Jan. 15, 1952 D. A. WEBER 2,582,302

MATERIAL SEPARATING APPARATUS

Filed June 19, 1947 3 Sheets-Sheet 1

FIG. 1.

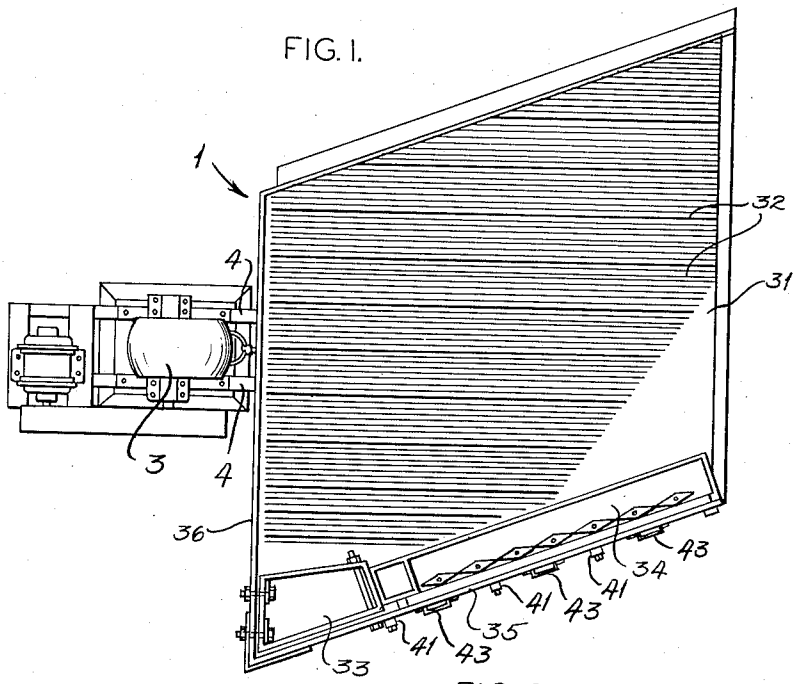


FIG. 2.

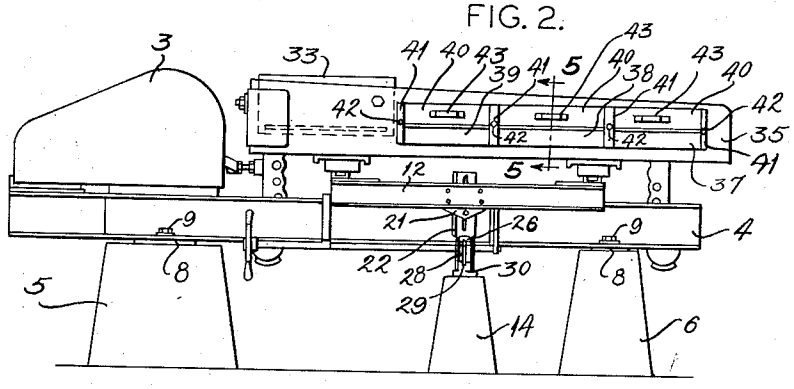
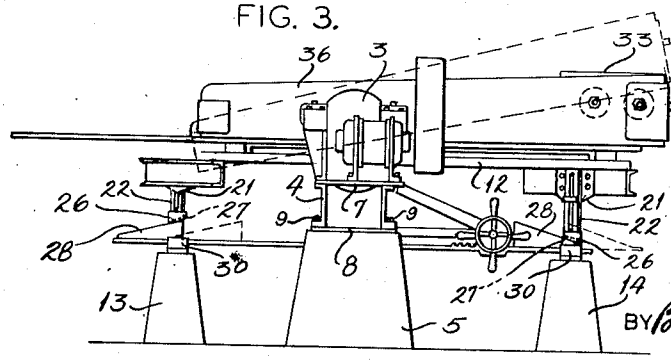


FIG. 3.



INVENTOR:
DON A. WEBER

BY Bruning and Hauke

ATTORNEYS.

Jan. 15, 1952 D. A. WEBER 2,582,302

MATERIAL SEPARATING APPARATUS

Filed June 19, 1947 3 Sheets-Sheet 2

FIG. 4.

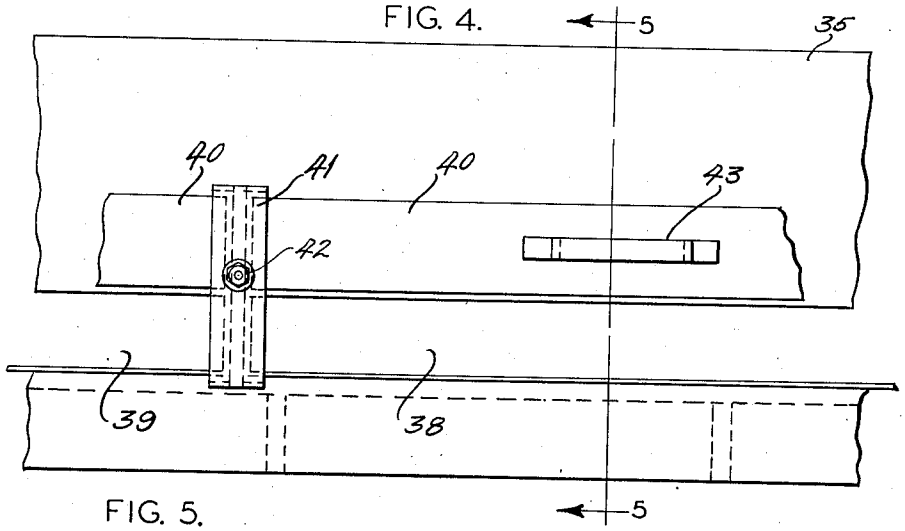


FIG. 5.

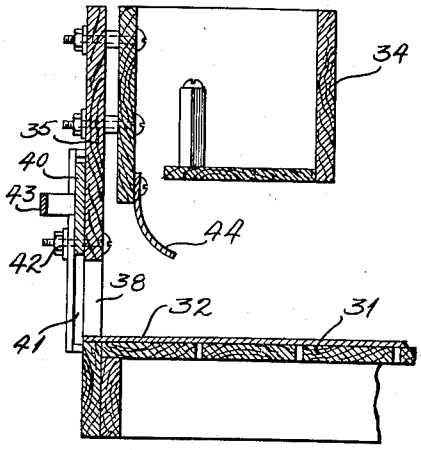


FIG. 6.

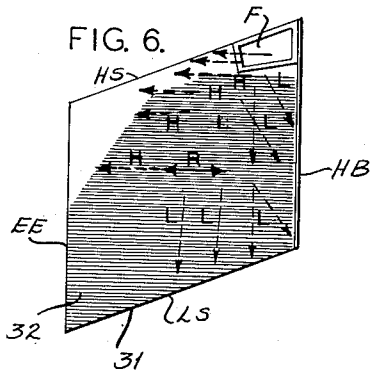


FIG. 7.

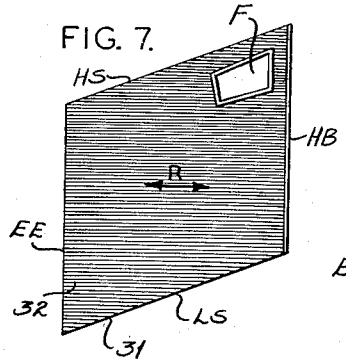


FIG. 8.

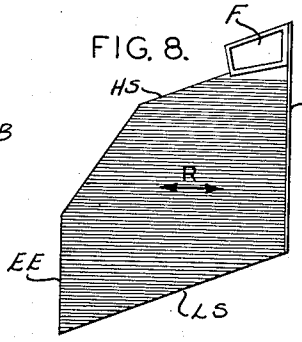
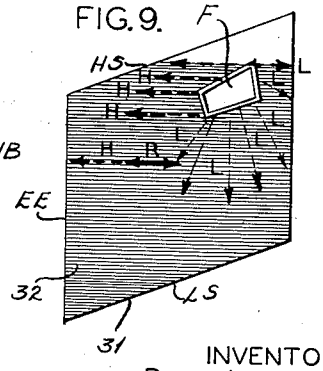


FIG. 9.



INVENTOR:
DON A. WEBER

BY Browning and Scarborough
ATTORNEYS.

Jan. 15, 1952 D. A. WEBER 2,582,302

MATERIAL SEPARATING APPARATUS

Filed June 19, 1947 3 Sheets-Sheet 3

FIG. 10.

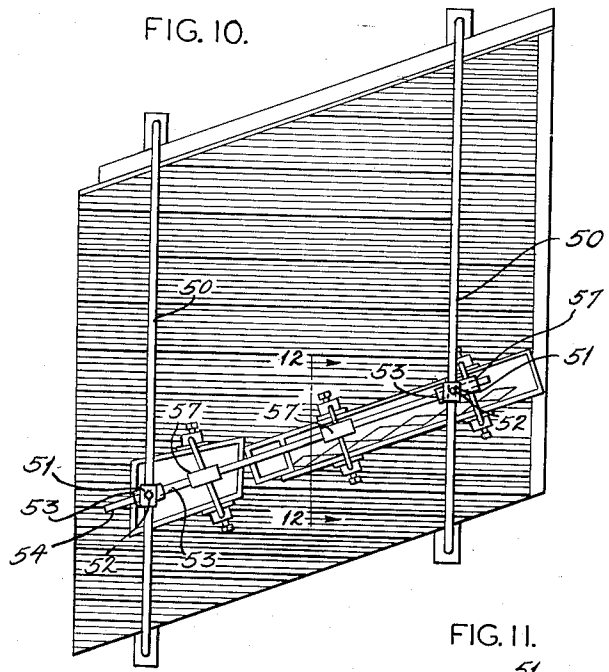


FIG. 11.

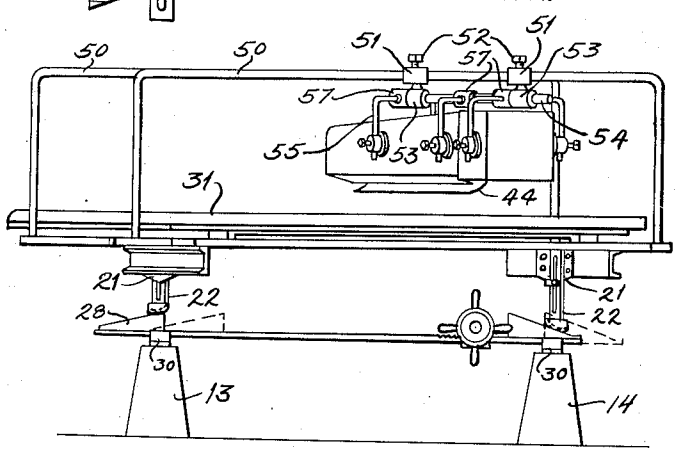
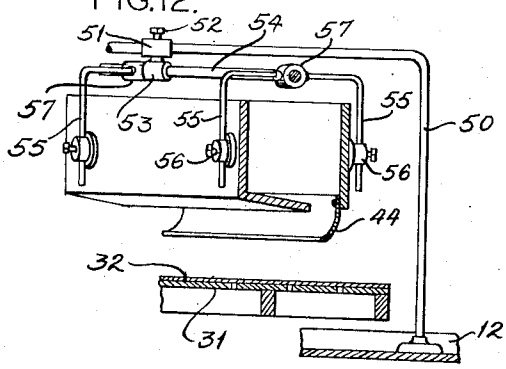


FIG. 12.



INVENTOR:
DON A. WEBER

BY Bruninga and Strauss
ATTORNEYS.

Patented Jan. 15, 1952

2,582,302

UNITED STATES PATENT OFFICE

2,582,302

MATERIAL SEPARATING APPARATUS

Don A. Weber, Fort Wayne, Ind., assignor to The Deister Concentrator Company, Fort Wayne, Ind., a corporation of Indiana

Application June 19, 1947, Serial No. 755,563

10 Claims. (Cl. 209—441)

1

This invention relates generally to materials separating apparatus and particularly to concentrating tables. The concentrating table is used extensively in the separation of various kinds of mixed materials, whether granular, fibrous, or viscous in character on the basis of differences in physical characteristics of the components of the mixed feed, such physical characteristics differing with respect to specific gravity, size, shape, and/or surface structure within component parts of the material mixture. The concentrating table is a specific gravity separating device, which, when properly designed and employed, will, in the course of operation under its fundamental principles, go its way reliably and unerringly in producing separations, the better and more efficiently if left to its natural utilization of cause and effect, over which man has no control. Efforts to increase the capacity of the device by unnatural riffling devices and by other pushing, such as the increase of particle-travel impetus beyond balanced considerations for the operative possibilities under any set of conditions, are merely blundering by human agency contrary to the inherent and potential possibilities of this practical device, which even in our present day and age have not been fully evolved for optimum utility, perhaps because complete knowledge and understanding are thwarted when dealing with an art rather than a science.

In its own right the concentrating table is the expert, and man merely a servant striving to make it free, so that it may function as such while he further strives to provide for its full utilization of natural forces. Unnatural riffling devices pile up mixed or separated portions of the feed. Forcing travel endwise by unreasonable increased mechanical action fails to consider that the component of directional effect thus produced (in what should be natural sequence of specific gravity separating phenomenon) upsets the ratio for balance necessary to be maintained between itself and the directional component acting on particles that must move crosswise on the separating surface.

In the past, the separating area of concentrating tables has been closed on two or more sides, some such devices having only one open discharge side. Modern devices, as represented by United States Patent No. 2,242,562, provide for discharge from one end and one side—the heavy gravity material at the end remote from the feed corner, and the light gravity material from the side remote from the feed corner, while a middling zone overlaps and juncture of said end and said

2

side. The end and the side which are adjacent the feed corner, on the other hand, are closed, respectively, by, so-called, head and side boards to prevent the escape of material from the separating area, in these regions.

We have observed that the heaviest components of materials being separated tend to climb toward the high side of the table, adjacent the side board, and there accumulate in such quantities as to impede the separating function of the table and hence reduce the capacity thereof. It is possible that this condition may have impelled the art, from an early date, to subtract from the potential separation area by interrupting the riffles of the separating surface so as to leave a smooth unobstructed channel of substantial and increasing width along the side board—the more freely that the heaviest components might travel therealong from near the feed corner to the discharge end. Efforts to increase the capacity of the table by imparting to it peculiar mechanical impulses or providing accessory elements calculated to clear the table of the accumulated heavy components have resulted in a sacrifice of separating efficiency.

Hitherto the concentrator table has been required to function both as a separator and as a conveyor. It seems to have been overlooked that the conditions conducive to efficiency in the one functional aspect reduce the efficiency in the other functional aspect. To achieve efficiency and high capacity in separation requires that the table be unburdened, as much as may be, of its conveyor function, and this is a general object of the present invention.

The primary object of the present invention is to provide a novel material separating apparatus wherein a smaller treating area is required to obtain a given capacity and separating efficiency and where an equally high efficiency at greater capacity than has been possible with prior apparatus will result with a given treating area or surface such as is now accepted to be of substantially standard size.

A further object of the invention is to provide a concentrating table, which is highly sensitive to variations in the reciprocating impulses and wherein the interference with such sensitivity by unnecessary dead weight and accessories tending to produce false and detrimental vibrations, is minimized.

Other objects will become apparent to those skilled in the art when the following description is read in connection with the accompanying drawings, in which:

Figure 1 is a plan view of a concentrating table having a single deck constructed in accordance with the present invention;

Figure 2 is a view in side elevation of the table shown in Figure 1;

Figure 3 is an end view of the table shown in Figures 1 and 2;

Figure 4 is a view on substantially enlarged scale of a portion of the side elevation shown in Figure 2;

Figure 5 is a sectional view taken along line 5—5 of Figure 2 and Figure 4;

Figure 6 is a plan view diagrammatically showing the directions of reciprocation and travel of material across a concentrating table deck constructed according to one embodiment of the invention;

Figures 7, 8, and 9 are views corresponding to Figure 6, but showing different modifications of the table deck;

Figure 10 is a view corresponding to Figure 1, but showing a modified form of apparatus wherein the usual feed box and wash water inlets are supported independently of the reciprocating deck;

Figure 11 is an end elevation of the apparatus shown in Figure 10; and

Figure 12 is a partial sectional view taken along line 12—12 of Figure 10.

Generally stated, the invention contemplates that the reciprocating deck of a concentrator table be freed in so far as possible of loads and confinements, and particularly that components of material undergoing treatment be removed from the reciprocating deck immediately as they are separated and without having to travel for discharge over needless distances to points far remote from the locus of separation. The discharge of heaviest components may be accomplished to a practical extent by eliminating or venting the side board which extends along the "high side" of the ordinary concentrator table, and results, without other changes in construction, in a substantial increase in the capacity of the table, not only without reduction of efficiency of separation, but ofttimes with an increase in such efficiency.

The successive unloading of the heaviest components, immediately as they are separated, makes it possible to further increase the capacity per unit of area of the ordinary concentrator table deck by eliminating the ways customarily provided for conducting the heavy components from their locus of separation to the point of discharge. This may be done either by reducing the area of the usual deck to be substantially coextensive with the active (usually riffled) area thereof, or by extending the riffles toward the margin of the deck. In the former case, the capacity per unit of area is increased by reducing the area without sacrifice of capacity. In the latter case, the capacity is increased by utilizing, for separation, the portion of the deck area usually devoted to mere conveying.

While in this description, as well as in the appended claims, reference is made to the "high side" and "low side" of the concentrator table and also to the fact that the table is "tilted," such expressions are not intended to proscribe the possibility that the table may be operated horizontal, i. e., substantially level in a direction transverse to the direction of reciprocation, or with so-called "end elevation" (where the end remote from the feed, in the direction of reciprocation, is higher than the end adjacent the point of feed). On the contrary, the expression "high side" is used, as in the common parlance of the art, merely to identify the side which would be elevated if the table were not level about an axis parallel to the direction of reciprocation. While, in practically all cases, concentrator tables are operated with some tilt (usually between 15° and 6° to the horizontal) about an axis parallel to the direction of reciprocation, there are rare, but well recognized, instances where because of extrinsic influences or inherent characteristics of the material being treated, the effect of tilt is achieved with little actual departure from level; and consequently the word "tilted," as used herein, is intended to include such relations.

Moreover, the invention contemplates freeing the deck for discharge of the light components at the "head end" immediately as the separation is accomplished and without requiring such separated components to travel all the way to the "low side" of the table before they are unloaded. With decks which are operated with "end elevation," the light components tend to accumulate adjacent the head board of the ordinary concentrator deck and particularly so with decks having end elevation. By eliminating or venting the usual head board, the deck may be freed of some of the burden of conveying the accumulation of light components, with concomitant increase in capacity or efficiency, or both.

Lightening the burden on the reciprocating deck by unloading the components as and when separated permits variation and control of reciprocation impulses without regard to their effect upon the movement of separated components along arbitrary paths; and additionally renders the deck (with its necessary load of material undergoing separation) more acutely responsive to variations in the reciprocating impulses. To achieve the greatest possible sensitivity of the table to variations in the reciprocating impulses, the deck should be freed of all possible dead weight, and consequently the invention further contemplates supporting the feed boxes, wash water discharges, receiving troughs, and launders otherwise than upon the reciprocating deck. For example, all such dead weight accessories may be carried by the tiltable but non-reciprocating sub-frame usually provided for the deck.

While the invention will be disclosed in connection with concentrator tables of the type shown in United States Patent No. 2,242,562, it is to be understood that such is only for illustration. The present invention is neither limited to multiple deck concentrating apparatus nor to other details of construction described in said patent, but is applicable at large to conventional types of concentrator tables.

Referring now to Figures 1, 2, and 3, the treating unit 1 is actuated by a reciprocating mechanism 3 and comprises a longitudinal base frame 4, which is rigidly mounted at opposite ends upon upright foundation piers 5 and 6. Preferably, the frame 4 is constructed of two spaced parallel channels disposed on edge with the legs projecting outwardly and rigidly connected and cross-braced by suitable spaced cradle-seats 7 at the top, and longitudinally spaced sole-plates 8 at the bottom, resting on the piers 5 and 6. The frame 4, with sole-plates 8, is removably anchored to the piers 5 and 6 by means of bolts 9, thereby permitting assembly adjustment for end elevation. More particularly, the right end of frame 4 (as seen in Figure 2) may be

raised as by means of a shim, wedge, or jack (not shown) and then bolted rigidly in position to obtain any desired "end elevation" necessary for the most efficient operation.

A sub-frame 12 extending transversely of the main frame 4 is adjustably mounted for side tilt on the cradle-seats 7 and is additionally supported at the overhanging ends by outboard foundation piers 13 and 14, all as described in greater detail in the aforesaid Patent No. 2,242,562.

The adjustable outboard supports for the frame 12 may be of any suitable construction. In the present instance, each comprises a bracket 21, bolted to a side member of the sub-frame 12, and a vertical tilting post 22 adjustably clamped to the bracket 21. A shoe 26 is rigid with the lower end of tilting post 22 and slidably engages the upper inclined face of a wedge 28 adapted for adjustment transversely of the cradle axis. The lower face of the wedge 28 is slidably supported in a guide block 30 mounted on the associated foundation pier 13 or 14 directly beneath the shoe 26. It will be seen that adjustment of the wedge 28 in opposite directions will respectively elevate and lower the post 22 to tilt the sub-frame 12, all as described in greater detail in the aforesaid Patent No. 2,242,562.

The present invention is particularly concerned with the treating surface or deck 31, which is supported on sub-frame 12. The deck 31 is reciprocable longitudinally of the base frame 4 in accordance with impulses delivered by the mechanism 3. The deck 31 is shown, for purposes of illustration, as diagonal or rhomboidal in outline, but the invention is not limited to decks of that particular shape. The top or treating surface of the deck 31 may be formed with suitable riffles 32 extending generally parallel to the direction of reciprocation. In the embodiment shown in Figure 1, the riffles 32 terminate short of the margin of the deck 31 in the zones adjacent the high side of the table. Such a shortening of the riffles in these areas is consistent with conventional concentrating table construction, but, as will appear hereinafter, the invention is not limited thereto.

A feed box 33 is, in the embodiment shown in Figure 1, provided in the corner adjacent the high side and low end of the deck 31 for delivering the composite material to be separated onto the deck for treatment. Extending along the high side of the deck 31 is a launder 34 arranged to deliver wash water to the deck. In the form shown in Figures 1, 2, and 3, the launder 34 is mounted upon a side board 35, which extends the entire length of the high side of the deck. Likewise, in the embodiment shown in Figure 1, a head board 36 extends along the entire end of the deck adjacent the reciprocating mechanism 3, and the feed box 33 may be secured to said head board.

All of the foregoing description of the parts shown in Figures 1, 2, and 3 is consistent with well known construction of concentrating tables. The present invention, as shown in Figures 1 to 5, inclusive, is, however, characterized by venting the side board 35 to provide spillways therealong in order that the heaviest components of material undergoing treatment may be unloaded from the deck 31 immediately as and when the separation is accomplished and without requiring such components to travel along arbitrary paths between the locus of separation and the point of discharge. In the embodiment shown in Figures 1 to 5, inclusive, the head board 35 is

provided with vents 37, 38, and 39. The lower confining edge of said vents is arranged so as not to extend above the level of the treating surface of the deck and, in fact, the riffles 32 may, if desired, extend to the vents.

Since, under some circumstances, it may be preferred to retain the heavy components on the deck without immediate discharge, and, under other circumstances, it may be desired to regulate the rate of discharge of such components, each of the vents 37, 38, and 39 is provided with a gate 40 mounted in guide-ways 41. Each of the guide-ways 41 is provided with a loose front plate and a clamping bolt 42, so that, upon tightening of the latter, the gates may be held in any desired position of elevation between fully open and fully closed limits. The gates 40 are provided with a suitable handle 43 to facilitate manipulation.

The launder 34 is mounted on side board 35 in such manner as to avoid interference with the discharge of the heavy components from the deck 31 outwardly through vents 37, 38, and 39. As shown clearly in Figure 5, the launder 34 is elevated sufficiently above the surface of deck 31 as to allow ample clearance for the passage of material from the deck through the vents and, in order that the discharge of wash water from the launder 34 be effectively controlled to the practical purposes of the deck's separating and/or concentrating action, and, so as not to impede the discharge of material from the deck, a sweep plate 44 is provided for directing the wash water so as to deposit the latter upon the deck at a point substantially inward from the side board 35.

In Figures 6 to 9, inclusive, several deck forms are diagrammatically shown and like reference characters denote corresponding parts.

Referring now to Figure 6, the operation of the deck in accordance with the present invention will be described. The feed box is indicated by the letter F; the head board 36 by the letters HB; the high side of the deck along which side board 35 extended in the embodiment shown in Figures 1, 2, and 3 is designated by the letters HS; the opposite side by the letters LS; and the elevated end by the letters EE. The direction of reciprocation is indicated by the double-pointed arrow R and is substantially parallel with the direction in which the riffles 32 extend. When material is deposited upon the reciprocating deck from the feed box F, a stratification takes place, which tends to move the heavier components in the direction indicated by the broken arrows H. At the same time, the lighter components are moved in the directions indicated by the broken arrows L, the latter movement being largely influenced by the travel of wash water across the deck. The wash water discharge mechanism is, for clarity of illustration, omitted from Figure 6, but it will be understood that, in normal operations, a suitable wash water discharge arrangement is provided. By freeing the deck of confining walls along the high side HS, the heavy components may spill over the margin thereof immediately as and when they reach such margin.

In the form shown in Figure 6, the riffles 32, consistent with the showing of Figure 1, terminate short of the high side HS. With many materials, such a shortening of the riffles subtracts from the useful separating area of the deck. Consequently, in the form shown in Figure 7, the riffles are extended all the way to the margin of the deck, thus, with many materials, increasing the capac-

ity of the device. Otherwise, the form shown in Figure 7 is identical in construction and operation with the form shown in Figure 6.

In the form shown in Figure 8, the overall area of the deck is reduced to the extent of eliminating the unriffled portions of the deck. With the form of deck shown in Figure 8, as tailored to a specific separating and/or concentrating problem, the total capacity is substantially the same as with the form shown in Figure 6, but the capacity per unit of area is increased and the load of material upon the table at any time correspondingly reduced.

In the form shown in Figure 9, both the high side and the head end of the deck are freed to permit spilling of the separated material over the margins thereof as and when the components reach these margins. Since, with the form shown in Figure 9, there are neither side boards nor head boards for supporting the feed box F, the latter may be suitably supported independently of the deck as by a suitable bracket extending grom the sub-frame 12. In this case, however, the feed box is moved out of the corner where it is customarily situated and along the long diagonal of the deck for a distance sufficient that material discharging from the feed box will not reach the margins of the deck until it has undergone stratification and complete separation. In any case, the position of the feed box thus depends upon the amount of deck area required for practical stratification leading to separation, but is modified also by necessary adjustment of cross tilt and end elevation of the deck as indicated for the efficient separation of the material being treated.

As a practical embodiment of the apparatus wherein the reciprocating deck is freed of the burden of supporting the feed box and wash water launders, reference may be had to Figures 10, 11, and 12. In this embodiment, a pair of supporting bars 50 is mounted upon the sub-frame 12, so as to extend upwardly on the outside of the side margins of deck 31 and thence entirely across the deck in elevated relation thereto. Mounted upon the laterally extending portion of each of the bars 50 is a slidable collar 51 having a clamping screw 52 adapted, when tightened, to retain the collar 51 in fixed position upon the bar 50. Depending below each of the collars 51, and supported thereby, is a swivel collar 53 having a barrel adapted to receive a rod 54. The opposite ends of the rod 54 are thus supported by each of the collars 53. Mounted upon rod 54 is a plurality of collars 57, from each of which downwardly depends a pair of arms 55 adapted to be received within sleeves 56, which latter are secured to the wash water launder 34 or the feed box 33, as the case may be. Each of the sleeves 56 is provided with a set screw so as to clamp the respective collars in any selected position vertically along the arms 55.

With the arrangement of parts just described, the deck is relieved of load incident to the feed box and the wash water launders. Since the latter are supported upon the tilting, but non-reciprocable, sub-frame 12, the deck itself becomes the only reciprocating part and, due to the lightening thereof, is rendered more highly sensitive to variations in the reciprocating impulses. Since the sub-frame 12 must be tilted in order to tilt the deck 31, however, the feed box 33 and the launder 34, when once adjusted relative to the deck, remain in such adjusted relation despite variations in the degree of tilt or the degree of end elevation of the deck.

The arrangement shown in Figures 10, 11, and 12 for supporting the feed box and wash water launder independently of the reciprocating deck is intended to permit variation in the position of these accessory parts in order best to adapt the table to the idiosyncrasies of the material being operated upon. The arrangement described permits adjustment of the position of the feed box and wash water launder either transversely or longitudinally of the deck, as well as in a vertical direction, but it will be understood that, where a concentrating table is built for a specific application, the adjustability features of the supporting framework 50—54—55 may be dispensed with.

From the foregoing description, those skilled in the art will readily understand that the reciprocating deck, upon which the separation is accomplished, is unburdened of much of the load which such tables have heretofore been required to sustain. Such unburdening of the table includes not only immediate discharge of the heavy and/or the light components of the material being separated, as and when the separation is accomplished, without requiring them to follow arbitrary paths for substantial distances across the table, but, in addition, or as an alternative thereto, may involve relieving the reciprocating table of the weight of the feed and wash water devices. Any such lightening of the burden on the table permits of greater latitude of effect when varying the reciprocating impulses and renders the table, together with the material undergoing separation thereon, more sensitive to such variations. Moreover, discharging the separated components from the table, without requiring their unnecessary conveyance across the same, eliminates the necessity of so regulating the reciprocating impulses or providing ancillary devices emphasized to urge the separated components across the table. Not only the efficiency, but the capacity per unit of area, is substantially increased.

Those familiar with the art will also recognize that the substantial lineal increase for peripheral discharge, and therewith corresponding expansion of discharge zones for products of any gravity range, greatly increases the spread of products, permitting the most finished of separations and insuring the greatest accuracy in making cuts of this deck's yield.

While one complete embodiment of the invention has been disclosed in detail and a number of modifications suggested, it is not to be understood that the invention is limited to the structures specifically described, but that the principles of the invention are applicable at large to concentrating tables. Consequently, such modifications and variations as do not depart from the spirit of the invention are contemplated by and within the scope of the appended claims.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. In a material separating apparatus of the character described having a rectilinearly reciprocating imperforate deck tilted about an axis substantially parallel to the direction of reciprocation to provide a high side and a low side, said high side extending in a direction which converges toward one end with the direction of reciprocation, a feed device located in the quadrant of the deck nearest the high side and remote from the end toward which the high side converges with the direction of reciprocation, the end remote from the feed device, the low side,

and a substantial part of said high side being free to spill material over the edge thereof.

2. In a material separating apparatus of the character described having a rectilinearly reciprocating imperforate deck tilted to provide a high side, a low side substantially parallel with but lower than the high side, and low and high ends connecting said high and low sides, said high side extending in a direction which intersects the direction of reciprocation beyond said high end, a substantial part of said high side, low side, and high end each being arranged to spill material over the edge thereof.

3. In a material separating apparatus of the character described having a rectilinearly reciprocating imperforate deck tilted to provide a high side and to provide an elevated end extending transversely of the line of reciprocation, said high side extending in a direction which intersects the direction of reciprocation beyond said elevated end, a substantial part of said high side being arranged to spill material over the edge thereof, and means for feeding said material to said deck remote from the elevated end, said feed means being disposed adjacent the high side but sufficiently remote from the spilling edge thereof that material will not fall directly from said feed means over the spilling edge.

4. In a material separating apparatus of the character described having a reciprocating imperforate deck tilted to provide a high side extending in a direction which intersects the line of reciprocation and to provide a low side substantially parallel with the high side, said low side and a substantial part of said high side being free to spill material over the edge thereof, a side board extending along said high side, a spillway at the deck level in said side board, and a gate for said spillway.

5. In a material separating apparatus of the character described having a rectilinearly reciprocating imperforate deck tilted to provide a high side, means for feeding material to said deck near a corner adjacent the high side, said high side extending in a direction which converges with the direction of reciprocation at a position remote from said feeding means, said deck having the end remote from the feed means elevated above the end theradjacent, and a substantial part of both said high side and the end opposite said elevated end being arranged to spill material over the edge thereof.

6. In a material separating apparatus of the character described having a reciprocating imperforate deck tilted to provide an elevated end extending transversely of the direction of reciprocation, means for feeding material to said deck near a corner remote from the elevated end, and a substantial part of the end remote from the elevated end being arranged to spill material over the edge thereof.

7. In a materials separating apparatus of the character described having an imperforate deck tilted to provide a high side, a low side substantially parallel with but lower than the high side, and low and high ends connecting said high and low sides; means for feeding heterogeneous particulate material to said deck adjacent the corner between said high side and said low end; means for imparting impositive differently directed forces to particles of material on said deck, one of said forces being directed to move particles up hill and another of said forces being directed to move particles down hill; said forces having preferential effectiveness respectively upon the heavier and the lighter particles on said deck, whereby the heavier particles move across said deck toward said high side, and the lighter particles move in a different direction across said deck; the improvement which comprises, said high side being free to spill said heavier particles over the edge of said deck as said particles reach said high side.

8. In a material separating apparatus of the character described having a deck tilted to provide a high side, a low side substantially parallel with but lower than the high side, and low and high ends connecting said high and low sides; means for feeding heterogeneous particulate material to said deck adjacent the corner between said high side and said low end; means for rectilinearly reciprocating said deck in a direction and with a differential stroke such as to move heavier particles of such material from adjacent the feeding means upwardly toward the high end; said high side extending in a direction which converges toward said direction of reciprocation at said high end; said low side and said high end being arranged to pass material from said deck over the edges thereof; the improvement which comprises, said deck being free to pass to said high side material which is moved in the direction of reciprocation and toward said high side, and said high side being free to spill such material over the edge of said deck between said feed box and said high end.

9. In a method of separating materials on a deck tilted to provide a high side having one end higher than the other, wherein material is deposited on the deck in the quadrant nearest the low end of the high side and the deck is reciprocated in a direction which converges with the high side toward its high end; the step which consists of unloading material from the deck immediately as and when it reaches the high side.

10. In a method of separating materials on a deck tilted to provide a high side having one end higher than the other, wherein material is deposited on the deck in the quadrant nearest the low end of the high side and the deck is reciprocated in a direction which converges with the high side toward its high end; the step which consists of unloading material from the deck immediately as and when it reaches a position along the high side sufficiently remote from the point of feed that the material has stratified under the influence of reciprocation.

DON A. WEBER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
349,504	Krause	Sept. 21, 1886
650,673	Dodd	May 29, 1900
763,783	Overstrom	June 28, 1904
780,031	Torster	Jan. 17, 1905
895,169	Deister	Aug. 4, 1908
895,170	Deister	Aug. 4, 1908
921,090	Deister	May 11, 1909
1,019,884	Deister	Mar. 12, 1912
1,044,030	Deister	Nov. 12, 1912
1,105,912	Kirby	Aug. 4, 1914
1,291,616	O'Connell	Jan. 14, 1919
2,242,562	Weber	May 20, 1941