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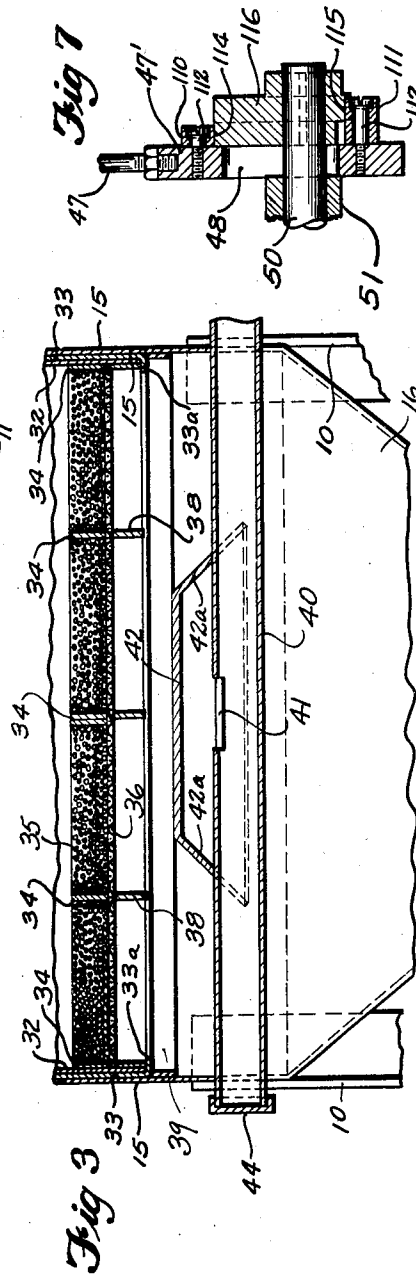
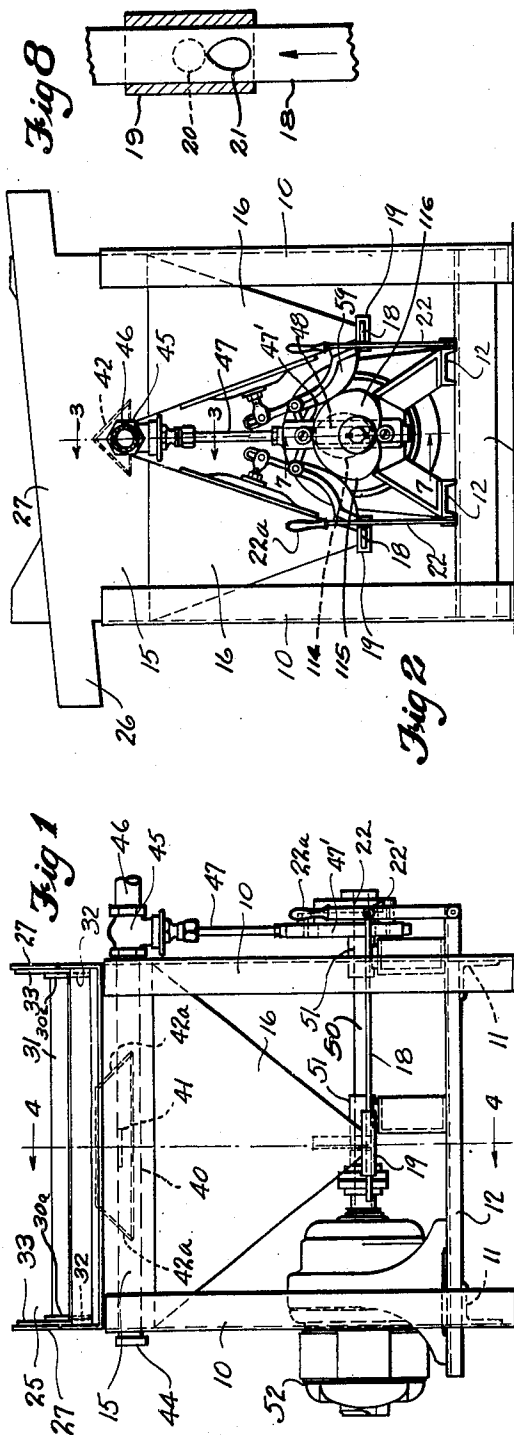
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MINERAL JIG

Filed Sept. 3, 1938

2 Sheets-Sheet 1



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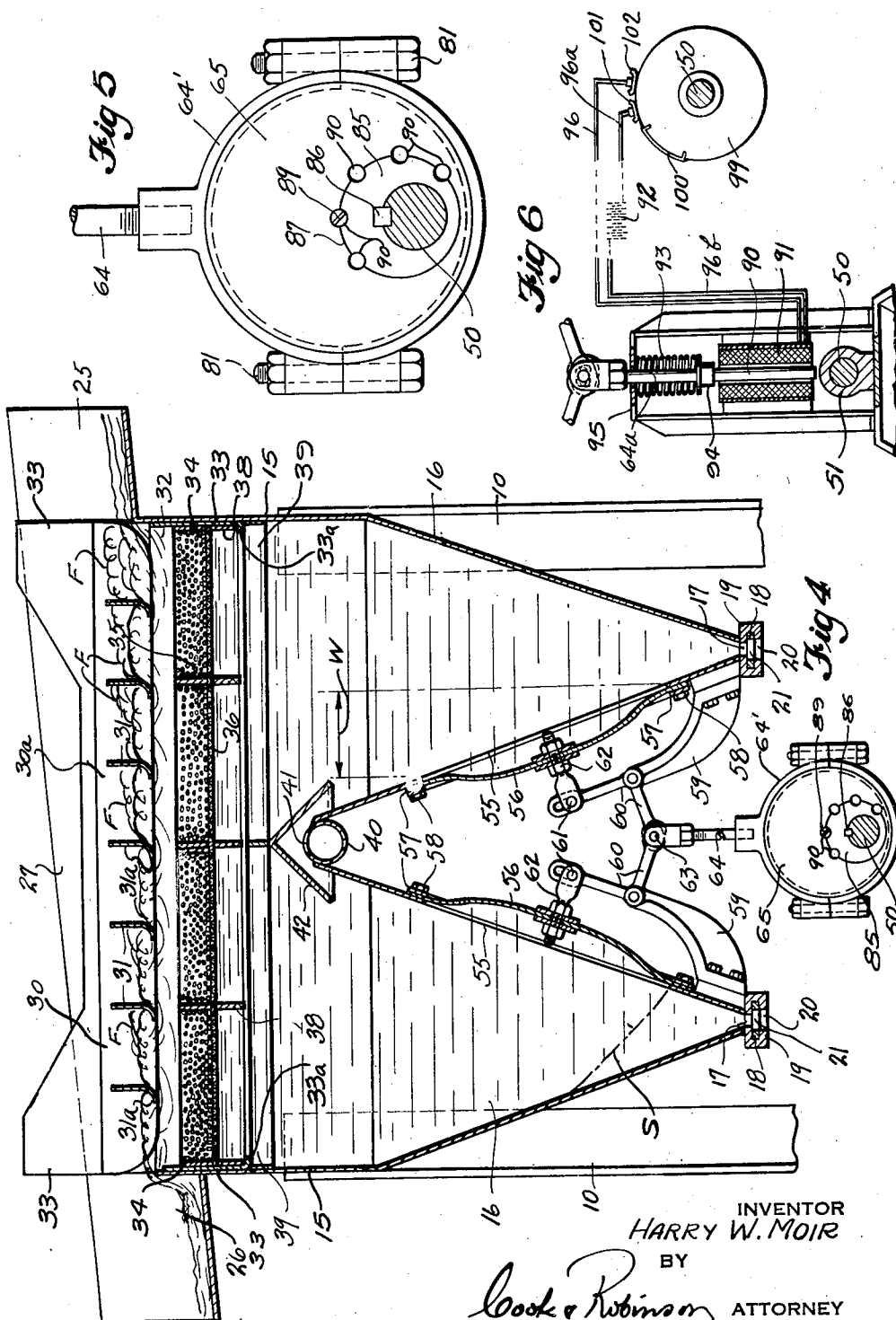
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UNITED STATES PATENT OFFICE

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MINERAL JIG

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2 Claims. (Cl. 209—455)

This invention relates to improvements in mineral separation and concentration jigs that operate to separate the metallic particles from pulp, retaining the said particles therein and discharging waste materials through the differences in their respective densities and specific gravities, and it has reference more particularly to what is known in the mining industry as "pulsating jigs" of the mechanically operated type; it being the principal object of this invention to provide a jig of the above stated character, having an improved type of pulsator and water supply mechanism whereby greater efficiency in the separation of mineral from pulp is obtained, and which, by reason of its design and construction will operate much more economically than has been possible by the use of jigs of those kinds now generally in use.

More specifically stated, the objects of the present invention are to be found in the provision of a mechanical, pulsating jig comprising paired, water containing hutches, covered by a shot bed that is supported by a screen grid, and with diaphragmatic pulsators associated with the hutches to cause the water to surge alternately upwardly and downwardly through the bed incident to the pressure and suction that is alternately created on the water in the hutches by the pulsating action of the diaphragms.

It is a further object of the invention to provide a jig of increased effectiveness by reason of the use of more efficient pulsator mechanisms made so by reason of their location in the hutches, the direction of the force they impact to the water in the hutches, and the relative amount of water they have to "lift" by reason of their position in the alternate application of pressure and suction, and the provision of intermittent and timed delivery of water under pressure into the hutches with a resultant stimulation of the separating and setting action of the mineral through the shot bed and the carrying to waste over the shot bed of the lighter gangue of the pulp.

Other objects of the invention reside in the provision of a mineral jig utilizing one shot bed overlying twin hutches; the latter being equipped with diaphragms operated in unison by means of an eccentric on a motor driven shaft. Provision is made also for the admission of predetermined amounts of water into the hutches in timing with the functional operations of the diaphragms, which are also under the control of the action of eccentric cams on the driven shaft.

Another object of the invention is to expedite

and facilitate the washing action of the non-soluble material by the novel use of a series of baffles located just above the shot bed.

Still further objects of the invention reside in the details of construction of the various parts of the jig; in the combination of parts and mode of operation of the jig, as will hereinafter be described.

In accomplishing these and other objects of the invention, I have provided the improved details of construction, the preferred forms of which are illustrated in the accompanying drawings, wherein—

Fig. 1 is a front elevation of the mineral jig embodied by the present invention.

Fig. 2 is a side elevation of the same.

Fig. 3 is an enlarged, cross sectional view of the upper portion of the jig, as seen on line 3—3 in Fig. 2.

Fig. 4 is an enlarged cross sectional view of the hutches and pulsator mechanisms, taken on line 4—4 in Fig. 1.

Fig. 5 is an enlarged detail of the pulsator eccentric.

Fig. 6 is a sectional detail diagrammatically illustrating an alternative means for operating the pulsators, utilizing a solenoid.

Fig. 7 is a vertical cross section of the cam arrangement for opening the water inlet valve, as seen on the line 7—7 in Fig. 2.

Fig. 8 is an enlarged view of the slide valve.

Explanatory to the present invention, it will here be stated that there are several mineral separation devices now in general use that operate similarly, but are not so efficient and require considerably more power to operate. Some of these faults encountered in their operation are: the partial activity of the separating area provided; the applying of the hydraulic forces in such a manner and direction as to positively "pack" the separated mineral particles so tightly together that they must be forcibly removed, and the loss of considerable quantities of the mineral particles through "flotation."

The invention herein disclosed provides for the overcoming of these and many other defects and is of maximum efficiency and capacity, is light and easily constructed, simple in its design and operates on a minimum of power, as will be hereinafter fully described.

Referring more in detail to the drawings—

The jig, as herein illustrated, is supported by a frame structure comprising four, vertical corner posts 10, of angle iron. The two posts at each of the opposite sides of the jig are joined

rigidly together near their lower ends by horizontal bars 11—11, and these, in turn, are joined together by two spaced cross beams 12—12 of channel iron and which, as noted in Figs. 1 and 2, extend at their ends somewhat beyond the beams 11 and mount the driving motor and the main drive shaft thereon, as later described.

Supported by the upper ends of the four corner posts 10 is the jig body or housing 15. This preferably is constructed of sheet metal and embodies two hutches 16—16 of the same size, and disposed side by side, in the direction of flow of water through the jig, and at the same level, as noted by reference to Fig. 4. Each hutch is rectangular at its upper end and has the four side walls thereof downwardly converged to a relatively small discharge opening 17 that is controlled by a slide valve 18.

The valve 18 for each hutch is in the form of a flat bar or plate, slidably contained in a water-tight guideway 19. This guideway is fixed to the lower end of the hutch and has a port 20 opening therethrough into the base of the hutch. The valve plate 18 has a port 21 therethrough that may be brought from and into registration with port 20, and this action of the plate is effected by an operating lever 22.

As seen in Fig. 8, this port 21 is of particular design, being substantially of "teardrop" shape, round at its rearward end and coming to a point at its forward end. This provides that the valve may be opened just slightly, by bringing just the point of the opening 21 to overlie the port 20, or it may be opened entirely by bringing the large end of the port 21 into registration with the port 20.

The levers 22 for the valves of the two hutches are pivotally mounted at their lower ends on the cross bars 12, and, near their upper ends, they have operating connections, as at 22', with the valve plates for shifting the latter. The upper ends of the levers have handle portions 22a.

The jig body or housing above the hutches, as seen in Fig. 2, comprises a sluice trough 25 along which the pulp is washed over the hutches, and it has a discharge chute 26 continuing therefrom whereby the washed pulp is carried from the jig. The sluice trough, as noted in Fig. 4, is disposed at a somewhat higher level than the discharge trough. Also, it will be seen that side plates 27 of the trough constitute upwardly extending portions of the jig body and extend to the front and rear thereof to form side portions of the troughs 25 and 26.

A baffle plate assembly 30, comprising opposite side wall portions 30a and 30b spaced apart by a plurality of vertical cross baffles 31, is removably and reversibly disposed upon shoulder strips 32—32 that are fixed horizontally to the side walls of the grid retainer 33. The baffles 31, as noted in Fig. 4, are disposed transversely to the direction of flow of water across the hutches and have their lower edge portions 31a curved in the direction of flow, for a purpose presently understood.

Spaced somewhat below the plane of the bottom edges of the baffles 31 is the shot bed 35; the spacing providing an unrestricted space between the parts for the flow of water and pulp. The shot bed is supported upon a screen 36, which, in turn, is supported by a horizontal grid 38 that rests at its edges removably upon the inwardly formed shoulders 33a of the grid retainer 33, which, in turn, rests removably upon shoulder strips 39 that are secured to the body walls of the jig body 15.

By reference to Figs. 3 and 4, it will be seen that the shot bed is divided by a grid 34, which is divided into four sections for easy removal. It will also be understood from these Figs. 3 and 4, that the entire grid and baffle assembly may be easily removed since the grid retainer rests on the shoulder straps 39, and this grid retainer 33 holds therein, on the formed shoulders, the shot bed retaining grid, upon which are the shot bed screen 36, the shot bed dividing grid 34, and the baffle assembly, which rests on the shoulder strips 32.

Referring now more particularly to Fig. 4, it will be observed that a water supply pipe 40 is disposed between the upper horizontal edges of the two hutches 16—16; the adjacent walls of the hutches being welded to the pipe to add strength to the structure and provide a water-tight joint. The pipe extends through the opposite side walls of the sluice trough and are welded thereto. A slot 41 longitudinally in the top of the pipe 40 provides for a discharge of water into the hutches, and a deflector 42, in the form of an inverted V-shaped trough, is disposed longitudinally over the pipe to deflect the current of discharged water laterally in opposite directions, and downwardly into the two hutches. The deflector trough, as noted in Fig. 3, is closed at its opposite ends by inclined walls 42a whereby it is fixedly mounted on the pipe 40, and the disposition of the several walls of the deflector are such that the water from the pipe will be directed in equal amounts into the hutches.

At one end, the pipe 40 is closed by a cap 44 and at its opposite end is connected through the mediacy of a quick opening gate valve 45 with a water supply pipe 46 which leads from a source of supply under pressure. The valve gate is adapted to be opened and closed by the action of a connecting rod 47 which, at its upper end is attached to the valve gate, and at its lower end has a collar 47' mounted thereon. This collar is provided with a rectangular opening or slot 48, slightly wider than the driven shaft 50 which it surrounds, thus allowing for a sliding, up and down movement of the collar 47', as will now be explained.

Two cam rollers 110 and 111 are mounted upon the collar 47' by shouldered studs 112, and adapted to be in contact with the cam surfaces 114 and 115 respectively of the cam 116, which is fixedly mounted upon the shaft 50. As illustrated in Fig. 7, the cam roller 110 is somewhat shorter than the roller 111, and the cam surface 114 is of different contour and lies inside of the cam surface 115. These cam surfaces are designed, as seen in Fig. 2, to positively control the up and down movement of the valve gate at all times, providing for a quick opening and closing thereof, and a very short period of time for the valve to remain open. It is thought to be evident that the cam surface 114 operates the valve gate downwardly to open, and the cam surface 115 operates it upwardly to closed position. The collar 47' will be in a slidable position between the bearing 51 and the cam 116, so that no lateral movement is effected.

By providing a key-way in the shaft 50 in which a key is inserted, between the shaft and the cam 116, and providing two key-ways in the cam 116 at diametrically opposite sides of the shaft bore therein, the cam may be reversed and in this way reverse the action of the gate valve 45 with reference to its timing with the action of the pulsator diaphragms 56.

The inside walls of the two hutches 16—16 are provided with relatively large, circular openings 55, over each of which is secured a flexible, water-tight diaphragm 56; the diaphragms being clamped about their edges to the hutch walls by means of overlying rings 57 secured by attaching bolts 58.

Secured to each hutch, below the diaphragm opening 55, is an upwardly directed bracket or arm 59, and pivotally mounted by these arms at their upper ends are bell crank levers 60 that are disposed to oscillate on their pivots in the same vertical plane. The bell crank levers have upwardly directed arms which, at their upper ends, have pin and slot connections, as at 61, with stems 62 fixed centrally to the corresponding diaphragms. Also, they have inwardly directed lever arms operatively attached by pin and slot connection, as at 63, with the upper end of a connecting rod 64, which, at its lower end, has a collar 64' rotatably fitted about an eccentric 65 on the driven shaft 50. The disposition of the eccentric and the cam on shaft 50 relative to each other is such as to cause the valve to open as the diaphragms are flexed outwardly. However, this action may be reversed, as previously stated, so as to cause the valve to open as the diaphragms are flexed inwardly.

The eccentric 65 comprises a relatively large circular cam or disk about which the mounting collar 64', for the application of the connecting rod, is fitted; the collar preferably being diametrically divided for easy removal or application and the two parts thereof operatively connected by bolts 81 as illustrated.

To provide for an arcuate adjustment and regulation and timing of the water injection into the hutches with reference to the pulsating action of the diaphragms 56, and also to provide for a variation in the extent of the pulsating action of the diaphragms, the eccentric is mounted on the shaft 50 through the mediacy of a secondary eccentric that provides for adjustment. The arrangement of parts is best illustrated in Fig. 5 which discloses the mounting of the eccentric 65 for the actuation of the diaphragms. In this view, 65 designates the eccentric disk, provided with an eccentric opening 87 in which the secondary eccentric 85 is fitted for relative rotation. The eccentric 85 is keyed on shaft 50 by a key 86 and the parts 85 and 65 may be secured at different positions of relative adjustment by a key 89 that is threaded into registering key slots 90 in these parts; it being understood that with the key withdrawn the parts are adjustable and since each part, 65 and 85, is eccentric of shaft 50, a relative rotation will cause the eccentricity of the disk 65 to be varied accordingly relative to shaft 50.

An alternative means for actuation of the diaphragms is illustrated in Fig. 6. In this arrangement a rod 64a is substituted for rod 64 and is attached at its lower end to the core 90 of a solenoid coil 91. A spring 93 surrounds the rod 64a and bears downwardly on a shoulder member 94 which serves also to connect the rods 64a and 90, thus to yieldingly hold the core retracted and the diaphragms outwardly disposed.

The spring 93 bears at its upper end against a frame 95 which is fastened to the support for the bearing 51. An electric circuit from a source of electrical energy 92 may be closed through lines 96a and 96b to one side of the solenoid, and through a line 96 leading back to the source of power. The means of closing the circuit com-

prises a non-conductive disk 99, which is mounted upon the motor shaft 50 to revolve therewith, and provided with a metal plate 100 on its periphery adapted to contact with metal shoes 101 and 102 that are disposed to slide upon the disk 99 as it revolves. These shoes 101 and 102 simultaneously contact the plate 100 for a period of time as determined by the length of the plate, thus closing the circuit to the solenoid to energize and lift the core to actuate the diaphragms inwardly.

Assuming that the jig is so constructed, its mode of operation is as follows:

As the shaft 50 is rotated by the driving motor 52, the eccentric 65 is rotated therewith. With each turn of the shaft, the two diaphragms are actuated inwardly, then outwardly, thus alternately creating pressure and suction on the water contained in the hutches below the shot bed.

The pulp that is delivered to the jig consists of finely divided or pulverized sand or ore particles, earth particles and mineral particles, washed therein by a constant flow of water. With the diaphragm operating simultaneously inwardly and outwardly with each revolution of the drive shaft, an upwardly directed surge or pulsating force is imparted to the water in the hutches 16 upon the in-stroke of the diaphragms and a downwardly directed suction or pulsation will be imparted to the water upon the outward stroke of the diaphragm. With this pulsating or vibrating motion that is imparted to the water occurring at a relatively high number of times per minute, it is obvious that the pulp that is delivered onto the shot bed will be moved up and down accordingly in the water. The finer particles of sand and earth will be carried along with the water in an up and down motion, and will be washed away, out through the discharge trough first, then the heavier particles being washed out at a slower rate of speed.

The metallic particles, being of a larger size, because they resist the grinding or abrasive forces of the grinding mill, and are also of a greater density and specific gravity, will be drawn downwardly, through the shot bed, by the downward suction, but will resist the upward pressure to a greater degree because of their larger size, greater density and specific gravity, and consequently greater weight than the sand particles.

At the same time the water supply valve 45 is being actuated to open and closed positions with each revolution of the drive shaft 50, but at opposite time intervals as regulated by placing the eccentric and cam at 180° spacing on the shaft 50. This provides that when the water supply valve 45 is open, the diaphragms are in "in" position. This provides that, as the water surges upwardly, an additional surge is given to the water, which lifts up and carries to discharge a portion of the water, and the pulp carried up by the water.

This arrangement provides that for a pulp of a coarser or large classification may be given a greater valve opening for a longer period of time; hence, a greater upward surge in the water to carry the particles out to discharge, and a smaller valve opening for a shorter period of time with a lesser upward surge in the water. This provides greater efficiency in the metal separation, as it is evident that if the jig is used with a very fine pulp, according to classification, too large an opening of the valve for too long a time will carry away to discharge

not only the waste particles of the pulp, but also metallic particles.

By the particular location of the diaphragms in the adjacent inner walls of the hutch, as illustrated, the impulses transmitted to the water will be applied in an outward direction whereby to activate or keep alive the entire shot bed area, instead of just the center area as in jigs using only a single hutch and directing an impulse directly upwardly. Also, with the deflector 42 so located and formed as to direct the force of the admitted water downwardly, this force will be evenly distributed throughout the water according to hydraulic principles.

As illustrated in Fig. 4, the actual weight of water lifted by the diaphragms is proportional to the horizontal, projected length of the diaphragms, illustrated by the line W. It is evident then that this is much more easily accomplished by the applied power than if the entire lower part of the hutch 16 where oscillated up and down, thereby lifting the entire volume of water contained therein. The importance of the angle of inclination is stressed, insofar as that in this particular construction, the impulse or surge of water is forced directly at the corners of the shot bed. Closely analyzing this with respect to the reaction caused, it will be understood that the rise or surge of water is upward at the front and rear edges of the shot bed, with reference to the direction of flow of the pulp and water in the sluices 25 and 26. This leaves the surface of the water in substantially meniscus shape; i. e., high on the edges and low in the center. As the center rises to bring the water to an even surface, the two edges fall away with a downward or outward stroke of the diaphragms. This action, occurring rapidly per minute, sets up a wave motion in the water, the waves extending crosswise to the direction of flow of the water and moving parallel with the direction of flow. It is evident that not only the central area, but the entire shot bed area will be activated. The fact that this wave motion is set up crosswise to the direction of flow of pulp through the jig is of considerable importance in that it insures every particle of pulp that enters into the jig a thorough washing by the up and down motion in the water.

A matter of great importance in cost of operation is the relative low horsepower motor needed to operate the present jig as compared to operating costs of other well known jigs. Because of the low dead weight of water on the diaphragms, or required to be lifted by the diaphragms because of their particular location on the side walls, only about one-sixth as much power is needed as is required where the entire lower half of the hutch is oscillated through a diaphragm connection between the upper and lower halves thereof. Also, a vital factor in the efficiency of the jig resides in the fact that the water in the lower part of the hutch is comparatively undisturbed by the diaphragmatic action, which facili-

tates the settling of the metallic particles, especially the very fine pieces. This still zone is designated by S in Fig. 4, and although certain hydraulic pressures are brought to bear upon the metallic settlings thereon, they do not cause these settlings to be packed tightly in this area, as do some other machines. These settlings are drawn off very easily by merely opening the valve in the bottom of the hutch, and it is never necessary to forcibly remove them.

Use of the baffle assembly 30, having the baffle plates 31 across the direction of flow of the water, and having the lower curved edges 31a extended slightly below the surface of the water, a nozzle action is induced in the water as it passes thereunder, and any insoluble material that has a tendency to create a flotation or froth on the water, as indicated at F, will be carried down under the baffle plate and will be carried well into the turbulent water and thoroughly washed therein.

It has been ascertained that the loss of metallic ore in mining from flotation is surprisingly high, so by the use of this type of baffle assembly, the jig is rendered much more efficient. Such a baffle assembly may also be incorporated into the construction of ordinary sluice troughs or sluice boxes, and render them much more efficient.

It is understood, of course, that when utilizing the solenoid operated diaphragms, as illustrated in Fig. 6, the action will be identical with that of the eccentrics, and that the solenoid is included only as an alternate means of operation.

It is thought that the construction, operation, utility and advantages of this invention will be quite apparent to those skilled in this art without a more detailed description thereof.

It is not intended that the claims be confined only to the disclosures made herein, but that they be given an interpretation commensurate to the spirit and scope of the invention disclosed.

Having thus described my invention, what I claim as new therein and desire to secure by Letters Patent is—

1. In a mineral jig, a shot bed, a trough for directing the flow of a stream of water and pulp across the bed, a baffle frame supported above the bed and comprising a plurality of transverse, vertical baffle plates for impeding the flow of water and each having its longitudinal lower edge portion curved toward the direction of flow of the stream of water.

2. In a mineral jig, a shot bed, a housing for the shot bed having an inlet and an outlet at opposite sides for the flow of a stream of water across the shot bed, a baffle frame removably mounted in the housing, means for supporting the frame in spaced relation above the shot bed, and a plurality of vertical baffle plates in the frame disposed transversely of the flow of water and adapted for impeding its flow, having their lower longitudinal edge portions curved laterally in the direction of flow of water.

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