

June 17, 1941.

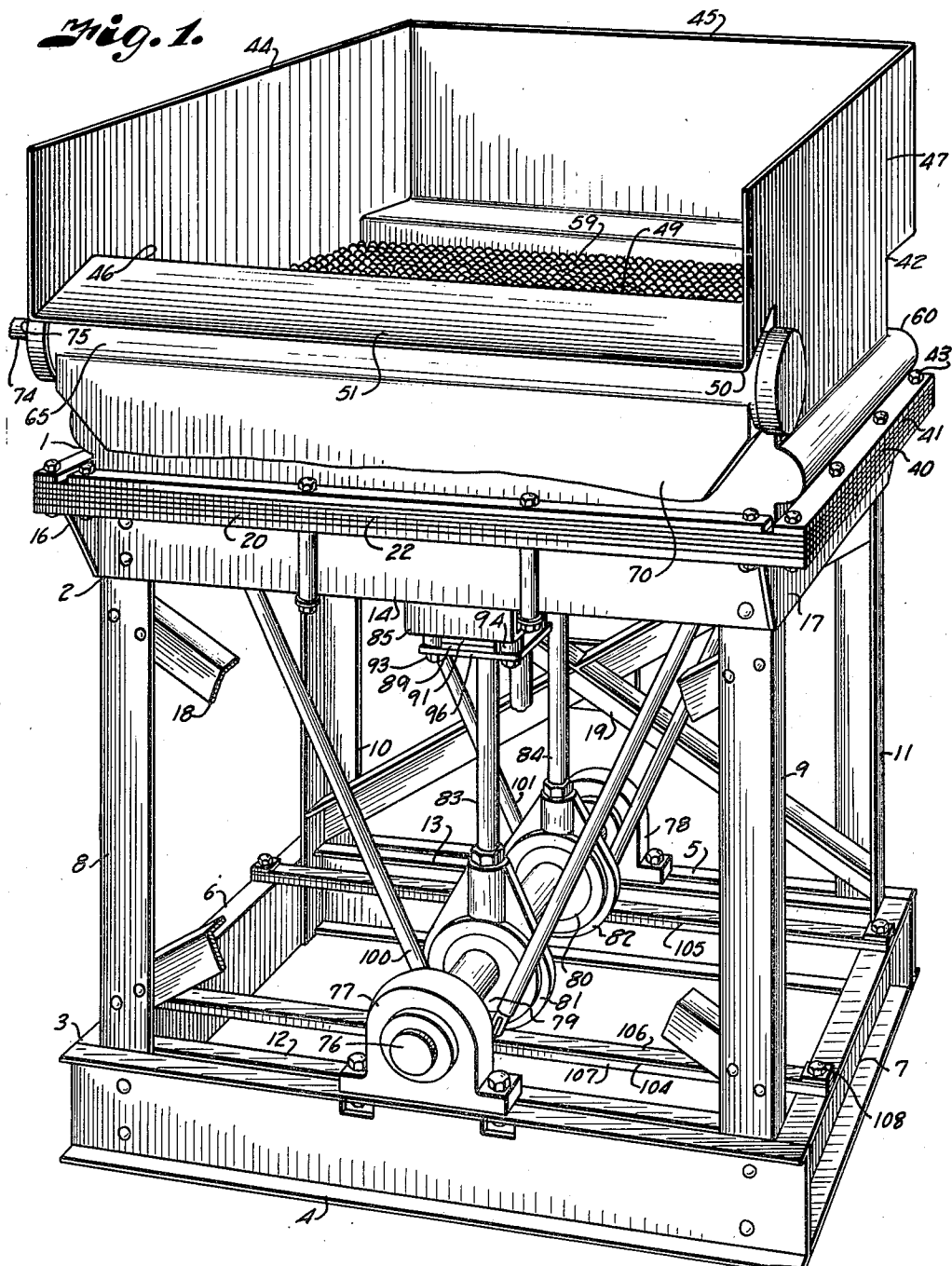
C. E. WOOD

2,246,084

JIG

Filed Oct. 3, 1938

4 Sheets-Sheet 1



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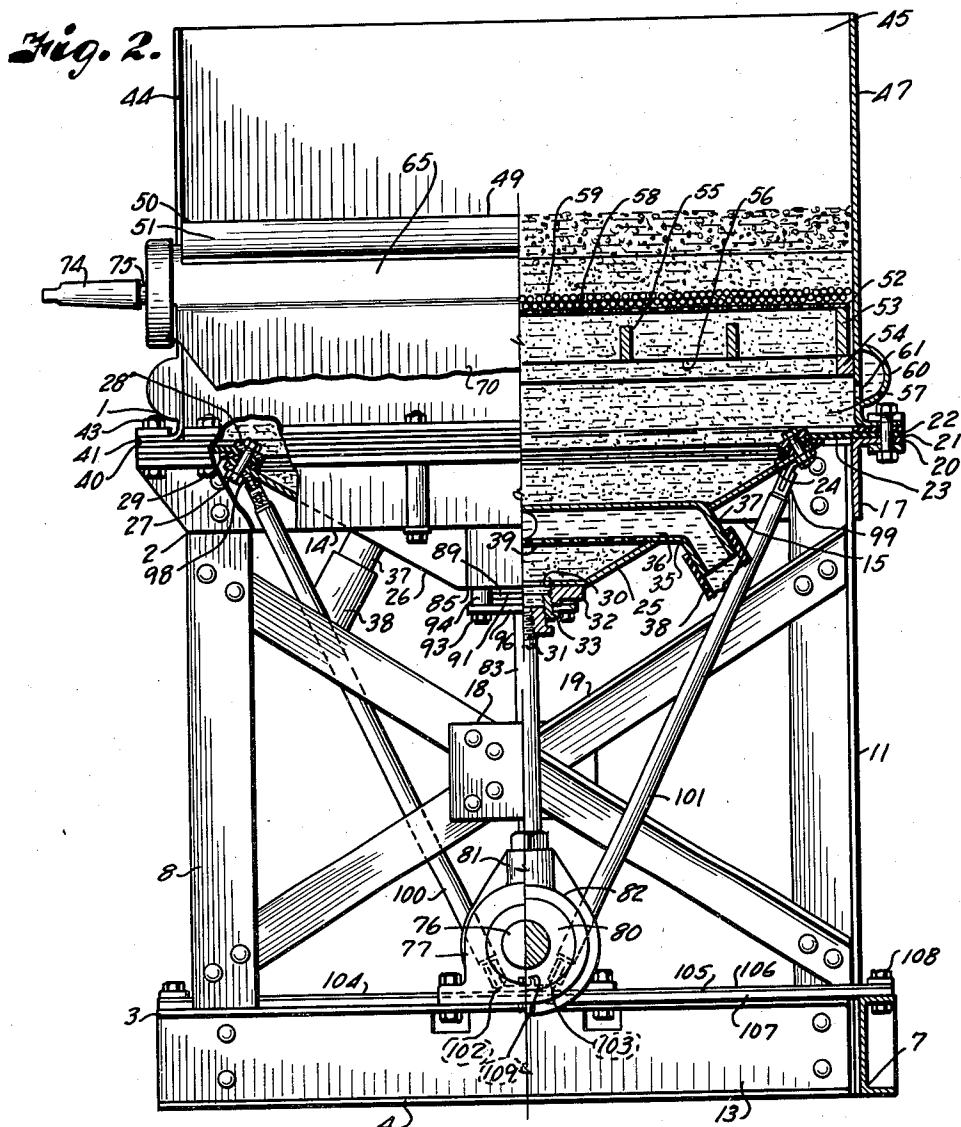
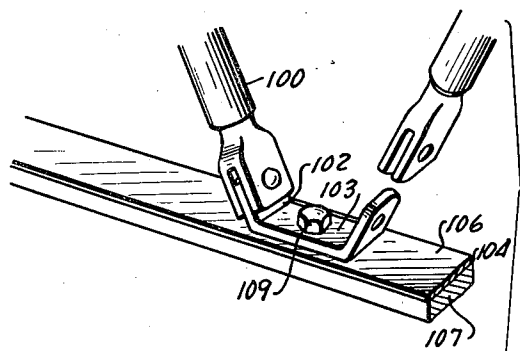
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JIG

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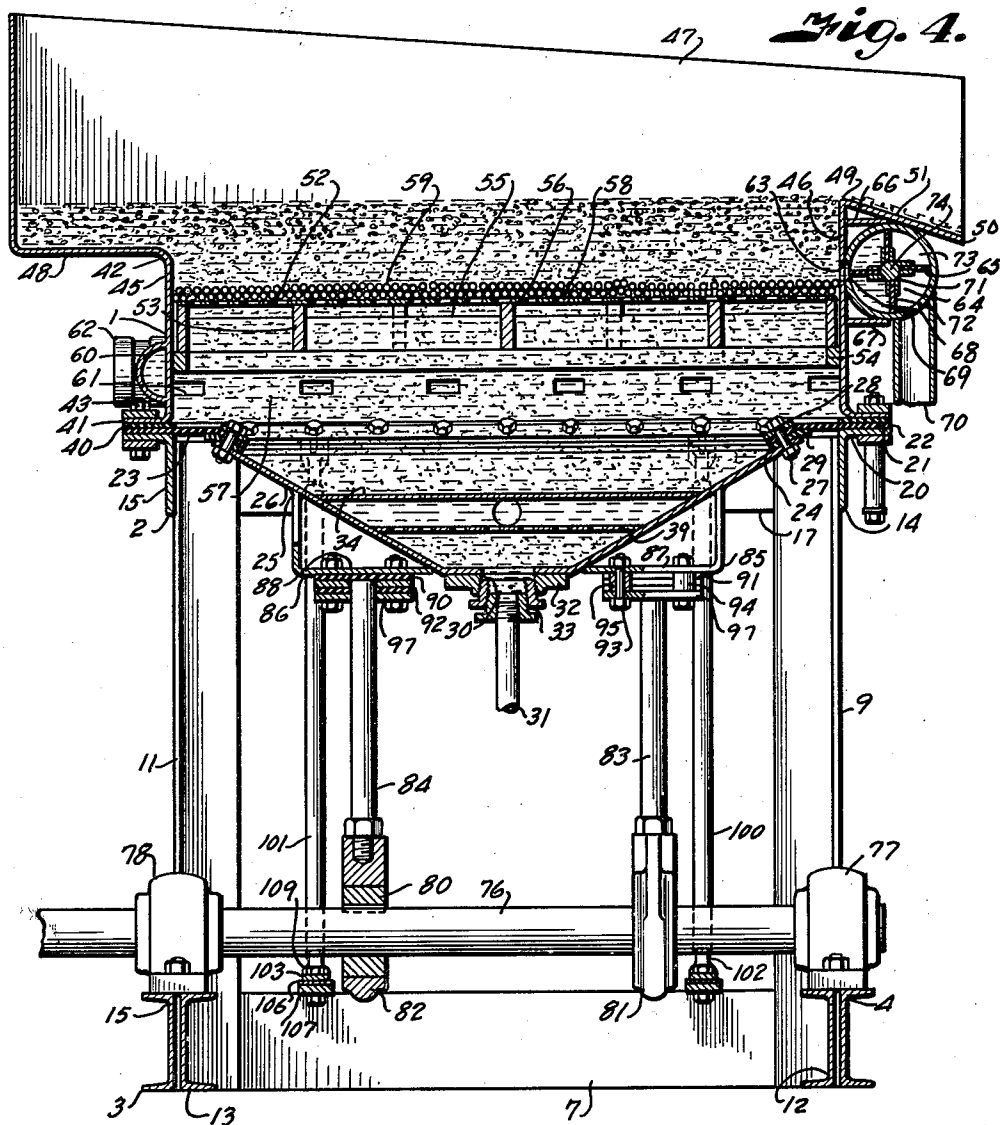
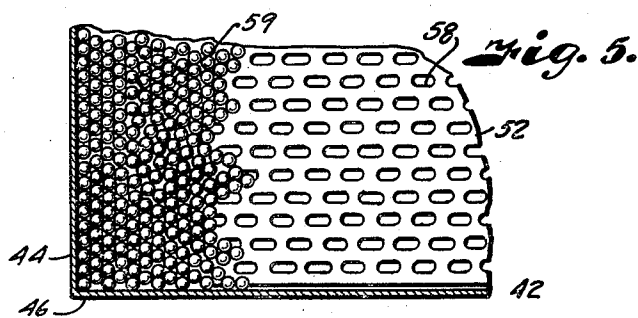
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JIG

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4 Sheets-Sheet 4

Fig. 6.

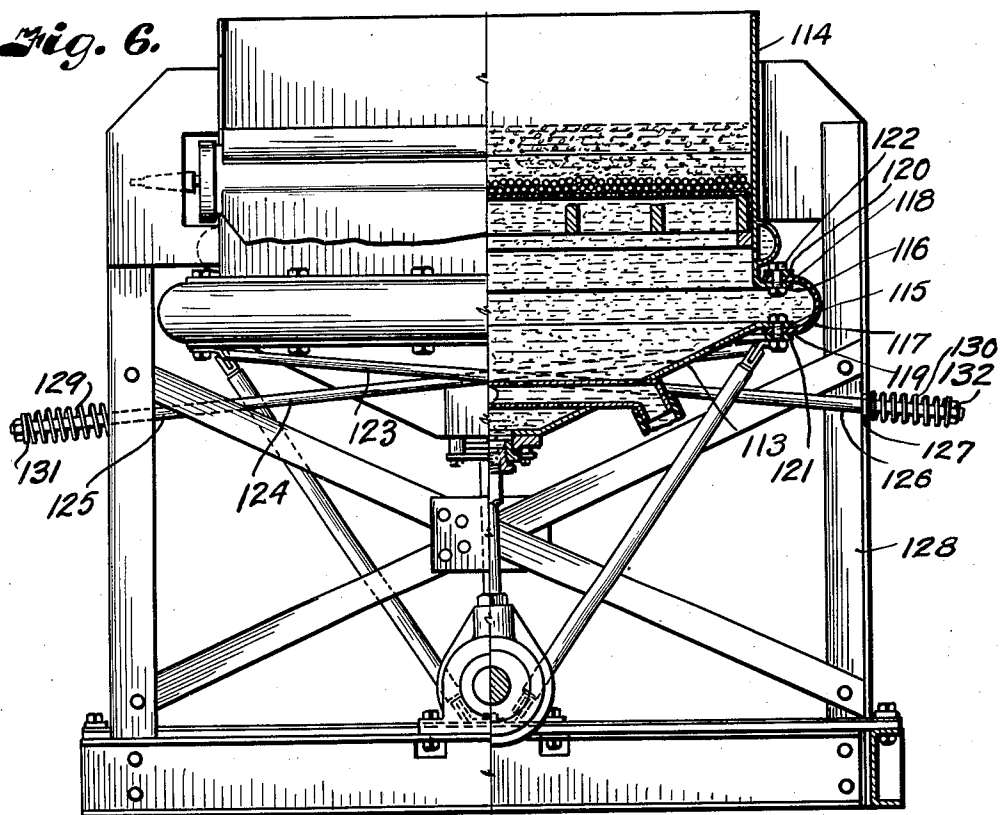
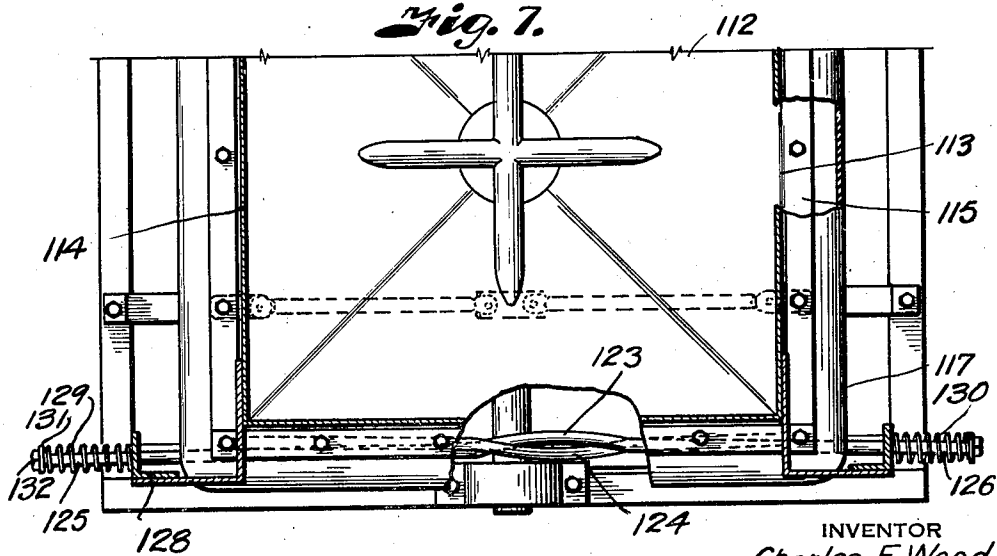


Fig. 7.



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JIG

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Application October 3, 1938, Serial No. 233,001

7 Claims. (Cl. 209—457)

This invention relates to apparatus commonly known as jigs for separation of solid particles of material according to specific gravities by effecting alternate pulsations of liquid through a bed of the particles so that they are caused to arrange themselves in strata for draw-off at predetermined levels.

In jigs of this character it is difficult to obtain uniform pulsation throughout the entire area of the bed, consequently the strata are not clearly defined in horizontal planes, and therefore the respective draw-offs remove particles of varying specific gravities. This trouble has been reduced in part by spacing the pulsator a material distance from the bed but this requires movement of a greater volume of liquid upon each pulsation. Even then the physical difficulties involved have materially interfered with use of the desired frequency of pulsation or with use of a pulsation in which time for the upward action is less than the time for the downward motion.

It is, therefore, a principal object of the present invention to provide a pulsating jig constructed to effect uniform pulsation throughout the entire area of the bed with a relatively small volume and weight of liquid, thereby enabling use of higher frequency pulsations with less power than is usually required for operating machines of this character. High frequency pulsations are advantageous because the greater number of reversals in the liquid flow produces better stratification.

Other objects of the invention are to provide a jig of simplified construction; to provide a jig which requires less head room in the plant in which it is installed; to provide a jig with a pulsating diaphragm substantially corresponding in size and shape with the bed; to provide for support of the diaphragm in close proximity to the bottom of the bed; to provide the jig with means for maintaining the diaphragm substantially level during pulsation thereof; to provide a diaphragm construction in which the actuating element thereof is rigidly braced against distortion incidental to thrust of the actuating mechanism; to provide for introduction of liquid through the stiffening member of the diaphragm; and to provide a flexible connection between the actuating mechanism and the diaphragm which is entirely free of wear.

In accomplishing these and other objects of the invention, as hereinafter pointed out, I have provided improved details of structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a perspective view of a jig constructed in accordance with the present invention.

Fig. 2 is a side elevational view of the jig, partly in vertical section.

Fig. 3 is a detail perspective view of the lower ends of one pair of stabilizer rods and showing their connection with the flexible support.

Fig. 4 is a central vertical section through the jig.

Fig. 5 is a detail sectional plan of one corner of the bed, particularly illustrating the supporting screen and the shot covering therefor.

Fig. 6 is a side elevational view in quarter section of a modified form of the invention.

Fig. 7 is a horizontal section through one side of the apparatus shown in Fig. 6.

Referring more in detail to the drawings:

1 designates a jig constructed in accordance with the present invention and which includes a frame 2 having a rectangular base 3 formed of channel members 4—5 and 6—7, arranged on edge with their flanges projecting outwardly, and connected together at their corners by angle-shaped posts 8—9 and 10—11 having their flanges riveted or otherwise suitably attached to the webs of the channels. The channel members 4 and 5 are preferably reinforced by inner channels 12 and 13 having their ends overlapping the flanges of the corner posts, as shown in Fig. 1. The upper ends of the posts are connected by angle-irons 14—15 and 16—17, and the pairs of posts 8—9 and 10—11 are respectively connected by cross bracings 18 and 19. The angles 14—15 and 16—17 are arranged with one of their flanges 20 extending horizontally in an outward direction to provide a flat peripheral seat 21 for mounting the overlapping edge 22 of a flexible ring-like membrane 23 that extends entirely around the seat 21 and has an inner edge 24 projecting inwardly thereof and secured to the rim of a rigid diaphragm member 25.

The diaphragm 25 is formed of sheet material shaped to provide a shallow funnel or hopper 26 having its perimeter conforming in shape to the inner periphery of the seat 21 but which is spaced therefrom a sufficient distance to allow free flexibility of the membrane 23 upon pulsation of the diaphragm as later described. The inner perimetrical edge of the membrane overlaps the upper face of the diaphragm and is clamped thereto by fastening devices such as bolts 27 extending through a clamping ring 28, the membrane 23, a gasket 29, and the diaphragm 25, to provide a leak-tight joint as best shown in Fig. 4. The depending portion of the diaphragm converges

toward a central draw-off opening 30 whereby the heavier concentrates are drawn from the machine through a conduit 31 that is connected with a flange 32 secured to the bottom of the diaphragm in encircling relation with the opening 30, the conduit 31 being connected by bushings 33.

In order to reinforce the diaphragm so that it is substantially rigid under thrusts imparted by pulsator mechanism, later described, the sides thereof are connected by transverse tubular members 34 and 35. The transverse member 34 extends in a transverse direction relatively to the channels 4—12 and 5—13 of the frame 2, and has its ends welded to the inner adjacent sides of the diaphragm. The other member 35 has its ends welded in openings 36 of the diaphragm and terminates in depending necks 37 to which are connected flexible conduits 38. The members 34 and 35 are preferably interconnected at their crossing points and are provided with downwardly opening apertures 39 through which a liquid is admitted into the interior of the hopper-shaped diaphragm.

Extending about the perimeter of the membrane 23, in alignment with the seat 21, is a gasket ring 40, and seated thereon is a laterally extending flange 41 of a housing 42. The flange 41 is clamped to the seat 21 by fastening devices such as bolts 43 extending therethrough as shown in Fig. 4 to form a leak-tight joint. The housing 42 conforms in shape to the seat 21 and includes side walls 44—45 and 46—47, the wall 45 being provided with an offset 48 substantially midway the height thereof and the wall 46 terminating slightly above the offset to form a weir 49 across which tailings are discharged from the machine to a spout 50 that is formed by the upper portions of the side walls 44 and 45 and an inclined connecting plate 51 secured to the upper edge of the weir 49.

Supported a relatively short distance above the diaphragm, for example a distance less than one-half the width of the housing, is a screen 52, the screen 52 being carried upon a grid 53 that in turn is supported on a ledge 54 attached to the inner faces of the side walls. The grid 53 comprises longitudinal and transverse bars 55 and 56 arranged on edge and spaced apart a distance to form adequate support for the screen. The screen 52 covers the entire area of the housing to cooperate with the diaphragm and side walls to form a pulsating chamber 57 and is spaced below the weir 49 so that a bed of pulp is carried thereabove as shown in Fig. 4. The screen 52 is formed of sheet material and has a plurality of elongated apertures 58 through which liquid is pulsated responsive to movement of the diaphragm for keeping the bed of pulp alive so that particles of different specific gravities may seek their level in the bed.

In order to prevent clogging of the screen, it is preferably covered with two or more layers of shot or balls 59 that are of larger diameter than the apertures 58 and of a size to form openings therebetween for passage of the heaviest particles or concentrates, as later described.

Fixed to the outer sides of the housing walls 44—45 and 46—47 are interconnected conduits 60 having communication with the pulsating chamber through slots 61 that are formed in the corresponding walls of the housing at a point slightly below the ledge 54 and through which wash liquid is supplied to the diaphragm chamber 57 for flow through the pulp bed, as later described, the con-

duits 60 having common connection 62 with a suitable source of supply (not shown). In the illustrated instance a draw-off opening 63 extends transversely across the side of the bed just above the upper layer of balls and directly connects with a draw-off gate 64. The gate 64 includes a cylindrical housing 65 secured to the outer face of the side wall 46 by supporting plates 66 and 67, and has a slotted opening 68 registering with the opening 63 and an outlet opening 69 that is spaced therefrom to connect with an outlet duct 70. Rotatable in the housing is a gate 71 having radial blades 72 forming pockets 73 therebetween, so that when one of the pockets is in receiving relation with the opening 68, that pocket is sealed from the outlet opening 69, whereby the concentrates are retained therein. The blades are preferably formed of flexible material that sealingly engages the wall of the housing to prevent leakage therebetween and thereby retain the level of the pulp bed up to the weir 49. The gate is rotated by a shaft 74 that projects from an end of the housing as shown at 75 in Fig. 2.

The diaphragm pulsator mechanism includes a shaft 76 that is rotatably journaled in bearings 77 and 78 mounted on the upper flanges of the paired channels 4—12 and 5—13. Splined on the shaft 76 at spaced points on opposite sides of the axis of the diaphragm are eccentrics 79 and 80 carrying eccentric straps 81 and 82 having rods 83 and 84 which are connected with brackets 85 and 86 fixed to the outer side of the diaphragm at points above the actuating shaft.

The brackets 85 and 86 include horizontal portions 87 and 88 and positioned therebeneath are pads of resilient material, such as rubber 89 and 90, for engaging therebetween plate-like heads 91 and 92 on the upper ends of the rods 83 and 84. The resilient pads are clamped against the plate-like heads 91 and 92 and against the horizontal portions of the brackets by fastening devices, such as bolts 93, extending through suitable openings in the brackets, through spacer sleeves 94 and 95, and through aligning openings in clamping plates 96 and 97 that are loosely sleeved over the rods 83 and 84. The connecting rods 83 and 84 are thus positively attached to the brackets but the resilient blocks provide sufficient flexibility to accommodate movement responsive to throw of the eccentrics.

In order to retain the diaphragm in horizontal alignment, under thrusts of the eccentrics, so that all of the area thereof is effective in forcing liquid through the screen, the sides thereof are provided with pairs of ears 98 and 99 to which are connected pairs of brace rods 100 and 101 having their lower ends connected to ears 102 of clips 103 that are attached to resilient cross members 104 and 105 extending across the base frame and having their ends fixed to the upper flanges of the channel members 6 and 7 as best shown in Fig. 1. The resilient members are preferably laminated and include flat, spring-like leaves 106, juxtaposed by a shock absorbing strip 107 of a material such as wood. The ends of the members 104 and 105 are firmly anchored to the flanges of the channels by fastening devices, such as bolts 108, and the clips 103 are secured by bolts 109 as best illustrated in Fig. 3. The brace rods thus stabilize the diaphragm on the respective sides of the actuating shaft to retain it in horizontal position. The resilient members have sufficient flexibility to allow for movement of the diaphragm responsive to actuation of the eccentrics. The diaphragm is thus supported so that

all of the area thereof is equally effective in forcing the pulsating liquid through the apertures of the diaphragm.

In operating a jig constructed and assembled as described, pulp containing the particles to be separated is admitted to the housing at the offset side thereof so that a bed of the pulp is deposited and maintained upon the screen up to the level of the weir 49. The connections 38 and 62 are connected with suitable sources of liquid so that liquid is admitted to the diaphragm chamber for flow upwardly through the screen and over the weir along with the tailings or lighter particles carried in the pulp stream. Upon rotation of the shaft, the eccentrics produce a vibratory movement of the diaphragm to pulsate the liquid upwardly through the screen, raising the balls and loosening the bed so that the particles may seek their level according to their specific gravities, the heavier particles collecting at the bottom of the bed and the lightest particles at the top of the bed where they are washed over the edge of the weir and out through the spout 50. Upon reverse movement of the diaphragm, the balls reseat and the heaviest concentrates are drawn through the spaces therebetween and through the openings of the screen and settle to the bottom of the diaphragm chamber where they collect on the diaphragm for draw-off through the conduit 31. The next heavier concentrates and those unable to pass the apertures between the balls are discharged through the openings 63 and 68 into a registering pocket of the rotary valve. The valve may be rotated from time to time so as to carry a filled pocket into communication with the outlet 69 where the collected concentrates are discharged through the outlet duct 70. During pulsation of the diaphragm the brace members maintain the level position thereof so that the liquid is discharged with the same effective force through all of the area of the bed and since the diaphragm is substantially the same dimensions as the bed the liquid is discharged with equal force through the entire area thereof. Attention is directed to the fact that since the diaphragm is located very close to the bed the diaphragm is actuated against a minimum head of liquid thereby reducing the amount of power required and enabling actuation of the diaphragm at higher frequencies.

With the structure illustrated the diaphragm may be located so that it may be successfully operated at a distance less than half the width of the bed and yet obtain equal distribution of the flow through the screen.

In the form of the invention illustrated in Fig. 6 the diaphragm 112 has an upper portion 113 substantially conforming in dimensions to the cell or bed enclosure housing 114. The marginal edge of the diaphragm has a laterally extending flange 115 underlying an outturned flange 116 on the lower edge of the housing 114 and which corresponds with the flange 41 in the first form of the invention. The flanges 115 and 116 are spaced apart and connected by a flexible member 117 of U-shaped cross-section and having attaching portions 118 and 119 engaging the outer faces of the respective flanges. Cooperating with the flanges are clamping strips 120 and 121 to retain the flexible member in leak-proof engagement with the flanges, the clamping strips being retained by fastening devices such as bolts 122 extending through the clamping strips, through the attaching portions of the flexible member, and through the flanges as shown in Fig. 6. In order

to retain the diaphragm in aligning registry with the bed so that there is relatively no lateral movement with respect thereto, the opposite sides of the diaphragm are connected by pairs of links 123 and 124 having their opposite ends 125 and 126 extending loosely through apertures 127 in the flanges of the legs 128 of the supporting frame. Sleeved over the projecting ends of the links are compression springs 129 and 130 having one of their ends bearing against the legs and their opposite ends against washers 131 backed by adjusting nuts 132 that are threadedly mounted on the links. By uniformly tensioning the springs the diaphragm is centrally supported with respect to the bed and yet reciprocably movable for reciprocation by the eccentrics, otherwise the construction is substantially the same as that of the preferred form. In the latter form the rigid portion of the diaphragm, being the same area as the bed, effects movement of the pulsating liquid uniformly and at substantially the same speed throughout the entire area of the bed.

What I claim and desire to secure by Letters Patent is:

1. A jig including a supporting frame, a pulsating chamber, a movable diaphragm substantially conforming in size to the horizontal section of the pulsating chamber, a shaft rotatably supported on the frame below said diaphragm, eccentrics on said shaft, means connecting the eccentrics with the diaphragm, brace members connected with the diaphragm on opposite sides of said eccentrics, leaf-like resilient members having ends connected with opposite sides of said frame, and means connecting the brace members with center portions of said leaf-like resilient members to maintain horizontal relationship of said diaphragm during actuation of said eccentrics.

2. A jig including a supporting frame, a pulsating chamber, means closing the bottom of the pulsating chamber including a ring-like flexible membrane, a substantially rigid diaphragm connected with the membrane and substantially conforming to the area of the pulsating chamber, a shaft rotatably supported on the frame below said diaphragm, eccentrics on said shaft, means connecting the eccentrics with the diaphragm, spaced pairs of brace members connected with the diaphragm on opposite sides of said eccentrics, leaf-like resilient members spaced on said frame substantially in correspondence with spacing of said pairs of brace members, and means connecting said resilient members with said brace members.

3. A jig including a frame, a pulsating chamber, a movable diaphragm forming the bottom of the pulsating chamber, means in the chamber for supporting a bed of particles to be separated according to specific gravity, means for pulsating the diaphragm, spaced brace means connected with outer side portions of the diaphragm on opposite sides of said pulsating means, leaf-like resilient members having their ends fixed to the frame and extending transversely below said diaphragm, and means connecting the brace means with said resilient members.

4. A jig including a frame, a pulsating chamber, a movable diaphragm forming the bottom of the pulsating chamber, means in the chamber for supporting a bed of particles to be separated according to specific gravity, means for pulsating the diaphragm, brace means connected with the diaphragm on opposite sides of said pulsating means, laminated resilient members

having their respective ends fixed to opposite sides of the frame, and means connecting the brace means with said resilient members.

5. In a jig, a ring-like membrane, a funnel-shaped diaphragm member, means clamping the inner edge of the ring-like membrane to the rim of the diaphragm member, cross bracing connecting opposite sides of the diaphragm member including apertured tubes, and means connected with said tubes for supplying liquid for flow into the funnel-like diaphragm member through said apertures.

6. In a jig, a pulsating chamber, a vibratory funnel-shaped diaphragm forming the bottom of said pulsating chamber, cross-bracing connect-

ing opposite sides of the diaphragm including apertured ducts, and means connected with said ducts for supplying liquid for flow through said apertures into the pulsating chamber.

7. In a jig, a ring-like membrane, a funnel-shaped diaphragm member, means clamping the inner edge of the ring-like membrane to the rim of the diaphragm member, bracing connecting opposite sides of the diaphragm member comprising transversely arranged tubes having perforations, and means connected with said tubes for supplying liquid for flow through the perforations into the funnel-like diaphragm member.

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