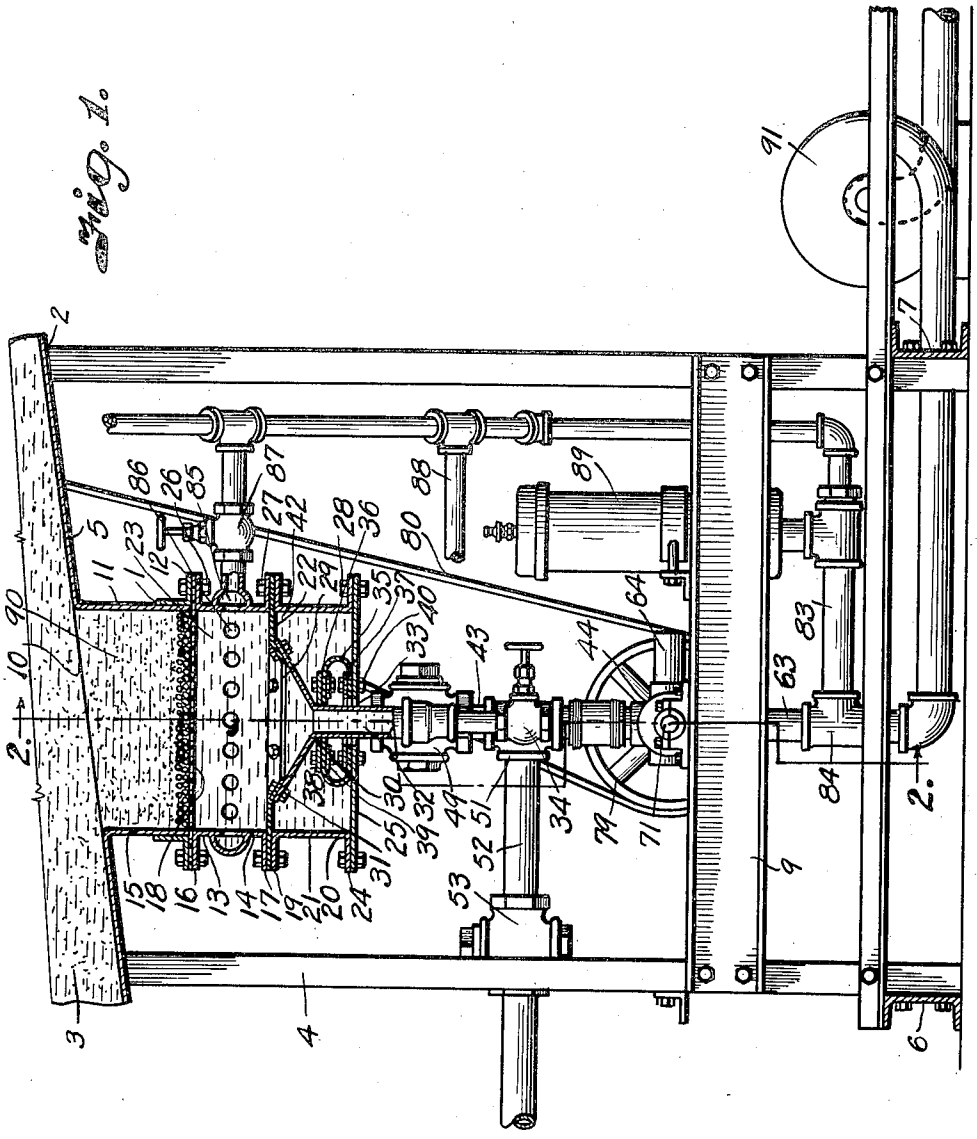
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CONCENTRATING CELL

Original Filed March 28, 1934 2 Sheets-Sheet 1

Fig. 1.



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Fig. 3.

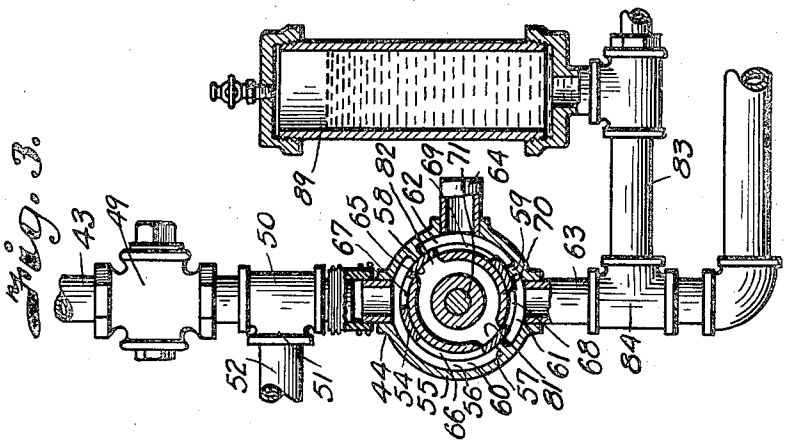
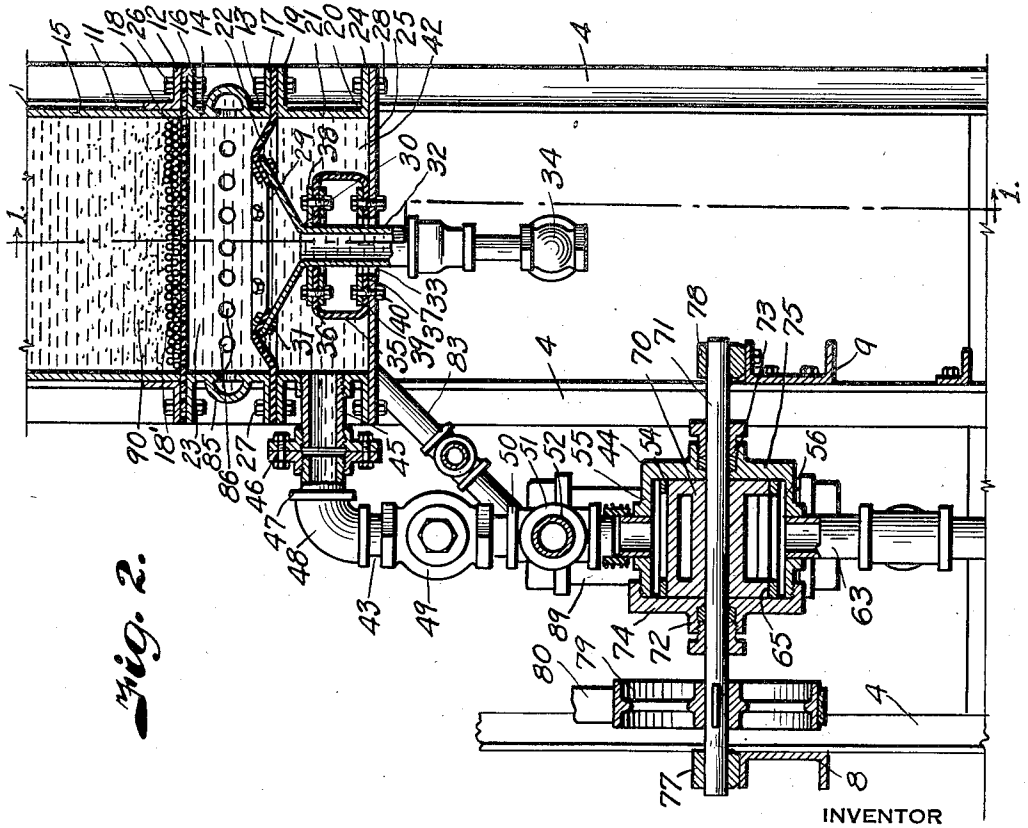


Fig. 2.



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CONCENTRATING CELL

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Original application March 28, 1934, Serial No. 717,739. Divided and this application September 26, 1938, Serial No. 231,707

3 Claims. (Cl. 209—455)

This invention relates to a concentrating cell or jig of the type illustrated and described in my copending application Serial No. 717,739, filed March 28, 1934, and of which the present application is a division.

The principal objects of the present invention are to provide a jig or pulsating cell that is constructed to effect uniform pulsation throughout the entire area of the bed of material being concentrated; to provide a device of this character constructed for actuation by means of a pulsating fluid medium under control of a valve; and to provide a device of this character whereby the change in frequency of pulsations may be readily effected through variation in speed of valve operation and wherein the time interval of the pulsation in one direction may be varied with respect to the time of pulsation in the opposite direction.

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

Fig. 1 is a vertical section through a concentrating cell or jig embodying the features of the present invention, the section being taken on the line 1—1 of Fig. 2.

Fig. 2 is a vertical section through the concentrating cell or jig on the line 2—2 of Fig. 1.

Fig. 3 is an enlarged detail view, partly in section, of the valve and pipe connections controlling flow of liquid for actuating the diaphragm which pulsates water through the bed of material to be concentrated.

Referring more in detail to the drawings:

1 designates an ore concentrating cell or jig for separating materials according to their specific gravities and in the illustrated instance the cell or jig is shown as associated with classifying apparatus 2 illustrated in the above entitled application of which the present application is a division, however, the structure covered in the present invention is adapted for any purpose where a pulsating concentrator cell or jig is required and I do not wish to be understood as limited to the adaptation illustrated and described.

As described in the forementioned application, the concentrating apparatus includes a tank 3 supported on legs 4 and having a sloping bottom 5 along which the ore stock or other material to be concentrated is moved responsive to actuation of a suitable conveyor (not shown). The legs 4 are connected adjacent their lower ends by longitudinal channels 6 and 7 and upwardly spaced cross channels 8 and 9 which mount actuating mechanism of the cell later described.

Formed in the bottom of the tank is an opening 10 through which the material to be concentrated is discharged onto a concentrating bed that is carried within a depending collar 11, preferably conforming in cross-section to the shape of the opening 10 and having its lower edge provided with a perimetrical flange 12 to which is secured a cell section 13. The section 13 includes vertical walls 14 aligning with the walls 15 of the collar 11 and having upper and lower flanges 16 and 17 extending outwardly therefrom. The flanges 16 cooperate with the flange 12 to clamp a screen-like diaphragm 18 that extends horizontally across the cell. The lower flanges 17 cooperate with similar flanges 19 on a lower section 20, having side walls 21 corresponding to the side walls 14 of the upper section. The flanges 17 and 19 clamp therebetween a movable diaphragm 22 forming a movable bottom for the cell and which cooperates with the screen 18 to form a collecting and pulsating chamber 23.

The section 20 also includes outwardly extending lower flanges 24 for securing a bottom plate 25. The flanges 12—16 and 17—19 are respectively connected by fastening devices such as bolts 26 and 27 to sealingly retain the screen and diaphragm and prevent leakage between the cell sections. The plate 25 is also attached to the flanges 24 by similar fastening devices 28. The screen 18 has ample stiffness to provide a support or grate over which the materials to be concentrated are passed and through which a liquid medium, such as water, is caused to pulsate in effecting stratification of the materials according to their specific gravity, that is, the heavier materials collect on the screen and move therethrough while the lighter materials collect above the screen and are drawn off along the bottom of the tank 5 or through separate draw-offs located at superimposed levels along the height of the collar 11, as in conventional jig design.

To prevent clogging of the screen it may carry a plurality of layers of balls or similar pellets 18' which are moved upwardly by the liquid medium upon pulsation in an upward direction and which move downwardly against the screen upon movement of the liquid medium in the opposite direction. The size of the balls is such that the spaces or interstices between adjacent contacting balls allow passage of the heavy concentrates into the pulsating or collecting chamber 23.

The diaphragm 22 substantially conforms in size and shape to the cross-section of the cell and

is provided with a central outlet opening 29 for the concentrated materials which are discharged through a funnel-shaped member 30 constituting a rigid central assembly of the diaphragm. The funnel-shaped member 30 is of larger dimensions than the opening 29 so that the perimetrical edge thereof underlies the inner edge of the flexible portion of the diaphragm and is secured thereto by fastening devices such as bolts 31, as clearly shown in Figs. 1 and 2. The funnel-shaped member includes a tubular discharge duct 32 which extends loosely through an opening 33 in the plate 25 and has connected thereto a valve 34. The valve 34 normally closes the lower end of the duct but is opened from time to time to effect withdrawal of concentrates, as later described.

The opening 33 is closed by a flexible packing element 35 preferably formed of rubberized fabric of U-shaped cross-section to provide upper and lower attaching portions 36 and 37 which are respectively connected to a flange 38 fixed to the duct and to the portion of the plate 25 surrounding the opening 33 by means of clamping rings 39 retained by fastening devices such as bolts 40. The section 20 is thus sealed to form a fluid piston chamber 42 in which a fluid medium is intermittently admitted to effect pulsation of the diaphragm. The fluid medium may be a liquid such as water and is admitted to and discharged from the piston chamber through a conduit 43 that is connected with a valve 44. The conduit 43 includes a nipple 45 that is secured to the side of the lower section 20 and is connected by a flanged coupling 46 with a nipple 47, the nipple 47 being connected by an L-fitting 48 with a manually operated shut-off valve 49 carried in the vertical leg of the conduit which connects with the valve 44.

Also connected in the vertical leg of the conduit, between the shut-off valve and the valve housing, is a T-fitting 50 having its lateral branch 51 connected with a conduit 52 also provided with a shut-off valve 53 (Fig. 1) which is adapted to be connected with another concentrating cell when the cells are arranged in batteries as disclosed in the aforementioned application. It is thus obvious that the piston chambers of a plurality of cells may be supplied with an actuating medium through a common control valve 44.

The housing of the valve 44 is best illustrated in Fig. 3 and comprises inner and outer concentric cylindrical shells 54 and 55 to provide an annular space 56 therebetween. The space 56 is divided by partitions 57 and 58 at opposite diametrical sides and an intermediate partition 59, the partitions being arranged to form separate passages 60, 61 and 62 respectively communicating with the conduit 43, an inlet conduit 63 and an outlet nipple 64. The inner wall of the valve housing forms a cylindrical valve chamber 65 having spaced ports 66 and 67 communicating with the passage 60 and ports 68 and 69 respectively communicating with the passageways 61 and 62. Rotatable in the valve chamber is a valve core 70 that is fixed to a shaft 71 extending through the packing boxes 72 and 73 provided in end walls 74 and 75 of the valve housing (Fig. 2), the shaft 71 being rotatably mounted in bearings 77 and 78 carried on the channels 8 and 9, previously mentioned. The shaft 71 carries a pulley 79 that is operated by a belt 80 running thereover and over a corresponding pulley on a rotating member (not shown). The valve core has diametrically opposed ports 81 and 82 (Fig. 3) which successively communicate with the inlet, outlet, and discharge passages 61, 60 and 62 respectively to direct the liquid to and from the piston chamber in effecting pulsation of the diaphragm.

The liquid medium for the pulsating chamber may be supplied from the same source with which the conduit 43 is connected by way of a branch conduit 83 having connection with a T-fitting 84 in the conduit 63, as shown in Fig. 2. The conduit 83 is connected with a manifold 85 that extends about the periphery of the cell section 13, the manifold being preferably formed as a part of the section and communicates with the interior thereof through a series of ports 86. The conduit 83 may be provided with a hand operated valve 87 whereby the pulsating liquid may be regulated to control condition of the concentrating bed. The conduit 83 may also be provided with branch conduits 88 to connect with other cells when arranged in batteries as above mentioned.

In order to prevent a water hammer effect incident to actuation of a rotary valve, the conduit 83 is provided with an air compression chamber 89 as best shown in Fig. 3.

The operation of a concentrating cell or jig constructed and assembled as described, is as follows:

The material to be concentrated will be carried across a bed of material 90 filling the collar section 11 of the cell and supported on the layers of pellets carried on the screen 18. Upon rotation of the valve core 70, the ports therein will successively pass the respective ports in the inner shell 54 to control flow of pulsating medium to and from the piston chamber to effect pulsation of the flexible diaphragm which in turn effects alternate gushes of liquid through the bed of material collecting in the cell for effecting stratification of the particles according to specific gravity, the heavier particles collecting on the screen and passing therethrough while the lighter materials collect in the upper portion of the bed and in position to be carried, up the bottom of the tank or to be drawn off through side outlets in the cell. For example, when the ports 81 of the valve is in registry with the water inlet port 68, water is admitted from the conduit 63 under pressure of a pump 91, through the valve core, for discharge through the ports 82 and 67 for flow through the conduit 43 into the piston chamber to effect upward movement of the diaphragm as shown in Fig. 2. This movement of the diaphragm displaces the water in the pulsating chamber 23 through the bed to effect loosening thereof and rearrangement of the particles according to their specific gravities. As the valve core continues its rotation the ports 81 and 82 therein will move out of registry with the ports 68 and 67 and cross the intermediate valving portions of the valve housing into registry with the ports 66 and 69, whereupon the water supply from the pipe 63 is cut off and the flow in the piston chamber is reversed, the water discharging through the conduit 43 by way of the ports 66, 81, 82 and 69 to the outlet 64. This discharge permits downward movement of the diaphragm and allows return of the pulsating liquid in a downward direction through the bed, seating the pellets and drawing the heavy concentrates therebetween and through the screen into the pulsating or collecting chamber 23, where they drop through the funnel-shaped member 30 into the draw-off conduit 32 completing a cycle of operation. Attention is directed to the fact that

all points of the diaphragm are constrained to move at right angles to the surface of liquid pulsated through the bed so that the pulsating liquid is equally effective throughout the entire area thereof. Similar cycles will follow in timed relation depending upon the speed of rotation of the valve core and the relative spacing and length of the valve ports. It is thus obvious that any timed differential may be established between the input and release of water through the valve core by variation in the relative spacing of the valve ports or the valve may be irregularly timed.

The heavy concentrates may be drawn off from time to time by opening the valve **34** while the light materials will be progressively moved across the bottom of the tank as described in the above mentioned application of which the present application is a division. Simultaneously with flushing of the water through the bed, fresh water is continuously being supplied thereto by way of the branch conduit **83** which water carries away silt and light particles which may have been scoured from the heavier concentrates by the pulsating action in the cell. The amount of water admitted influences fluidity or density of the concentrating bed and is preferably maintained so that the materials being concentrated are in relatively loose condition whereby the heavy concentrates move freely toward the bottom of the cell and in reverse direction to the movement of the lighter materials. If desired, the valve **34** may be left open so that the heavy concentrates are continuously drawn from the pulsating chamber.

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

1. An apparatus of the character described, including a cell, an apertured support in the cell for retaining a bed of material to be concentrated, a movable diaphragm positioned directly below and in close proximity to the support including a rigid central portion and flexible edge portions attached to said cell at a point directly below said support for bodily supporting a pulsating liquid thereon and to form the top of a fluid piston chamber above the bottom of said cell, a cencentrate outlet tube connected with said rigid portion of the diaphragm and reciprocable in the fluid piston chamber and through an opening in the bottom of the cell, flexible sealing means connecting said tube with the bottom of the cell for closing the piston chamber, and means for intermittently introducing a fluid pulsating medium into said fluid piston chamber to effect vibration of the diaphragm and bodily pulsation of the liquid carried thereon through the bed of material carried on said support.

2. An apparatus of the character described, including a cell, an apertured support in the cell for retaining a bed of material to be concentrated, a movable diaphragm positioned directly below and in close proximity to the support including a rigid central portion and flexible edge portions attached directly to said cell at a point below said support for bodily supporting a pulsating liquid thereon and to form the top of a fluid piston chamber above the bottom of said cell, a concentrate outlet tube connected with said rigid portion of the diaphragm and reciprocable through an opening in the bottom of the cell, flexible sealing means connecting said tube with the bottom of the cell for closing the piston chamber, means for intermittently introducing a fluid pulsating medium into said fluid piston chamber to effect vibration of the diaphragm and pulsation of the body of liquid carried thereon through the bed of material carried on said support including means for supplying the fluid pulsating medium, a valve in said fluid pulsating medium supply having inlet and exhaust ports for admitting said fluid pulsating medium to the piston chamber and for discharging the fluid pulsating medium from said chamber, and means for actuating said valve.

3. An apparatus of the character described, including a cell, an apertured support in the cell for retaining a bed of material to be concentrated, a movable diaphragm positioned directly below and in close proximity to the support and having sealed engagement with the cell to form an upper pulsating chamber for containing a body of pulsating liquid, a liquid piston chamber wholly positioned below said pulsating chamber, means connected with said piston chamber for admitting and discharging a liquid medium for effecting rise and fall of the diaphragm for bodily reciprocation of the liquid in the pulsating chamber through said bed of material, a valve controlling the admission and discharge of said liquid, and an air cushioning chamber connected with said valve on the inlet side thereof.

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