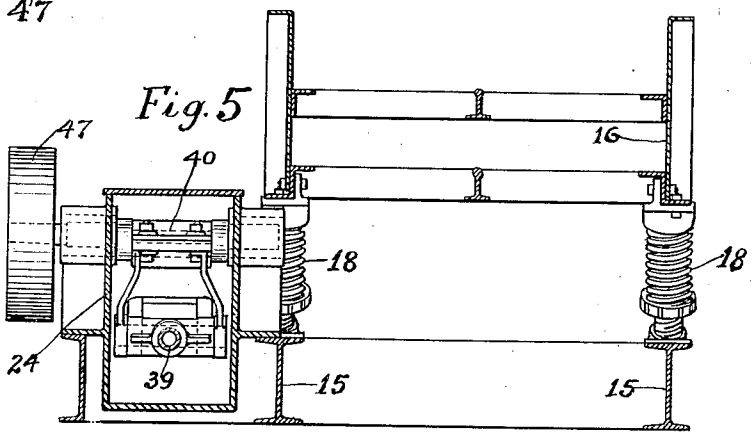


Fig. 7

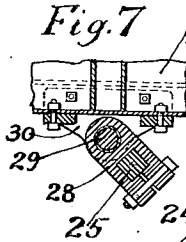


Fig. 6

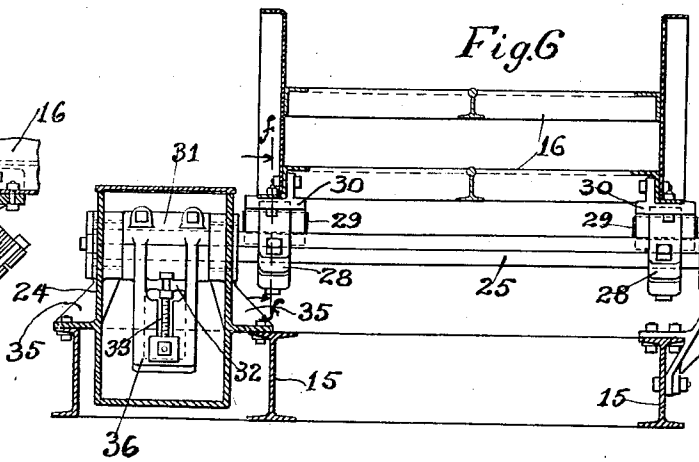
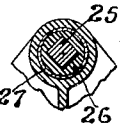


Fig. 8



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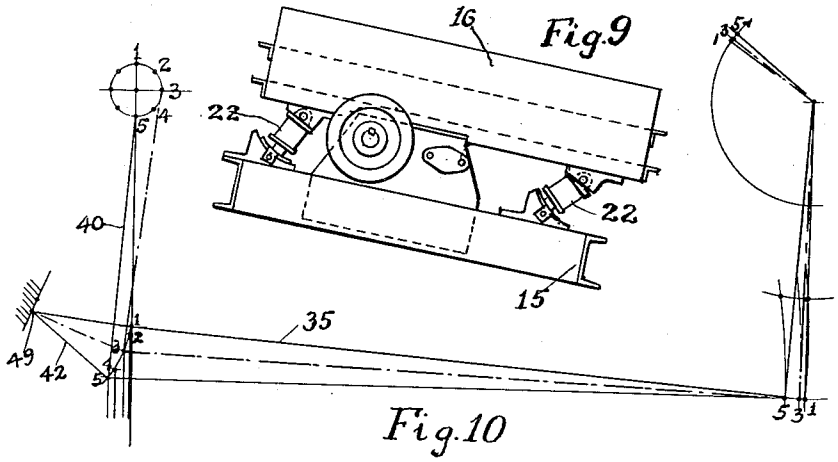

Fig.9

Fig.10

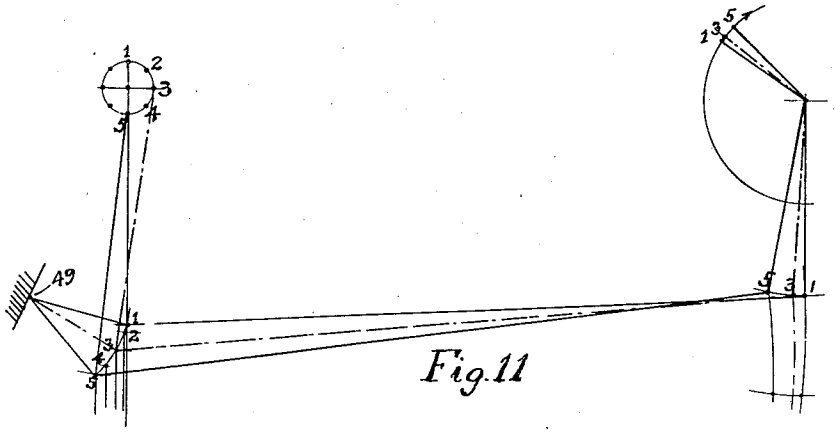

Fig.11

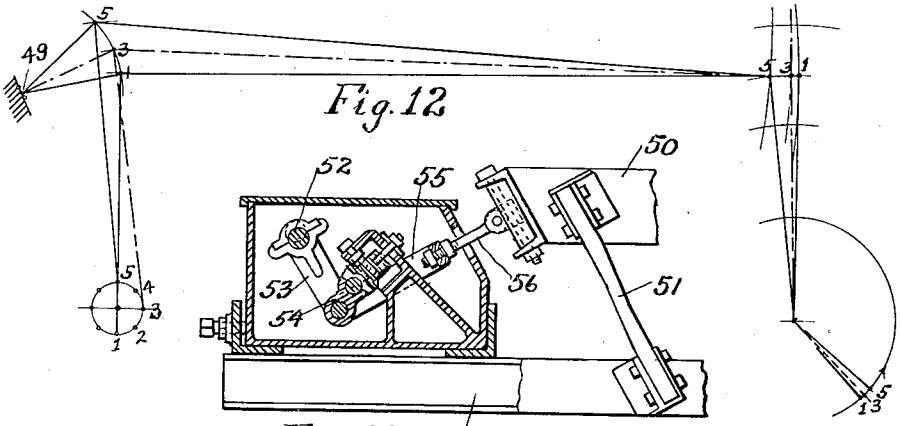

Fig.12

Fig 13

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SCREEN APPARATUS

Gustave A. Overstrom, Big Sur, Calif.

Application December 20, 1935, Serial No. 55,352

12 Claims. (Cl. 209—329)

This invention relates to screen apparatus, and more specifically to apparatus of the type in which a positive differential movement is imparted to the screen element.

A further object is to provide a screen structure of the nature referred to wherein the positive differential movement is capable of adjustment to vary the length as well as the nature of the stroke which imparts the movements to the screen element, and without interrupting the continuity of the operation of the apparatus.

A further object is to provide a screen structure having a comparatively slow speed and specially adapted to the screening of large sizes of material, such as crushed stone, coal, coke, and some characters of mining operations, and the like, without blinding or clogging the meshes of the screen element.

A further object is to provide a screen structure capable of handling large quantities of material per unit of time while at the same time securing efficient screening action.

Other objects of the invention will appear more fully hereinafter.

The invention consists substantially in the construction, combination, location and relative arrangement of parts, all as will be more fully hereinafter set forth, as illustrated in the accompanying drawings, and finally pointed out in the appended claims.

Referring to the accompanying drawings,—

Fig. 1 is a view in top plan, parts broken out, of a structure embodying the principles of my invention.

Fig. 2 is a view in vertical section on the line *a*, *a*, Fig. 1, looking in the direction of the arrows.

Fig. 3 is a broken detail view in section on the line *b*, *b*, Fig. 2, looking in the direction of the arrows, the adjacent screen supporting spring being omitted.

Fig. 4 is a similar view on the line *c*, *c*, Fig. 2, looking in the direction of the arrows.

Fig. 5 is a similar view on the line *d*, *d*, Fig. 2, looking in the direction of the arrows.

Fig. 6 is a similar view on the line *e*, *e*, Fig. 2, looking in the direction of the arrows.

Fig. 7 is a broken detail view in section on the line *f*, *f*, Fig. 6.

Fig. 8 is a similar view on the line *g*, *g*, Figs. 1 and 6.

Fig. 9 is a view in side elevation, and somewhat diagrammatic, of a modified structure embodying the principles of my invention.

Figs. 10, 11 and 12, are diagrammatic views illustrating the action of the mechanism for imparting a positive differential motion to the screening element.

Fig. 13 is a broken view in vertical section illustrating a modified structure for effecting the positive differential movement.

Serious difficulties have heretofore been encountered in attempting to screen large sized material, such as crushed stone, coal, coke, and other material, where the individual lumps run to two, three and four inches in size, and sometimes larger. These large sized lumps frequently get caught in the meshes of the screening element thereby blinding the effective screening area of the screen element, as well as imposing irregular loads promiscuously over the surface of said element which disturb and interfere with the proper balance of the apparatus and prevent smooth regular screening action. It has been endeavored to avoid this trouble by increasing the length of throw of the screen element in its vibratory movements, and by increasing the speed of operation. Both of these expedients are destructive of the apparatus and are especially injurious to the screen element.

In accordance with my invention I propose to avoid this difficulty by imparting to the screen element a short positive differential movement, and at a comparatively slow speed of operation,—from four to six hundred revolutions per minute. By differential movement I mean a reciprocatory movement in a more or less vertical direction in which the movement in one direction is more prolonged in distance than the movement in the opposite direction, during each cycle of operation, although occupying the same time interval. This results in imparting a positive sharply abrupt tossing action of prolonged duration, to the material under treatment, which catapults the particles of material upwardly away from the surface of the screen element, thereby preventing the lumps from becoming lodged in the meshes of said element, or detaching any lumps that may have become caught in the meshes, and hence enables a quick separation and screen action to be secured. It also permits the handling of larger quantities of material per unit of time.

In accordance with my invention I propose to provide means to adjust the length of throw of the differential movement, thereby accommodating the apparatus to various characters of material to be screened.

I also provide means for adjusting or varying

the throw of the differential while the apparatus is in operation and without interfering with its continuous operation.

I also propose, in accordance with my invention, to provide means to adjustably vary the angle or line of differential action with relation to the surface of the screen element to relatively vary the screening and material feeding or progression effect upon the material under treatment.

In the drawings I have shown a structure for carrying out my invention wherein is provided a supporting frame work 15, upon which is yieldingly mounted a screen box 16, carrying one or more screen elements or cloths 17. The yielding supports for the screen box are shown as consisting of coil springs 18, interposed between the frame work 15 and the screen box 16, and which are arranged to sustain the weight of the screen box, said supports being disposed adjacent the respective ends of the screen box. In practice I prefer to dispose the coil springs in such relation to the screen box as to exert their yielding tension in lines inclined to the plane of the feeding surface of the screen element. If desired the yielding tension of the springs may be adjusted in any suitable manner, as, for example, by means of nuts 19, mounted on threaded studs, and held in adjusted position by means of a latch member 21, in a well understood manner. In some instances it may be desirable to relatively incline the lines of tension of the yielding supporting springs at the respective ends of the screen box, and to adjustably vary such relative inclination, in order to vary the relative screening and material feeding actions of the screen element. In Fig. 9 I have illustrated such an adjustment wherein the spring structure, indicated generally at 22, is hingedly connected to the screen box 16 and is slidably connected to the supporting frame work 15. By relatively swinging the spring structures about their points of hinge connection with the screen box any desired relation of screening and material feeding actions may be imparted to the material according to the requirements of the material.

Positive differential screening movements may be imparted to the screen box by the conjoint and cooperative action of the yielding screen supports and of actuating means now to be described.

At one side of the frame work 15 is secured a vertically extending bracket 23, see Fig. 6, and at the opposite side is mounted a housing or casing 24. A shaft 25 extends transversely across the screen box, either above or below the same, shown in this instance as located below, and at approximately the region of the mid-length point of said box. This shaft is preferably polygonally shaped, in cross section, shown in this instance as squared. The respective ends of shaft 25 are journaled in the bracket 23 and in bracket 35, mounted on the walls of the housing 24, in such manner as to permit rotative movements of said shaft. A simple journal structure is shown for this purpose, in which circular collars 26, are mounted upon the shaft 25, which collars fit within bushings 27, mounted within bearings formed, respectively in the brackets 23 and 35. Suitably clamped upon the shaft 25, to partake of any rotative movements which may be imparted to said shaft, are blocks 28, see Fig. 7, which extend radially of said shaft. Each clamp block 28 is hinged to a stud 29, carried by a bracket 30, fastened to the screen box.

While I have shown, and prefer to employ a clamp block and pin connection at each side of the screen box, this is not essential, as only one such connection may be employed. Where two such connections are used, one at each side of the screen box, a smoother and more steady action is obtained.

From the foregoing description it will be seen that when a rocking movement is imparted to the shaft 25, a positive and more or less vertical movement is imparted to the screen box, said movement, in one direction, being opposed by the yielding supporting springs 18, and in the other direction being reinforced by the rebound of said springs. It will also be seen that the extent of rocking movement imparted to shaft 25 will determine the extent of vibratory movement of the screen box.

Various specific structures may be employed for imparting positive rocking movements to shaft 25, and for adjustably varying the extent of such movements. I have shown a simple and efficient illustrative arrangement, which I have found to be suitable and prefer to use, but my invention is not to be limited or restricted to the specific details thereof. In the form shown, a block 31 is clamped upon the shaft 25 and is provided with an off-set extension 32. A bolt 33 is mounted in said extension 32, and, depending therefrom, is adjustably threaded into a bearing block 34, mounted to slide vertically in ways or guides formed in or on a yoke 36, which forms part of the block 31, said yoke being slightly displaced out of vertical line with the axis of shaft 25 and constituting, in substantial effect, a crank arm with respect to said shaft. In ears 37 on block 34 is mounted a pin 38, connected to one end of an arm 39, the other end of which is pivotally connected to a pin 41 which is carried by a pitman 40. This pin 41 is also pivotally connected to one end of a block 42, the other end of said block being pivotally connected as at 49 to a block 43, mounted for slight vertical adjustment in a box carried by a convenient wall of the casing or housing 24. An adjusting screw 44 serves to adjust the block 42. The pitman 40 is carried by a crank 45 on a driven shaft 46, suitably and conveniently mounted, as for instance in bearing boxes in the casing or housing 24, and which may be driven from any suitable or convenient source of power as, for example, through a driven pulley or wheel 47.

It will be seen that the mechanism described constitutes in effect a toggle-joint whereby, as the pitman 40 operates, the angle between the lines of the axes of pivot connections 49, 41, and that of the axes 41, 38, is alternately increased and decreased, as the pitman moves up and down. This causes a slight longitudinal movement of the connection 39, by reason of the block 42 rocking about the pivot axis 49, and the extent of said movements may be adjustably varied by the adjusting screw 44, by which the pivot 49 may be slightly raised and lowered. This adjustment may be readily effected without interrupting the operation of the apparatus The longitudinal movements imparted to the connection 39, effects a swinging movement of the yoke 36 about the axis of the shaft 25. This causes said shaft to be rocked in its bearings thereby swinging or rocking correspondingly the blocks 28, which, through their pivotal connections to the screen box, effects a vibratory up

and down movement to said box. By suitably adjusting the block 34, by means of adjusting screw 33, as indicated in dotted lines in Fig. 2 the extent or rocking movement imparted to the yoke 36, and hence that of shaft 25 is varied, thereby varying the length of throw imparted to the screen box.

In Figs. 10, 11 and 12 I have diagrammatically illustrated the action of the toggle-joint structure under varying conditions of adjustment of the pivots 49 and 38. Thus, in Fig. 10, I have illustrated the action when the pivots 49 and 38 are adjusted to give the shortest stroke or throw of the screen box, that is, when the pivots 49, 38 occupy their lowest positions of adjustment. The points 1, 2, 3, 4 and 5 indicate various successive positions of the crank movement during one complete down stroke, and the corresponding positions of the pivot axes 41 and 38, as well as the resultant movements of the screen box. This diagram reveals that the movement of the crank from point 1 to point 2, there is scarcely a perceptible endwise movement of connection 39, and hence of the yoke 36 and screen box. The crank movement from 2 to 3 causes a more pronounced angle between the block 42 and connection 39, as indicated by dotted lines, with a greater extent of endwise movement of connection 39, but still only a slight movement of the screen box is effected. During the movement of the crank from point 3 to 5, which is the limit of the downstroke of the pitman 40, the greatest extent of endwise movement of the connection 39 is effected with a consequent greater extent of movement of the screen box. The action indicated in this diagram is for the shortest possible stroke of which the apparatus is capable. Thus it will be seen that the upwardly inclined throw of the screen box begins imperceptibly and then rapidly increases and finally slows down, thereby giving the material a sharp catapulting toss upwardly, and securing the benefits and advantages of my invention in preventing blinding of the effective screening area of the screen element.

In Fig. 11 I have illustrated the similar action where the pivot point 49 is adjusted to its highest point to secure the longest possible throw of the tossing action imparted to the screen element. Here again is observed the differential action secured by the positive drive of the apparatus.

In Fig. 12, I have illustrated the similar action where the pitman drive crank is located below the knuckle-joint, and with the pivot 49 adjusted to a point intermediate its highest and lowest points.

In Fig. 13 I have shown a modified structure of vibrating means for imparting positive differential movements to the screen box. In this structure the screen box 50, is shown as supported on inclined spring legs 51 which are rigidly fastened at its respective ends, to the base frame 15 and to the screen box. A driven crank shaft 52, operates a pitman 53 pivotally connected at its free end to an adjustable swinging link 54, to which is also pivotally connected one end of a yoke 55. The other end of this yoke is adjustably connected to a rod 56, the other end of which is pivotally connected to the screen box 50. This constitutes in substantial effect, a knuckle-joint connection by means of which the reciprocations of the pitman 52 are transmitted to the screen box and by the same character of positive differential movements as in the case of the structure shown in Figs. 1 and 2.

In order to secure smooth running action of the apparatus and to avoid undue wear of pivot points, I prefer to mount the entire motion producing parts within the casing or housing 24, and to maintain an oil supply within said casing or housing so that said parts may be immersed in the oil.

In this disclosure the term "differential motion" is used to define a motion of the screen box caused by operating members including a crank for example, which when rotating at a uniform angular velocity causes the screen box to move a much greater distance during the last half of its forward stroke and the first half of its return stroke than at the beginning of the forward stroke and the end of the return stroke. It is termed a positive motion because the screen box is connected to the operating or crank mechanism so as to be forced to move with it at all times.

From the foregoing description it will be seen that I provide a most simple and efficient positive differential movement, employing a camparatively short stroke, and operating at a slow speed, whereby I am enabled to secure efficient screening action and to avoid clogging or blinding of the screen area. I am also enabled to handle large volumes of material of comparatively large lumps without injury, and am enabled to effect adjustments of stroke and of screen action according to the character of material to be handled without interrupting the operation of the apparatus.

While I have shown and described a specific structure for attaining the objects of my invention, I wish it to be understood that variations and changes in the details of the structure and arrangement may be made without departure from the spirit and scope of my invention.

But what I claim as new and useful and of my own invention, and desire to secure by Letters Patent is:—

1. In a vibrating screen, a base frame, a screen box, a screening member secured in said box, longitudinally resilient springs mounted on said frame and secured to said box to form the sole support therefor, the longitudinal axes of said springs being inclined to the plane of said screening member in the direction of progression thereover of the material being screened, and driving means connected to the screen box so as to place said springs under compression for all positions of the driving means, said driving means imparting a differential movement to the screen box in an upward and forward direction to sharply toss the material upwardly and forwardly.

2. In a screening apparatus the combination including a screen box, a screen element secued therein, resilient springs freely supporting said box, the longitudinal axes of said springs being inclined upwardly and in the direction of travel of material over the screen element, and a positive drive mechanism connected to said box to depress it along the axes of the springs and coacting to resist return movement of the box whereby the box responds in its return movements under the control of said drive mechanism.

3. In a screening apparatus the combination including a supporting base, a screen box, a screen secured in said box, said base and box being disposed in parallel relation to each other, spring supports for said box interposed between the base and the box, said spring supports being flexible along a line inclined upwardly and in the direction of travel of material over the screen, and a positive differential drive mechanism connected to said screen box to impart a slow upward motion to said screen box in a quarter part of the working cycle of the drive mechanism, a fast upward

movement to the box in the next quarter working cycle thereof, a fast recession of the screen box during the next quarter working cycle thereof, and a slow downward movement to the screen box during the last quarter working cycle thereof.

4. In a screen structure, a fixed frame, a screen box, spring supports having their axes inclined relative to the screen box supporting said screen box on said fixed frame, a bell crank pivotally mounted on said fixed frame, a normally fixed block mounted on said fixed frame, one arm of said bell crank being pivotally connected to said screen box, a toggle connecting the other arm of said bell crank and said block, a crankshaft and pitman applying power to said toggle, and means for adjusting the position of said block, said block being so positioned that the links of the toggle diverge more from a straight line at one end of the stroke than at the other whereby a positive differential motion is imparted to the screen box.

5. In a screen structure, a fixed frame, a screen box, spring supports having their axes inclined relative to the screen box supporting said screen box on said fixed frame, a bell crank pivotally mounted on said fixed frame, a normally fixed block mounted on said fixed frame, one arm of said bell crank being pivotally connected to said screen box, a toggle connecting the other arm of said bell crank and said block, a crankshaft and pitman applying power to said toggle, means for adjusting the position of said block, said block being so positioned that the links of the toggle diverge more from a straight line at one end of the stroke than at the other whereby a positive differential motion is imparted to the screen box, and means for adjusting the point of connection of said toggle and the arm of said bell crank.

6. In a screen structure, a fixed frame, a screen box, resilient members supporting said screen box on said fixed frame, a bell crank pivotally mounted on said fixed frame, a normally fixed block mounted on said fixed frame, one arm of said bell crank being pivotally connected to said screen box, a toggle connecting the other arm of said bell crank and said block, and a crankshaft and pitman applying power to said toggle, said block being so positioned that the links of the toggle diverge more from a straight line at one end of the stroke than at the other to impart a slow upward motion to said screen box in a quarter part of the working cycle of the drive mechanism, a fast upward motion to the box in the next quarter working cycle thereof, a fast recession of the screen box during the next quarter working cycle thereof, and a slow downward movement to the screen box during the last quarter working cycle thereof, said motion being along a single substantially straight line in a direction inclined upwardly and forwardly of the screen.

7. In a screen structure a screen box having a screening member therein, spring supports attached to the respective ends of the box as substantially the sole support thereof, and mechanism directly connected to said box for causing differential movements thereof comprising a slow upward motion in a quarter part of the working cycle of the drive mechanism, a fast upward motion in the next quarter working cycle thereof, a fast downward motion during the next quarter working cycle thereof, and a slow downward motion during the last quarter working cycle thereof, said mechanism being so constructed and arranged as to cause said motion along a single substantially straight line in a direction inclined upwardly and in the direction of travel of material along the screening member.

8. In a screen apparatus the combination with a screen box having a screen therein, a plurality of coiled springs for supporting said box, the axes of the springs lying along substantially straight lines inclined upwardly and in the direction of travel of material over the screen, means to adjust the position of the springs to vary the inclination of the axes thereof, and a positive driving means directly connected to the screen box for applying an operating force to said box to cause a slow upward motion thereof in a quarter part of the working cycle of the driving means, a fast upward motion in the next quarter cycle thereof, a fast recession in the next quarter cycle thereof, and a slow recession during the final quarter cycle thereof along said lines.

9. In a screening apparatus, the combination comprising a screen box, a screen element securely fixed therein, resilient supports for said box, a shaft rotatably mounted for oscillation, means for connecting said shaft to said box to move the entire box and screen element against the resistance of said springs along a substantially straight line inclined upwardly and in the direction of travel of the material over the screen element, and a differential drive mechanism connected to said shaft to oscillate it to impart a slow upward motion to said screen box in a quarter part of the working cycle of the drive mechanism, a fast upward motion to the box in the next quarter working cycle thereof, a fast recession of the screen box during the next quarter working cycle thereof, and a slow downward movement to the screen box during the last quarter working cycle thereof, said motion being substantially along said line.

10. In a screening apparatus the combination comprising a supporting base, a screen box, a screen fixedly secured in said box, springs substantially solely supporting said box interposed between the base and the box, said springs being flexible along a line inclined upwardly and in the direction of travel of material along the surface of said screen, and a positive differential drive mechanism connected directly to said screen box to impart a slow upward motion thereto in a quarter part of the working cycle of the drive mechanism, a fast upward motion in the next quarter working cycle, a fast recession during the next quarter working cycle, and slow recession during the last quarter working cycle.

11. In a screening structure a support, a screen box, a screen element fastened in said box to move positively with it, a differential motion mechanism interposed between the support and the box and connected to the box, said mechanism being so constructed and arranged as to move the box up and down along a single substantially straight line in the direction of movement of the material over the screen element and at a greater velocity at the end of the forward and the beginning of the return stroke than at the end of the return stroke and beginning of the forward stroke, and springs interposed between the support and screen box to support it and take up lost motion in the mechanism.

12. In a screening apparatus the combination including a screen box, a screen element securely fixed therein, a resilient support for said box,

a member mounted for oscillation, means connecting said member to said box to move it against the resistance of said springs along lines inclined upwardly in the direction of movement of material on the screen element, and a differential drive mechanism connected to said member to oscillate it to cause the screen box to move upwardly and in the direction of movement of material on the screen element at a greater velocity at the end of the forward and beginning of the return stroke than at the end of the return stroke and the beginning of the forward stroke.

GUSTAVE A. OVERSTROM.