P. F. PECK.

CENTRIFUGAL ORE SEPARATOR.

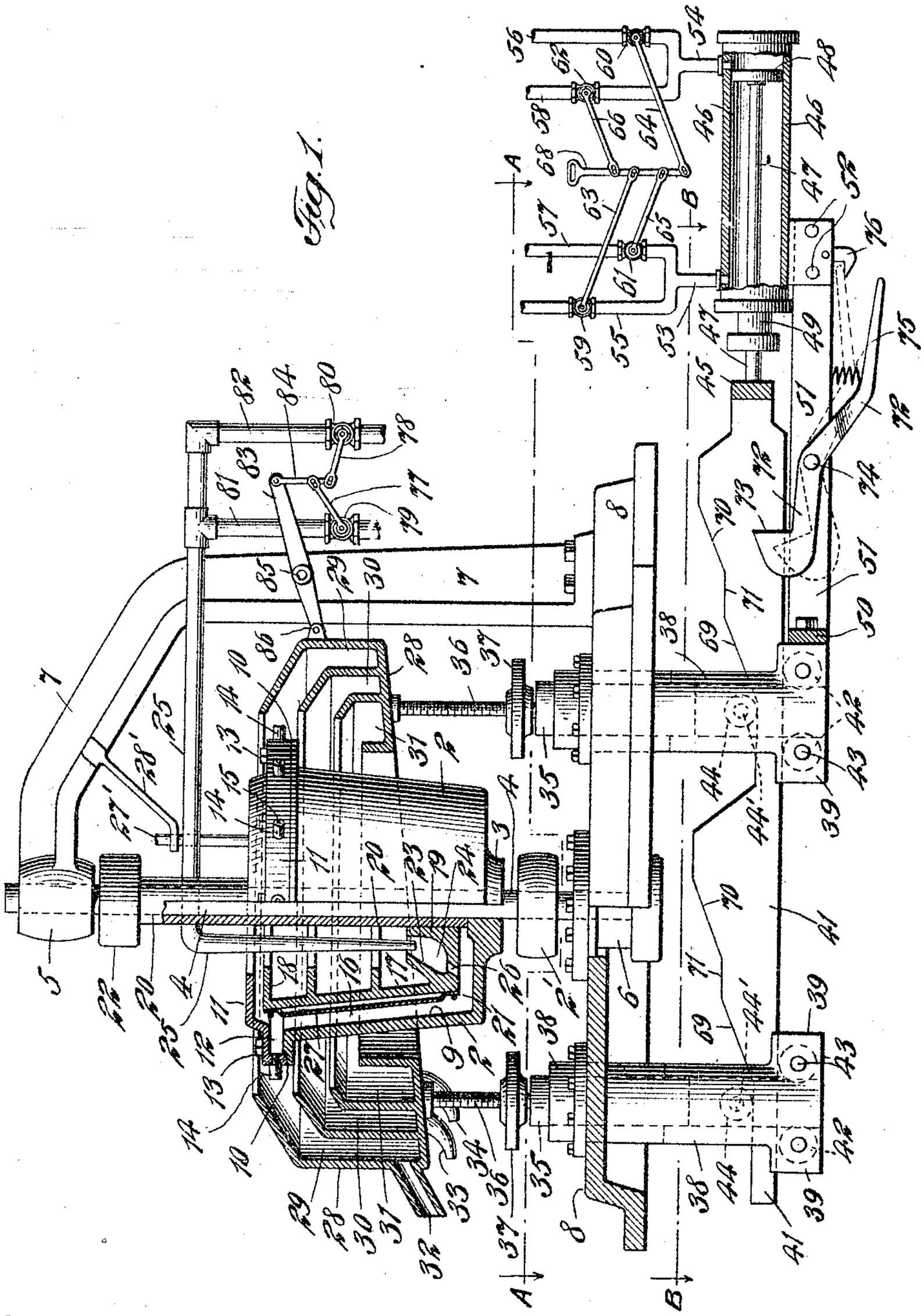
APPLICATION FILED MAR. 28, 1910.

981,680.

Patented Jan. 17, 1911.

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS—SHEET 2.

Fig. 2.

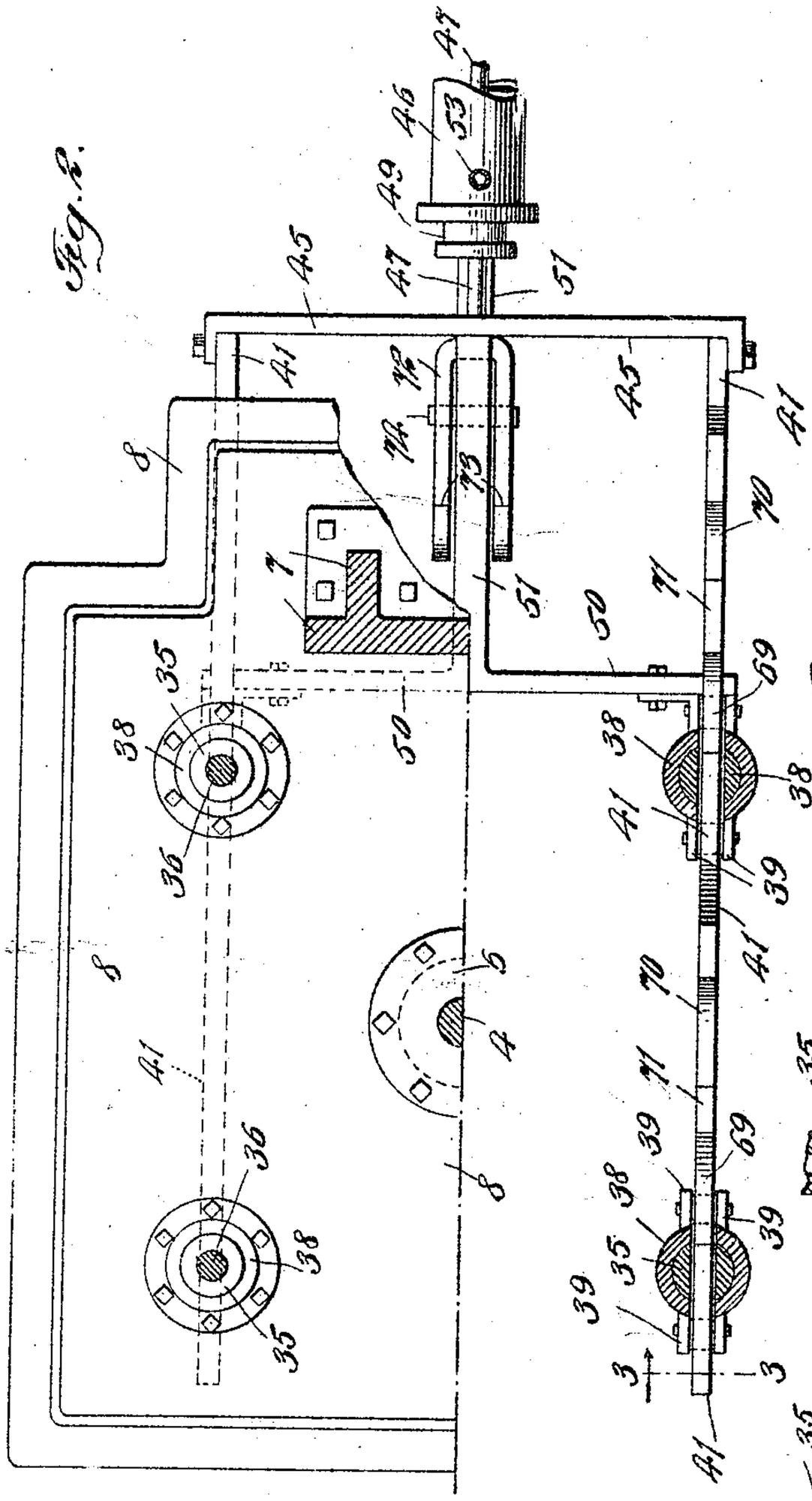


Fig. 6.

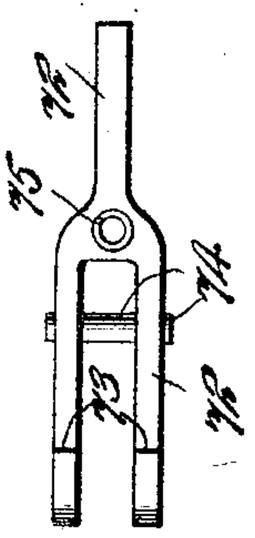


Fig. 5.

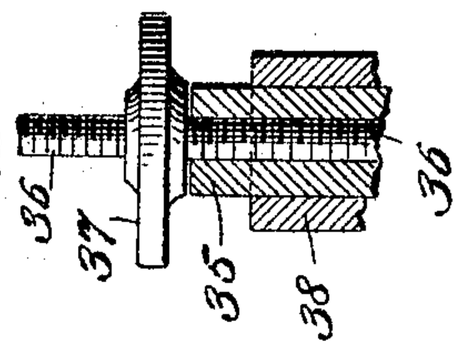


Fig. 4.

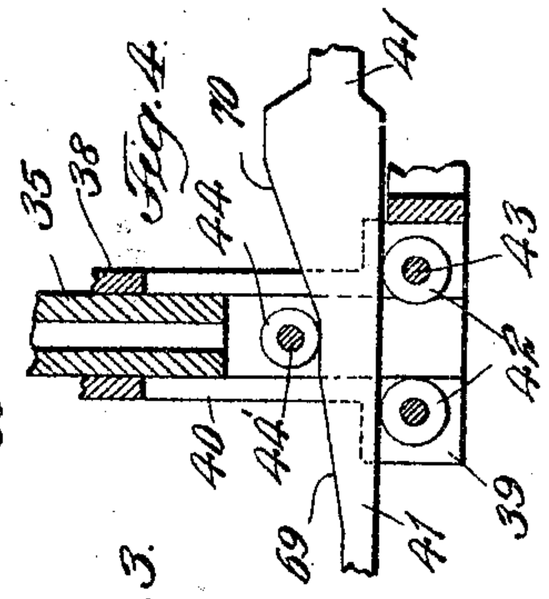
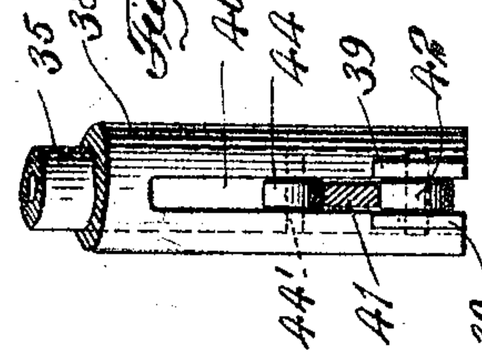


Fig. 3.



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3 SHEETS—SHEET 3.

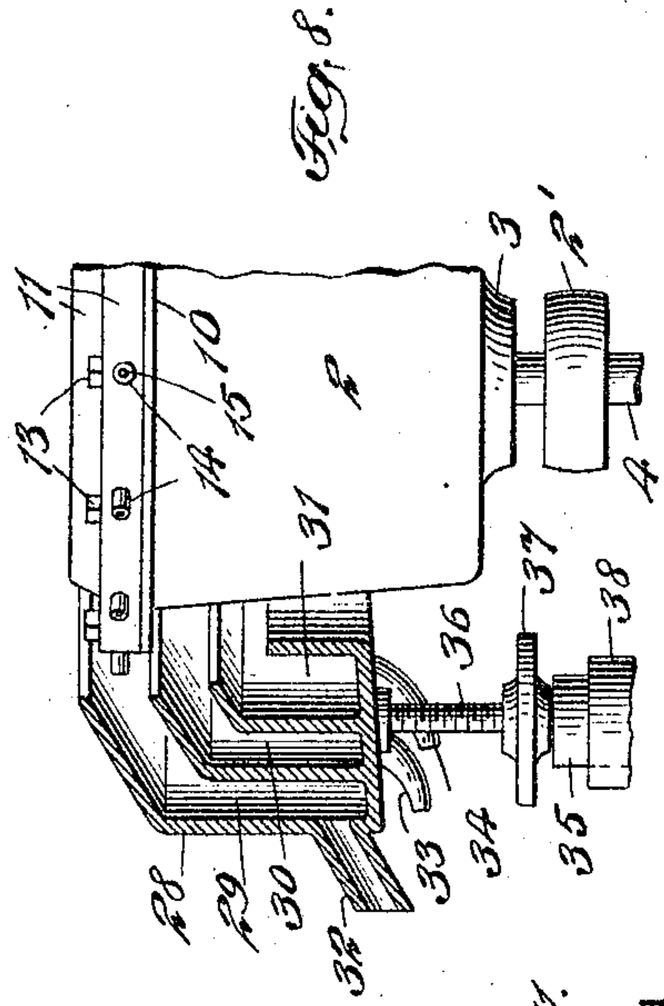

Fig. 7.

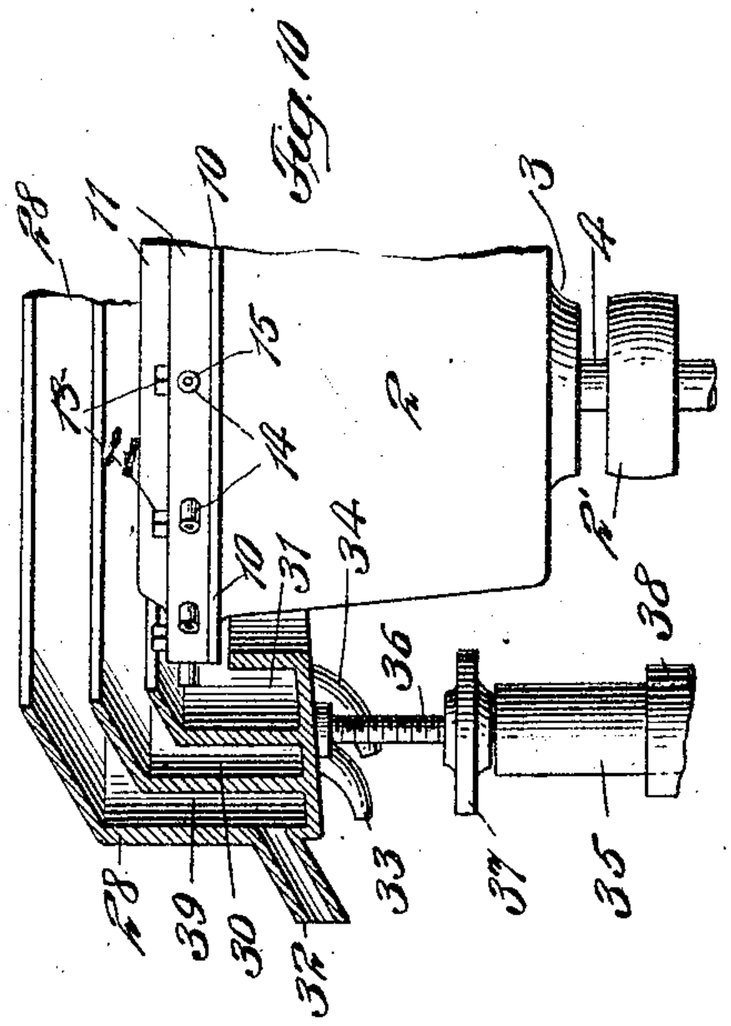

Fig. 10.

Fig. 11.

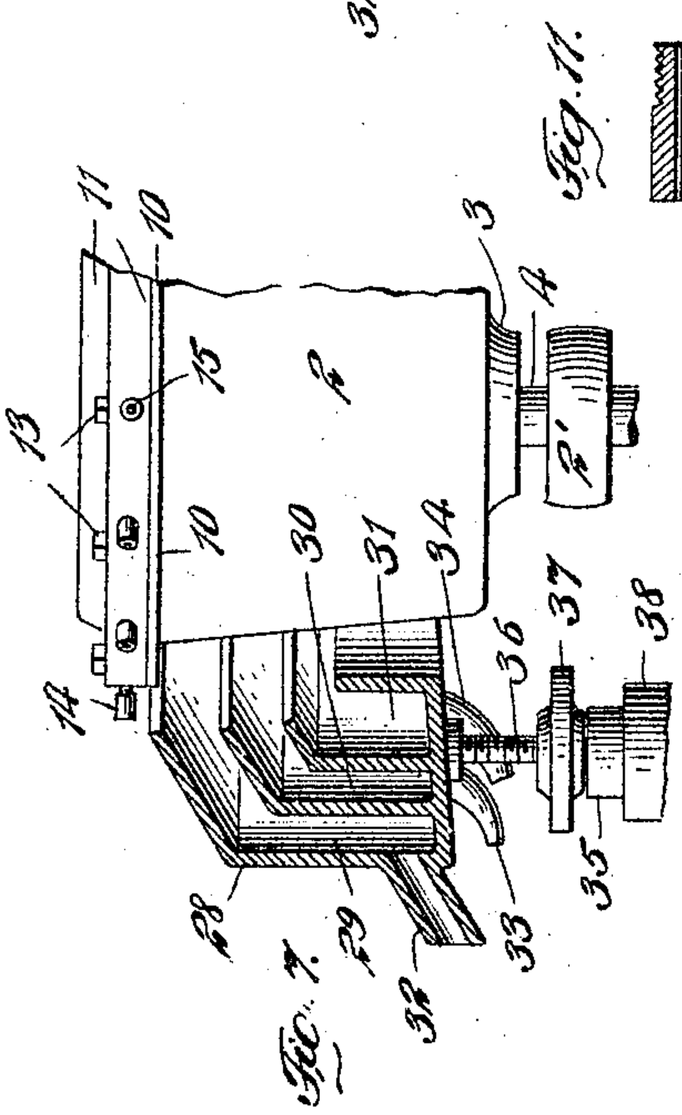

Fig. 8.

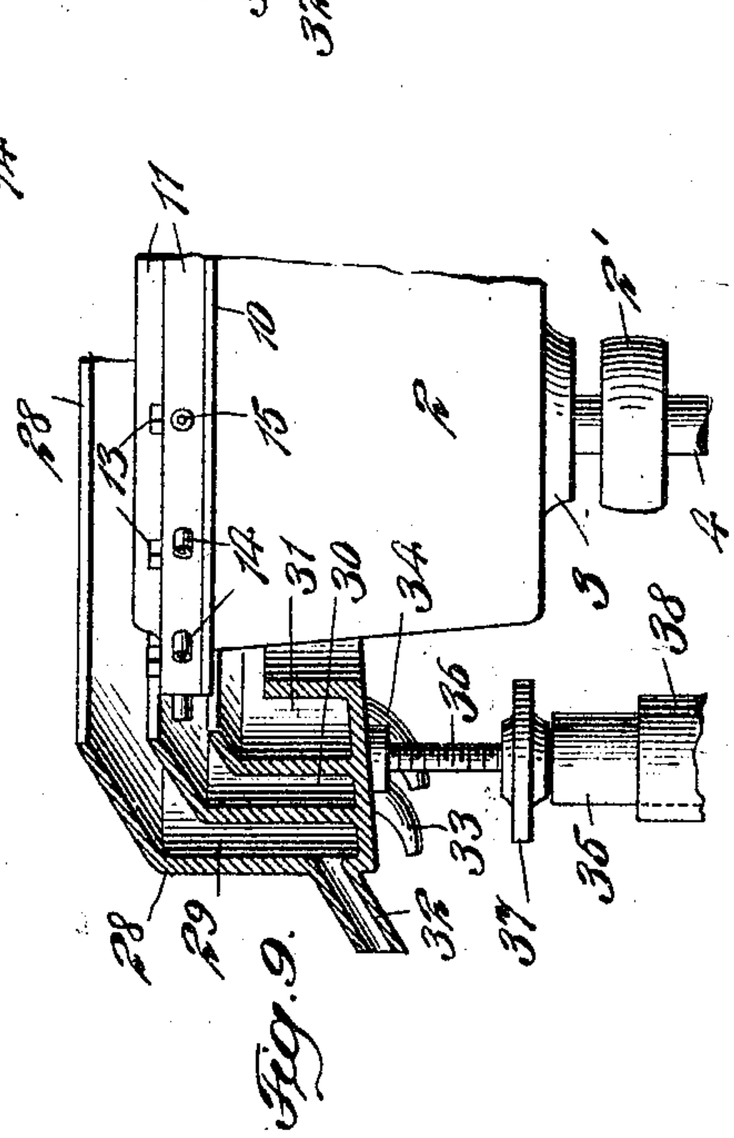

Fig. 9.

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UNITED STATES PATENT OFFICE.

PHILIP F. PECK, OF TACOMA, WASHINGTON.

CENTRIFUGAL ORE-SEPARATOR.

981,680. Specification of Letters Patent. Patented Jan. 17, 1911.

Application filed March 28, 1910. Serial No. 551,920.

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.

The objects of my invention are to make an improved centrifugal ore separating apparatus for separation of heavier from lighter particles in finely pulverized ores, and the like, while mixed with liquid, having better capability and more economic operation, of the general type in which a load or body of concentrates are alternately accumulated and then discharged, illustrated and described in my Letters Patent of the United States, Nos. 917120; 917121; 917122; and 917123, issued April 6, 1909, and to which belongs my pending application for centrifugal ore separators, Serial No. 554805, filed April 11th, 1910, cross reference to which is hereby made, in which is claimed in substance, a vertically adjustable multi-chambered receptacle in combination with a centrifugal separating member of the kind described and hydraulic and wedge shaped mechanism to effect adjustment, which is herein disclosed but not claimed, and my present inventions more particularly relate to the launder, its association with the separating vessel and the means for moving the launder into the several positions required.

In the drawings, Figure 1, is partly a side elevation and partly a longitudinal central section of my separator. Fig. 2, is partly a plan and partly a section on line A—A, of Fig. 1, looking in the direction of the arrows, and partly a section on line B—B, Fig. 1, looking in the direction of the arrows, also showing some parts in dotted lines, and a part of the base and frame broken away. Fig. 3, is a detail part taken on line 3—3, of Fig. 2, looking in the direction of the arrow, but showing the top portion in broken perspective. Fig. 4, is a vertical cross section of a part of a guide post and inserted column taken through the slots or cross channels, also showing part of the inserted wedge mechanism in elevation. Fig. 5, is a detail showing one of the hand wheels in elevation and some fragmentary adjacent parts, some of which are in central vertical section. Fig. 6, is a top plan of the forked lever partly shown in Fig. 2, detached. Fig. 7, is a side elevation of part of the separating vessel and some other parts, and a cross section of one side of the movable launder, shown lowered by the secondary means for that purpose, to a position below the zone of the discharge plugs of the vessel, rendering these plugs accessible, such secondary means embodying the hand wheel and associated parts, which are also shown. Fig. 8, is similar to Fig. 7, except that the launder is shown moved by use of the hand wheel, in position to receive tailings in their appropriate compartment. Fig. 9, is similar to Fig. 8, only the launder is moved in position to receive middlings in their appropriate compartments. Fig. 10, is similar to Fig. 9, only the launder is moved in position to receive concentrates in their appropriate compartment. Fig. 11, is a longitudinal central section of one of the discharge plugs showing the discharge hole or passage through it.

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 vessel 2, is turned smoothly and concentrically 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 edge of 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 somewhat 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 also 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, enabling when desired, a sufficient body of liquid to be retained in the vessel to fill the separating passage and submerge the separating surface.

The ring 11, is held in place on the flange of the 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 plugs or members 14, that are provided with small holes 15, shown best in enlarged sectional Fig. 11, 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 2, 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 specification, 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 pipe 25. The feed ring in this instance is formed integral with the deflector vessel. Near the 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 in regulating the size of the separating passage, which facilitates bedding of the concentrates as they are separated. The expansible element also assists in intermittently removing the concentrates after a desired bed has accumulated. As means for introducing water into the deflector vessel to effect expansion of the element 27, as explained in said Letters Patent, I employ a pipe 27′, which is held by a brace 28′.

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 28, having several separate compartments,—in this instance I have provided three of such compartments,—as indicated by 29, 30 and 31, 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 suitable size and location 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. The compartments in the launder are provided with discharge passages through their respective spouts 32, 33 and 34, for the separate flow of material and water from the different compartments.

As means for moving the launder into appropriate relative positions so each of the desired compartments will receive the particular material for it, I provide hollow supporting posts 35, having screw threaded rods 36, extending upward out of the opening in each of the posts, and passing through internally screw threaded hubs of hand wheels 37, which are in suitable accessible positions, resting on the upper end of the posts, as illustrated. The rods 36, are attached to the bottom side of the launder, thereby holding it in position as well as supporting its weight; the posts pass in a sliding or travelable manner, through hollow guide columns 38, which are suitably bored to nicely receive and hold the posts in place and in alinement, permitting them to be slid up and down as desired. There are preferably four of these columns 38, depending some considerable desired distance below the bed plate 8, as illustrated, to which they are secured, and preferably they have protruding wings or ears 39, at their lower ends, with slots between the ears, shown best in Figs. 2, 3 and 4, which slots extend a suitable distance up through the columns, where they are shown in Figs. 2 and 4, are indicated by the initialing numeral 40.

The posts 35, preferably extend down into the columns 38, to their bottom portions and each have a slot corresponding to and registering with the slot in its respective column, and the columns are in suitable relative position so that a bar 41, may be inserted and slid or traveled through both the slots in two columns and posts at the same time, as illustrated. In the slots between the ears 39, I have provided rollers 42, held in place respectively by pins 43, and in position to carry or support the bars 41. In each of the slots in the posts 35, I have provided a roller 44, somewhat above the rollers 42; and in position to rest and roll on the top side or surface of the respective bars, thereby serving as means to support the posts; the posts, in turn, serve as means, through the instrumentality of the screws 36, and hand wheels 37, to support the launder; the rollers 44 are held in place by pins 44′. As is illustrated, these bars or members 41, are preferably smooth and even on their lower sides, and are of suitable width and adapted to enter and be traveled through the slots 40, in the columns, and over, and be supported by the several rollers 42, and at the same time to pass through the slots in the posts and under, and to support the rollers 44, as above stated. There are preferably two of these bars or travelable members 41, each passing through the slots of two of the columns and posts, which are located in suitable relative alinement as stated to permit of this, and to enable and insure a concerted movement, the two bars are preferably secured together by a cross piece 45, as shown in Figs. 1 and 2. To actuate or effect travel of these bars, I have provided a hydraulic member or cylinder 46, with its piston rod 47, at one end, carrying a suitable piston head 48, while its other end extends out of the cylinder through an ordinary suitable packing box 49, and engages the cross piece 45, as shown, so that as the piston rod is moved by hydraulic pressure in the cylinder, the bars 41, will be correspondingly traveled.

As means for holding the cylinder in place I have provided a cross stay 50, best shown in Fig. 2, secured to the lower portions of two of the columns 38, and have extended a bar 51, from it to the cylinder, engaging the cylinder at 52.

The hydraulic cylinder or member is provided with suitable water pipes 53, and 54, and these pipes are provided with branch pipes 55, and 56, adapted to supply water under pressure at desired times from any appropriate source; there are also branch pipes 57, and 58, provided, adapted to afford escape channels for water from the cylinder at desired times. These pipes are supplied with suitable valves 59, 60, 61 and 62, 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 63, 64, 65 and 66, which are located relatively to be attached to a rod 68, 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 bars 41, will be had when and in the direction desired, depending on which way the rod 68, is moved; I prefer however for best convenience that the valves be located so that movement of the rod 68, upward, will effect raising of the launder.

As is most clearly illustrated in Fig. 1, the upper surfaces or edges of the bars 41, are provided with multiple wedge shaped or inclined portions 69, and 70, and with straight portions 71, interposed between the wedge shaped portions; the straight portions have their surfaces substantially parallel to the bottom sides of the bars, and to the course of their travel. The wedge shaped portions, as well as the interposed, straight portions are so relatively located and are also located with respect to the rollers 44, in the different posts through which they travel, that the several rollers 44 will at the same time pass over the same relative portions of the wedges or straight portions, resulting during the time the wedge portions are traveling under the rollers, in movement of the posts relatively the same, carrying the launder up or down as the wedge movement may be, and during the time the rollers 44, are traveling over the straight portions 71, of the bars, the posts and launder will not be moved. The heights 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 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.

As means for temporarily stopping or arresting the travel of the bars 41, with their wedge mechanism at the time when the rollers 44, are passing over the straight portions interposed between the wedges, and thereby maintain the launder in position to receive middlings in the central compartment 30, I have provided a forked lever 72, (shown in plan in Fig. 6,) having a shoulder 73, near one end, and being fulcrumed at 74, in position for this shoulder to engage and retain the cross bar 45, in its movement, and thereby stop the travel of the piston rod 47, and parts actuated by it until, through the extended opposite or handle end of the lever 72, the retaining shoulder is drawn downward out of engagement and releases the cross bar, which enables the piston and parts actuated by it, to resume movement to the limit of their travel. The movement of these parts is arrested only in the direction of entering the wedges, which accomplishes upward movement of the launder, and is uninterrupted in its travel in the opposite direction. The cross bar 45, in this direction passes over the shoulder end of the lever by diverting it downward. The spring 75, serves to hold the lever in its normal position for arresting the travel of the cross bar, and of restoring such position when the lever is diverted otherwise.

If it is desired to retain the launder in an intermediate position to receive middlings in its compartment 30, for only a comparatively short period during operation, this result may be had without stopping the travel of the piston and bars or wedge mechanism, from the fact that during the time the rollers 44, are passing over the interposed straight portions, the launder remains in a state of rest, and during this time, as above stated, the launder is in position to receive product from the vessel, in its intermediate compartment. These interposed straight portions, if desired, may be made of greater length than illustrated and thereby afford means by which movement of the launder may be intermittently stopped a proportionately greater length of time without stopping travel of the hydraulic actuating member and wedge mechanism.

To prevent the shoulder on the lever 72, from catching and stopping the travel of the cross bar 45, when not desired, there is provided a hook 76, Fig. 1, adapted to catch and hold the lever in position, as illustrated in dotted lines so its shoulder will be out of the range of engagement with the bar.

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 posi-

tion 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 such that the compartment 29, will catch the tailings, while pulp is being fed to the vessel; the compartment 30, will receive middlings immediately after stoppage of feed of pulp, and the compartment 31, will receive concentrates while concentrate-removing water is being introduced, and the vessel unloaded. These three positions of the launder are respectively illustrated by Figs. 8, 9 and 10, which also show corresponding different positions of the upper end of one of the posts 35. It will therefore be seen that the movement of the launder governs and controls the supply of pulp and water to the separating vessel.

It is necessary to occasionally remove the discharge plugs 14, from the separating vessel, by unscrewing them, for purposes of renewal or otherwise, and to enable access to them for this purpose I have more especially provided the screw rods 36, and hand wheels 37, which form means supplementary, to the movement of the posts 35, and the wedge mechanism and their hydrostatic actuating agencies, for conveniently lowering the launder below the zone of the row of discharge plugs 14, as illustrated in Fig. 7, bringing the plugs accessibly exposed above the top of the launder. In this figure one of these plugs is shown partly unscrewed for removal from the separating vessel, and in detail Fig. 11, one of the plugs is illustrated in enlarged longitudinal central section, clearly showing the discharge hole through it. To effect movement or adjustment of the launder by these supplemental means, irrespective of the wedge mechanism and their actuating agencies, the hand wheels are turned in the direction desired, and after the discharge plugs have been removed and restored so the vessel is ready for operation, the launder may be raised and adjusted to position to be properly moved and operated through the agency of the hydraulic cylinder and mechanism actuated by it.

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 68, is then moved downward, shifting its attached valve handles, resulting in the hydraulic member, 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 29, 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 load or bed of concentrates; after this condition has prevailed until the separating vessel is sufficiently loaded with concentrates, the rod 68, 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 wedges 69, under the rollers 44, and lifting the launder till the cross bar 45, engages the shoulder 73, of the lever 72, which stops the movement of the hydraulic member, and the travel of the wedges at the time when the rollers 44, are passing over the interposed straight portions 71. At this time the launder has reached a position adapted for the compartment 30, to receive material discharged by the vessel 2,—it being the time when middlings are 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 should be continued for but a comparatively short time before the shoulder 73, should be disengaged from retaining the bar 45, by pulling upward the handle end of the fulcrumed lever 72, so the hydraulic member will complete its course of travel, and drive the wedges 70, under the rollers 44, and move the launder upward to its fullest extent, in position so the compartment 31, 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.

After the concentrates have been discharged, the concentrating speed of the vessel should be restored and the rod 68, 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.

If it is desired to retain the launder in the intermediate or middlings receiving position a short enough period of time, the lever 72, may be drawn up at its handle end and engaged by the hook 76, to hold the shoulder 73, out of range of travel of the bar 45, so the launder will only remain in that intermediate position during the time the rollers 44, are traveling over the interposed straight portions 71. These interposed straight portions may be made of greater length if desired, thereby prolonging the period of rest of the launder at its intermediate position without the use of the shoulder on the lever 72, from the fact that at a predetermined speed of travel of the wedge carrying mechanism it will require a greater length of time for the rollers 44, to pass over the lengthened interposed straight portions.

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

1. In a centrifugal ore separator having a rotatable separating vessel provided with removable discharge members adapted to intermittently discharge tailings and concentrates, the combination of a movable launder having compartments adapted to receive tailings and concentrates separately, means for intermittently introducing pulp into the separating vessel, primary means adapted to move said launder into appropriate positions to receive the tailings and concentrates in their respective compartments, and secondary means interposed between said launder and said primary means adapted to move independently the launder below the zone of said movable discharge members, substantially as described.

2. In a centrifugal ore separator having a rotatable separating vessel provided with removable discharge members adapted to intermittently discharge tailings and concentrates, the combination of a movable launder containing compartments adapted to receive tailings and concentrates separately, means for intermittently introducing pulp into the separating vessel, primary means adapted to move said launder into appropriate positions to receive tailings and concentrates in their respective compartments, secondary means adapted to move the launder below said discharge members, embodying hand-wheel and screw-threaded mechanism interposed between the launder and said primary means, operable independently of said primary means and automatic means governed and operated by said launder adapted to stop the supply of said pulp while concentrates are being discharged from the vessel, substantially as described.

3. In a centrifugal ore separator having a rotatable separating vessel, provided with removable discharge members, adapted to intermittently discharge tailings and concentrates, the combination of a movable launder containing compartments adapted to receive said tailings and concentrates separately, means for intermittently introducing pulp and concentrate-removing water into the vessel, primary means embodying reciprocable supports, movable wedge-carrying mechanism and hydraulic agencies connected to the wedge carrying mechanism, adapted to move said launder into appropriate positions to receive tailings and concentrates in their respective compartments, and secondary means interposed between said reciprocable supports and said launder adapted to independently move the launder below said discharge members, substantially as described.

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Witnesses:
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