

June 20, 1961

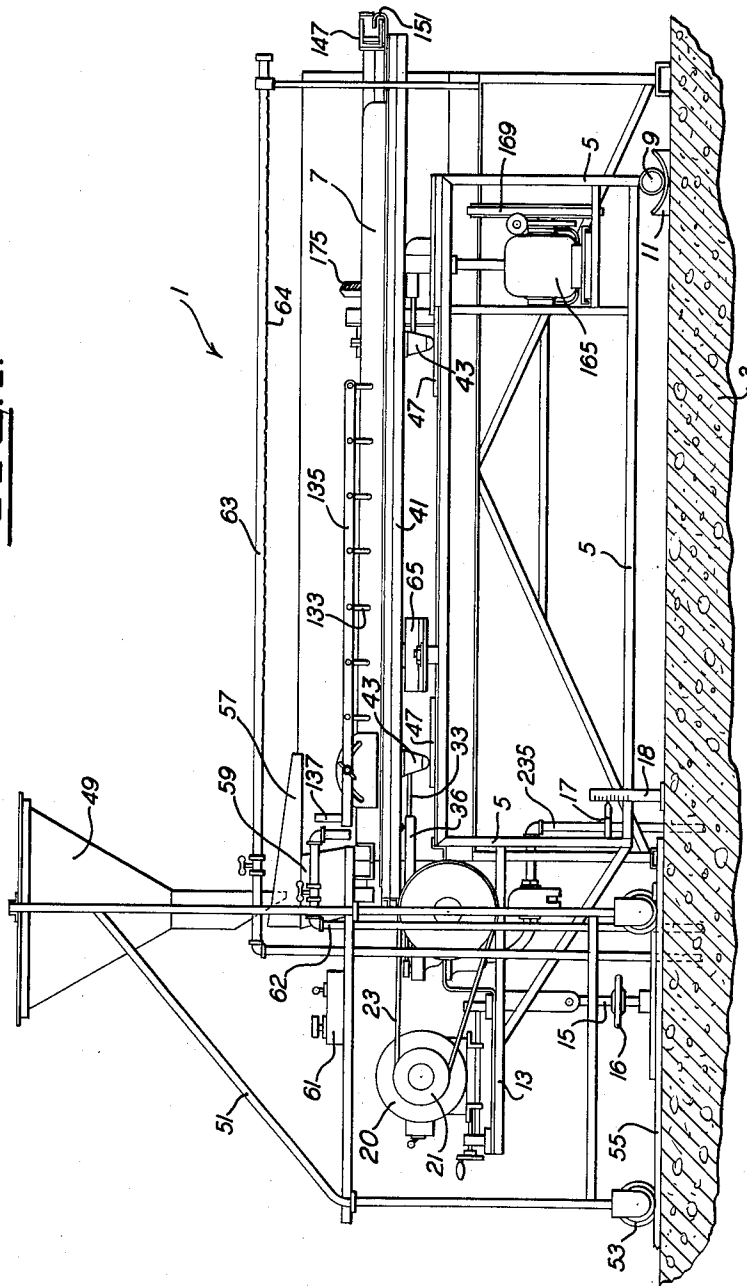
E. F. GOBATTI
CONCENTRATOR

2,989,184

Filed Sept. 26, 1958

8 Sheets-Sheet 1

Fig. 1.



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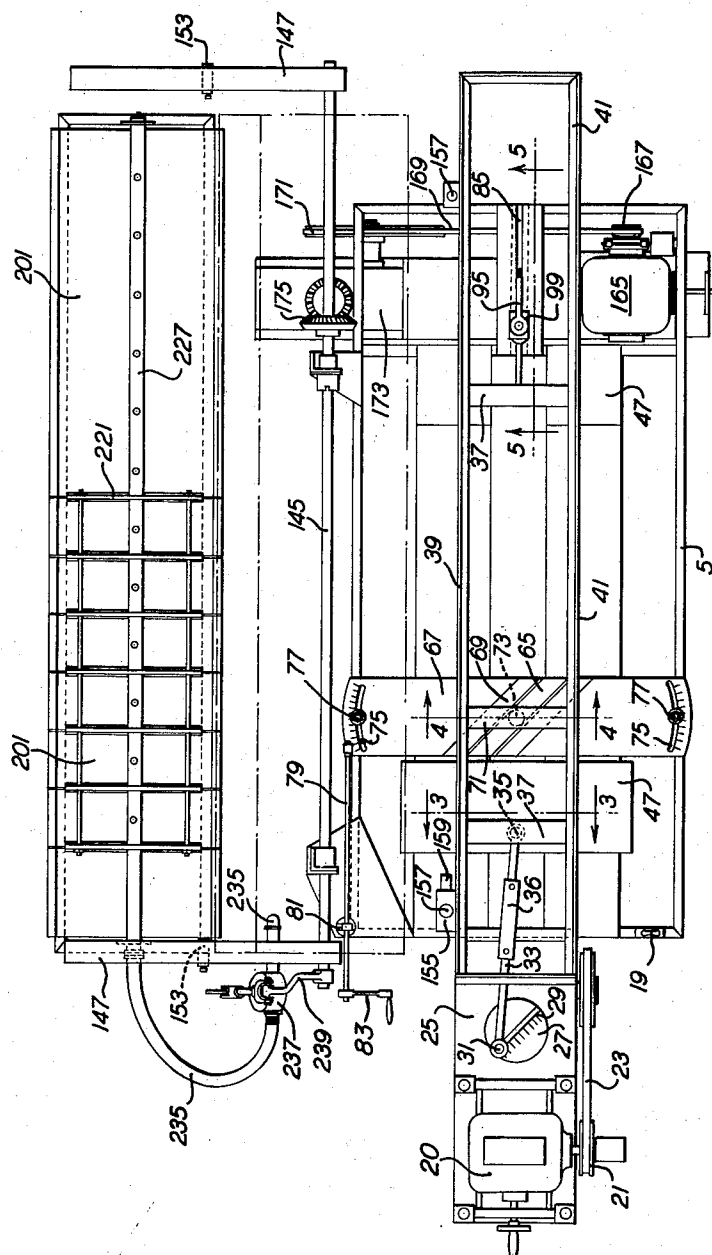
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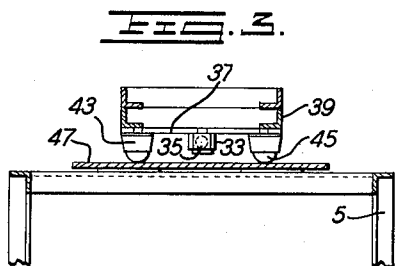
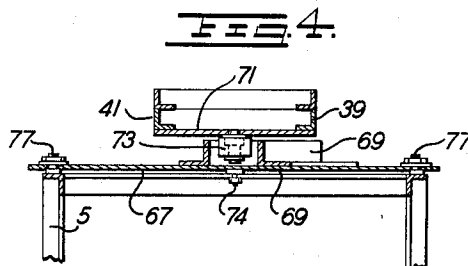
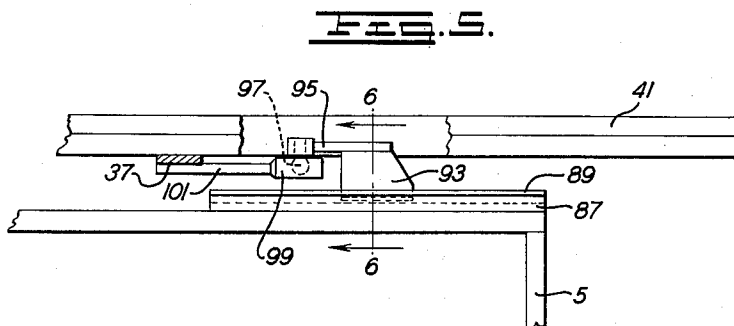
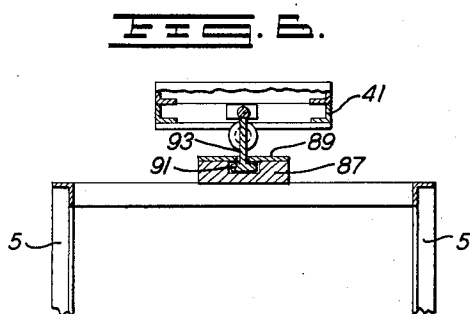
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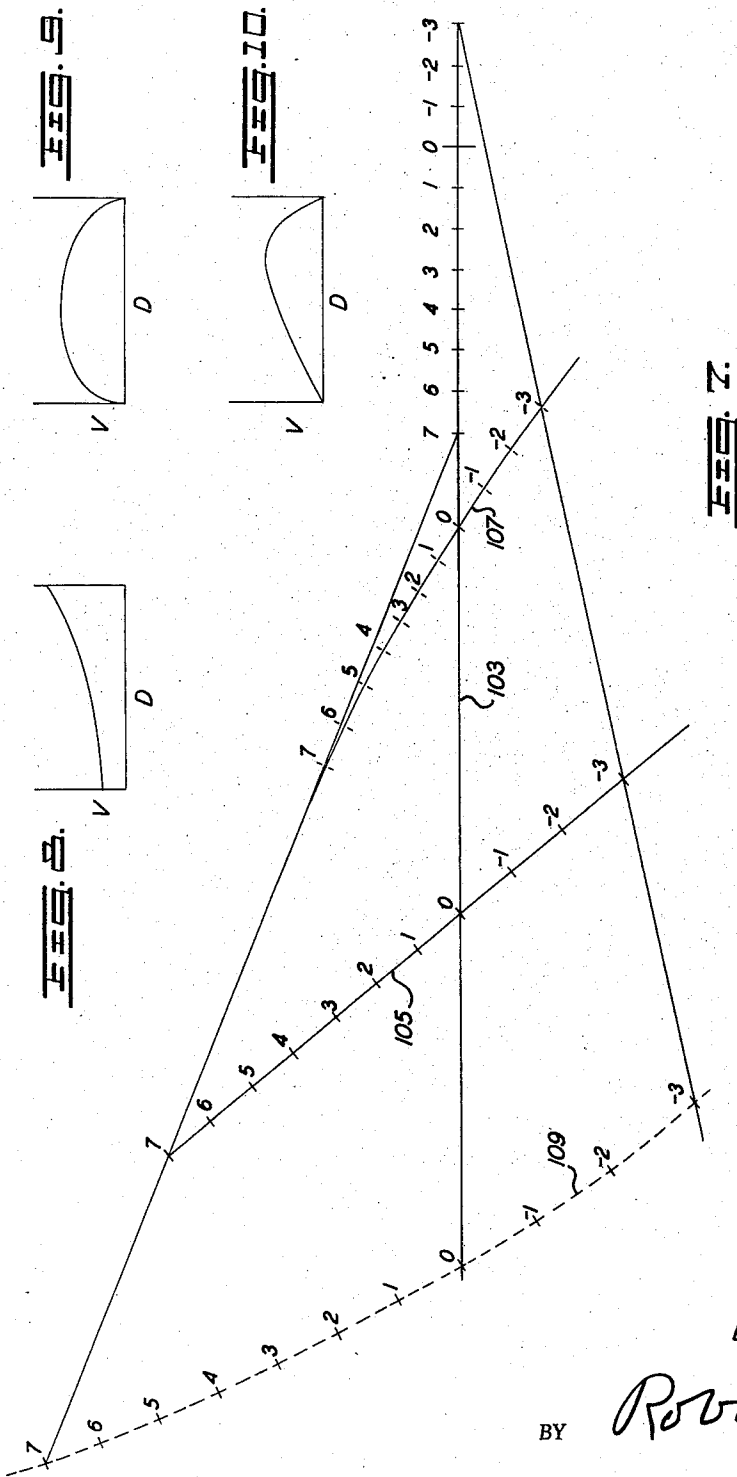
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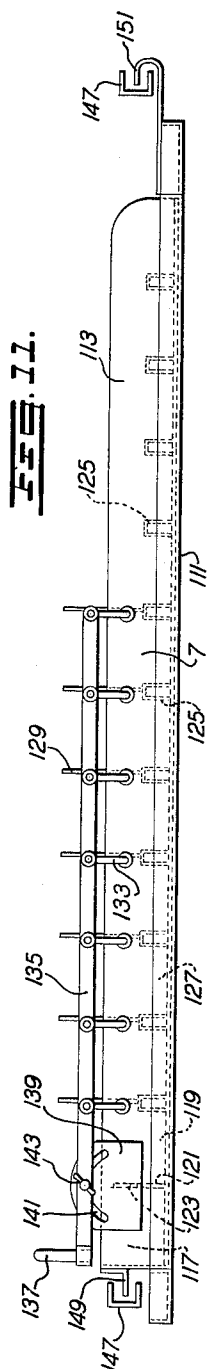
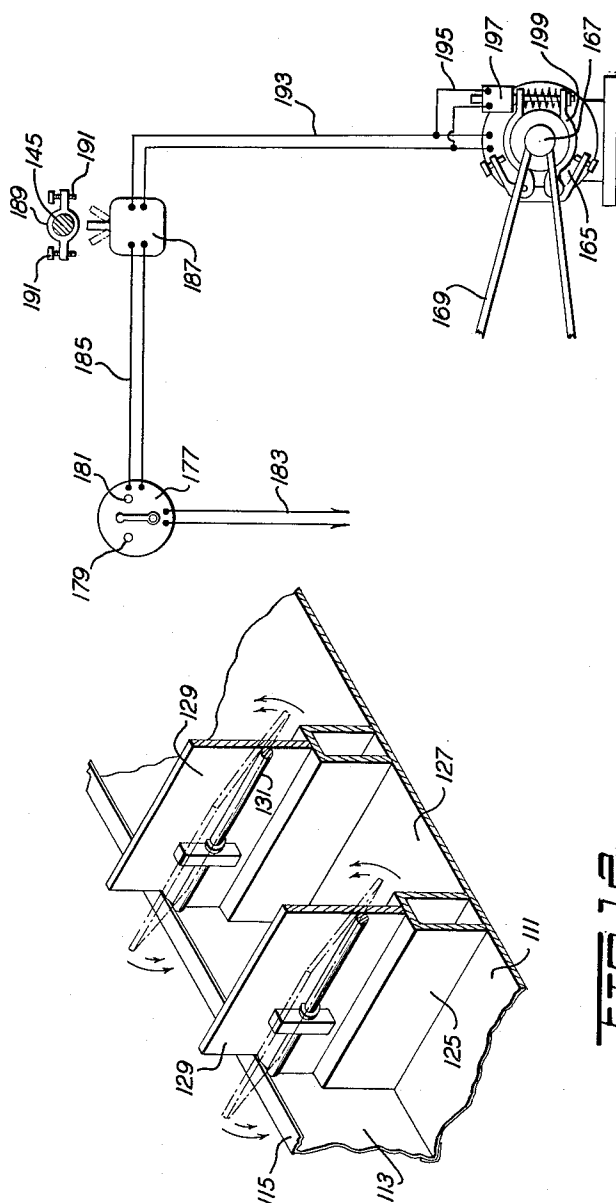
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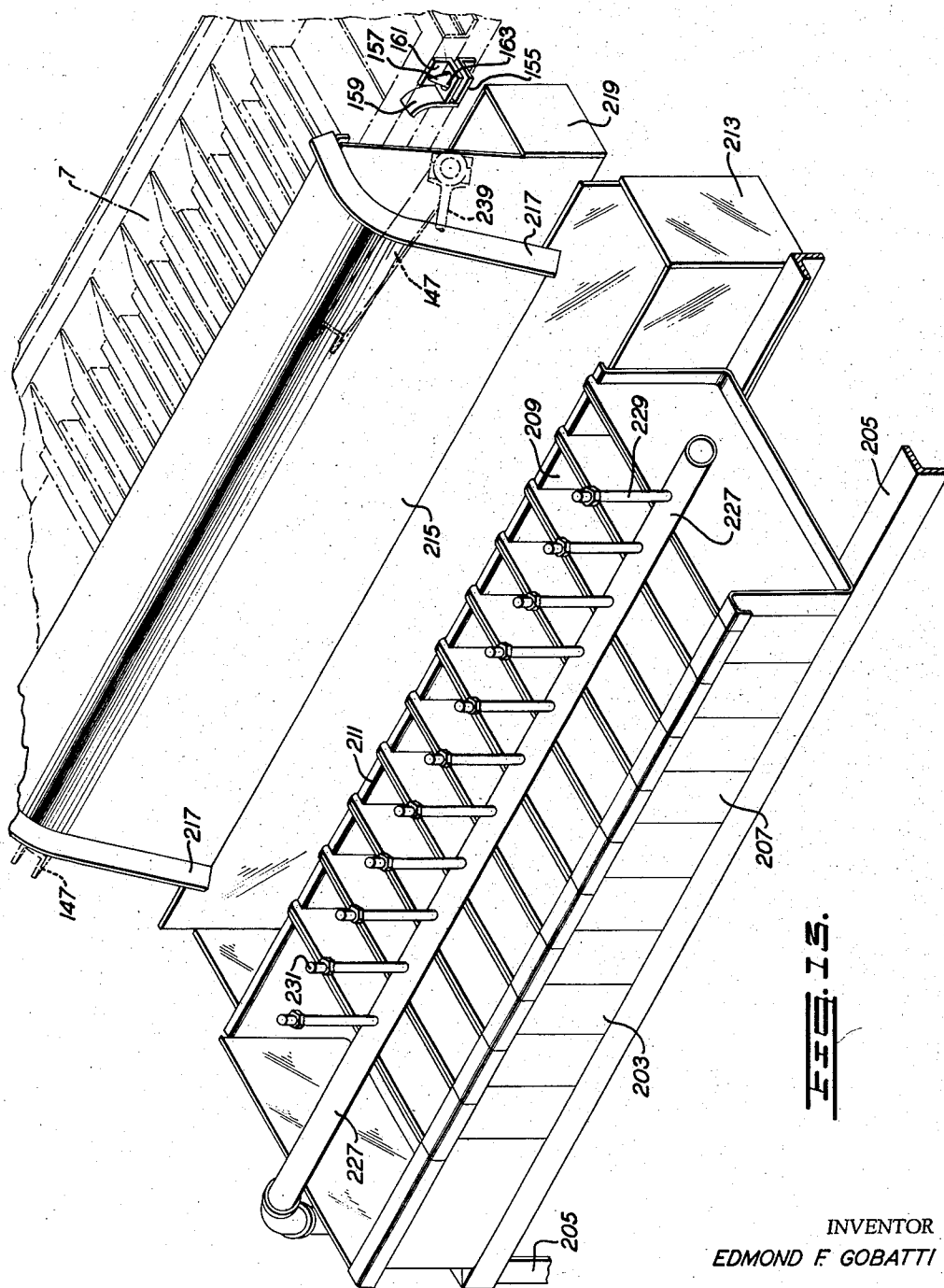
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8 Sheets-Sheet 6



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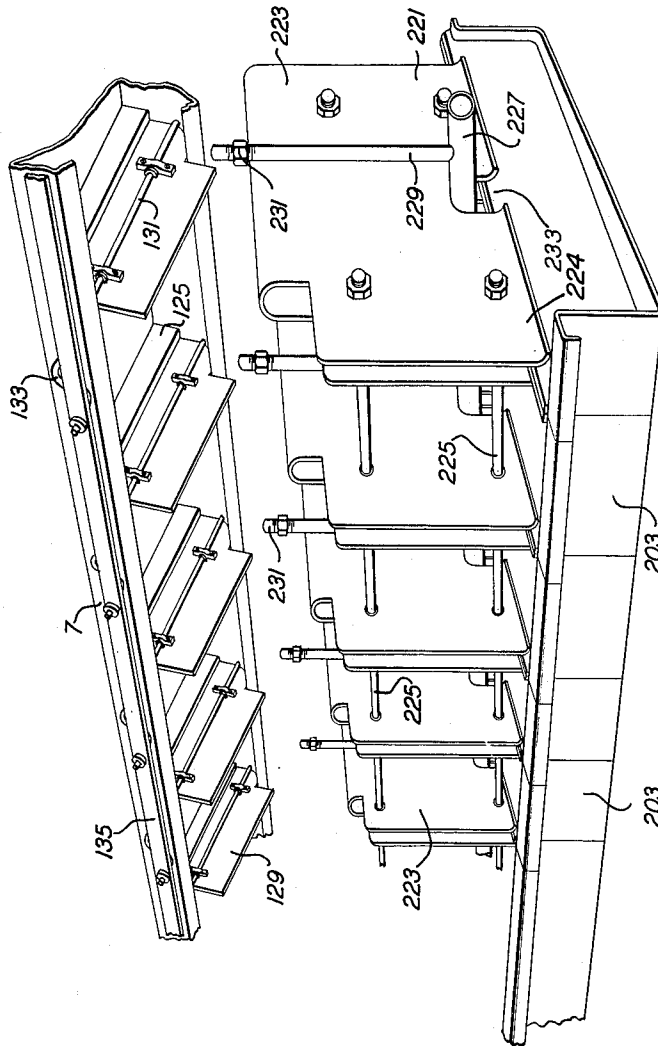
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FIG. 14.



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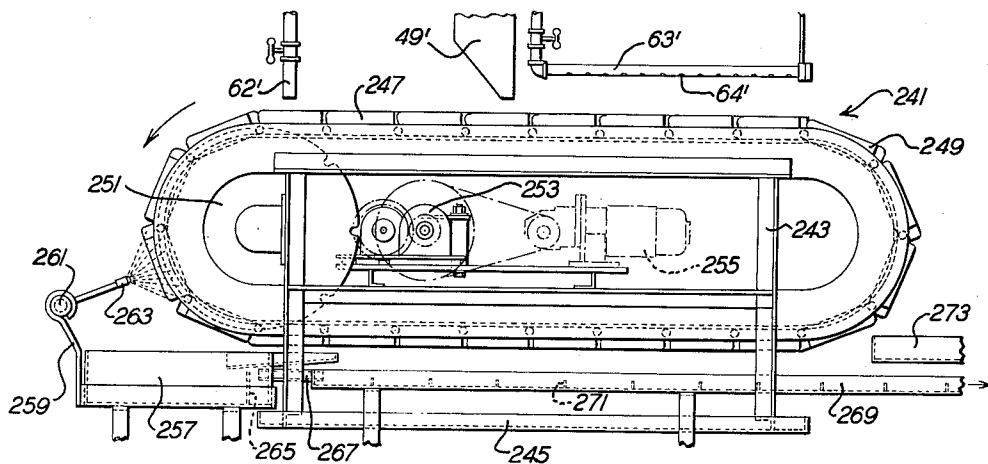


FIG. 16.

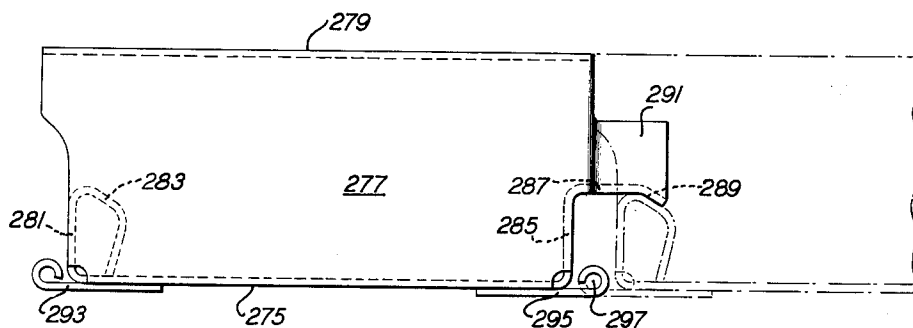


FIG. 17.

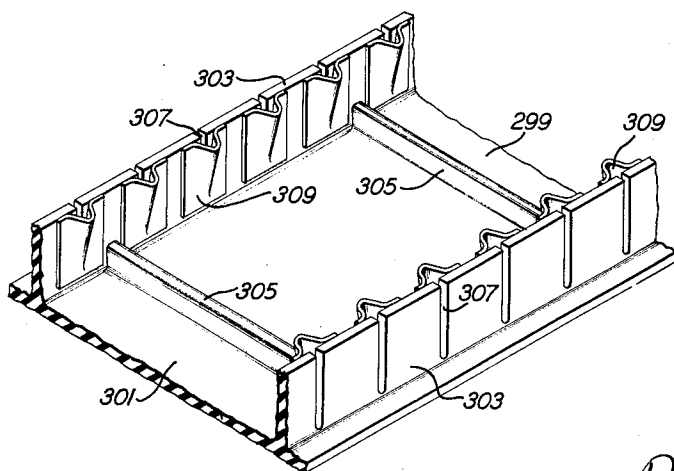


FIG. 18.

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47 Claims. (Cl. 209—437)

The present invention relates to a concentrator, and more particularly to a concentrator of the reciprocating sluice trough type.

In the separation of materials of various particle weights and sizes, it is common practice to concentrate an aqueous slurry of the material by feeding it to an elongated box or trough having a plurality of longitudinally spaced obstacles over which the slurry passes. The trough is reciprocated lengthwise and the water and lighter particles tend to pass over the obstacles while the heavy particles tend to be left behind in the bottom of the trough.

For example, in ore dressing operations, ground ore is frequently fed to such a trough along with water. The trough is provided with transverse partitions known as "riffles," and as the trough is reciprocated the "concentrates" tend to collect in the compartments between the riffles while the lighter "middlings" and "tailings" or "gangue" pass over the riffles to further compartments. Finally, the tailings and water leave the end of the sluice trough which is opposite the feed end.

This is the field of development to which the present invention pertains; and the invention has utility in the concentration of all materials which may be subjected to the foregoing operations, and particularly mineral ores. Examples of these ores are the ores of gold and silver, gold quartz, copper, copper and silver, tungsten scheelite, thorium, gold placer sands, zinc and lead, ground scrap mica, zinc carbonate, beryllium, etc.

Accordingly, it is an object of the present invention to provide a concentrator of the reciprocatory sluice trough type having mounting means adjustable to vary the inclination of the trough.

Another object of the present invention is the provision of a concentrator of the reciprocatory sluice trough type in which the trough has a compound motion such that different points on the trough follow paths of different shape, length and direction.

Still another object of the present invention is the provision of a concentrator as aforesaid in which the paths of movement of various points on the trough may be readily selectively altered.

A still further object of the present invention is the provision of a concentrator of the reciprocatory sluice trough type having a plurality of riffles over which material passes, in which provision is made for varying the flow of material over the riffles.

A major object of the present invention is the provision of a concentrator of the reciprocatory sluice trough type having provision for emptying the trough by dumping. Another aspect of this same object is the provision of means for accurately relocating the trough for a further concentrating operation after dumping. Still another aspect of this object in connection with troughs having plural compartments is the provision of means for maintaining the contents of the compartments segregated during and after dumping. Further aspects of this object include the provision of means for receiving the material dumped from the trough, means for selectively controlling dumping of the trough, and means for cleaning material from the trough to complete dumping of the trough.

Yet another object of the present invention is the provision of a concentrator of the reciprocatory sluice trough type in which the trough is comprised of an endless power-driven conveyor.

The invention also comprises the provision of a concentrator of the endless power-driven conveyor sluice

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trough type in which novel and improved means are provided for dividing the conveyor into a longitudinally disposed series of compartments.

Finally, it is an object of the present invention to provide a concentrator of the reciprocatory sluice trough type which will be relatively easy and inexpensive to manufacture, simple to assemble, disassemble, adjust, clean, maintain, and repair, and rugged and durable in use.

Very broadly, the present invention achieves these objects by providing a concentrator of the reciprocatory sluice trough type, in which the frame carrying the trough and drive motor may be swung vertically about one end to vary the inclination of the trough. A novel trough guiding arrangement is also provided, including a first guideway sharply and adjustably inclined to the length of the trough adjacent to the head of the trough and a second guideway more in line with the length of the trough adjacent the tail of the trough, so that a substantially greater component of lateral movement is imparted to the trough adjacent the head end than adjacent the tail end thereof. This guiding arrangement also imparts substantially greater acceleration and deceleration to portions of the trough adjacent the head end when the trough is in extended positions than to the tail portions of the trough in those extended positions. Moreover, swinging baffles meter the flow of material over the riffles. A very important feature of the invention is that the trough may be swung about an axis parallel to its length to an inverted position to empty it by dumping. In this position, coating baffles assure segregation of the concentrates from the various compartments and individual receptacles receive the concentrates from individual compartments. Spray nozzles individual to at least some of the compartments complete the cleaning of the inverted trough and are operated by a swinging movement of the trough. Limit switch and brake arrangements assure accurate inverting and re-inverting movements of the trough and guide means accurately relocate the trough in operative position. Alternatively, the trough may be an endless conveyor having a series of compartments which dump one by one as they reach the head of the conveyor. In one conveyor embodiment, the compartments are provided by pivotally interconnected pans or trays which discharge into each other while in another conveyor embodiment the endless member is unitary and constructed of flexible material.

Other features and advantages of the present invention will become apparent from a consideration of the following description, taken in connection with the accompanying drawings, in which:

FIGURE 1 is a side elevational view of a concentrator according to the present invention, showing the trough in its operative position and the material feeding means in feeding position;

FIGURE 2 is a plan view of a concentrator according to the present invention, with the sluice trough removed;

FIGURES 3, 4 and 5 are enlarged fragmentary cross-sectional views taken on the lines 3—3, 4—4 and 5—5, respectively, of Figure 2;

FIGURE 6 is a cross-sectional view taken on the line 6—6 of FIGURE 5;

FIGURE 7 is a diagram of the loci of various points on the sluice trough during reciprocatory movement thereof;

FIGURES 8, 9 and 10 are velocity-distance diagrams illustrating various relationships of components of the movements of various points on the sluice trough;

FIGURE 11 is a side elevational view of a sluice trough according to the present invention;

FIGURE 12 is an enlarged fragmentary perspective view of a portion of the sluice trough;

FIGURE 13 is a perspective view of that portion of the structure of the present invention which receives material dumped from the sluice trough;

FIGURE 14 is a fragmentary perspective view showing the relationship of the sluice trough and material-receiving means immediately prior to attaining fully inverted position;

FIGURE 15 is a somewhat diagrammatic illustration of the drive and controls for dumping the trough;

FIGURE 16 is a fragmentary elevational view of an alternative form of sluice trough comprising an endless power-driven conveyor;

FIGURE 17 is an enlarged fragment of the endless member of FIGURE 16; and

FIGURE 18 is a view somewhat similar to FIGURE 17 but showing in perspective a fragment of another embodiment of endless member for use in the environment of FIGURE 16.

Referring now to the drawings in greater detail, the major aspects of the novel concentrator of the present invention will be described under separate headings, as follows:

Adjustable frame

In FIGURE 1, there is shown a concentrator according to the present invention, indicated generally at 1. Concentrator 1 rests on a first base comprising flooring 3 and comprises a second base or frame 5 in the form of an elongated, generally rectangular open framework. Supported generally horizontally on frame 5 is an elongated sluice trough 7 which is longitudinally and laterally oscillatable relative to frame 5.

At its end corresponding to the tail end of sluice trough 7, frame 5 carries a rocker 9 which is supported for rocking movement about a horizontal axis perpendicular to the longitudinal extent of trough 7 in an upwardly open cradle 11 which rests on flooring 3. At its opposite end, that is, the end corresponding to the head end of trough 7, frame 5 carries in unitary assembly an overhanging shelf 13 on which the trough drive is supported. An extensible and retractable screw jack 15 engages beneath shelf 13 and acts between the portion of frame 5 comprised by shelf 13 and flooring 3. A hand wheel 16 enables lengthening and shortening of jack 15 thereby to raise or lower the engaged end of frame 5 and alter the inclination of trough 7 by raising or lowering the head end thereof. It will be appreciated that frame 5 is supported on and between rocker 9 and jack 15, so that upon adjustment of the length of jack 15, frame 5 rocks about rocker 9. In place of a single centrally disposed jack 15, a pair of jacks mounted at the head end on opposite sides of frame 5 and operated in unison by a single handwheel or the like through bevel or other gear drive can be used to advantage, particularly on larger machines.

The drive for trough 7 is mounted on shelf 13 and since trough 7 is supported on frame 5, it will be appreciated that the inclination of trough 7 can thus be altered without in the least affecting the continuity of the drive or requiring any other adjustive steps. It will also be appreciated that different inclinations of trough 7 are desirable in the handling of various materials having particular particle sizes and densities and that in any event trough 7 will be somewhat downwardly inclined from its head end to its tail end to promote movement of material along its length. The optimum inclination for a particular concentration operation will be determined by trial. To this end, a pointer 17 mounted on frame 5 registers with indicia on a fixed scale 18. Once the optimum inclination for a particular feed composition or feed rate has been attained, the scale reading can be noted and the frame quickly set at this reading for subsequent concentration operations of a similar nature. A bubble level 19 is mounted horizontally on and transversely of frame 5 and indicates any undesirable lateral inclination of frame 5.

Trough drive

The trough drive supported on shelf 13 comprises a drive motor 20 which in the illustrated embodiment is electric but could be powered by gasoline or other means. Motor 20 has the usual drive shaft terminating in a drive pulley 21 which is adjustable as to effective driving radius so as to obtain various drive speeds. A drive belt 23 connects pulley 21 with the larger pulley of a gear reduction unit 25 which rotates a rotor 27 about a vertical axis counterclockwise as seen in FIGURE 2. Rotor 27 has a diametral slot 29 across its upper surface in which an eccentric drive pin 31 may be clamped at any selected distance from the axis of rotor 27. A pitman 33 is journaled at one end on drive pin 31 and at its other or trough end on a connector pin 35. Pitman 33 is provided intermediate its length with an adjustable telescopic sleeve assembly 36 for changing the length of pitman 33 thereby to alter the movement of the trough in a manner to be described hereinafter.

A pair of longitudinally spaced crosspieces 37 extend between and interconnect a pair of parallel, longitudinally disposed side channel members 39. Connector pin 35 is secured on a vertical axis beneath the crosspiece 37 which is disposed adjacent the head end of trough 7. Channel members 39 are interconnected at their ends to form an open rectangular frame 41 which is the principal support of trough 7. Frame 41 in turn is supported on frame 5 for longitudinal reciprocatory movement relative thereto by four brackets 43, two of which are secured beneath the ends of each crosspiece 37. Each bracket 43 retains within its lower end a spherical roller 45, the rollers 45 being supported for rolling movement on a pair of longitudinally spaced plates 47 which extend transversely of the top of frame 5, all as shown in FIGURE 3.

Frame 41 thus provides an upwardly open base on the inwardly extending horizontal channels of which trough 7 detachably rests. Reciprocatory motion is imparted to frame 41 and hence to trough 7 by the drive train between and including motor 20 and pitman 33, and the speed and stroke of this drive is variable by adjustment of drive pulley 21 and/or drive pin 31 as described above. The optimum adjustment of drive pin 31 in slot 29 will be found experimentally for each set of operating conditions. The marginal edges of slot 29 are provided with indicia so that drive pin 31 can be quickly reset at its optimum position for subsequent operations of a similar nature.

Shelf 13 need not be disposed in line with frame 5, as shown in FIGURE 2, but may be placed at various angles to the longitudinal extent of frame 5 when viewed from above. For example, a highly desirable arrangement of shelf 13 is such that pitman 33 be disposed roughly parallel to the oblique line of movement of the head end of the trough, as will be described hereinafter.

Material feed

The material to be concentrated is fed to the head end of trough 7 adjacent the drive train by a feed hopper 49 supported on a movable carriage 51. Carriage 51 is comprised of open framework which straddles the drive train in feeding position and is movable away from the concentrator when the material feed is discontinued. For this purpose, carriage 51 is supported on four wheels 53 which roll on a pair of tracks 55 which are parallel to each other and to the longitudinal extent of frame 5 so that the carriage may be rolled into and out of feeding position.

A vibratory feed trough 57 is mounted on carriage 51 below the lower end of hopper 49 to receive material from the hopper and feed it at a controlled rate to the head end of trough 7. Trough 57 is given rapid vibratory feeding movement by an electromagnetic vibratory motor 59 mounted on carriage 51 and controlled as to frequency of vibratory movement from a control box 61

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which is mounted on carriage 51 and which also includes a switch for actuating motor 59.

The material is fed to trough 7 dry and the water to make up the slurry is separately fed to the head end of trough 7 via a water supply conduit 62. Conduit 62 is secured adjacent its discharge end to carriage 51 and has a flexible intermediate portion to enable movement of carriage 51 without disconnecting the water supply.

Separate from conduit 62 is a spray pipe 63 having a portion that extends lengthwise above frame 5. A multiplicity of downwardly opening holes 64 extend through the underside of the horizontal portion of pipe 63 along most of the length of trough 7. Holes 64 are directed toward trough 7; and when water under pressure is supplied to pipe 63, a multiplicity of sprays of water will be directed into trough 7 from above. The purpose and effect of these multiple jets of water is to maintain the slurry in the trough in a state of agitation additional to that imparted to the slurry by trough movement, thereby to prevent packing of the material in the trough and to aid in the uniform movement of the material through the trough.

Trough movement

The drive train described above assures that the movement of trough 7 will be generally longitudinally reciprocatory. The particular paths of movement followed by various points on the trough, however, are determined by a pair of guideways, one disposed adjacent the head end of trough 7 and the other disposed adjacent the tail end of the trough. First guideway 65 is the guideway adjacent the head end of the trough and is comprised of a horizontal plate 67 extending transversely of frame 5. Secured to the upper surface of plate 67 is a pair of parallel channels 69 having upstanding spaced parallel flanges. Channels 69 are disposed at a substantial and adjustable angle to the longitudinal extent of trough 7 in all trough positions, for example, at an angle of 45° to the mean trough position indicated in FIGURE 2. A crosspiece 71 interconnects the undersides of longitudinal channel members 39 of frame 41, and a guide roller 73 is journaled for rotation about a vertical axis beneath crosspiece 71. Thus, upon reciprocatory movement of frame 41 and with it trough 7, roller 73 moves along a diagonal path between channels 69, as best seen by comparison of FIGURES 2 and 4, thereby to impart a substantial lateral component to the reciprocatory movement of trough 7.

Means are also provided for varying the lateral and longitudinal components of the movement of trough 7 adjacent roller 73 by rotation of plate 67 about a vertical axis which is preferably but not necessarily the axis of roller 73 in the mean position of trough 7 thereby to alter the inclination of channels 69 about that axis. For this purpose, plate 67 is provided with a downwardly depending pin 74 journaled for rotation in a crosspiece of frame 5 and is provided adjacent its ends with a pair of concentric arcuate slots 75 in each of which is disposed one of a pair of posts 77 mounted on opposite sides of frame 5. Posts 77 include clamping nuts for clamping the plate 67 in any adjusted rotated position; and when these clamping nuts are released, plate 67 may be rotated in its horizontal plane with posts 77 moving in slots 75. Means are provided for thus moving plate 67, comprising a longitudinally extending adjustment rod 79 which is externally screw-threaded and connected at one end to an end of plate 67. The screw-threaded portion of rod 79 is disposed in an internally screw-threaded bracket 81 secured to frame 5 and the other end of rod 79 carries a crank handle 83. Upon rotation of handle 83, rod 79 turns and moves lengthwise in bracket 81 thereby to rotate plate 67 about a vertical axis which preferably but not necessarily passes through first guideway 65.

The optimum adjustment of plate 67 about its vertical

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axis will be determined by trial for each set of operating conditions. The marginal edges of at least one arcuate slot 75 are provided with indicia with which posts 77 register so that a position of plate 67 found desirable for a particular set of conditions can be quickly duplicated.

Second guideway 85 is disposed adjacent the tail of trough 7 and restrains a point on that trough to rectilinear movement longitudinally of the mean longitudinal extent thereof. As best seen by comparison of FIGURES 2, 5 and 6, guideway 85 comprises an elongated guide plate 87 disposed longitudinally of and supported on frame 5 and having a cover plate 89. Plates 87 and 89 define between them a longitudinally extending T-groove in which is disposed for longitudinal sliding movement the head of a T-member 93 having an upstanding web at the top of which is secured a forwardly extending bracket 95. A ball 97 depends from the forward end of the bracket 95 and is disposed for universal movement in a socket 99 carried at the rear end of a longitudinally extending bracket 101 which is secured at its forward end to the underside of the rear crosspiece 37. In this way, that portion of trough 7 which intersects the vertical axis of ball 97 at all time follows a path parallel to and above T-groove 91.

In general, therefore, it will be appreciated that trough 7 has a lengthwise reciprocatory movement characterized by longitudinal and lateral components and that portions of trough 7 adjacent the head end thereof tend to have a substantially greater component of lateral movement than the portions of the trough adjacent the tail end thereof and that portions of the trough adjacent the tail end thereof tend to have a greater component of longitudinal movement than portions adjacent the head end. It will also be realized that the variation in the magnitude of these lateral and longitudinal components will be progressive from one end of the trough to the other. For a better understanding of the various movements of different portions of the trough and their significance, the paths of movement of various parts of the trough are shown diagrammatically in FIGURE 7 and the correlation of these relationships with the factor of trough velocity is indicated in FIGURES 8, 9 and 10.

In FIGURE 7, the line 103 represents the mean longitudinal center line of the trough and is parallel to T-groove 91. Line 105 represents the locus of the axis of guide roller 73 in channels 69. Line 107 represents the locus of a point on trough 7 intermediate roller 73 and ball 97; while line 109 represents the locus of a point about an equal distance along trough 7 on the opposite side of line 105 or roller 73. Hence, when trough 7 is in its mean position parallel to T-groove 91, these four points along the trough will correspond to the four zero positions along line 103. It will also be noted that on either side of each zero position along each locus is a plurality of sequential numerals of opposite sign on each side of the zero point. Along the right end of line 103 as seen in FIGURE 7, these numerals are evenly spaced apart, which represents movement of ball 97 through equal increments of distance. It will further be noted from FIGURE 7 that the trough is always at an acute angle to the first guideway, and that this angle is always of the same sense, that is, always positive or always negative; and it will also be noted that the trough is alternately at acute angles of opposite sense relative to the second guideway, as represented by the midline of the trough repeatedly crossing line 103 to be disposed alternately at positive and negative acute angles with line 103.

It is of particular importance to observe in connection with FIGURE 7 that it is only along line 103 that these increments remain of constant length. Along lines 105, 107 and 109, the increments progressively increase in length while moving from plus values toward minus values. Thus, in the most noticeable case, that of locus line 109, it will be seen that the increment between points

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6 and 7 is only about half that between points —2 and —3. This means that while a point adjacent the tail of the trough is traversing a certain distance during one portion of the stroke, a portion adjacent the head of the trough may be traversing a distance not much greater; but during another portion of the stroke, a part of the trough adjacent the tail may traverse the same distance but the portion adjacent the head will traverse a distance more than twice that distance. In other words, during the extension stroke, the head of the trough is accelerating relative to the tail of the trough and during the retraction stroke the head of the trough is decelerating relative to the tail of the trough.

The relationship may be better understood by reference to FIGURE 8. Considering that ball 97 in a hypothetical case is caused to move rearwardly at constant velocity, this relationship would be seen in FIGURE 7 as the movement of a point along line 103 from point 7 toward the minus end at the extreme right of FIGURE 7. A point on the opposite end of trough 7 would move along line 109. The movement of the point along line 103 could then be considered to be represented by movement from left to right with constant velocity along the abscissa D of FIGURE 8, and in terms of FIGURE 8 the velocity of the point moving along line 109 would then be represented against the ordinate V by the rising curve of FIGURE 8.

However, in reality, ball 97 never moves at constant velocity since it is in something approaching simple harmonic motion, as represented roughly by the curve of FIGURE 9. Therefore, the motion curve along 109 can be approximated by modifying the curve of FIGURE 9, according to the curve of FIGURE 8, with the result that the curve of FIGURE 10 is obtained. The significance of FIGURE 10 is that it demonstrates that the acceleration and deceleration of the head end of the trough, as represented by the slope of the curve of FIGURE 10, is much greater in extended positions of the trough than in retracted positions of the trough.

From the standpoint of concentrating materials by use of a reciprocating sluice trough, it will be understood that the velocity of any point on the trough is immaterial but that the acceleration or deceleration of that point is all-important. Hence, it will be apparent from FIGURES 9 and 10 that these acceleration-deceleration relationships vary progressively along the length of the trough of the present invention. Stated in another way, the maxima of the velocity-distance curves of points along the trough move progressively to the left from the head of the trough to the tail of the trough, as seen by comparison of FIGURES 9 and 10. It will also be understood that farther toward the tail of the trough beyond ball 97, the maximum of the curve is always to the left of the mid-point of the abscissa, so that the acceleration and deceleration are greater adjacent retracted trough positions than adjacent extended trough positions.

From the standpoint of a concentration operation, the significance of all of this is that adjacent the head of the trough the material tends to be thrown more vigorously over the riffles than adjacent the tail of the trough, so that a gross separation of the heaviest particles of concentrate is rapidly and effectively achieved adjacent the head of the trough, while adjacent the tail of the trough a finer, more gentle and more thorough separation of the fines is achieved. Hence, the double guideway arrangement of the present invention provides a highly desirable means for regulating the velocity of any portion of the trough at any point along its path of movement so as to obtain optimum concentrating effect.

A second advantage resulting from the double guideway arrangement is that the direction of movement of points along the trough varies from head to tail thereof. As seen by a comparison of the inclinations of lines 103, 105, 107 and 109, the lateral component of trough movement decreases from head to tail thereof. In a concen-

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trating operation, this means that the material at the head of the trough is thrown with greater force against the side walls of the trough than at the tail of the trough. This contact with the sides of the trough is in addition to that with the riffles, so that the agitation of the material adjacent the head of the trough is much greater than adjacent the tail of the trough. This increased agitation is desirable near the head of the trough to effect the initial crude separation but would be undesirable adjacent the tail of the trough where it is desired to recover the fines; and hence the double guide arrangement of the present invention insures optimum concentrating characteristics with regard to the turbulence of the material in the trough.

A third and more subtle advantage of the double guide arrangement of the present invention will be appreciated from a consideration of FIGURE 7, in which it will be seen that lines 107 and 109 are not straight but are concave and open toward each other. This means that the portion of the trough on one side of first guideway 65 is imparting a swirling movement to the material while that portion of the trough on the other side of the first guideway is imparting a reversed swirling movement to the material. From the standpoint of a concentration operation, this swirling movement is advantageous in much the same manner as in panning for minerals by hand; and in addition, it will be appreciated that the reversal of the tendencies to impart swirling movement on opposite sides of the first guideway tends in turn to balance the dynamic forces of the material in contact with the trough.

For ease of understanding, FIGURE 7 shows the area swept by the longitudinal center line of trough 7 to be disposed about half on one side of line 103 and half on the other side of line 103. In actual practice, however, this relationship will rarely obtain. For example, it has been found that optimum concentration of most metallic ores is achieved when pitman 33 is lengthened by adjustment of sleeve assembly 36 so that this area is disposed at least primarily below line 103. For certain non-metallics, it has been found best to shorten pitman 33 by adjustment of assembly 36 so that this area lies at least primarily above line 103. Thus, the mean longitudinal outer line of trough 7 will rarely if ever include the mid-points of the loci of all points along the longitudinal center line of trough 7. Of course, as before, the optimum adjustment of the length of pitman 33 will be determined by trial for each particular type of concentration operation.

The shape and direction of the locus of any point on the trough can be varied as desired by rotation of plate 67 and/or by adjustment of drive pin 31, drive pulley 21 and telescopic assembly 36.

Trough structure

Trough 7 comprises an imperforate bottom 111 to which are secured upwardly extending sides 113 which terminate at their upper ends in inwardly extending flanges 115. The trough is closed at its head end between sides 113 and is open at its tail end for the discharge of tailings and water. At its head end, the trough is provided with an open-topped water compartment 117 into which conduit 62 discharges and an open-topped feed compartment 119 into which feed trough 57 discharges. Compartments 117 and 119 are separated from each other by a transverse water partition 121 having holes 123 therethrough at a height to assure the presence of the desired quantity of water in the remainder of the trough.

Along trough 7 toward the tail end thereof the trough is provided with a series of longitudinally spaced apart riffles 125 which upstand from bottom 111 and extend between sides 113 and terminate upwardly a substantial distance below the flanges 115. Thus, riffles 125 divide the through lengthwise into a plurality of compartments

127 in each of which a portion of the concentrates is retained as the remainder of the material passes over the riffles and finally to a tailings disposal conduit (not shown). Mounted for swinging movement above each of a plurality of riffles 125 is a baffle 129. The baffles 129 are mounted on horizontal rods 131 intermediate the heights of the baffles. Rods 131 are journaled at opposite ends for rotation in sides 113 of trough 7, and each rod 131 carries at one end thereof on the outside of trough 7 a crank arm 133. The crank arms are pivotally secured at their ends to a common longitudinally extending operating bar 135 having an operating handle 137 at one end thereof. A vertical guide plate 139 is secured to one of sides 113 and has an arcuate slot 141 therethrough of a radius about equal to the radial distance between a rod 131 and the pivotal connection of the associated crank arm 133 with operating bar 135. A wing nut and bolt assembly 143 extends through bar 135 and slot 141 and is adapted selectively to clamp bar 135 in adjusted positions to plate 139 thereby to fix the swung positions of baffles 129.

Upon manipulation of handle 137, baffles 129 may be swung together about axes defined by their associated rods 131 and will at all times remain in parallelism with each other. In the vertical position of the baffles shown in FIGURE 11 and in full line in FIGURE 12, the baffles contact the tops of riffles 125 for a purpose to be described later. During reciprocation of trough 7, however, it is intended that the baffles will at all times be swung greater or lesser distances away from riffles 125 thereby to provide openings between the baffles and the riffles of selected size. These openings of selected size meter the flow of material over the riffles and hence enable a nice control of the movement of the material over the riffles in operation.

Trough dumping

A very important feature of the present invention is that the trough may be swung to inverted position to empty accumulated concentrates by dumping. For this purpose, a horizontal rock shaft 145 is journaled for rotation on frame 5 and is disposed parallel to the mean longitudinal extent of trough 7 and about on a level therewith. Shaft 145 is disposed a substantial distance laterally of trough 7 and is longitudinally coextensive therewith. At its opposite ends, shaft 145 carries a pair of radially extending parallel dumping arms 147. Arms 147 are channel members both of which open toward the tail of trough 7. A horizontal flange 149 is secured to the closed head end of trough 7 and extends toward the drive train, while a coplanar flange 151 is secured to the tail end of trough 7 and extends toward the head end thereof. Flanges 149 and 151 are spaced apart about the same distance as arms 147 so that flange 149 is receivable within the channel of one arm 147 while flange 151 is receivable in the channel of the other arm 147 when the arms 147 are swung over on the trough side of rock shaft 145. Then, when the arms are swung back, they will carry trough 7 with them, lifting it off frame 41 and swinging it to an inverted position to dump. To prevent trough 7 from sliding radially inwardly along arms 147 when it is swung upwardly and over, plugs 153 are secured within the channels of arms 147 to maintain trough 7 in a desired position during swinging.

Needless to say, spray pipe 63 and its supports are positioned sufficiently far above and/or to the side of trough 7 as not to interfere with swinging movement of the trough.

Guide means are provided for relocating trough 7 accurately on frame 41 when it is returned to operative position after dumping. Thus, as seen in FIGURES 2 and 13, brackets 155 are secured to the edges of frame 41 adjacent rock shaft 145 at each end of the frame and tapered conical locator pins 157 extend upwardly from brackets 155. To the side of at least one bracket 155

is secured a rounded cam guide 159 which curves upwardly away from its associated locator pin 157. Secured to corresponding locations on trough 7 are brackets 161 having holes 163 therethrough which are in registry with and receive locator pins 157 when trough 7 rests in proper position on frame 41. Thus, upon return movement of trough 7, bracket 161 will tend to strike guide 159 and be cammed in proper position such that pins 157 may enter holes 163. Upon movement of brackets 161 down about pins 157, the marginal edges of holes 163 will align the holes and pins by a self-centering cam action.

In order that flanges 149 and 151 may be disposed in the channels of arms 147, it is necessary only to move trough 7 to an extended position before arms 147 are lowered into trough receiving position. Then, upon movement of trough 7 to a somewhat retracted position, flanges 149 and 151 enter into the channels of arms 147. The arms are then swung and the dumping operation performed; and after the trough has been returned to operative position and centered by means of locator pins 157, the trough is returned to an extended position to remove the flanges 149 and 151 from the channels of arms 147. Thereafter, arms 147 are swung back out of the way.

Dumping control

The arms 147 are swung back and forth by a motor 165 mounted on frame 5 having a drive shaft bearing a drive pulley 167 over which is disposed a drive belt 169 also trained about a relatively large driven pulley 171 which operates through a gear reduction unit 173 to drive one of a pair of meshing bevel gears 175 the other of which is splined on rock shaft 145. The control of this drive is illustrated somewhat schematically in FIGURE 15. As there shown, a manually operated control switch 177 has a forward contact 179 and a reverse contact 181 thereby selectively to connect motor 165 for forward or reverse operation with a source of electric power (not shown) through lines 183 and 185. In this circuit is also disposed a time delay self-respecting switch 187 of which the closed position is shown in full line and various open positions in dotted line in FIGURE 15. A collar 189 is secured to shaft 145 and carries a pair of adjustable screws 191 which extend through ears of the collar to contact and open switch 187 in extreme positions of shaft 145 and arms 147 in the manner of a limit switch arrangement. The circuit to motor 165 is completed through lines 193 and through branch lines 195 to a solenoid 197 which sets or releases a spring actuated brake assembly 199.

In operation, to swing arms 147 with trough 7 to a dumping position, forward contact 179 of switch 177 is closed whereupon solenoid 197 is actuated to release brake 199 and motor 165 drives in a forward sense. Rock shaft 145 turns until one of screws 191 contacts switch 187, thereby opening the circuit to motor 165 and solenoid 197. Motor 165 stops and brake 199 sets to hold rock shaft 145 and arms 147 with trough 7 in the proper inverted position. After a short period of time, switch 187 resets itself so that when contact 181 of switch 187 is closed, solenoid 197 is actuated to release brake 199 and motor 165 is driven in the opposite sense to return trough 7 to operative position. The other screw 191 is set so that when trough 7 reaches its operative position again, this other screw will contact switch 187 to open the switch and deactivate motor 165 and solenoid 197 and set brake 199. Again, after a short period of time, switch 187 resets itself and is ready for the next cycle of operation.

Concentration reception

The concentrates dumped from the inverted trough fall into receptacle means 201, which includes a plurality of separable receptacles 203 resting on a base 205 which is separate from frame 5. Each receptacle 203 is rectangular and open at its top and a plurality of the recep-

tacles may be aligned in side-by-side relationship as seen in FIGURES 13 and 14. Each receptacle 203 has a relatively high outer side wall 207 on the side opposite frame 5 and a relatively low inner side wall 209 on the side of receptacle 203 adjacent frame 5. Inner side walls 209 terminate upwardly each in an overflow lip 211 which overlies the edge of a common open-topped discharge trough 213 which provides a discharge conduit through which overflow from receptacles 203 may be removed lengthwise of the concentrator. A deflector 215 extends substantially full length of trough 7 and overhangs the other side of discharge trough 213 and is inclined downwardly from its side adjacent the reciprocating mechanism toward the receptacle means 201. Deflector 215 is for the purpose of catching material which falls from trough 7 during trough swinging movement before the trough has reached its final inverted position. Accordingly, it will be obvious that it may be desirable to recycle the material which is received in discharge trough 213, although ordinarily this material will simply consist of the water which initially decants from compartments 127 of trough 7. To prevent escape of water from the ends of deflector 215, this deflector has raised end flanges 217. Similarly, an elongated discharge trough 219 is disposed on the side of deflector 215 opposite discharge trough 213 for the collection of water which initially decants from compartments 127; and this water ordinarily need not be recycled.

As was indicated above, the swinging baffles 129 of trough 7 perform a function in addition to metering the flow of material over riffles 125 during reciprocation of the trough 7. This additional function is that when the baffles 129 are in the upright position shown in FIGURES 11 and 14, they contact the upper edges of riffles 125 and form in effect elongations or extensions of those riffles. Thus, baffles 129 in this position, to which the baffles will be moved just prior to dumping, provide means for segregating the material which is discharged from compartments 127 so that the material from each compartment falls directly below its compartment when the trough is inverted and does not fall to one side and mingle with material from other compartments.

Therefore, the receptacles 203 are formed of about the same width as compartments 127, so that each of a plurality of receptacles 203 is individual to a superposed compartment 127 in the dumping position of trough 7; and baffles 129 in their fully upright position aid in maintaining this segregation of the concentrates from various compartments. Segregation of the concentrates in this way is quite helpful as it provides a rough separation of the concentrates according to particle size. As was indicated above, the heaviest particles of concentrate tend to collect at the head of the trough while the fines tend to collect toward the tail of the trough; and with the arrangement just described, the contents of the various receptacles 203 will be fairly well graded as to particle size. It will also be observed from FIGURES 2 and 11 that the baffles 129 are not provided for the riffles 125 adjacent the tail of the trough nor are individual receptacles 203 provided for the compartments 127 adjacent the tail of the trough. This is because the principal gradation of particle size occurs in the first several compartments 127 of the trough, the tail end of the trough being merely for the purpose of assuring that the last fines are recovered. Therefore, the compartments adjacent the tail of the trough will contain little but fines of about the same range of particle size.

The segregating effect of the baffles 129 in the inverted trough position is augmented by a detachable baffle assembly 221 comprising a series of parallel baffles 223 each formed from a sheet of metal bent double so as to provide a pair of oppositely outwardly flaring lower edges 224 which fit over and hold together in close relationship each of a plurality of pairs of contiguous side walls of adjacent receptacles 203, as seen in FIGURE 14. The

baffles 223 are maintained in assembled relationship and in proper orientation relative to each other and to the line of receptacles 203 by a plurality of tie rods 225 extending therethrough. Thus, baffle assembly 221 may be positioned as seen in 14 in a single operation on top of the loose line of receptacles 203; and in that position, the upper edges of baffles 223 and the outermost edges of baffles 129 will be contiguous when trough 7 is in the inverted position which is being approached in FIGURE 14. Thus, baffles 129 and 223 coact to provide a series of virtually completely separate compartments in each of which the concentrates from a particular compartment 127 are transferred by gravity to a particular receptacle 203.

Spray cleaning

The discharge of concentrates from the compartments of trough 7 would not be complete if gravity were relied on alone; and hence, means are provided for spray cleaning these compartments. Accordingly, a spray water manifold 227 extends lengthwise above the receptacle means 201, and a number of risers 229 extend upwardly from manifold 227 and terminate at their upper ends in upwardly directed spray nozzles 231. Manifold 227 is spaced above receptacle means 201, so that when baffle assembly 221 is removed, the individual receptacles 203 may simply be lifted from base 205 beneath manifold 227 and may be emplaced and removed without interference with the manifold. To accommodate baffle assembly 221 in connection with manifold 227, each baffle 223 is provided with a downwardly opening notch 233 in the upper end of which the manifold 227 is receivable. In this position, the inner ends of notches 233 resting on manifold 227 and/or tie rods 225 resting on the upper side edges of receptacles 203 support baffle assembly 221 in its operative position.

Spray water for manifold 227 is supplied through a water supply line 235, as seen in FIGURE 2. A valve 237 is disposed in this line and is actuated by a crank arm 239 on rock shaft 145 to open or close valve 237 upon swinging movement of trough 7. Specifically, valve 237 and crank arm 239 coact so that as trough 7 reaches its inverted position crank arm 239 opens valve 237 to permit flow of spray water through line 235 and into manifold 227 and up risers 229 and out nozzles 231; while at about the time arms 147 begin their return movement, crank arm 239 closes valve 237 to discontinue the flow of spray water.

Each of a plurality of risers 229 is individual to each of a plurality of compartments 127 of trough 7. Thus, each adjacent pair of baffles 223 of baffle assembly 221 receives between them a single riser 229, so that each of the relatively closed compartments defined by the contiguous relationship of the outermost edges of baffles 129 and the uppermost edges of baffles 223 has a spray nozzle which will assure that spray water is sprayed up against the bottom of the corresponding compartment 127 of trough 7 so that substantially all of the concentrate in that compartment is washed down into the corresponding receptacle 203. As also seen in FIGURE 2, the plurality of risers 229 extends down to the tail end of receptacle means 201 beyond baffle assembly 221 to remove fines from the tail end of trough 7 with no attempt to maintain these fines segregated in receptacle means 201 as to the trough compartment of origin.

The operation of the concentrator according to the present invention as thus far described is quite simple. With the drive pulley 21, drive pin 31 and plate 67 properly adjusted and with baffles 129 in an open adjustable position relative to riffles 125, carriage 51 is moved over tracks 55 to the feed position shown in FIGURE 1 and vibratory motor 59 is actuated to commence the feed of material. The flow of water through conduit 62 is initiated and motor 20 is turned on to begin reciprocatory motion of trough 7. When the quantity of concentrates in the trough has reached a desired amount, the material

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and water feed is discontinued and the carriage 51 is rolled back from its feed position. The reciprocatory movement of trough 7 is continued until the last tailings and water to leave the trough have passed from the tail end thereof and then trough movement is discontinued. Baffles 129 are swung to the upright position in which their lower edges contact the upper edges of riffles 125. The trough is engaged with arms 147 as described above and contact 179 of switch 177 closed, whereupon the trough swings to inverted position and automatically stops and holds that position. At this point, the spray water is automatically actuated and spray cleaning continues until the operator is satisfied that the compartments of trough 7 are clean. Contact 181 of switch 177 is then closed and the trough 7 is automatically returned to operative position on frame 41 and automatically correctly located in that position whereupon the movement of arms 147 drops. Carriage 51 may then be rolled back to feed position and baffles 129 again swung open, whereupon a further cycle of operation may be commenced.

Endless conveyor

As seen in FIGURE 16, trough 7 may be replaced by an alternative form of sluice trough comprising an endless power-driven conveyor indicated generally at 241 and comprising an open framework 243 which rests at its lower end on an open rectangular horizontal frame 245 of about the same size and shape as trough 7 and which is adapted to rest on open frame 41 in the same manner as and instead of trough 7. Framework 243 supports conveyor guideways about which is trained an endless conveyor member 247 comprised of a plurality of pivotally interconnected open-topped pans or trays 249. The head end of conveyor member 247, which is the end at the left of FIGURE 16, is trained about the head wheel assembly 251 which is driven to circulate conveyor member 247 by a speed change device or variable speed mechanism 253 which in turn is driven by electric gear unit motor 255. In this way, any of a plurality of linear velocities may be imparted to conveyor member 247, as desired.

Conveyor 241 thus provides a sluice trough having a plurality of longitudinally spaced outstanding riffles extending from side-to-side thereof and enjoys the same lengthwise reciprocatory movement with lateral components as does trough 7 of the preceding embodiment. Thus, it is intended that in connection with the embodiment of FIGURE 16, the carriage 51 also be used so as to feed material from hopper 49' or other feed device such as an endless belt or vibratory feeder. Contrary to the practice in connection with the preceding embodiment, the feed point is about midway between the ends of the conveyor member. As before, water to make up the slurry is fed to the head end of the upper run of the conveyor member by a water supply conduit 62'; and a longitudinally extending spray pipe 63' directs agitating jets of water onto the material in the conveyor trough through a multiplicity of holes 64'. However, conveyor 241 does not empty by inverting to dump. Instead, the progression of the upper run of the conveyor to the left as seen in FIGURE 16 and counterclockwise about head wheel assembly 251 assures that the compartments between the riffles of the conveyor will successively dump by gravity to an open-topped receptacle 257, so that the production of a uniform concentrate of any desired characteristics is continuous rather than intermittent. To clean the receptacles as they successively dump, receptacle 257 carries thereon a bracket 259 in which is mounted a water supply conduit 261 which feeds water under pressure to at least one spray nozzle 263 directed toward the conveyor. It should be noted that the spray strikes the conveyor at that portion of the conveyor which is just entering the lower or return run thereof. The concentrates and spray water falling from the head end of the conveyor are caught in receptacle 257 where the concen-

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trates remain for the most part in a state of more or less turbulence induced by the fall of the spray water and concentrates, the excess water in receptacle 257 being discharged by decanting so as to leave at least the heaviest portions of the concentrates in that receptacle.

In order to assure that the water removed by decanting has been freed of fines, receptacle 257 is provided with a vertical baffle 265 over which excess water passes to an overflow conduit 267 which feeds to a sluice trough 269 having a plurality of longitudinally spaced laterally extending riffles upstanding from the bottom thereof. In this latter sluice trough, the last of the fines are separated from the water. Trough 269 is adjustably inclined downwardly from its head end to its tail end to promote movement of material in this direction. Meanwhile, at the tail end of conveyor 241, the water and tailings from the initial separation are continuously falling into a tailings discharge trough 273 and being carried away to the right of FIGURE 16.

Although conveyor 241 has the same reciprocatory movement as trough 7, since it rests on the same frame 41, it is important to note that receptacle 257 and sluice trough 269 are fixed relative to conveyor 241 and may for example be mounted on frame 5. The significance of this feature is that the agitation induced by movement of conveyor 241 aids in an initial rough separation of concentrates from gangue, while the fixed mounting of receptacle 257 and trough 269 assures that the maximum quantity of fines will be recovered. Also, the positioning of trough 269 directly beneath conveyor member 247 assures that the last quantity of wash water and any concentrates therein will proceed to the secondary separation operation being conducted in trough 269 and will be recovered regardless of whether all the wash water is caught in receptacle 257. In any event, sluice trough 269 is readily removable from the assembly for emptying and cleaning.

The structure of endless member 247 is also of importance and two highly desirable embodiments of this structure are separately illustrated in enlarged fragmentary views in FIGURES 17 and 18. In FIGURE 17, the trays 249 are seen to have an imperforate bottom 275 which is integral with opposite upstanding side walls 277 which terminate upwardly in inturned flanges 279. Bottom 275 terminates forwardly in a leading end wall 281 of substantially less height than side walls 277, which has at its upper edge a downwardly rearwardly inclined lip 283 connected with end wall 281 by an integral curved portion. At its rear end, bottom 275 is integral with a trailing end wall 285 which is also of substantially less height than side wall 277 but is of a height greater than the height of leading end wall 281 by an amount equal to about the thickness of the sheet metal material of trays 249. Trailing end wall 285 has a horizontal rearwardly extending portion 287 which terminates rearwardly in a downwardly rearwardly inclined lip 289 adapted to overlie and contact over a substantial area the underlying lip 283 of the next tray 249 to the rear. Integral with horizontal portion 287 and inclined lip 289 at each side thereof are upstanding flanges 291 which terminate upwardly a substantial distance below inturned flanges 279 and are inclined inwardly toward each other by an amount about equal to the thickness of the sheet metal material of trays 249, so that the forward ends of side walls 271 overlie a major portion of upstanding flanges 291 in closely contiguous relationship. Trays 249 are formed of sheet metal cut and bent up to shape, and the lower corners thus provided, which are shown open in FIGURE 17, are filled with solder to provide a watertight construction.

Secured to the underside of the leading end of bottom 275 is a forwardly extending hinge bracket 293 which interfingers with a corresponding rearwardly extending hinge bracket 295 secured to the underside of the rear

end of bottom 275 of the next adjacent tray 249. A hinge pin 297 passes through the eyes of brackets 293 and 295 to provide a pivotal interconnection between adjacent trays 249. Thus, in assembled relationship, the trays 249 along the upper or concentrating runs of conveyor 241 will have the relationship illustrated in FIGURE 17, with the bottoms 275 thereof coplanar and the remainder of the trays otherwise aligned. The upper portions of side walls 277 and flanges 279 of adjacent trays will abut endwise and the structure 281, 283, 285, 287 and 289 will provide riffles having downwardly rearwardly inclined trailing projections which permit flow of material rearwardly over these riffles but which discourage flow of material in the reverse direction over the riffles. At the same time, free movement over the head end of the conveyor frame to discharge and up over the tail end of the frame to return to the concentrating run is facilitated. Moreover, the contact of lips 283 and 289 over substantial areas and the contiguity of upstanding flanges 291 and side walls 277 over substantial areas assures that the sluice trough provided by the straight upper run of conveyor member 247 will not leak.

In FIGURE 18 there is shown another embodiment of an endless sluice trough, in which an endless conveyor member 299 is molded integrally of neoprene, natural rubber or the like and may if desired be provided with cord reinforcing (not shown). In any event, all portions of conveyor member 299 are elastic deformable and waterproof. This embodiment comprises an endless sleeve or band having a substantially flat bottom 301 from opposite sides of which upstand side walls 303 running full length about the conveyor member. Upstanding from bottom 301 and extending transversely from side wall to side wall is a plurality of longitudinally spaced riffles 305 which are integral both with bottom 301 and with side walls 303. Between each pair of adjacent riffles 305 is a plurality of longitudinally spaced slots 307 which extend through each of side walls 303 and are of a depth more than half the height of side walls 303 and open through the outer or upper edges of side walls 303. A plurality of bellows 309, one individual to each slot 307, is disposed on the inner of confronting sides of slots 307, and each of them is secured to its side wall 303 about the margins of the corresponding slot 307. It should be noted that there is considerable slack in each of the bellows 309 when bottom 301 is straight as seen in FIGURE 18, so that each slot 307 may be spread a considerable distance before the bellows 309 are straightened. Bellows 309 may be of the same material as conveyor member 299 and may for example be vulcanized or riveted thereto. In either event, slots 307 may be as deep as possible consistent with the riveting or vulcanizing operation.

In use, the conveyor member 299 of FIGURE 18 can simply replace that of the FIGURE 17; and if desired, head wheel assembly 251 may include the usual smooth cylindrical drum for endless belt conveyors (not shown). In the straight upper or concentrating run, the side walls 303 and bellows 309 coact with imperforate water-tight bottom 301 to provide a water-tight sluice trough having riffles 305 therealong; and the oscillatory movement discussed in connection with sluice trough 7 provides the concentrating movement. As the endless member 299 moves over the head wheel assembly, it dumps and is cleaned essentially as in the preceding endless conveyor embodiment. The slots 307 in side walls 303 enable these side walls to remain perpendicular to bottom 301 even while passing about the head and tail of the conveyor frame and bellows 309 keep the slots closed even in their stretched positions, so that the spray water from nozzle 263 at no time washes material off the sides of the conveyor to the extent that it misses receptacle 257.

From a consideration of all of the foregoing disclosure, it will be obvious that each of the initially recited objects of the present invention has been achieved.

Although the present invention has been described and illustrated in connection with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit of the invention, as those skilled in this art will readily understand. Such modifications and variations are considered to be within the purview and scope of the present invention as defined by the appended claims.

What is claimed is:

1. A concentrator comprising a base, an elongated sluice trough having a feed end and a discharge end, means supporting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, means supported on the base defining a guideway, means mounting the last named means on the base for rotation relative to the base about a vertical axis passing through the guideway, means for adjustably rotating the guideway-defining means about said axis, and guide follower means mounted for movement with the sluice trough adjacent the feed end thereof and guidedly disposed in the guideway.

2. A concentrator as claimed in claim 1, the guideway being disposed at an acute angle to the lengthwise extent of the sluice trough in all adjusted positions of the guideway-defining means.

3. A concentrator comprising a base, an elongated sluice trough having a feed end and a discharge end, means supporting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, means supported on the base defining a first guideway, the first guideway being elongated diagonally to the length of the trough, first guide follower means mounted for movement with the sluice trough adjacent the feed end thereof and guidedly disposed in the first guideway, means supported on the base defining a second guideway, the second guideway being elongated generally parallel to the length of the trough, second guide follower means mounted for movement with the length of the sluice trough adjacent the discharge end thereof and guidedly disposed in the second guideway, the first and second guideways being disposed at an acute angle to each other with the first guideway extending on either side of a prolongation of the second guideway.

4. A concentrator comprising a base, an elongated sluice trough having a feed end and a discharge end, means supporting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, means supported on the base defining a first guideway, first guide follower means mounted for movement with the sluice trough adjacent the feed end thereof and guidedly disposed in the first guideway, means supported on the base defining a second guideway, second guide follower means mounted for movement with the sluice trough adjacent the discharge end thereof and guidedly disposed in the second guideway, means mounting the first guideway-defining means on the base for rotation relative to the base about a vertical axis passing through the first guideway, and means for adjustably rotating the first guideway-defining means about said axis.

5. A concentrator as claimed in claim 4, the first guideway being disposed at an acute angle to the lengthwise extent of the sluice trough in all adjusted positions of the first guideway-defining means.

6. A concentrator comprising a base, an elongated sluice trough having a feed end and a discharge end, means supporting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, means supported on the base defining a first guideway, first guide follower means mounted for movement with the sluice trough adjacent the feed end thereof and guidedly disposed in the first guideway, means supported on the base defining a second guideway, second guide follower means mounted for movement with the sluice trough adjacent the discharge end thereof and

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guidedly disposed in the second guideway, the first and second guideways being elongated and having their greatest lengths angularly related to each other in such manner that upon lengthwise reciprocatory movement of the sluice trough the lengthwise extent of the sluice trough will at all times be disposed at acute angles of the same sense relative to the first guideway and alternately at acute angles of opposite sense relative to the second guideway.

7. A concentrator as claimed in claim 1, and means mounting the first guideway-defining means on the base for rotation relative to the base about a vertical axis passing through the first guideway, and means for adjustably rotating the guideway-defining means about said axis.

8. A concentrator as claimed in claim 2, the first guideway being disposed at an acute angle to the lengthwise extent of the sluice trough in all adjusted positions of the first guideway-defining means.

9. A concentrator comprising a base, an elongated sluice trough, means mounting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, a plurality of upstanding riffles disposed transversely of and spaced longitudinally along the trough and dividing the trough into a plurality of compartments, baffle means mounted above a plurality of the riffles, means for selectively moving the baffle means toward and away from the riffles to control the flow of material from compartment to compartment over the riffles, and means for releasably fixing the baffle means in any of a plurality of adjusted positions spaced different distances from the riffles.

10. A concentrator comprising a base, an elongated sluice trough, means mounting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, a plurality of upstanding riffles disposed transversely of and spaced longitudinally along the trough and dividing the trough into a plurality of compartments, a plurality of baffles disposed one above each of a plurality of the riffles, means for selectively moving the baffles toward and away from the riffles to control the flow of material from compartment to compartment over the riffles, and means for releasably fixing the baffles in any of a plurality of adjusted positions spaced different distances from the riffles.

11. A concentrator as claimed in claim 10, the means for selectively moving the baffles including means interconnecting the baffles for simultaneous movement of the baffles toward and away from the riffles.

12. A concentrator comprising a base, a flat elongated sluice trough, means mounting the trough on the base for lengthwise reciprocatory movement of the trough relative to the base in the plane of the trough, a plurality of upstanding riffles disposed transversely of and spaced longitudinally along the trough and dividing the trough into a plurality of compartments, a plurality of baffles disposed one above each of a plurality of the riffles, means mounting each baffle for swinging movement of a portion of the baffle about an axis disposed transversely of the trough and lying in a plane parallel to the plane of the trough, means for selectively swinging said portion of each baffle about its said axis toward and away from its associated riffle to control the flow of material from compartment to compartment over the riffles, and means for releasably fixing said portion of each baffle in any of a plurality of adjusted positions spaced different distances from the riffles.

13. A concentrator as claimed in claim 12, the axes of the baffles lying in a common plane.

14. A concentrator as claimed in claim 13, the means for selectively swinging the baffle portions including means interconnecting the baffles for simultaneous swinging movement of the baffle portions toward and away from the riffles.

15. A concentrator comprising a base, an elongated

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sluice trough, means supporting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, a plurality of upstanding riffles disposed transversely of and spaced longitudinally along the trough and dividing the trough into a plurality of compartments, baffle means mounted above a plurality of the riffles, means for swinging the sluice trough relative to the base about an axis extending generally parallel to the length of the sluice trough to invert and dump the sluice trough, and means for selectively moving the baffle means toward and away from the riffles to control the flow of material from compartment to compartment over the riffles when the trough is in its base supported position and for selectively moving the baffle means toward and into contiguity with the riffles to extend the riffles to segregate material dumped from the compartments when the trough is in its inverted position.

16. A concentrator comprising a base, an elongated sluice trough, means supporting the trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, a plurality of upstanding riffles disposed transversely of and spaced longitudinally along the trough and dividing the trough into a plurality of compartments, a plurality of baffles disposed one above each of a plurality of the riffles, means for swinging the sluice trough relative to the base about an axis extending generally parallel to the length of the sluice trough to invert and dump the sluice trough, and means for selectively moving the baffles toward and away from the riffles to control the flow of material from compartment to compartment over the riffles when the trough is in its base supported position and for selectively moving the baffles toward and into contiguity with the riffles to extend the riffles to segregate material dumped from the compartments when the trough is in its inverted position.

17. A concentrator as claimed in claim 16, the means for selectively moving the baffles including means interconnecting the baffles for simultaneous movement of the baffles toward and away from the riffles.

18. A concentrator comprising a base, a flat elongated sluice trough, means mounting the trough on the base for lengthwise reciprocatory movement of the trough relative to the base in the plane of the trough, a plurality of upstanding riffles disposed transversely of and spaced longitudinally along the trough and dividing the trough into a plurality of compartments, a plurality of baffles disposed one above each of a plurality of the riffles, means mounting each baffle for swinging movement of a portion of the baffles about an axis disposed transversely of the trough and lying in a plane parallel to the plane of the trough, means for swinging the trough relative to the base about an axis extending generally parallel to the length of the trough to invert and dump the trough, and means for selectively swinging said portion of each baffle about its said axis toward and away from its associated riffle to control the flow of material from compartment to compartment over the riffles when the trough is in its base supported position and for selectively swinging said portion of each baffle about its said axis toward and into contiguity with its associated riffle to extend the riffles to segregate material dumped from the compartments when the trough is in its inverted position.

19. A concentrator as claimed in claim 18, the axes of the baffles lying in a common plane.

20. A concentrator as claimed in claim 19, the means for selectively swinging the baffle portions including means interconnecting the baffles for simultaneous swinging movement of the baffle portions toward and away from the riffles.

21. A concentrator comprising a base, an elongated sluice trough, means mounting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, means for swinging the sluice trough through more than 90° relative to the base

about an axis extending generally parallel to the length of the sluice trough to invert and dump the sluice trough, receptacle means disposed below the trough in the inverted position of the trough to receive material discharged from the inverted trough, and a deflector extending generally parallel to the length of the trough and inclined downwardly from adjacent the base-supported position of the trough toward the receptacle means to direct toward the receptacle means material falling from the trough during the first portion of the trough swinging movement.

22. A concentrator as claimed in claim 21, the receptacle means having overflow means discharging into open-topped discharge conduit means disposed between the receptacle means and the downwardly inclined deflector.

23. A concentrator comprising a base, an elongated sluice trough, means supporting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, a plurality of upstanding riffles disposed transversely of and spaced longitudinally along the trough and dividing the trough into a plurality of compartments, means for swinging the sluice trough through more than 90° relative to the base about an axis extending generally parallel to the length of the sluice trough to invert and dump the sluice trough, and open-topped receptacle means disposed below the trough in the inverted trough position and adapted to receive and segregate material discharged from the trough according to the trough compartment of origin.

24. A concentrator as claimed in claim 23, the receptacle means comprising a plurality of separable receptacles.

25. A concentrator as claimed in claim 24, each receptacle having overflow means discharging into open-topped discharge conduit means common to a plurality of the receptacles.

26. A concentrator as claimed in claim 25, the discharge conduit means being disposed between the receptacles and the base-supported portion of the trough, and a deflector extending generally parallel to the length of the trough and inclined downwardly from adjacent the base-supported position of the trough to the discharge conduit means to direct to the discharge conduit means material falling from the trough during the first portion of the trough swinging movement.

27. A concentrator comprising a first base, a second base supported by the first base, an elongated sluice trough, means supporting the sluice trough on the second base for lengthwise reciprocatory movement of the sluice trough relative to the second base, an extensible and retractable member acting between the first base and the second base to change the inclination of the second base relative to the first base thereby to change the inclination of the trough relative to the first base, the sluice trough having a feed end and a discharge end, means supported on the second base defining a guideway, means mounting the last-named means on the second base for rotation relative to the second base about a vertical axis passing through the guideway, means for adjustably rotating the guideway defining means about said axis, and guide follower means mounted for movement with the sluice trough adjacent the feed end thereof and guidedly disposed in the guideway.

28. A concentrator comprising a first base, a second base supported by the first base, an elongated sluice trough, means supporting the sluice trough on the second base for lengthwise reciprocatory movement of the sluice trough relative to the second base, an extensible and retractable member acting between the first base and the second base to change the inclination of the second base relative to the first base thereby to change the inclination of the trough relative to the first base, a plurality of upstanding riffles disposed transversely of and spaced longitudinally along the trough and dividing the trough into a

plurality of compartments, baffle means mounted above a plurality of the riffles, means for selectively moving the baffle means toward and away from the riffles to control the flow of material from compartment to compartment over the riffles, and means for releasably fixing the baffle means in any of a plurality of adjusted positions spaced different distances from the riffles.

29. A concentrator comprising a base, an elongated sluice trough having a feed end and a discharge end, means supporting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, means supporting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, means mounting the last-named means on the base for rotation relative to the base about a vertical axis passing through the guideway, means for adjustably rotating the guideway-defining means about said axis, guide follower means mounted for movement with the sluice trough adjacent the feed end thereof and guidedly disposed in the guideway, a plurality of upstanding riffles disposed transversely of and spaced longitudinally along the trough and dividing the trough into a plurality of compartments, baffle means mounted above a plurality of the riffles, and means for selectively moving the baffle means toward and away from the riffles to control the flow of material from compartment to compartment over the riffles.

30. A concentrator comprising a base, an elongated sluice trough having a feed end and a discharge end, means supporting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, first guide means for confining movement of a point on the trough adjacent the feed end to reciprocatory movement along a first line, and second guide means for confining movement of a point on the trough adjacent the discharge end to reciprocatory movement along a second line, the first line being inclined from the lengthwise extent of the trough at a greater angle than the second line.

31. A concentrator as claimed in claim 30, said first line extending on either side of a prolongation of said second line.

32. A concentrator as claimed in claim 30, and means mounting said first guide means for rotation relative to the base about a vertical axis passing through the first guide means, and means for adjustably rotating the first guide means about said axis.

33. A concentrator comprising a base, an elongated sluice trough having a feed end and a discharge end, means supporting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, a first pair of parallel guiding elements fixed relative to one of the trough and base and a first guided element fixed relative to the other of the trough and base and confined between the first guiding elements for movement along a first line parallel to the first guiding elements adjacent the feed end of the trough, a second pair of parallel guiding elements fixed relative to one of the trough and base and a second guided element fixed relative to the other of the trough and base and confined between the second guiding elements for movement along a second line parallel to the second guiding elements adjacent the discharge end of the trough, the first line being inclined from the lengthwise extent of the trough at a greater angle than the second line.

34. A concentrator as claimed in claim 33, said first line extending on either side of a prolongation of said second line.

35. A concentrator comprising a base, an elongated sluice trough, means mounting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, a plurality of upstanding riffles disposed transversely of and spaced longitudinally along the trough and dividing the trough into a plurality of compartments, baffle means mounted above a plurality of the riffles, means for selectively moving the baffle means

toward and away from the riffles to control the flow of material from compartment to compartment over the riffles, and means for releasably fixing the baffle means in any of a plurality of adjusted positions in one of which the baffle means are spaced from the riffles and in another of which the baffle means are in contact with the riffles.

36. A concentrator comprising a base, an elongated sluice trough, means mounting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, a plurality of upstanding riffles disposed transversely of and spaced longitudinally along the trough and dividing the trough into a plurality of compartments, a plurality of baffles disposed one above each of a plurality of the riffles, means for selectively moving the baffles toward and away from the riffles to control the flow of material from compartment to compartment over the riffles, and means for releasably fixing the baffles in any of a plurality of adjusted positions in one of which the baffles are spaced from the riffles and in another of which the baffles are in contact with the riffles.

37. A concentrator as claimed in claim 36, the means for selectively moving the baffles including means interconnecting the baffles for simultaneous movement of the baffles toward and away from the riffles.

38. A concentrator comprising a base, a flat elongated sluice trough, means mounting the trough on the base for lengthwise reciprocatory movement of the trough relative to the base in the plane of the trough, a plurality of upstanding riffles disposed transversely of and spaced longitudinally along the trough and dividing the trough into a plurality of compartments, a plurality of baffles disposed one above each of a plurality of the riffles, means mounting each baffle for swinging movement of a portion of the baffle about an axis disposed transversely of the trough and lying in a plane parallel to the plane of the trough, means for selectively swinging said portion of each baffle about its said axis toward and away from its associated riffle to control the flow of material from compartment to compartment over the riffles, and means for releasably fixing said portion of each baffle in any of a plurality of adjusted positions in one of which said portion of each baffle is spaced from its associated riffle and in another of which said portion of each baffle is in contact with its associated riffle.

39. A concentrator as claimed in claim 38, the axes of the baffles lying in a common plane.

40. A concentrator as claimed in claim 39, the means for selectively swinging the baffle portions including means interconnecting the baffles for simultaneous swinging movement of the baffle portions toward and away from the riffles.

41. A concentrator comprising a first base, a second base supported by the first base, an elongated sluice trough, means supporting the sluice trough on the second base for lengthwise reciprocatory movement of the sluice trough relative to the second base, an extensible and retractable member acting between the first base and the second base to change the inclination of the second base relative to the first base thereby to change the inclination of the trough relative to the first base, a plurality of upstanding riffles disposed transversely of and spaced longitudinally along the trough and dividing the trough into a plurality of compartments, baffle means mounted above a plurality of the riffles, means for selectively moving the baffle means toward and away from the riffles to control the flow of material from compartment to compartment over the riffles, and means for releasably fixing the baffle means in any of a plurality of adjusted positions in one of which the baffle means are spaced from the riffles and in another of which the baffle means are in contact with the riffles.

42. A concentrator comprising a base, an elongated sluice trough having a feed end and a discharge end, means supporting the sluice trough on the base for length-

wise reciprocatory movement of the sluice trough relative to the base, first guide means for confining movement of a point on the trough adjacent the feed end to oscillatory movement along a first path elongated diagonally to the length of the trough, and second guide means for confining movement of a point on the trough adjacent the discharge end to oscillatory movement along a second path elongated generally parallel to the length of the trough, the lengths of the first and second paths being disposed at an acute angle to each other with the length of the first path extending on either side of a prolongation of the length of the second path.

43. A concentrator as claimed in claim 42, and means mounting said first guide means for rotation relative to the base about a vertical axis passing through the first guide means, and means for adjustably rotating the first guide means about said axis.

44. A concentrator comprising a base, an elongated sluice trough, means mounting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, a plurality of upstanding riffles disposed transversely of and spaced longitudinally along the trough and dividing the trough into a plurality of compartments, means for swinging the trough more than 90° relative to the base about an axis generally parallel to the length of the trough to invert and dump the trough, means for directing water upwardly against the interior of each of a plurality of the compartments of the trough in inverted position, and means for separately collecting the material falling from each of a plurality of the compartments of the trough in inverted position.

45. A concentrator as claimed in claim 44, the means for separately collecting the material comprising a plurality of open-topped receptacles separable from each other and disposed beneath the trough when the trough is inverted, each of a plurality of the receptacles being individual to each of a plurality of the compartments of the trough.

46. A concentrator comprising a base, an elongated sluice trough, means mounting the sluice trough on the base for lengthwise reciprocatory movement of the sluice trough relative to the base, a plurality of upstanding riffles disposed transversely of and spaced longitudinally along the trough and dividing the trough into a plurality of compartments, means for swinging the trough more than 90° relative to the base about an axis extending generally parallel to the length of the trough to invert and dump the trough, a plurality of nozzles each directed upwardly toward the interior of a trough compartment when the trough is inverted, means for supplying water under pressure to each of the nozzles, and a separate receptacle disposed beneath each nozzle to collect separately the material falling from each of a plurality of the trough compartments.

47. A concentrator as claimed in claim 46, and detachable baffle means disposed between each pair of adjacent nozzles to segregate the material falling into the various receptacles.

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