

April 17, 1934.

W. W. STEVENSON, JR

1,955,032

APPARATUS FOR SEPARATING MATERIALS

Filed Dec. 22, 1931

4 Sheets-Sheet 1

Fig. 2.

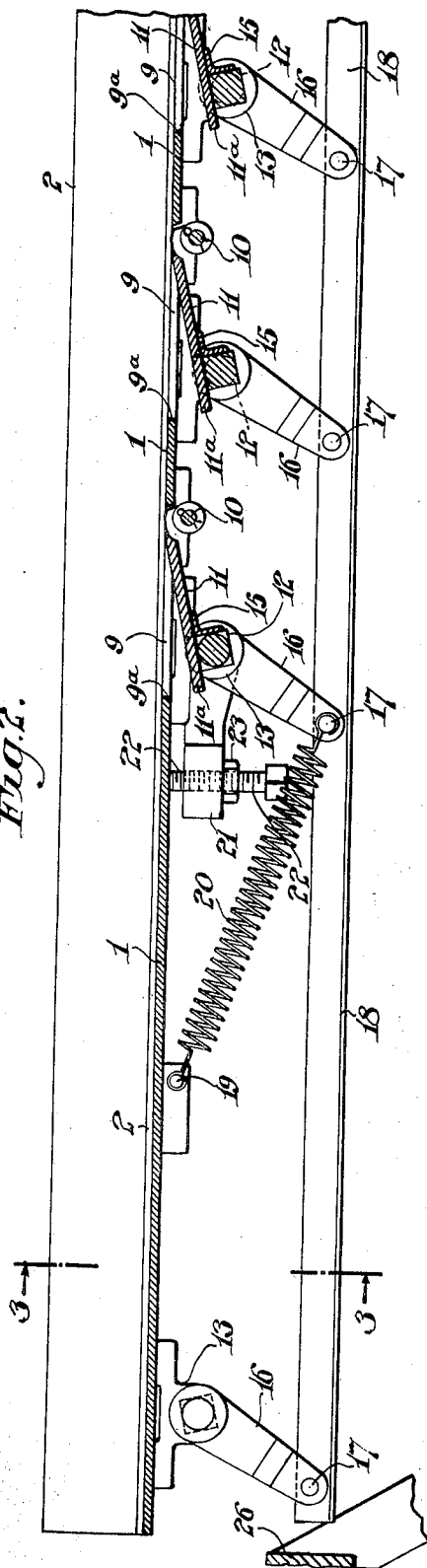


Fig. 3.

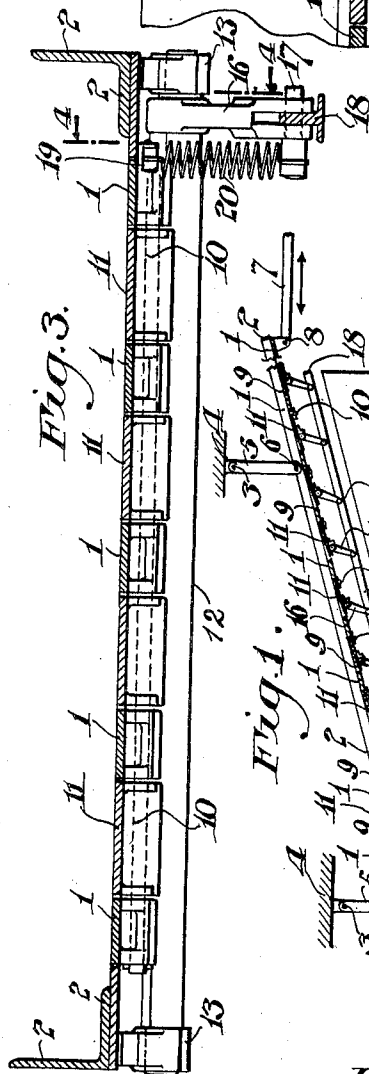


Fig. 4.

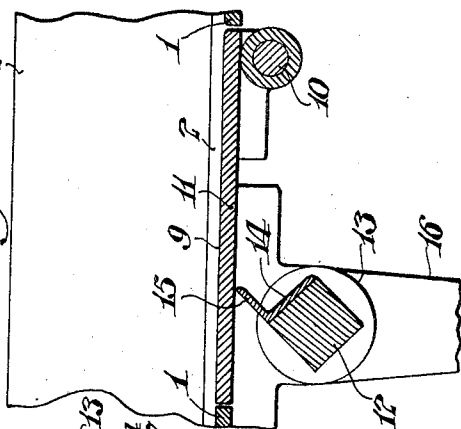
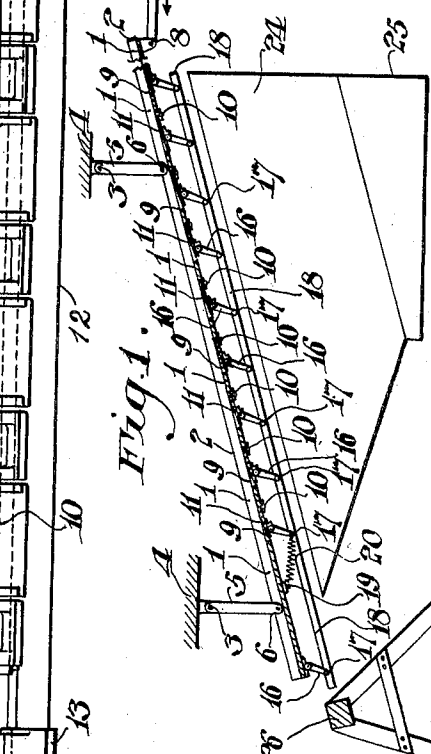


Fig. 1.



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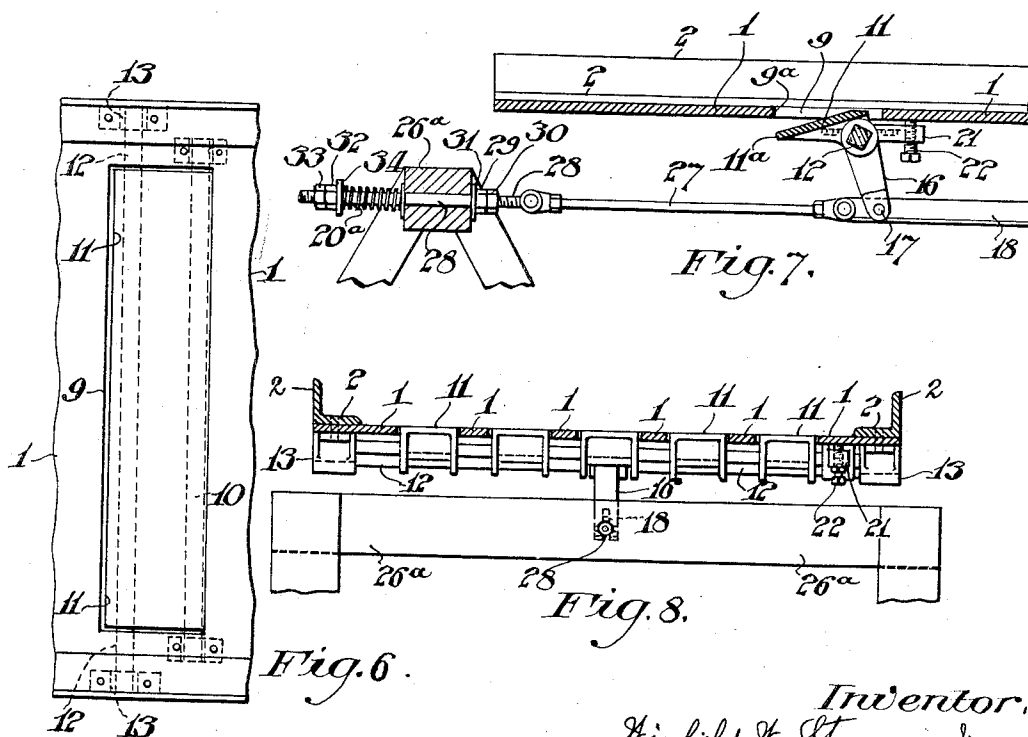
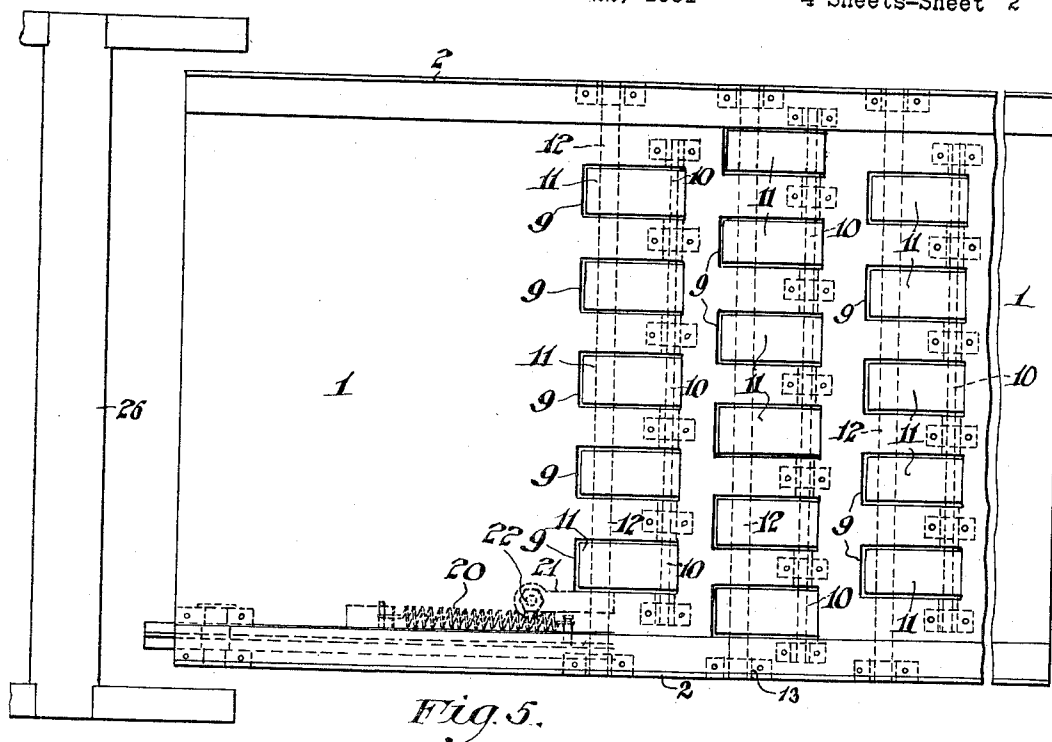
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APPARATUS FOR SEPARATING MATERIALS

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4 Sheets-Sheet 2



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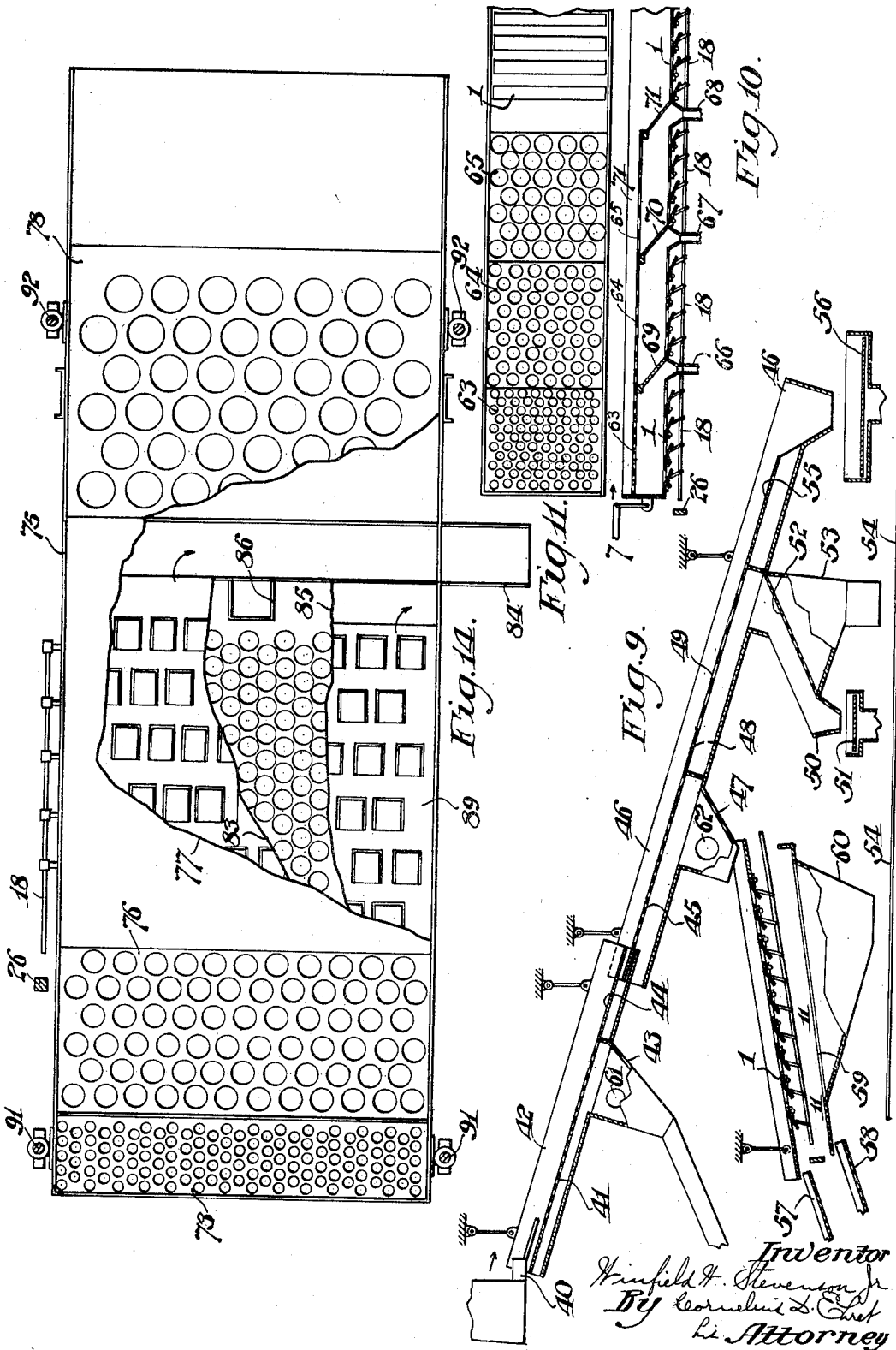
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APPARATUS FOR SEPARATING MATERIALS

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4 Sheets-Sheet 3



April 17, 1934.

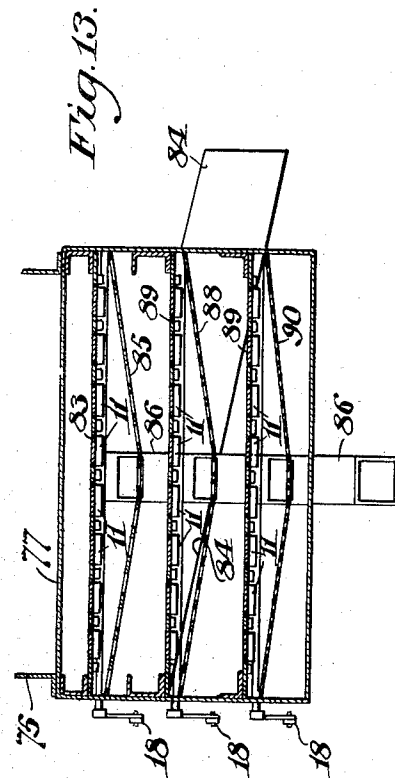
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1,955,032

APPARATUS FOR SEPARATING MATERIALS

Filed Dec. 22, 1931

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

1,955,032

APPARATUS FOR SEPARATING MATERIALS

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Application December 22 1931, Serial No. 582,598

4 Claims. (Cl. 209—90)

My invention relates to apparatus for separating from a mixture of materials previously graded as to size, pieces of material of different characters, and more particularly for separating such materials, as coal, from impurities occurring therewith as slate, bone, shale or the like.

In accordance with my invention, which for brevity will be described more particularly with respect to the separation of slate from coal, the mixture, previously graded as to size, as by a screen, or the like, is passed over a vibratory surface, preferably, downwardly inclined, having openings with which are associated more steeply inclined secondary surfaces defining elongated slots. The pieces of coal and slate being of different general shapes, of different weights or specific gravities, and of different co-efficients of friction with respect to the vibratory surface, the pieces of coal pass over the openings continuing along the vibratory surface to a suitable receptacle or destination, while the pieces of slate upon falling on the secondary surfaces slide through the slots to another suitable receptacle or destination.

More particularly in accordance with my invention, the secondary surfaces have imparted thereto, preferably at a rate corresponding with the vibratory movements of the primary surface, movements substantially to close the openings in the primary surface, more particularly for the purpose of freeing the openings from slate or material otherwise tending to accumulate therein to the detriment of continued efficiency of cleaning or slate separation.

Further in accordance with my invention, instead of separating the coal and slate mixture in batches of different size grades, and then cleaning the batches of slate, the coal and slate mixture passing through a grading screen moves directly to a vibratory cleaning surface of the character aforesaid, while the coal and slate mixture passing through another or other grading screens move to corresponding cleaning surfaces for separation of slate.

More particularly in one form of my grading and cleaning system, a mixture of coal and slate of many sizes flows over a series of grading screens, the screen openings being progressively larger in the direction of flow successively to remove the larger and larger sizes of coal and slate from the mixture, and the graded coal and slate mixture passing through each screen falls on a cleaning plate, preferably vibrated in unison therewith, the cleaned, graded coal passing from each plate to a suitable destination, and the graded slate pass-

ing through each cleaning plate to a suitable point.

In another form of my grading and cleaning system, the main grading screens are disposed one above the other, the bottom screen having the smallest openings and the screens above each having larger openings than the screen below, and the coal and slate not passed through each screen moves to a cleaning plate of the character described. The larger coal on each plate passes to a suitable destination while the slate and any smaller coal which did not pass through the main screen drops on an auxiliary screen which rejects the slate and removes the coal by permitting it to fall through onto the cleaning plate below which receives the smaller size coal and slate mixture from the lower main screen. This modification, in particular, results in coal having a very low percentage of slate with negligible loss of coal.

My invention resides in apparatus of the character hereinafter described and claimed.

This application is a continuation in part of my application Serial No. 506,887, filed January 6, 1931.

Fig. 1 is a simplified side elevational view, partly in vertical section, of a separating or cleaning system embodying my invention.

Fig. 2 is a sectional side elevational view on larger scale of a portion of the apparatus shown in Fig. 1.

Fig. 3 is a cross sectional view, taken on the line 3—3 of Fig. 2.

Fig. 4 is an enlarged sectional view, partly in elevation, taken on the line 4—4 of Fig. 3.

Fig. 5 is a fragmentary top plan view of structure shown in Figs. 1, 2, etc.

Fig. 6 is a fragmentary plan view illustrating a modification.

Fig. 7 is a vertical sectional view, parts in elevation, illustrating a modification of the structure of Fig. 2.

Fig. 8 is a sectional view, partly in elevation, looking from the left toward the right in Fig. 7.

Fig. 9 is a simplified side elevational view, principally in section, of a combined grading and cleaning system.

Fig. 10 is a side elevational view in section of another grading and cleaning system.

Fig. 11 is a plan view of Fig. 10.

Fig. 12 is a side elevational view, in section, of a grading and cleaning system with provisions for recovering coal from slate.

Fig. 13 is a sectional view, in front elevation, taken on line 13—13 of Fig. 12.

Fig. 14 is a plan view of Fig. 12 with parts broken away better to illustrate the construction.

Referring to Figs. 1 to 5 inclusive, 1 is a screen, plate or table, of sheet metal or the like, whose upper surface is the primary surface over which the mixture of materials as coal and slate pass from upper right to the lower left, Fig. 1. Along the sides of the member 1 are disposed upstanding members 2 to form a channel, to prevent the mixed materials from falling off the side edges 1. Pivoted at 3 to suitable supports 4 are the links 5 pivoted at their lower ends at 6 to the table or vibratory member 1, as by location of the pivots on or in suitable relation to the elements 2. This structure permits oscillation or vibratory movements of the member 1 when actuated backwardly or forwardly by the connecting rod or pitman 7, pivoted to the member 1 at 8, and at its other end actuated by any suitable means as by a crank upon a shaft driven by an electric or other suitable motor. For the pivotal supporting structure and for the vibrating structure just described may be utilized any other suitable and equivalent structure, the general purpose being to vibrate the primary surface 1 at suitable frequency, such as heretofore commonly utilized, the direction of vibration being generally in the direction of the longitudinal extent of the surface 1, though it will be understood that the vibratory force may be applied in any other suitable or equivalent direction.

Distributed substantially uniformly throughout the member 1, within that part of the length thereof within which the separation is effected, are openings or apertures 9 of circular or any other suitable shape and of suitable dimensions. In the example illustrated these apertures are rectangular, and are preferably staggered as indicated in Fig. 5.

On shafts or pivot rods 10, supported by or in fixed relation with respect to the member 1 and extending transversely thereof, are pivoted the members 11, one for each of the openings 9, in such position with respect thereto as to substantially close them, as hereinafter described. The upper surfaces of these members or gates 11, normally more steeply inclined than the member 1, are secondary surfaces, partaking of vibration with the member 1, and periodically actuated from their normally open position indicated in Fig. 2 to a position for closing the apertures or openings 9.

Extending transversely of the screen, table or member 1, adjacent each transverse row of openings 9 and members 11, is a shaft or bar 12, which may be square in cross section as indicated, with bearings at its opposite ends in the bearing members 13 carried by or movable with the member 1. Along the member 12, and secured thereto, are distributed angle irons 14, or equivalent, Figs. 2 and 4, whose parts or lugs 15 are adapted to engage the under sides of the members 11 to actuate them upon their pivots 10.

Secured upon each of the members 12 is a crank or lever arm 16. At their lower ends the levers 16 are pivoted at 17 to the member or bar 18 extending longitudinally of and generally parallel to the vibratory member 1.

Secured at its one end at 19 to the member 1 is a spring 20 under tension, secured at its other end to one of the pivots 17 or to a pin carried by the bar 18.

Secured to one of the bars or members 12, as indicated in Fig. 2, is an arm 21 through which is threaded the bolt 22, or equivalent, locked in

suitably adjusted position by the nut 23 and adapted to abut against the member 1 or any suitable part carried thereby. Adjustment of the member 22 serves to adjust or determine the opening between the left edges 11a, Fig. 2, of the secondary table or screen members 11, and the left edges 9a of the associated openings or apertures 9. This adjustment determines the opening at the points aforesaid and through which the slate or separated material passes off of the members 11.

The operation is as follows:

The mixture of pieces to be separated as of coal and slate previously graded as to size in any known manner, as by a grading screen, is delivered to the right or upper end of the table or screen 1, Fig. 1, which is continually vibrated at suitable frequency and through suitable amplitude by the member 7 or equivalent. The mass so vibrated passes downwardly over the primary surface, the upper surface of the member or table 1, the coal for example passing over or across the apertures 9, becoming more and more purified of slate as the left or lower end of the member 1 is approached and the separated coal being eventually discharged from the lower left end of the member 1 to any suitable receptacle or destination. The slate of the mixture having different weight or specific gravity from that of coal and whose pieces have a different characteristic shape from that of coal tends more readily to pass through the openings 9 on to the secondary vibratory surfaces of the members 11, inclined more steeply than the table 1 or the primary surface thereof. The pieces of slate pass from the right toward the left of the secondary surfaces and pass off the left edges 11a of the members 11, Fig. 2, through the space or elongated slot between those edges and the left edges 9a of the apertures 9 to a suitable receptacle or destination. In Fig. 1 there is shown a hopper 24 into which the slate is delivered and from which it passes through a chute 25 to a car, slate pile or other destination.

The normal position of the secondary surfaces, which are the upper surfaces of the members 11, with respect to the primary surface of the member 1, is that indicated in Figs. 1 and 2. The secondary surfaces are more steeply inclined, with respect to the horizontal, than the primary surface of the member 1, and during these relative positions of members 11 and 1 they are vibrated in unison by the member 7, or equivalent.

During such operation there is a tendency of the slate or other material to accumulate upon the members 11, and particularly in the space between the edges 11a and 9a of members 11 and 9 respectively. To prevent this accumulation and to keep the apertures and openings clear, the members 11 are periodically moved from their normal positions into position in which their secondary surfaces come substantially into register with the primary surface of the member 1. In fact, the members 11 are periodically brought to position to close the openings 9 in the member 1 with return to their normal positions. This action serves to keep the passages for the slate or other impurities free at all times.

This movement of the secondary surfaces with respect to the primary, or the movement of the members 11 substantially to close the openings 9, may be effected by any structure of which that hereinbefore described involving the members 12, 16 and 18, is of a suitable type.

Before the completion of a vibratory movement of the member 1 and attached parts towards the left, Figs. 1 and 2, the bar or rod 18 engages a suitable stop or abutment 26. The table 1 and attached parts continue their movement to the left, thereby causing relative movement of the bar 18 toward the right with respect to the table 1, moving the links or crank arms 16 in counter-clockwise direction, and causing the members 15, carried by the square bars or shafts 12, to push upwardly on the under sides of the members 11, which normally rest upon the members 15, causing the members 11 to rotate in clockwise direction about their pivots 10 to position to substantially close the openings 9, clearing out all accumulation of slate or other undesired materials. During this aperture closing movement of the members 11 the tension of the spring 20 has been increased. During the return stroke of the member 1, toward the right, as soon as the member 18 leaves the abutment 26 the spring 20 contracts, moving the crank arms 16 in clockwise direction, bringing the abutments 15 and members 11 to normal positions.

While a single spring 20 serves for actuating and controlling all the members 11, and while a single adjustable abutment 22 serves for adjusting or determining the normal positions of the members 11, it will be understood that a greater number of springs 20 and abutments 22 may be used, if and when desirable. But since the several crank arms 16 and shafts 12 are interconnected by the bar 18, an adjustment of any one of them serves to adjust all the members 11, and a single spring 20 will also serve for control and return of all of the secondary screens or gate members 11.

While in Fig. 5 there is illustrated a series of apertures 9 in a transverse row, it will be understood that a single aperture 9, and a single gate member 11, as indicated in Fig. 6, may be utilized extending substantially the entire distance across the table or screen 1. It will further be understood that a series of these long transverse apertures 9 and members 11 will be provided longitudinally of the table or primary screen 1. The several long transverse members or gates 11 are correlated and operated as described in connection with Figs. 2 and 7.

In Figs. 7 and 8 there is illustrated a modification of structure for periodically moving the secondary screen members 11 with respect to the primary screen member 1. In this instance the members 11 move in fixed angular position with respect to the crank arms or levers 16 secured upon the cross shafts 12. Again the several members 16 throughout the length of the member 1 are connected together by pivoting at 17 to the bar 18. Again the adjustment of normal positions of all the members 11 is procured by the adjustable abutment 22 threaded through the arm 21 on one of the members 16, and abutting against the plate 1.

Secured to the left end of the bar 18 is a flexible wire rope 27 or equivalent connected to the rod 28 upon which is threaded the nut 29 and lock nut 30, forming an abutment for the plate 31 adapted to abut against the right hand face of the stop member 26a through which the rod 28 extends and on whose left end is threaded a nut 32 with lock nut 33 forming an abutment for the plate 34 between which and the abutment member 26a is compressed the spring 20a.

In this modification the flow of mixture of coal and slate or other materials is again from right

to left along the member 1, which again is preferably inclined as indicated in Fig. 1. The spring 20a pulls toward the left upon rope 27 and rod 28, whose movement to the left is limited by the abutment 26a when engaged by the plate 31 backed by the nut 29 upon the rod 28.

In this modification the secondary screen members or gates 11 are actuated to close the apertures 9 in the main screen 1 during the latter portion of the stroke of member 1 toward the right. Assuming the full stroke of the member 1, as vibrated by the pitman 7 or equivalent, as indicated in Fig. 1, to be 4 inches, the gate members 11 remain in their normal position for say three quarters of such stroke or movement, and are moved to aperture-closing position during the last inch or quarter of the stroke in the forward direction toward the right, in Fig. 7. Assuming the plate 1, Fig. 7, to have completed all but about one inch of its forward stroke toward the right, upon further movement of the member 1 toward the right to complete its stroke in that direction, it will move toward the right with respect to the bar 18, causing the members 11 to move in clockwise direction with their shafts 12, reaching aperture-closing position at the end of the stroke of the member 1 with the upper surface of each member 11 substantially flush or in register with the upper surface of the member 1. On the return or backward stroke toward the left, when the member 1 has traveled the same distance, for example one inch, the members 11 will return to their normal position, indicated in Fig. 7, and remain therein throughout the completion of the backward stroke and during the longer portion of the immediately succeeding forward stroke toward the right.

Spring 20a, under compression, exerts a force sufficient to operate or control the bar 18 under usual and normal conditions, but will further compress and allow full forward movement to the right of the screen 1 should a piece of iron or like infrangible material become lodged between a member 11 and the screen 1.

Of all the structures above described, the same action and mode of operation are characteristic. Principally because coal is more nearly cubical than slate, which is generally in flat or thin and extended pieces, the slate passes through the openings 9 on to and along the gate members or secondary screens 11, while the coal passes on because generally having no dimension which will permit it to enter into or pass through the space between the edges 9a and 11a of members 1 and 11 respectively.

It is also preferably characteristic of all the structures described that the secondary screens or gate members 11 are normally open for the major portion of the complete forward and return vibration or oscillation of the screen 1, but during any suitable, preferably short, portion of the time required for complete forward and return movement of the screen 1, each member 11 has imparted thereto the aforesaid aperture-closing movement with subsequent return to normal position.

In Fig. 9 is shown a coal grading and cleaning system. A mixture of coal and slate of varying sizes falls from the chute 40 on to a grading screen 41 supported by and vibrating with the trough 42. The smallest sizes of coal and slate pass through the apertures of the screen and slide along the bottom of the trough into discharge pipe 43 or equivalent. The larger sizes of coal and slate rejected by screen 41 slide off plate 44 onto

a second grading screen 45 carried by and vibrating with the trough 46.

The next larger grade of coal and slate pass through the apertures of the grading screen 45 and travel along the bottom of the trough 46 to the discharge hopper 47.

The stream of coal and slate from which the two smaller sizes of coal have been removed, continues along the plate 48, passing onto another grading screen 49 which selects the next larger size of coal. As most of the slate has been removed with the smaller coal sizes, the coal passed by the screen 49 is discharged from the chute 50 to any suitable destination, as to a car, bin, or as indicated, to a conveyor belt 51 for transporting it to a desired destination. Preferably as shown, the coal in travelling to the chute 50 passes over a screen 52 whose mesh is smaller than that of screen 49, to rescreen the coal, any coal of smaller size, not removed by screens 41 or 45, dropping into the collecting chute of chamber 53, which as indicated, may discharge to a conveyor belt 54.

The largest coal of the original mixture passes beyond screen 49 along plate 55, finally discharging at the end of the trough 46 to any suitable receptacle, or destination, or as indicated, to a conveyor belt 56 which transports it to any suitable point.

Either, or both, of the side streams of graded coal and slate which are divided from the main stream of coal and slate by the grading screens 41 and 45, may pass over a cleaning apparatus or system of the type generally shown in Figs. 1 to 8. Specifically, as shown, the coal and slate passing through the grading screen 45 discharges from chute 47 onto a vibrating surface 1, having apertures with which cooperate the secondary surfaces 11 for removing slate. The graded coal travels along the surface 1, discharging into any suitable receptacle as a chute 57. The slate which passes through the openings in plate 1 discharges to another suitable point, for example, chute 58.

Preferably as indicated, the slate and any smaller size coal which may pass through the plate falls upon a screen 59, whose openings are smaller than those of grading screen 45. The smaller size coal or "rescreen" is discharged by the hopper 60, as to the conveyor belt 54.

Similarly, the coal and slate graded by screen 41 may be discharged onto a similar vibrating plate 1, and the slate separated from the coal by the selective action of cleaning apparatus similar to that previously described.

If the coal and slate has already been graded, it may be discharged directly to the proper cleaning plate without passing over the grading screens. To that end, there are provided openings 61 and 62 in the discharge hoppers 43 and 47 below screens 41 and 45 respectively for direct transfer of graded coal and slate to the desired cleaning device.

With the system shown in Fig. 9, the grading and cleaning of the coal is a continuous process, that is, the various sizes of coal and slate are not first segregated as batches of the same grade, with subsequent operation upon each batch to separate the slate from coal of the same grade size. With my system there is avoided accumulation of batches of uncleaned, graded coal, and need for transportation of the accumulation from the grading point or points to one or more cleaning stations.

In the system of Fig. 9, it shall be understood,

that the cleaning plate 1 may be vibrated by the same motive means that vibrates the grading screens, or they may be vibrated from a different source.

In Figs. 10 and 11 is shown another type of combined grading and cleaning system. The stream of coal and slate of various sizes passes in succession over the grading screens 63, 64, and 65, the openings of the screens being the greater the further the screens are downstream. That is, the first plate, plate 63, has the smallest holes and each of the succeeding screens has holes, larger than those of the preceding screen. Accordingly, the smallest size coal and slate falls through the screen 63, the next larger size coal and slate drops through grading screens 64, and so on. The largest size coal and whatever slate may remain, falls off the last grading screen upon a cleaning plate 1, of the type previously described, which removes the slate, permitting the coal to pass on to any suitable destination.

The coal and slate passing through each of the grading screens 63, 64 and 65, falls upon a cleaning plate 1, which is distinct and separate from the others. The mixture of coal and slate falling through the screen 63 for example, is cleaned of slate by the first plate 1, the coal passing out of the discharge duct 66.

Similarly, the stream of coal and slate passed by the grading screen 64 falls upon the second plate 1, through which the slate falls, the graded coal passing out through a suitable discharge conduit 67. And in like manner the next higher grade size of coal and slate is cleaned of slate and the coal passed to a suitable destination as through a discharge pipe 68. The partitions 69, 70 and 71 which extend across the vibrating trough, 71, divide it into several chambers each receiving a particular grade coal, as selected by the screen forming the top of the chamber. The bottom of each chamber is formed by a cleaning plate 1 which removes the slate from coal of the same size.

The actuating bars 18 for the members 11 of the several cleaning plates are, or may be, mechanically coupled, so that all the members 11 are actuated in unison. In this modification, as in that of Fig. 9, it may be desirable to adjust the normal openings afforded by the plates 1 to different settings from the different cleaning plates. That is, the normal openings of the plates further downstream will in general, be greater than those in the next cleaning plate up-stream.

Another grading and cleaning system is illustrated in Figs. 12 to 14. Referring particularly to Fig. 12, the stream of coal and slate of various sizes discharges from a chute 72 into the grading and cleaning apparatus 75. The smallest size coal falls through the screen 73 to the bottom of the apparatus 75, discharging at 74 to any suitable destination. The remaining coal and slate passes over the grading screen 76 which passes all of the coal and slate except the larger sizes. The coal which does not pass through or is rejected by the screen passes downwardly along the solid plate 77, the largest size coal passing over the screen 78 and discharging from the lower or right-hand end of the apparatus as viewed in Fig. 12.

The next largest coal, passes through the screen 78 and is discharged from the trough 79 to a suitable receptacle or destination.

Neither of the two largest sizes of coal is cleaned of slate by the system shown. A large percentage of the slate is removed by the first

grading screen 76 and the percentage of coal in the larger grades is usually such that in practice it is not separated. It is to be understood, however, that, when desirable slate may be removed from the larger sizes, and preferably by apparatus generally similar to that shown in Figs. 1 to 8.

Beneath the grading screen 76 are disposed the several grading screens 80, 81 and 82 of progressively smaller mesh. The coal and slate retained by screen 80 pass onto a cleaning plate 83 generally similar to that shown and described in Figs. 1 to 8. Coal of the grade passed by screen 76 and rejected by screen 80 passes along the cleaning plate 83 discharging at the lower end into a chute extending transversely of the grading and cleaning apparatus 75. Slate of the same grade passes through the openings in plate 83 onto a screen 85, the slate passing over the screen, which as most clearly shown in Fig. 13 forms a V-shaped trough, and discharging into a pipe or duct 86 extending substantially vertically and centrally of the apparatus 75.

Any small coal or slate upon the screen 85 drops through onto the cleaning plate 87 directly below it, which plate 87 also separates slate from coal of the size passed by screen 80 and rejected by screen 81. Coal of this lower grade size travels along the cleaning plate to any suitable destination, for example, as shown, to the duct 84. The slate removed by the selective action of the openings defined by the members 11 and plate 87 falls upon a screen 88, substantially V-shaped, as shown in Fig. 13, which discharges into duct 86.

Any small coal or slate upon screen 88 drops through it upon the cleaning plate 89, which receives the coal and slate passed by screen 81 and rejected by screen 82. The slate is removed, by action of plate 89, falling upon the screen 90 which discharges into the refuse duct 86. As indicated the coal passing through the screens 82, 73, and 90 may be combined in a single stream discharging through the opening 74.

Particularly with the system shown in Fig. 12, the percentage of slate in any of the various grades of coal is very low and many times less than has heretofore been possible and with much less expensive equipment. Further, the percentage of coal in the slate refuse is negligible, so that the method obtains both high purity of coal, with insubstantial loss.

The operating bars 18, for the plates 11 of the several plates 83, 87 and 89, may be individually operated, or may be mechanically coupled for operation in unison. As indicated most clearly in Fig. 12, the entire apparatus 75 may be suspended as a unit for vibration by any suitable means. The apparatus is preferably suspended, as generally illustrated, by the pivoted arms 91, 92. The entire apparatus may be oscillated by any suitable driving mechanism, and adjacent one extreme of its arcuate movement the operating bars 18 may engage common, or individual, abutments for effecting proper actuation of the members 11 to prevent clogging as previously described. Particularly in view of the full description of Figs. 1 and 8, a more detailed explanation of the operation of plates 83, 87 and 89 is not necessary. It will be understood that it may be desirable in practice to adjust to different extents the members 11 of the different plates 83, 87 and 89. That is, each of the different cleaning plates may be set by an adjusting screw 22 (shown most clearly in Fig. 2), to determine the normal opening be-

tween the members 11 and the edges 9a of the openings 9, correct for the particular selection to be effected by that particular plate.

To increase the flexibility of the apparatus, for use with coal which has been previously graded, or partly graded, as by exclusion of larger sizes, openings 93, 94 and 95 are provided above screens 80, 81 and 82 as shown in Fig. 12, to permit a graded mixture to pass directly to the proper point in the system for cleaning, and in some instances, for further grading and cleaning.

For brevity, in the appended claims the terms "coal" and "slate" are employed in a generic sense to include those materials, and any other materials so differing in shape or characteristics that the method and apparatus of the character hereinafter described is suitable for effecting their separation; and it shall be understood that the term "slate" with relation to coal specifically includes other impurities or materials, such as shale, bone and the like.

What I claim is:

1. Apparatus for operating upon a mixture of coal and slate previously graded as to size to separate coal from slate comprising an apertured primary surface downwardly inclined in the direction of flow of the mixture and devoid of obstructions to free flow of the mixture, means for effecting reciprocation of said plate longitudinally of said flow, and secondary surfaces disposed beneath and adjacent the apertures of said plate and downwardly inclined with respect thereto in the direction of flow, selectively to pass the slate.

2. Apparatus for operating upon a mixture of coal and slate previously graded as to size to separate coal from slate comprising a plate downwardly inclined in the direction of flow of the mixture, free of obstructions to the free flow of the mixture and having a plurality of apertures extending substantially across the plate transversely of said flow, means for effecting reciprocation of said plate longitudinally of said flow, and secondary surfaces disposed beneath and adjacent said apertures and downwardly inclined from the upper edges thereof, selectively to pass the slate.

3. Apparatus for operating upon a mixture of coal and slate previously graded as to size to separate coal from slate comprising an apertured plate downwardly inclined in the direction of flow of the mixture and free of obstructions to the free flow of the mixture, means for effecting reciprocation of said plate longitudinally of said flow, secondary surfaces disposed beneath and adjacent the apertures of said plate and downwardly inclined with respect thereto in the direction of flow, selectively to pass the slate, and means for swinging said secondary surfaces substantially into the plane of said plate at the end of each stroke.

4. Apparatus for operating upon a mixture of coal and slate previously graded as to size to separate coal from slate comprising a plate downwardly inclined in the direction of flow of the mixture, free of obstructions to the free flow of the mixture and having a plurality of rectangular apertures extending substantially across the plate transversely of said flow, means for effecting reciprocation of said plate longitudinally of said flow, secondary surfaces disposed beneath and adjacent said apertures and downwardly inclined from the upper edges thereof, selectively to pass the slate, and means for swinging said secondary surfaces substantially into the plane of said plate at the end of each stroke.

CERTIFICATE OF CORRECTION.

Patent No. 1,955,032.

April 17, 1934.

WINFIELD W. STEVENSON, JR.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, line 124, for the numeral "1" read 11; page 5, line 16, for "a chute" read the chute 84; and lines 91-92, for "hereing" read herein; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 19th day of June, A. D. 1934.

Bryan M. Battey

(Seal)

Acting Commissioner of Patents.