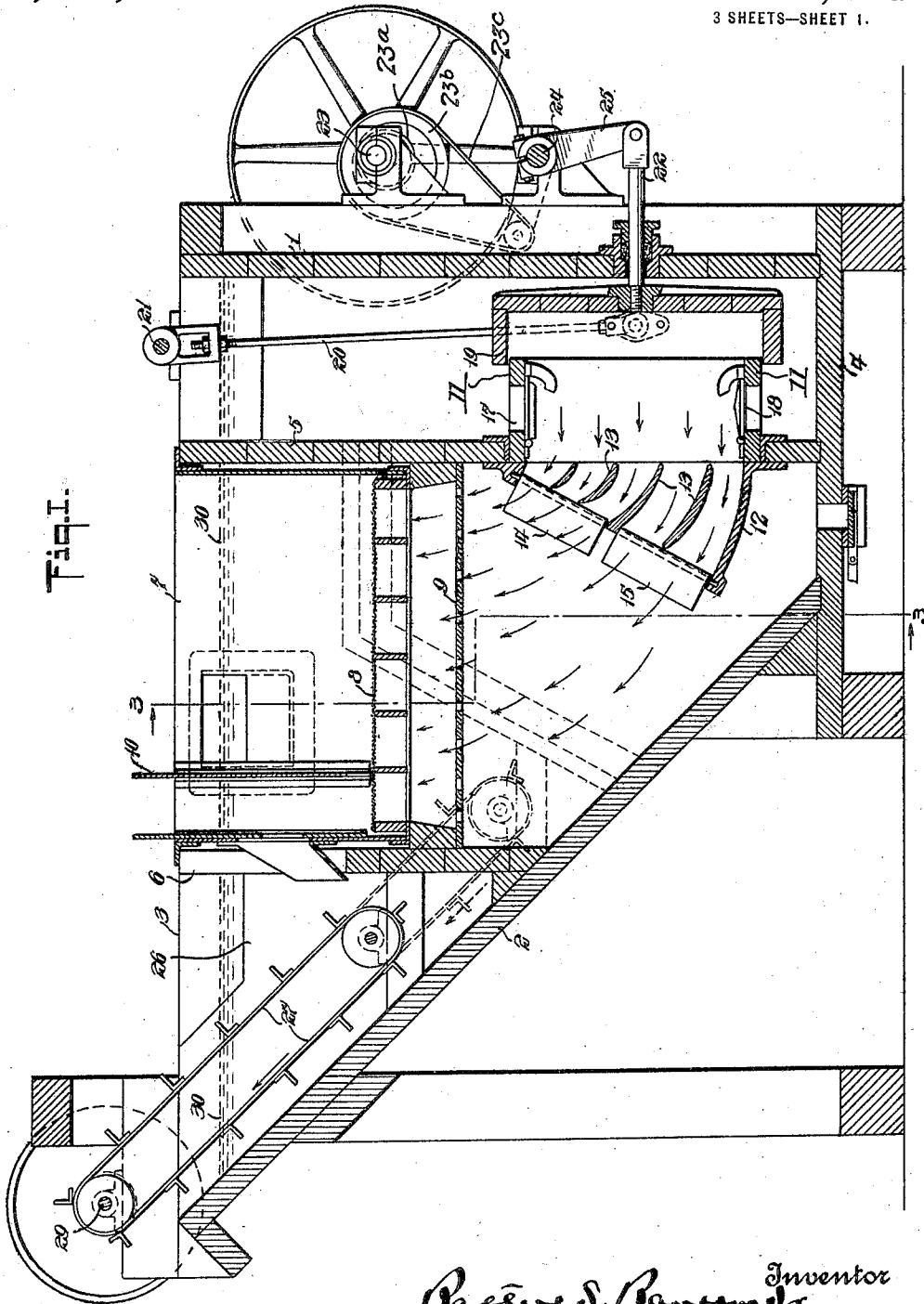


R. S. RANSOM, JR.
HYDRAULIC JIG SEPARATOR.
APPLICATION FILED APR. 2, 1920.

1,400,910.

Patented Dec. 20, 1921.

3 SHEETS—SHEET 1.



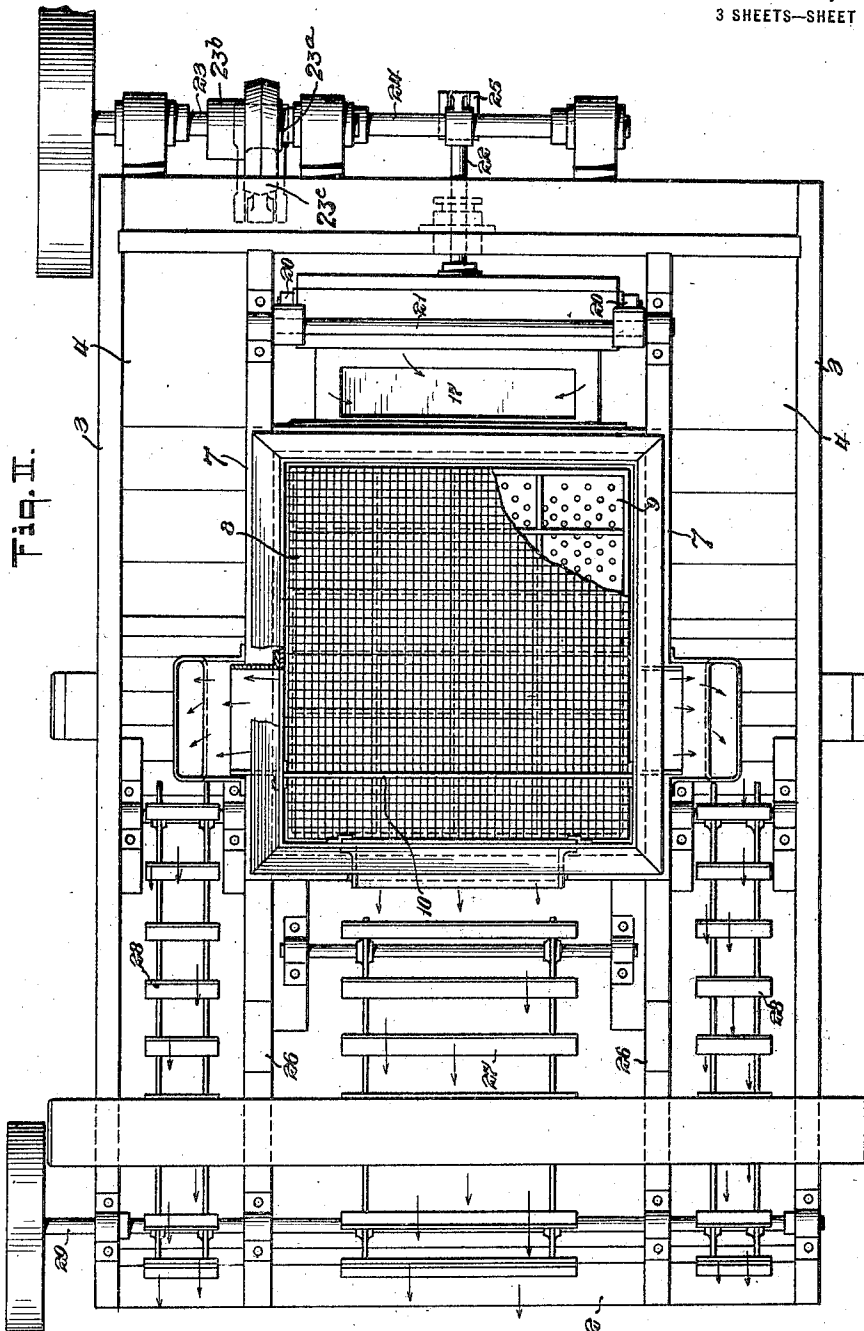
Ransom S. Ransom, Jr. Inventor
By his Attorneys
Dunn, Goodale, Morris & Scott

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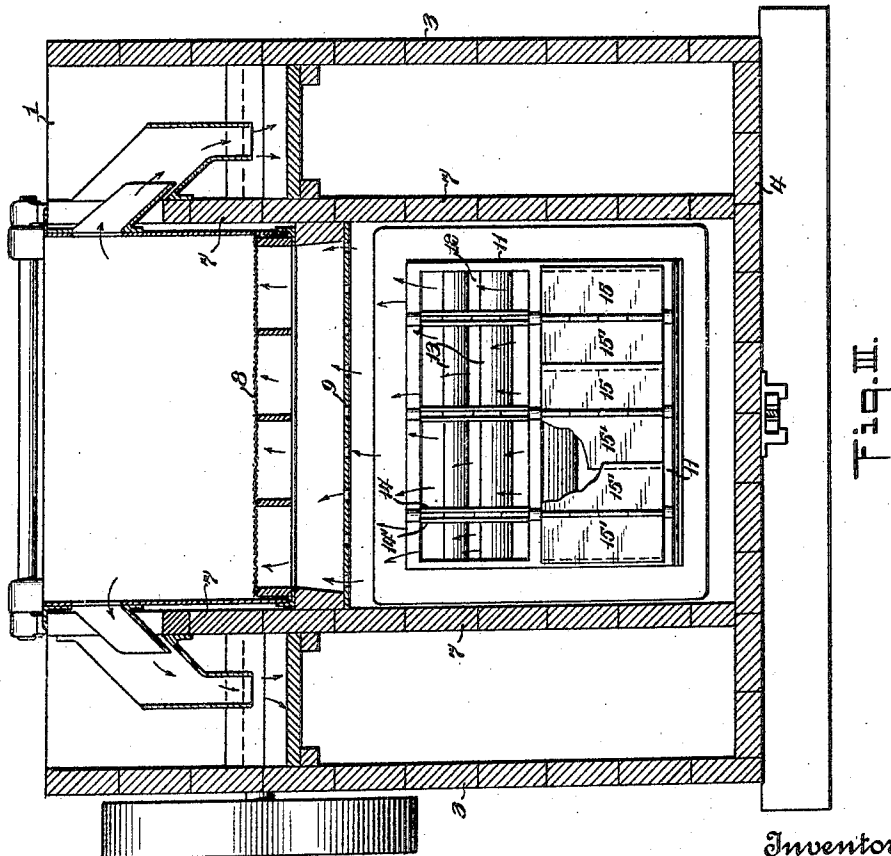
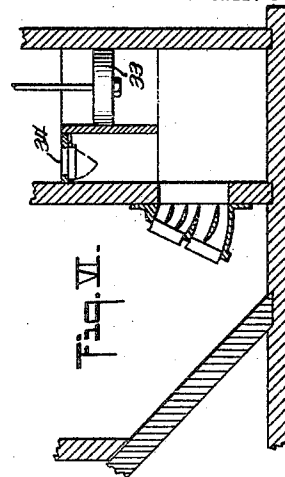
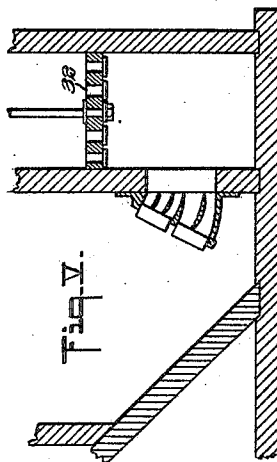
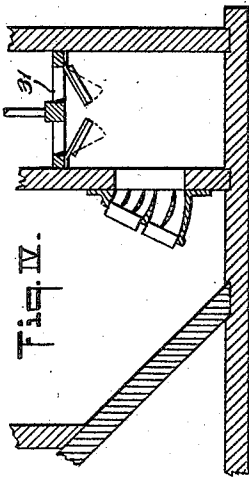
Dennis, Booklet, Harris, Scott

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3 SHEETS—SHEET 3.



Inventor

Ransom S. Ransom, Jr.
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UNITED STATES PATENT OFFICE.

RASTUS S. RANSOM, JR., OF NEWARK, NEW JERSEY.

HYDRAULIC JIG-SEPARATOR.

1,400,910.

Specification of Letters Patent.

Patented Dec. 20, 1921.

Application filed April 2, 1920. Serial No. 370,671.

To all whom it may concern:

Be it known that I, RASTUS S. RANSOM, Jr., citizen of the United States, residing at Newark, New Jersey, have invented a new and useful Hydraulic Jig-Separator, of which the following is a specification.

This invention relates to hydraulic jigs for separating mixtures of two (or more) materials that differ in specific gravity, such as ore mixed with gangue or other refuse. The application of the invention is not limited to any particular mixture of any two (or more) specific materials; but, for simplicity of explanation, one expression of the mechanical part of the invention will be described in detail, as applied to the separation of coal from the attendant refuse (slate, etc.); and such description will explain the new process also.

This expression of the invention is embodied in a hydraulic jig or separator in which successive impulses of water are forced, preferably upwardly, through the mixture of coal or refuse (or a mixture of ore and gangue, or of any other two or more bodies to be separated), by means of the reciprocations of a water-impeller which is preferably suspended like a pendulum to be reciprocated in substantially-horizontal direction, by any suitable power, and in which the same body of water is used repeatedly, in such manner as to entirely eliminate any suction or reverse current through the mixture, while acting uniformly and efficiently throughout the mass,—thereby avoiding the necessity for a large supply of water, reducing the amount of power required, increasing the durability of the apparatus, increasing the rate of output, and producing complete separation. The invention comprises the new improved apparatus for realizing the above-stated advantages.

One feature of the invention consists of an apparatus of the kind indicated, in which the same body of water is caused to circulate, and can be used repeatedly, with only such replenishment as may be desirable from time to time, thus dispensing with the necessity for a large and unfailing supply of fresh water.

Another feature of the invention consists of an apparatus of the kind indicated, which produces no suction or reverse flow of water through the mixture to be separated.

Another feature of the invention consists of providing, in the apparatus of the kind

indicated, means for insuring the application of the successive water-impulses (with more or less uniformity) throughout the entire area of the mass, and thereby eliminating any dead spaces, so as to produce rapid and uniformly-complete separation.

Another feature of the invention consists of the novel construction and arrangement of parts, whereby the mechanism will operate uniformly without intermittent strains upon the mechanism, resulting in greater durability of the parts, and requiring less power to operate the apparatus.

Another feature of the invention consists of employing a bellows-like pump or water-actuator in which a flat vertically-disposed water-impelling member is suspended like a pendulum to reciprocate in substantially horizontal direction, thereby entailing uniformity of movement and of strains upon the driving-mechanism, and requiring less power for actuation, and resulting in greater uniformity and power of the resultant water-impulses.

The invention further comprises various combinations of one or more of the above-enumerated features, and also the further features of procedure and of construction and arrangement hereinafter set forth and claimed.

The invention will be best understood by reference to the annexed drawings, which are given for the purpose of illustrating one particular embodiment of the mechanical portion thereof, and not for limiting the invention to what is shown and hereinafter described.

In this preferred embodiment, Figure I is a longitudinal vertical section through a tank containing a preferred form of mechanism for separating coal from the attendant slate and other refuse;

Fig. II is a plan view of the same tank and mechanism;

Fig. III is a transverse vertical section through the same, taken through the line 3—3 of Fig. I, and viewed from the front (left-hand) end thereof; and

Figs. IV, V and VI show, in longitudinal vertical sections, several modifications of certain details.

The foregoing drawings show a suitably-supported tank made up of the vertical rear-wall 1, through a packing-gland in which reciprocates the actuating-rod; the diagonal front-wall 2, over the end of which

the ultimate discharges pass; the vertical side-walls 3—3; and the floor 4, in which there is a gate-controlled outlet, for removing any particles of material that may have fallen to the bottom.

Located centrally of the tank, and inclosed therefrom, is the separating-compartment; at the rear (right-hand) thereof is the pumping-compartment, in free communication with the rest of the tank; and at the front, the discharge-compartments, the two compartments for discharging the coal extending along each side of the tank and serving also for the return-circulation of the water.

Said separating-compartment is inclosed by the rear partition 5, in the lower portion of which is secured the valve-controlled pump-tunnel (to be described later); the front partition 6, in the upper portion of which is a gate-controlled slate-discharging chute (to be described later); and the two side-partitions 7—7, each of which is provided at its top with a coal-discharging chute. Save for the aforesaid tunnel and chutes, the separating-compartment is thus completely inclosed from the rest of the tank by said partitions, which extend from the bottom to substantially the top of the tank. Said compartment is divided into upper and lower portions by means of a stationary horizontal screen or perforated plate 8, here shown as a meshed arrangement of rods or wires of suitable size and spacing, resting upon a plurality of parallel beams carried by the partitions of the compartment, and preferably located a few inches below the level of the lower or slate-discharging chute. If desired, there may be an auxiliary uniformly-perforated plate 9, located a suitable distance below said screen 8, to assist in producing uniformity of application of the successive water-impulses to the under surface of the mass lying upon said screen. In the upper portion of the separating-compartment, above the screen 8, is the vertical shield or partition 10, located between the coal-discharging chutes (on each side) and the slate-discharging chute. Said shield is indicated in Fig. 1 as mounted in vertical guideways, so as to be adjustable vertically.

As stated, in the lower portion of said rear partition 5 is mounted the pump-tunnel. As here shown, this consists of a rectangular boxing 11 located within the pumping-compartment, and an upwardly-directed portion 12 located within the lower portion of the separating-compartment. As here shown, the width of this tunnel approximates the full width of the screen as nearly as structural considerations permit. The rear end of said tunnel is open; while at the front it carries a plurality of upwardly-disposed parallel bars, upon which doors 14—15, 14'—15', etc., are hinged in pairs, to open

outwardly. If desired, there may be two rows of such pairs of doors, as shown in Fig. 1.

Also, if desired, one or more upwardly curving deflector-plates 13 may be located within said upwardly-directing portion 12, to contribute in deflecting the water-impulses upwardly toward the screen 8. Said doors 14—15, etc., function as outlet-valves, which are readily opened and folded back-to-back by the water-impulses of the advance-stroke of the pump, and close by gravity and the difference of water-pressure upon the return-stroke. Suitable inlet-valves are located in any convenient position for admitting water from the main portion of the tank into said pump-tunnel. They are here shown as an upper valve 17, preferably of buoyant material such as wood, located in the upper wall of the tunnel-member 11; and a lower valve 18, preferably of a heavier material such as metal, located in the lower wall of said member. A suitable stop, as indicated in Fig. 1, may be provided for each of said inlet-valves; and both sets of valves, inlet and outlet, may be provided with suitable packing-material such as rubber. The water-impelling member 19 is here shown as a flat member, located vertically before the mouth of the tunnel 11, and suspended from above like a pendulum, and surrounded by a forwardly-projecting rim which conforms to the shape of the tunnel 11, and is of a size to telescope freely over the latter. Said water-impeller 19 is suspended by means of two rods pivoted thereto at their lower ends, and each adjustably secured at its upper end to a stirrup upon the transverse horizontal shaft 21, which is supported in any convenient manner. Through the above-mentioned packing-gland, in the rear wall 1, extends the actuating-rod 22, secured to the water-impeller 19 at its inner end (if desired, by means of a curved slot, not shown) and at its outer end reciprocated by any suitable means. Preferably, however, the actuating-mechanism comprises: a power-shaft 23 suitably journaled upon the rear end of the tank and rotated as by means of a belt-pulley; a rock-shaft 24 suitably journaled parallel to said shaft 23, and carrying a crank-arm 25 coupled to said actuating rod 22; and suitable means for converting the continuous revolutions of said power-shaft into reciprocations of said rock-shaft. As shown, said means comprises the well-known "double eccentric" device, whereby the length of the strokes of the water-impeller can be varied at will. As here shown, this adjustable device comprises the inner eccentric-disk 23^a keyed or otherwise made fast on said power-shaft 23, the outer eccentric-disk 23^b adjustably secured around said disk 23^a and the usual eccentric-strap 23^c which engages a transverse boss or bearing carried

by a second crank-arm on said rock-shaft 24. By rotary adjustment of said double eccentric, the extent of movement of the two reciprocating crank-arms, and thereby the extent of throw of the actuating-rod and the water-impeller, can be adjusted at will.

As will be manifest, the fact that the width of the impeller and of the tunnel approximates the full width of the screen, entails the application of the water-impulses to the screen with undiminished force, said impulses not spreading out on each side and thereby losing power; and the additional facts that the member 12 has an upwardly-directing conformation, that the deflectors 13 likewise direct the impulses upwardly, and that the valves 15 open into vertical planes, all tend to the directness and uniformity of the application of the water-impulses against the screen and its superincumbent mass, and prevent any dead spaces in the latter.

Directly in front (at the left) of the separating-compartment, is the refuse-discharging compartment, separated from the two coal-discharging compartments (located on each side of the tank) by partitions 26—26, rising from the bottom of the tank but terminating sufficiently below the level of the water therein to permit the water to pass freely over their top from one compartment to the other. Suitably mounted in each of the three discharge-compartment is a suitable or any desired form of conveyer, such as 27 and 28—28, driven from any suitable source of power, as through the power-shaft 29 with its belt-pulley, which is preferably driven from the same source of power that actuates the first-named power-shaft 23.

To operate the apparatus: The tank is filled with water to approximately the level indicated at 30; the gate of the lower or slate-discharging chute is closed; the shield 10 is raised a suitable distance from the screen 8, according to the size of the articles to be separated; and the power is turned on to reciprocate the impeller 19, and a succession of powerful impulses (of the desired frequency) is thereby forced up through the screen 8. Thereafter the mixture to be separated, such as coal and slate, is introduced into the separating-compartment in any convenient manner, as by a suitably-supported hopper (not shown). The mixture, consisting of irregular lumps or pieces (hereinafter termed "particles"), accumulates in a mass upon the screen 8; and the recurring water-impulses force said particles upwardly, the comparatively lighter coal rising higher and then settling back more slowly, while the comparatively heavier slate rises less high and settles back more rapidly, until in the course of operation the slate has bedded itself directly upon the screen, (with little or no coal), while the coal (with little

or no slate) occupies a higher layer, resting upon the bed of slate-particles. This condition exists on both sides of the shield 10, inasmuch as the weight of the accumulated mass, together with the surging action of the water-impulses, has caused the lowermost particles (slate and coal) to advance along the screen and through the opening afforded by the lifted shield 10. After the slate has thus bedded itself, the gate is opened, and the slate (with such coal as may have accumulated in front of the shield) is permitted to escape into the slate-discharging compartment, whence it is carried over the end of the tank, as by conveyer 27, and dropped into cars or otherwise disposed of; and, if desired, such coal as may previously have accumulated beyond the shield 10 may be withdrawn and thrown back into the separator before opening the slate-chute. Meanwhile the coal-particles have been brought to the top, and are passing out through their discharge-chutes into the two discharge-compartments on each side of the tank, whence said coal is carried, as by conveyers 28—28, to be delivered at the front of the tank into suitable cars. And during all the foregoing, the water has been passing out through the two coal-chutes and subsequently through the slate-chute also, whence it passes back to the rear and enters freely into the pumping-compartment to be drawn through the inlet-valves 17—18, and again forced upwardly through the mass, the advance-stroke of impeller 19 holding said inlet-valves closed and opening the outlet-valves 14—15, and folding them back out of the way, while the upward deflection of tunnel member 12 aided by the upwardly-curved deflector-plates (when present) direct the water-impulses upward toward the screen, and the auxiliary perforated plate 9 (when employed) still further converts this movement into a practically-vertical movement whose impulses are distributed quite uniformly throughout the entire area of screen 8 and of the mass lying thereon. After the run has thus been established, all that is necessary is to continue introducing the mixture while applying the power, and to introduce such additional water as may be desired from time to time.

The extent of the opening provided by lifting said shield 10, may be increased or diminished at will, according to the largeness or smallness of the pieces or "particles" of the heavier body to be separated from the mixture. The length of stroke of the actuating rod 21 and of the water-impeller 19, may likewise be increased or diminished at will, by means of the double eccentric on the power shaft, according to whether there be greater or less difference between the respective specific gravities of the bodies to be separated. The frequency of the stroke and

of the water-impulses may, of course, be varied at will, if desired, by controlling the source of power itself.

Unlike hydraulic jigs heretofore known to this inventor, variations in the rate of supplying the mixture, do not affect the operation of this new machine or interfere with the rapid output of completely-separated product; nor do variations in the specific gravity of either (or both) of the constituent bodies; and even actual cessation of the supply of the mixture does not cause any trouble. Nor is a large and constant supply of water requisite, but only such replenishment as may be needed from time to time. Moreover, inasmuch as the opposition to the substantially-horizontal movement of the submerged impeller 19 is the same in both directions of its movement, there is no difference in the power required, and no variation of strain upon the parts.

There is sometimes occasion to separate a mixture of more than two bodies, say three, having respectively different specific gravities. In case the specific gravity of the intermediate body is nearer to that of the heavier body, the above-described process and machine will be utilized for separating out the lightest of the three, delivering it over the top of the separating-chamber, and discharging the remaining mixture of the other two at the bottom thereof; and said remaining mixture may thereafter be submitted to the separating action of the same or another similar machine, or preferably to a tandem separator as hereinafter indicated. On the other hand, in case the specific gravity of the intermediate body be nearer that of the lighter, then the above-described apparatus may be employed to discharge at the bottom the one heavier body while delivering at the top the mixture of the two lighter bodies, which mixture may thereafter be submitted to the same or a similar apparatus, or preferably the above-mentioned tandem apparatus may be employed for the three-fold mixture. Such tandem apparatus consists merely of the co-ordination and arrangement within the same tank of two of the above-described combinations of separating-chamber and pumping-device, but with the top of the second separator located below the discharge-chutes of the first one, so that the run will pass by gravity through the two devices in tandem relation. Inasmuch as the parts constituting such tandem apparatus are otherwise constructed and arranged as above set forth, further description is unnecessary.

In Figs. IV-VI, a similar tank and pumping-chamber are indicated, with a more or less similar pump-tunnel directed upwardly into the space below the perforated bed (not shown in these figures), and said

pump-tunnel is indicated as having the same or similar outlet-valves adapted to fold back together out of the way. But the water-impelling member is shown as disposed horizontally and reciprocating vertically. In Fig. IV, said impeller is indicated as a "clam shell" piston 31, which closes on the down-stroke and opens on the up-stroke. In Fig. V, the water-impelling member is indicated as a perforated piston 32, having for each perforation a valve which closes on the down-stroke and opens on the up-stroke. And in Fig. VI, the water-impelling member is shown as a solid piston 33 reciprocating vertically in a vertical passage, along with independently-located inlet-valve 34 which likewise closes on the down-stroke and opens on the up-stroke. In the preferred structure, as in each of the modifications, there are two sets of valves, inlet and outlet respectively, whereby suction or reverse flow of water through the mass is obviated.

A detailed description has thus been given of the invention, and of several modifications. But it must be understood that such description has been given solely for the sake of clearness; and that the invention is not limited to the construction and arrangement hereinabove set forth. Because features of the invention can be used to the exclusion of other features, and parts transposed or modified or admitted without in any case departing from the spirit of the invention. For example, one or more of the above-described valves can be located in some other position than as set forth, or the structure of such valves altered, or different means employed for applying the power, or for delivering the output; and, in general, various other changes may be made without departing from the spirit of the invention.

Having thus fully described the invention, what is claimed is:

1. In a hydraulic jig-separator, the combination of a tank, an upright separating-compartment located therein, and having a stationary horizontal perforated bed-plate such as a screen to support a mass of the mixture to be separated, and having also two discharge-chutes located at different levels above said screen, a gate controlling the lower of said chutes, a vertically-positioned and vertically-adjustable shield located above said screen and between the upper and lower chutes aforesaid, a horizontally-disposed and upwardly-directing pump-tunnel having suitable inlet-valves and affording communication from said tank into the portion of said compartment below said screen, outlet-valves for said tunnel adapted to occupy vertical planes when opened, a vertically-disposed water-impelling member suspended pendulum-wise in front of the entrance to said tunnel to be reciprocable

in substantially-horizontal direction, and means for reciprocating said impeller in strokes whose length is variable at will.

2. A hydraulic jig-separator comprising the combination of a tank having an upright separating-compartment, a horizontal screen dividing said separating-compartment into two chambers, two outlets located at different levels above the screen and both normally open during the run, a vertical shield positioned above the screen between the upper and lower outlets and leaving a passage between its lower edge and the screen, means including a reciprocable water-impeller for forcing water upwardly through said screen, means for preventing return-flow of the water through the screen, and a separate course for the return of water from the separating-compartment to the tank and in front of said impeller.

3. A hydraulic jig-separator comprising the combination of a tank having an upright separating-compartment, a horizontal screen dividing said separating-compartment into two chambers, two outlets located at different levels above the screen and both normally open during the run, a vertical shield positioned above the screen between the upper and lower outlets and leaving a passage between its lower edge and the screen, said shield being adjustable to vary the extent of the passage thereunder, means including a reciprocable water-impeller for forcing water upwardly through said screen, means for preventing return-flow of the water through the screen, and a separate course for the return of water from the separating-compartment to the tank and in front of said impeller.

4. In a hydraulic jig-separator, the combination with a tank, an inclosed separating-compartment located therein and supporting a perforated bed-plate such as a screen and provided with two discharge-chutes located at different levels above said screen, of a suitable pump-tunnel affording communication from said tank into said compartment below said screen, and a water-impeller therefor consisting of a flat vertically-positioned member pivotally suspended like a pendulum to reciprocate in substantially horizontal direction in front of the mouth of said water-chute.

5. In a hydraulic jig-separator, the combination with a tank, an inclosed separating-compartment located therein and supporting a perforated bed-plate such as a screen and provided with two discharge-chutes located at different levels above said screen and both normally open during the run, of a suitable pump-tunnel affording communication from said tank into said compartment below said screen, and a water-impeller therefor consisting of a flat vertically-positioned member pivotally suspended like a pendu-

lum to reciprocate in substantially horizontal direction in front of the mouth of said water-chute.

6. In a hydraulic jig-separator, the combination with a tank, an inclosed separating compartment located therein and supporting a perforated bed-plate such as a screen and provided with two discharge-chutes located at different levels above said screen, of a suitable pump-tunnel affording communication from said tank into said compartment below said screen, and a water-impeller therefor consisting of a flat vertically-positioned member pivotally suspended like a pendulum to reciprocate in substantially horizontal direction in front of the mouth of said water-chute, said tunnel and impeller being of approximately the full width of said screen.

7. In a hydraulic jig-separator, the combination with a tank, and an inclosed separating-compartment located therein and supporting a perforated bed-plate such as a screen and provided with two discharge-chutes located at different levels above said screen, of an upwardly-directing pump-tunnel having upwardly-directing deflectors and affording communication from said tank into said compartment below said screen, a suitable impeller for forcing water in successive impulses through said tunnel and screen, and means for preventing reverse flow through said screen comprising a separate course for the return of water from the separating-compartment into the tank and in front of the impeller.

8. In a hydraulic jig-separator, the combination with a tank, and an inclosed separating-compartment located therein and supporting a perforated bed-plate such as a screen and provided with two discharge-chutes located at different levels above said screen, of an upwardly-directing pump-tunnel affording communication from said tank into said compartment below said screen, and a suitable impeller for forcing water in successive impulses through said tunnel and screen, said impeller and tunnel being of approximately the full width of said screen.

9. In a hydraulic jig-separator, the combination with a tank and a separating-compartment supporting a screen and having a tunnel and another course for respectively passage of the water from said tank into said compartment and for passage back into said tank again, of a water-impeller operating at the entrance of said tunnel for forcing such circulation of water by successive impulses through said tunnel and screen, said impeller consisting of a vertically-positioned flat member suspended pendulum-wise to reciprocate in substantially horizontal direction.

10. In a hydraulic jig-separator, the combination with a tank and a separating-com-

partment supporting a screen and having a tunnel and another course for respectively passage of the water from said tank into said compartment and for passage back into said tank again, of a water-impeller operating at the entrance of said tunnel for forcing such circulation of water by successive impulses through said tunnel and screen, said impeller consisting of a vertically-positioned flat member suspended pendulumwise to reciprocate in substantially horizontal direction, said tunnel and impeller being of approximately the full width of said screen.

11. In an apparatus of the character described, the combination with a separating-screen, a suitable impeller for forcing successive water-impulses through said screen, and a separate return-passage from said screen to said impeller, of a water-tunnel affording the only conduit for said water-impulses to reach said screen, said tunnel having a suitable inlet-valve and provided with an outlet-valve occupying a substantially-vertical plane when opened, said impeller and tunnel being approximately the full width of said screen.

12. A hydraulic separator, comprising a suitable tank, a vertical separating-chamber inclosed within said tank and provided with two discharge-chutes located at different levels, a screen located within said compartment below the level of said chutes, an upwardly-directing pump-tunnel affording the only passage into said compartment below said screen, inlet and outlet valves for said tunnel, a vertically-positioned flat water-impeller suspended like a pendulum in front of said tunnel to reciprocate in substantially-horizontal direction, and suitable means for reciprocating said impeller.

13. A hydraulic jig-separator comprising a tank having therein an inclosed separating-compartment containing a screen and having two outlets located at different levels above the screen and an inlet located below said screen, whereby water may pass through said compartment and screen, and means for

forcing water-impulses into said inlet and through said compartment and screen and out of said outlets, said means comprising a rod pivoted at its upper end and depending downwardly, a water-impeller suspended in vertical position at the lower end of said rod and in front of said inlet, and means for reciprocating said suspended impeller in substantially horizontal direction.

14. A hydraulic jig-separator comprising the combination of a tank having an upright separating-compartment, a screen dividing said separating-compartment into two chambers, two outlets located at different levels above the screen and both normally open during the run, a vertical shield positioned above the screen between the upper and lower outlets and leaving a passage between its lower edge and the screen, means including a reciprocable water-impeller for forcing water upwardly through said screen, means for preventing return-flow of the water through the screen, and a separate course for the return of water from the separating-compartment to the tank and in front of said impeller.

15. A hydraulic jig-separator comprising the combination of a tank having an upright separating-compartment, a screen dividing said separating-compartment into two chambers, two outlets located at different levels above the screen and both normally open during the run, a vertical shield positioned above the screen between the upper and lower outlets and leaving a passage between its lower edge and the screen, said shield being adjustable to vary the extent of the passage thereunder, means including a reciprocable water-impeller for forcing water upwardly through said screen, means for preventing return-flow of the water through the screen, and a separate course for the return of water from the separating-compartment to the tank and in front of said impeller.

In testimony whereof I have signed this specification.

RASTUS S. RANSOM, JR.