P. F. PECK.

CENTRIFUGAL ORE SEPARATOR.

APPLICATION FILED APR. 11, 1910.

981,682.

Patented Jan. 17, 1911.

2 SHEETS—SHEET 1.

Fig. 2.

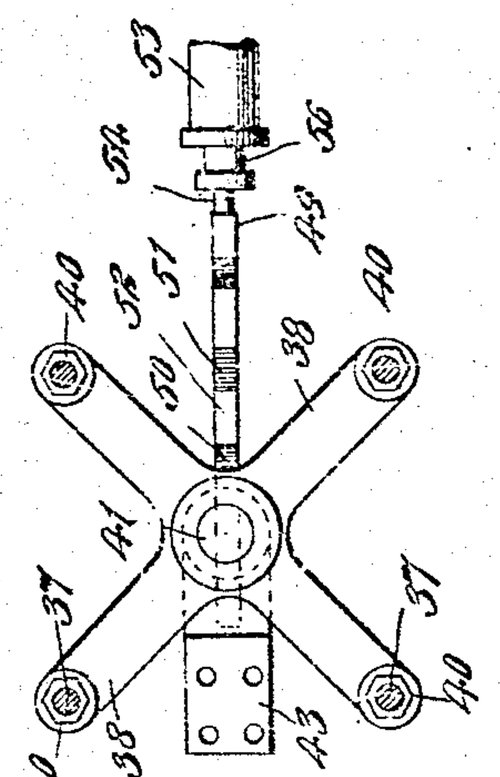

Fig. 1.

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2 SHEETS—SHEET 2.

Fig. 4.

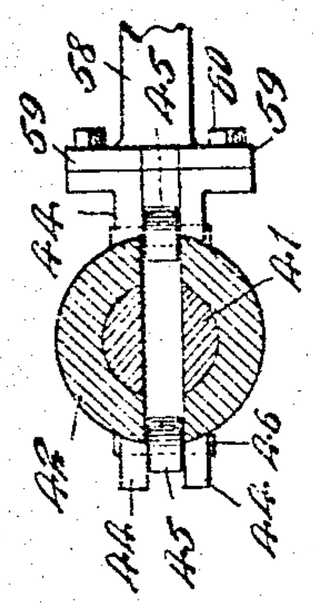


Fig. 5.

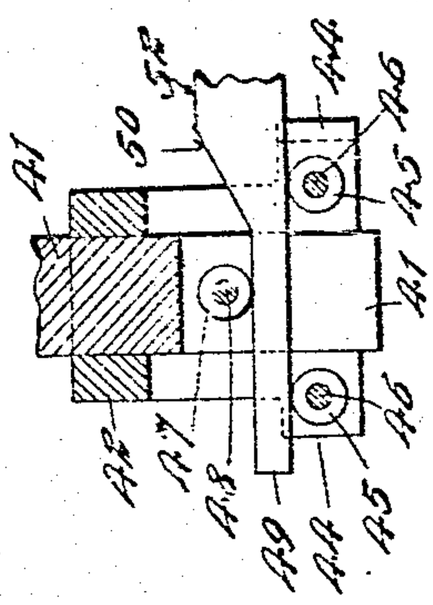


Fig. 6.

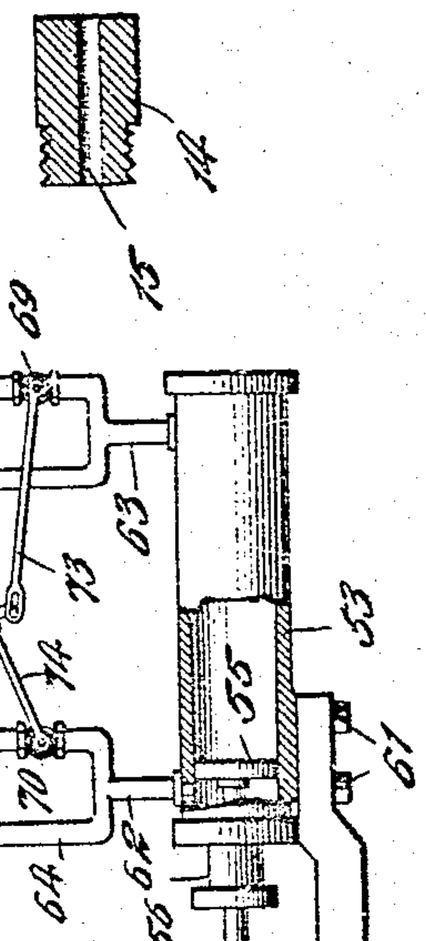
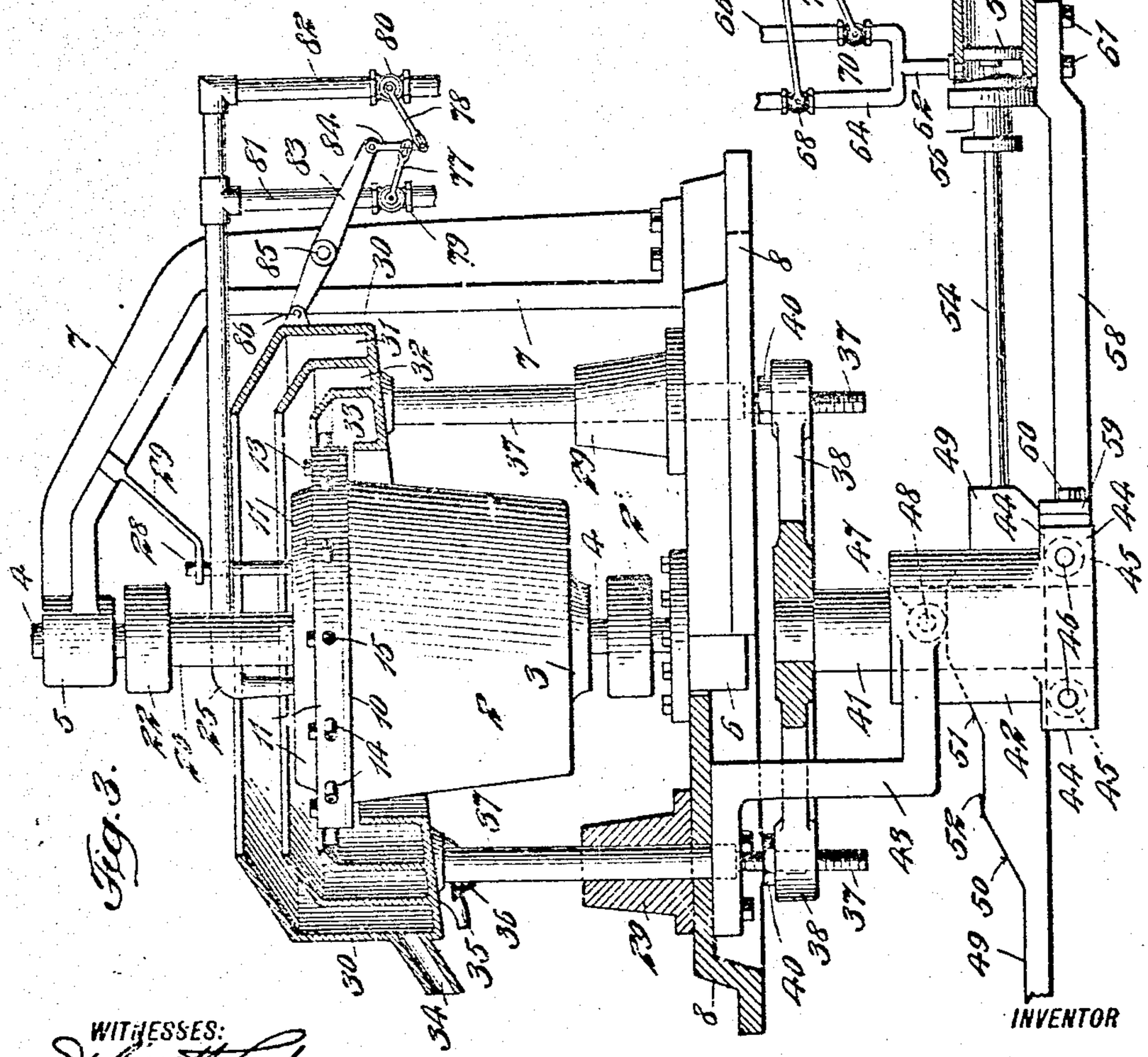


Fig. 3.



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PHILIP F. PECK, OF TACOMA, WASHINGTON.

CENTRIFUGAL ORE-SEPARATOR.

981,682. Specification of Letters Patent. Patented Jan. 17, 1911.

Application filed April 11, 1910. Serial No. 554,805.

To all whom it may concern:

Be it known that I, PHILIP F. PECK, a citizen of the United States, residing at Tacoma, State of Washington, have invented certain new and useful Improvements in Centrifugal Ore-Separators, of which the following is a specification.

My present invention relates to the general type of centrifugal separators to which belongs my pending application Serial Number 551,921, filed March 28, 1910, cross reference to which is hereby made and in which application is claimed in substance, a vertically adjustable multi-chambered receptacle with a centrifugal separating member and hydraulic and wedge-shaped mechanism to effect adjustment of such receptacle in combination with automatic control mechanism of the separator, and other elements, parts of which are disclosed in this application.

The objects of my invention are more especially directed to the relative association of the separating vessel and the launder, and mechanism for operating the latter to suitably coöperate with the former.

In the drawings, Figure 1, is partly a central vertical cross section and part in side elevation of my separator, showing the launder in the position it occupies during the concentrating period. Fig. 2, is a detail top plan view of the spider and wedge mechanism for effecting movement of the launder, also showing a part of the hydraulic cylinder, and some small parts in section. Fig. 3, is similar to Fig. 1, but showing the separating vessel all in side elevation and the launder elevated to the position it occupies during the unloading period, and showing other parts in appropriate positions for that period. Fig. 4, is a cross section of a part of Fig. 1, on line A—A, of Fig. 1, looking in the direction of the arrows, but omitting the wedge mechanism. Fig. 5, is a vertical transverse section of a portion of the lower part of my separator, in line through the slot in such part, also showing a portion of the wedge mechanism and its carrying agencies in side elevation. Fig. 6, is a detail longitudinal central section of a discharge plug enlarged.

In making my improved centrifugal ore separator, I provide a rotatable member 2, which is illustrated in the form of a vessel, and which serves as a separating vessel, having a closed bottom and open top. The bottom of the vessel has a central hub 3, that engages rigidly a shaft 4, which is mounted in journal boxes 5 and 6, respectively, to maintain it vertically. The vessel is rotated by a pulley 2′ adapted to carry a suitable driving belt (not shown). The journal box 5, is attached to the upper part of a suitable general supporting frame 7, and the box 6, is secured to the bed plate 8, of the separator, and the lower end of the shaft is stepped in the box 6, to carry its weight.

The separating vessel, is turned smoothly and concentric to its shaft or axis, and on its inner peripheral wall is a separating surface 9, over which the substance to be separated passes, as hereinafter described. The top or rim of the open end of the vessel is flanged outward, as shown and indicated by 10, which flange has an annular recess at its outer top edge, into which the depending peripheral part or edge of the plate shaped ring 11, is seated; this depending part being some greater in width than the depth of the annular recess in the flange 10, there is left between the ring and the flange, when the two are seated together, an annular space 12. The main part of the ring is made wide enough to extend inward some distance toward the axis of the vessel as illustrated, thereby partly closing the opening in the top of the vessel.

The separating vessel is preferably made with its walls and the separating surface inclined outward from its bottom to its top or open end, making it of greater diameter at this end, which is the discharge end of the vessel, and the plate or ring 11, extends a greater distance toward the axis than the extent of outward slant, or inclination of the wall of the vessel, so that the bore or opening of the ring is less in diameter than the inner diameter of the bottom of the vessel so as to hold a sufficient amount of liquid in the vessel to more than fill the separating passage and submerge the separating surface, when desired.

The ring 11, is held in place on the flange of the separting vessel by the screws 13, which pass through it and are threaded into the flange. This ring, around its outer diameter, through its depending part is provided with a row of screw-threaded holes, communicating with the space 12, into which are removably screwed discharge plugs or members 14, that are provided with small holes 15, shown best in enlarged sectional Fig. 6,

of suitable size to permit of desired discharge of liquid and material, yet to retain a sufficient quantity of liquid in the vessel to fill the separating passage and submerge the separating surface, as above stated.

Located inside of the separating vessel and with said vessel forming a separating passage 16, I provide a member to serve as a deflector, which preferably embodies a substantial non-elastic supporting element or portion 17, that I have illustrated in the form of a vessel, though this part may be any other suitable form of supporting structure. In most places in the specifications, I will refer to this supporting element as the deflector vessel. The deflector vessel has a closed bottom, and an open top, except that at its top is a ring 18, flanged or extended a desired distance inward toward the axis of rotation. This vessel is somewhat smaller in diameter than the inside of the separating vessel 2, thereby leaving the separating passage 16, adjacent to the separating surface; it is also somewhat shorter than the inside of the separating vessel, and has a central hub 19, which securely and rigidly engages the lower portion of a sleeve 20, that is mounted in a rotatable manner around the central shaft 4. The lower end of the sleeve 20, rests in a rotatable manner on the upper end of the hub 3, and is suitably proportioned to hold the bottom of the vessels 2 and 17, apart sufficiently to leave a comparatively small space 21, between them, as shown. The upper end of the sleeve 20, is provided with a pulley 22, by which the sleeve with the deflector may be revolved differentially to the separating vessel, by means of a suitable belt (not shown) from an appropriate source of power. Around the hub 19, of the deflector, I provide a ring 23, which rises above the bottom of the deflector vessel, and forms a feed chamber 24. This ring, which I will term a feed ring, has a central opening at its top, sufficiently larger than the outer diameter of the hub 19, to leave a suitable annular space around the hub, through which liquid and material, as well as concentrate-removing water may be introduced into the feed chamber 24, by means of a feed pipe 25. The feed ring in this instance is formed integral with the deflector vessel. Near the outer wall of the feed chamber 24, are provided a number of holes 26, through the bottom of the deflector vessel, which serve as material and liquid passages from the feed chamber down into the space 21, whence such material and liquid, actuated by centrifugal force, are driven into the separating passage, where separation or concentration takes place.

The deflector member, in addition to the deflector vessel, which serves as the supporting part or element 17, embodies an expansible and contractible element 27, which I will term an expansible element, and is in the nature of a covering or jacket, secured to and supported by the deflector vessel. This latter element serves the office of generating a frictional wash in the separating passage to assist in separation and of regulating the size of the separating passage, which facilitates bedding of the concentrates as they are separated. This expansible element also assists in intermittently removing and discharging such bedded concentrates. As means for introducing water into the deflector vessel to effect expansion of the element 27, to facilitate such removal of bedded concentrates, I employ a pipe 28, which is held by a brace 29.

It will be understood that both the tailings or waste material and the separated concentrates are discharged from the separating vessel through the same discharge holes in the several plugs 14, but at different times; the former during the loading or concentrating period and the latter during the unloading period, and between these periods it is usually advantageous to remove, discharge and collect separately a comparatively small intermediate or middlings product, which is largely made up of the material in transit through the separating vessel at the time and immediately after the flow of pulp to the vessel is discontinued preparatory to unloading concentrates. As means for catching and receiving the tailings or waste, the middlings and the concentrates products separately, while being discharged from the separating vessel, and to deliver them separately for further disposition, I provide a suitably shaped, preferably metal launder 30, having several separate compartments, being a multi-chambered receptacle—in this instance I have provided three of such compartments,—as indicated by 31, 32 and 33, which are intended and adapted to receive the tailings, middlings and concentrates, respectively. Each of these compartments is provided with an annular opening in the direction toward the axis of the vessel and is of size and is suitably located relatively and with relation to the several discharge plugs 14, in the vessel, so when the launder, during operation, is moved to its different positions, as hereinafter described, materials being discharged from the vessel will be delivered into the particular compartment desired to receive it. Each of the compartments in the launder is provided with discharge passages through its respective spout 34, 35 and 36, for the separate flow of material or water from the different compartments. As means for moving the launder in positions so each of the compartments will catch the particular materials intended for it, I provide rods 37, (in this instance there are four rods) which are attached to the lower or under part of the launder and ex-

tend them down through the bed plate 8, some considerable distance, where they each pass through the end portion of an arm of a suitable spider 38. The rods pass through guide posts or parts 39, in a travelable manner, which posts are suitably located on and attached to the bed plate of the separator, so as to form guides to the rods and assist in keeping them in alinement and in position. The lower end portions of the rods are made somewhat smaller in diameter than the upper portions, and are provided with screw threads, having nuts 40, on them, which rest on the upper sides of their respective arms of the spider, so as to not only serve to support the rods and launder, but also as facility through which the distance between spider and launder may be adjusted. The spider at its central hub portion, rigidly engages a comparatively short shaft 41, which extends down in a reciprocatory manner into the bore of the lower or hub portion 42, of a substantial depending bracket 43, which is rigidly secured at its upper end portion, to the under side of the base plate of the separator. This bracket serves as means for maintaining and guiding the shaft 41, in desired position, and in alinement, and the shaft, in turn, serves the same purpose for the spider part, 38. The hub portion 42, of the bracket is provided with ears 44, extending outwardly on two of its diametrically opposite sides, and between the ears is a slot which extends through the hub as illustrated, up a suitable distance above the ears to serve the purposes intended, which position is best shown in Figs. 4 and 5. There is in like manner a slot through the lower portion of the shaft 41, which is approximately the same width as the slot in the hub, and registers with that slot. Between the ears 44, approximately located, and of suitable size, are rollers 45, maintained in place by pins 46, and within the slot of the shaft 41, appropriately located, is a roller 47, maintained in place by the pin 48.

As means for effecting reciprocation of the shaft 41, with its spider 38, and the rods 37, as well as their superimposed launder, I provide a bar 49, of suitable size and thickness, having its lower edge straight, even and smooth, and being provided on its upper edge or side, with multiple wedge shaped portions 50 and 51, and with an interposed straight portion 52, between the wedge shaped portions. The bar 49, is adapted to be slid or traveled through the slots in the hub and shaft 41, by passing over the rollers 45, and under the roller 47, so that the bar will support the shaft 41, and its connected parts through contact of the roller 47, on its upper edge, and further, these parts will be traveled upward and be permitted to travel downward to conform to the surface contour of the wedges 50 and 51, as the bar is moved lengthwise and the roller 47, rolls along the upper surface of these wedged shaped parts. To actuate or effect travel of this bar 49, I have provided a suitable hydraulic cylinder 53, with its piston rod 54, at one end, carrying a suitable piston head 55, while its other end extends out of the cylinder through an ordinary suitable packing box 56, and engages one end of the bar 49, as shown, so, as the piston rod is moved by hydraulic pressure in the cylinder, the bar 49, will be correspondingly traveled.

As means for holding the cylinder 53, in place I have provided a stay 58, having a T head 59, at one end, which I have secured to two of the ears 44, by screw bolts 60. The other end of this stay I have extended out a suitable distance and have screwed it rigidly to the cylinder, by screw bolts 61.

The hydraulic cylinder or member is provided with suitable water pipes 62, and 63, and these pipes are provided with branch pipes 64 and 65, adapted to supply water under pressure at desired times from any appropriate source; there are also branch pipes 66 and 67, provided, adapted to afford escape channels for water from the cylinder at desired times. These pipes are supplied with suitable valves 68, 69, 70 and 71, respectively, the valves being relatively placed so when the feed or pressure valve at one end of the cylinder is open the escape valve at that end, as well as the feed valve at the opposite end of the cylinder will be closed, and the escape valve at the opposite end of the cylinder will be open, thereby enabling actuating liquid under pressure to pass in one end of the cylinder and drive the piston head and rod in a direction from that end while liquid is escaping from the opposite side of the piston head, and vice versa by the reverse movement of the valves. These valves are provided with handles 72, 73, 74 and 75, which are located relatively to be coupled to a rod 76, as shown, so that by movement of this rod, all of the handles will be moved at the same time, and movement of the piston rod, actuating the bar, will be had when and in the direction desired, depending on which way the rod 76, is moved; I prefer however for best convenience that the valves be located so movement of the rod 76, upward, will effect raising of the launder.

The height of the wedges, and the distance or spacing between the centers of the openings of the several compartments in the launder are intended to be substantially the same so the vertical movement of the launder, caused by the travel of the wedges, will be proper and the wedges will be adapted to move the launder so these annular openings will be in suitable alinement to receive materials being discharged through the plugs 14, from the separating vessel.

There are handles 77 and 78, provided on

valves 79 and 80, that govern the flow of pulp and concentrate removing water respectively, in branch pipes 81 and 82, for supplying the feed pipe 25, to the separating vessel, these several valves and handles are relatively located and hinged to a fulcrumed lever 83, through a connecting link 84, so that when one valve is open, the other is closed, and by predetermined movement of the lever 83, the valves assume an opposite position. The lever 83, is fulcrumed at 85, to the frame work of the separator, and has its opposite end suitably hinged at 86, to the launder as illustrated, in relative position so that the valves are appropriately and automatically opened and closed by and through the movement of the launder, to introduce pulp for separation and concentrate-removing water at the appropriate times with respect to the position of the launder. These movements are preferably so that the compartment 31, will catch the tailings, while pulp is being fed to the vessel: the compartment 32, will receive middlings immediately after stoppage of feed of pulp, and the compartment 33, will receive concentrates while concentrate-removing water is being introduced, and the vessel unloaded.

In operation, the separating vessel is rotated at a sufficient speed to develop the high degree of centrifugal force required to retain the concentrates on the separating surface, and the deflector is rotated at a sufficiently different speed to enable the expansion element, through travel differentially to the separating surface to create a washing or liquid scouring friction sufficient to wash and keep the waste substances moving to discharge, while the concentrates accumulate in a bed on the separating surface; the rod 76, is then moved downward, shifting its attached valve handles, resulting in the hydraulic member, or hydrostatic agencies traveling the wedges outward, withdrawing them to their full extent and lowering the launder to its lowest operating position adapted to receive tailings from the separating vessel, in the compartment 31, which is intended for them. By this movement of the launder, the pulp feed valve 79, is opened through its connection with the launder, by the lever 83, and the concentrate-removing water valve 80, if open, is, by the same means, closed. By opening of the pulp feed valve pulp in a state appropriately dilute is introduced to the separating vessel in sufficient quantities to form and maintain a desired body (mostly liquid) therein to fill the separating passage and submerge the separating surface as well as to supply the appropriate volume to pass through the separating passage for separation and to progressively accumulate the desired lode or bed of concentrates; after this condition has prevailed until the separating vessel is sufficiently loaded with concentrates, the rod 76, is moved upward, which moves the water governing valves to the cylinder and through hydraulic pressure, effects movement of the piston in the cylinder, thereby actuating the wedge carrying means, entering the wedge 50, under the roller 47, and lifting the launder till the time when the roller 47, has reached and is passing over the interposed straight portion 52, when, and during the time the roller 47, is traveling over the interposed straight portion, the launder will remain at rest. At this time the launder has reached a position adapted for the compartment 32, to receive material discharged by the separating vessel,—it being the time when middlings are being discharged;—through this movement, the launder also having closed the pulp supply valve, tailings have ceased to be discharged. If desired some water may, during this time, be introduced to the vessel to cleanse the surface of the bedded concentrates and assist in removal and discharge of middlings, this however will be continued for but a comparatively short time before the hydraulic member in its course of travel, will drive the wedge 51, under the roller 47, and move the launder upward to its fullest extent, in position so the compartment 33, will receive material from the separating vessel. By this last movement of the launder, the concentrate-removing water valve will be opened through the lever 83, so that comparatively clean water will be introduced in the vessel, and the rotating speed of the vessel should then, by any desired suitable means, be considerably decreased to sufficiently reduce the retaining centrifugal force acting on the concentrates, thereby enabling the clean water to dislodge and carry the concentrates to discharge from the vessel, to be caught in their appropriate compartment in the launder, which at this time is in position to receive them. It will be seen that the bar or member carrying the alternate wedge-shaped and straight portions serves as means for moving the launder or multi-chambered receptacle into positions successively to receive the tailings, middlings and concentrates in their respective chambers, and at the straight portions, of effecting a state of rest of the receptacle at such several positions. After the concentrates have been discharged, the concentrating speed of the vessel should be restored and the rod 76, moved downward again, which will result in movement of the launder to its low position appropriate to catch tailings; this movement of the launder will also close off the flow of concentrate-removing water, and will open the pulp feed valve and result in concentration as before, and

the operation of the separator may be continued by successively repeating these cycles of movements.

What I regard as new and desire to secure by Letters Patent is:

1. In a centrifugal ore separator, the combination of a rotatable separating member adapted to intermittently discharge tailings, middlings and concentrates successively through the same openings, a vertically adjustable multi-chambered receptacle adapted to receive said tailings, middlings and concentrates in the order named, in their respective chambers, with hydraulically actuated reciprocable means carrying multiple alternate wedge-shaped portions and straight portions, adapted to actuate said multi-chambered receptacle, substantially as described.

2. In a centrifugal ore separator, the combination of a rotatable separating member adapted to intermittently discharge tailings, middlings and concentrates successively through the same openings, a vertically adjustable multi-chambered receptacle adapted to receive said tailings, middlings and concentrates in the order named, in their respective chambers, with hydraulically actuated reciprocable members carrying multiple alternate wedge-shaped portions and straight portions, adapted to actuate said multi-chambered receptacle, and means adapted to automatically temporarily arrest the movement of said reciprocable members intermediate their limits of travel, substantially as described.

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Witnesses:
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