(No Model.) 3 Sheets—Sheet 1.

P. C. FORRESTER.

MACHINE FOR WASHING AND SEPARATING OR GRADING COAL.

No. 414,393. Patented Nov. 5, 1889.

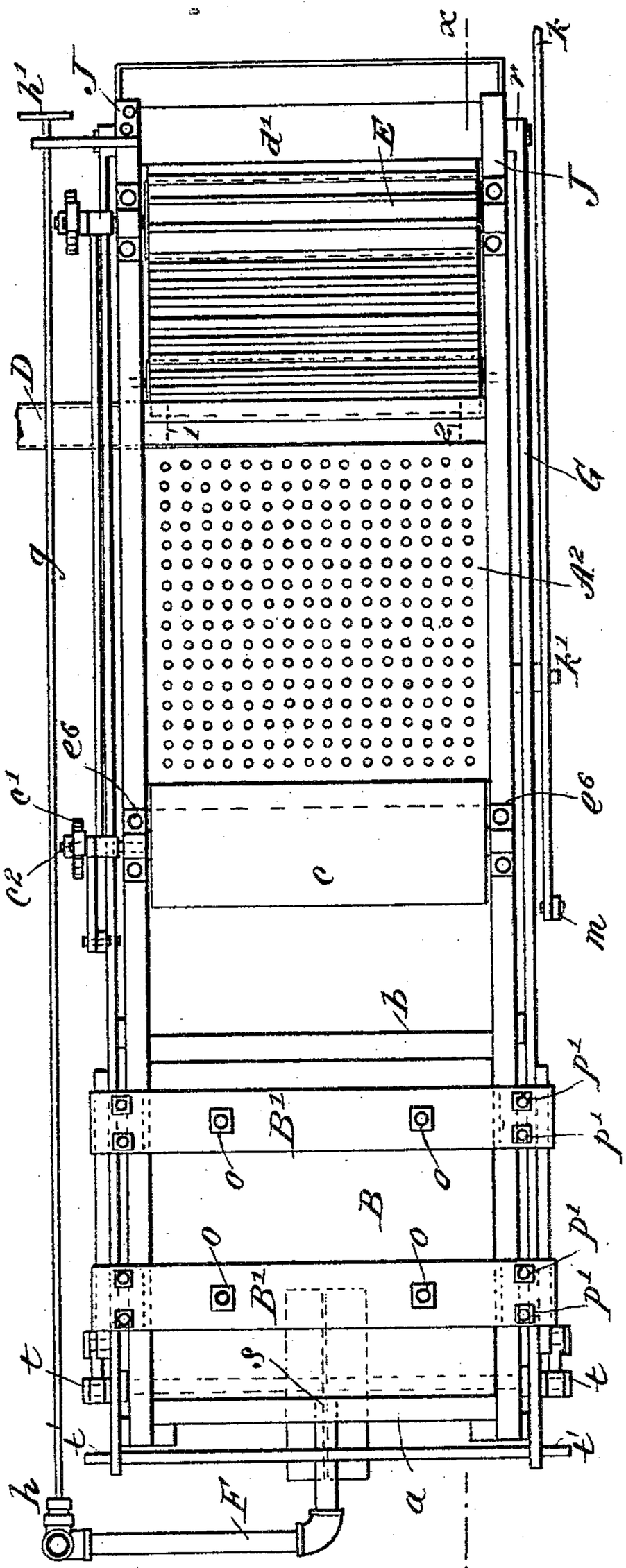

Fig. 1.

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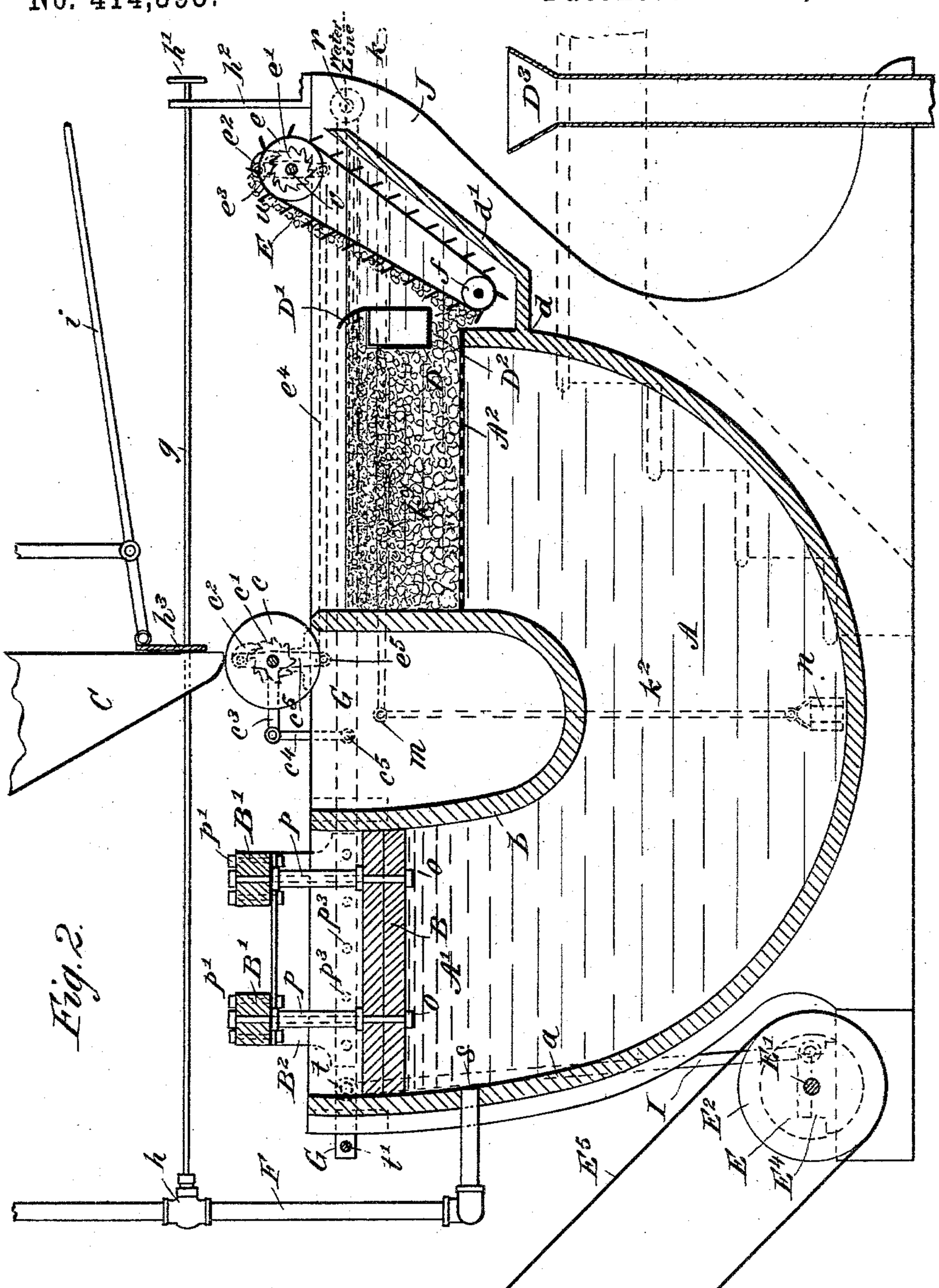

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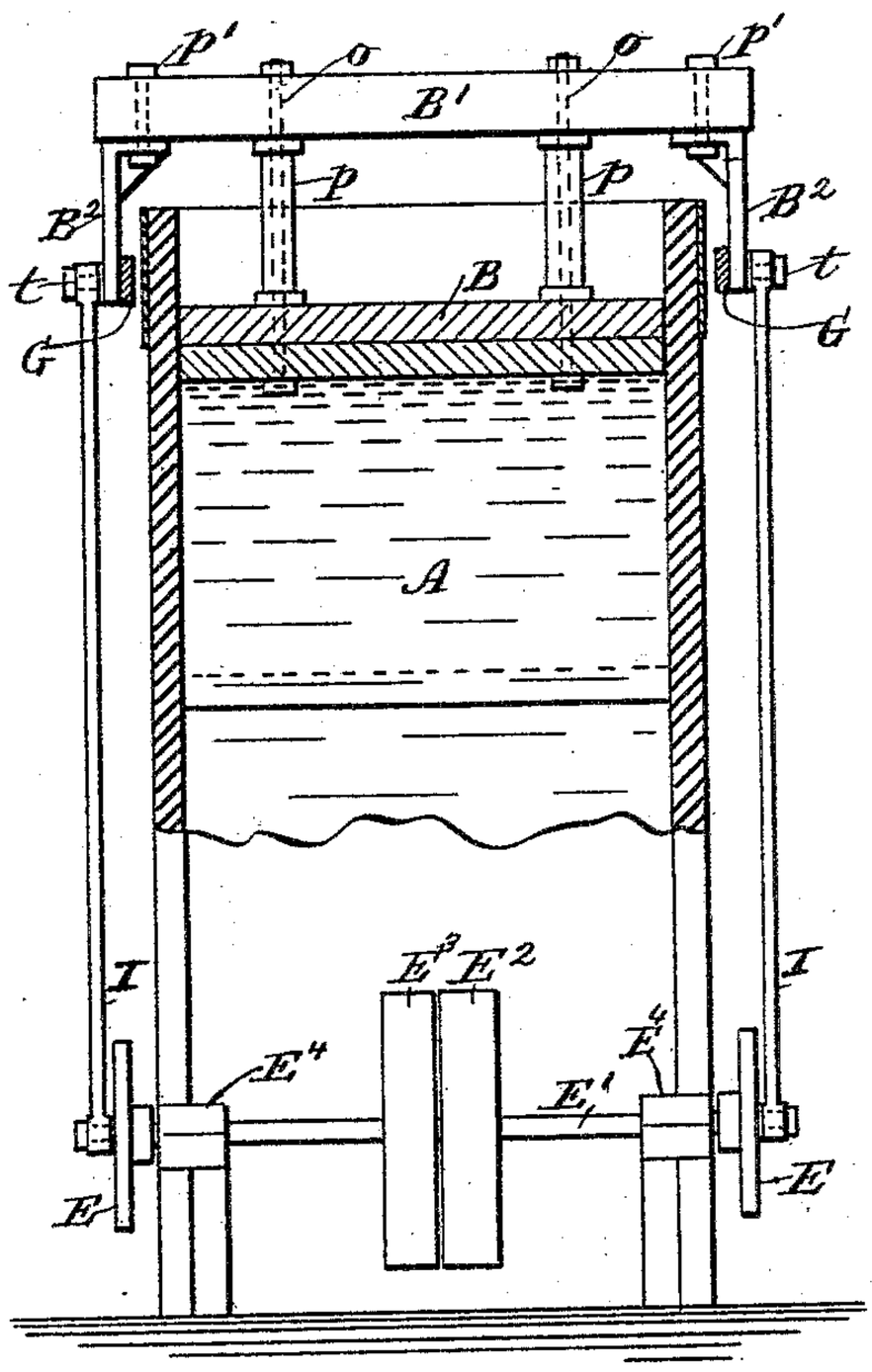
Fig. 3.



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UNITED STATES PATENT OFFICE.

PETER C. FORRESTER, OF WILKESON, WASHINGTON TERRITORY.

MACHINE FOR WASHING AND SEPARATING OR GRADING COAL.

SPECIFICATION forming part of Letters Patent No. 414,393, dated November 5, 1889.

Application filed July 13, 1889. Serial No. 317,465. (No model.)

To all whom it may concern:

Be it known that I, PETER C. FORRESTER, of Wilkeson, in the county of Pierce and Territory of Washington, have invented a new and useful Improvement in Machines for Washing and Separating or Grading Coal, which is also applicable to separate mineral ores from refuse matter, and of which the following is a full, clear, and exact description.

My invention relates to improvements in a class of coal or ore washing and separating machines in which water is forced through the coal or ore and grading or separating effected by the gravity of the material operated upon.

The object of my invention is to provide a compact, strong, and light machine for the purpose designated, which will be capable of regulation with regard to grading or separation of the material operated upon.

With these objects in view my invention consists in certain features of construction and combinations of parts, which will be hereinafter described, and pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a top plan view of my improved separator, and Fig. 2 is a side elevation of the same in section, taken on the line $x\,x$, Fig. 1. Fig. 3 is a transverse section in elevation, taken on the broken line $y\,y$. (See Fig. 2.)

A represents the main chamber of the machine. This is preferably made of wood, and, as shown in Fig. 2, it is given the form of an inverted siphon, the outer wall a and inner wall b being curved concentrically to provide a water-chamber with two short legs.

The leg portion A′ of the chamber A is of sufficient length vertically considered to afford a rectangular short receiver, in which a plunger B is fitted to reciprocate a limited distance, the bearing edges of the plunger having water-tight contact with the sides of the water-leg A′.

As shown in Fig. 2, the plunger B is secured by bolts o to the transverse timbers B′. The spacing-thimbles p, being inserted between the connected parts, hold them separated, the bolts passing through the thimbles, as shown in dotted lines. Upon the under sides of the cross-timbers B′, near their ends, the depending bracket-plates B^2 are fastened by the bolts p'. The lower portions of these plates engage and are secured to the side faces of the guide-bars G, which are pivoted by their opposite ends r to the sides of the main frame J of the machine.

By the attachment of the plunger to the guide-bars the travel of the latter named describes an arc of a circle, of which the guide-bars are the radius and the pivoted point r of said bars is the center of motion.

The reciprocation of the plunger B is produced by two pitmen I, which are loosely secured to the projecting ends of the guide-bars G by the wrist-pins t, the pitman ends being made changeable in position to engage the pins t' near the ends of the bars G, and thus reduce the stroke of the plunger.

The lower ends of the pitmen I are pivoted to the crank-disks E, that are mounted on and secured to the ends of the shaft E′. Fast and loose pulleys E^2 E^3 are placed on this shaft, which is revolubly supported in proper boxes E^4 and receives motion from the belt E^5, that engages a prime mover. (Not shown.)

At the side of the U-shaped chamber A, which is opposite the plunger B, a horizontal screen-plate or diaphragm A^2 is placed on top of the open leg of the chamber. The entire surface of the plate A^2 is perforated at spaced intervals, these foraminations being of proper size to pass water freely through them and retain solid material placed above the plate. Above the diaphragm-plate A^2 the transverse trough D is located. This is open on its upper side and has a guard-wall D′ on its side which is farthest removed from the center of the machine, a throat D^2 being formed between the bottom of the trough and the diaphragm A^2. At d the inclined wall d' is attached, which is secured to each side wall of the machine, and in effect is a chute for the reception of waste material which is being ejected from the machine, as will be further explained. Between the inclined wall d' and the cross-trough D the conveyer-belt E is revolubly supported on the drums $e\,f$, as shown in Fig. 2. The series of spaced buckets u are secured upon the flexible belt E, and are of proper size to

elevate material brought into contact with them in a speedy manner. The upper and larger drum *e* is supported on a shaft *v*, which is journaled on the frame J at each end, and on one extremity of the shaft *v* the ratchet-wheel *e'* is mounted outside of the frame J. Upon the shaft *v*, near the ratchet-wheel *e'*, the ratchet-bar e^3 is loosely mounted, said bar having a pawl e^2 pivoted near its upper end to permit the pawl to engage the teeth of the wheel *e'*. The lower end of the ratchet-bar e^3 is jointed to connecting-rod e^4, which is pivoted at its opposite end to the depending limb c^5 of a bell-crank at e^5. The bell-crank just indicated is mounted on a transverse shaft, which affords journaled support at e^6 to the feed-roller *c*. A ratchet-wheel *c'* and pawl c^2, that are operated by the vibration of the bell-crank lever-arm c^3, communicate periodical movement to the feed-roller. Motion is given to the bell-crank c^3 by the short link c^4, which is pivoted to the outer extremity of the bell-crank arm, and also to the guide-bar G on that side of the machine. The connection of parts just described will transmit a rotative motion to the feed-roller in unison with the reciprocation of the plunger B.

A hopper C is supported above the feed-roller *c*, having at its lower end a gate h^3, that is operated by the pivoted lever *i*, the free end of which lever is extended to afford a handle, whereby the gate may be elevated and coal or ore fed from the hopper upon the feed-roller.

Water is conveyed to the machine through the pipe F, valve *h*, and inlet-opening at *s*. The valve-rod *g* extends forwardly from valve *h* toward the front end of the machine, a bracket-stand h^2 supporting the rod, and a hand-wheel *h'* affording means for adjustment of the valve.

A discharge-water valve *n* is located on the side wall of the water-chamber A near the lowest point in the same. A rod k^2 is upwardly extended and jointed at *m* to the horizontal lever *k*, which is pivoted to vibrate at *k'*, so that a depression of the forward end of this lever will open the valve-gate and lower the level of water in the chamber A or entirely discharge it.

As previously intimated, the essential function of the machine under consideration is to wash and separate ungraded coal and discharge the coal through the trough D, while heavier waste is passed below this trough and taken up by the traveling buckets of the elevator E until it reaches its top, where the coal is discharged and falls into the vertical receiver D^3, through which it passes to a point of deposit.

In Fig. 1 there is shown in dotted lines the plan of the throat D^2, through which passes the heavy waste. This throat is made shorter from 1 to 2 by the introduction of end walls than the entire length of the buckets of the elevator, so as to give to the elevator a carrying capacity in excess of the delivery of waste material through the throat D^2. The manner of connecting the end e^5 of the bell-crank lever c^3, which moves the feed-roller *c* with the ratchet-gear of the elevator E, renders the feeding and elevating operations cooperative. The progressive movement of the elevator E may be quickly arrested or resumed by tripping out of gear the pawl e^2.

The provision of means for arresting the travel of the elevator E and the relative contraction of the throat D^2 with regard to the lifting capacity of the elevator E are important features of my present invention.

In operating the machine the chamber A is partially filled with water. Coal is fed through the hopper C upon the roller *c*, which by its rotary movement prevents clogging of the discharge-orifice of the hopper and also restricts the amount of material discharged, the latter-named function being effected by the adjustment of the feed-gate h^3, as well as the feed-roller. The coal falls upon the perforated diaphragm A^2, and the reciprocation of the plunger B causes a pulsating action of the water through the perforations of the diaphragm and also upon the body of material deposited thereon. The partial floatage of the coal or other material operated upon in the manner stated will, through the gravitation of the heavier portions, rearrange the mass, separating the lighter pieces therefrom. As the operation progresses the coal passes into the transverse trough D and is discharged at the side of the machine. The heavier waste by its accumulation is crowded through the throat D^2 and raised by the buckets of the elevator E, as before stated.

It has been found in operating hydraulic separators of the type to which my invention belongs that there is an unequal action of the gravitating operation. In view of this fact I have provided a means for regulation of the discharge of the heavy or waste material, so that it may be kept at a proper height in the space above the diaphragm-plate A^2, and the coal be regularly discharged through the spout D. The relative contraction of the throat D^2 by providing end walls 1 2, which make it shorter than the elevator-buckets, assures that the latter will take up all the waste that is moved toward them. If it is found that there is too free a removal of the waste, so that the coal is also taken out with the waste, it is only necessary for the operator to throw the pawl of the ratchet-gear out of mesh, and by so doing arrest the motion of the elevator. As soon as there is such an accumulation of the waste as will cause a proper discharge of the coal through the trough D, the dog or pawl e^2 should be thrown into mesh with the ratchet-wheel *e'*, when the elevator *e* will again commence the removal of the waste in an obvious manner.

Another feature of advantage embodied in my invention is the application of the motive power, which reciprocates the plunger and moves other parts of the machine at a point

below the plunger, so that the depression of the plunger, which requires force to move, will be produced by a pulling movement of the pitmen I. The draft force thus exerted can be transmitted to the plunger by lighter pitman-rods than would serve to overcome the same resistance if these were used as pusher-bars instead of draft-bars.

In utilizing this machine to wash and separate mineral ores the operation is similar, with this exception that the waste material which is to be removed passes into and through the trough D, while the concentrates of mineral are taken up by the elevator E, as in this case the waste is the lighter body.

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

1. In a separator, the combination, with a water-chamber, a plunger which is adapted to reciprocate, and a feeding device, of a perforated diaphragm, a transverse discharge-trough located above a discharge-throat, an elevator, and a device which causes the travel of the elevator and permits its arrest, substantially as set forth.

2. In a separator, the combination, with a water-chamber, a reciprocating plunger, and a material-feeding device which is adapted to move with the plunger, of a perforated diaphragm, a transverse discharge-trough located above the diaphragm, an elevator, and a device which causes the travel of the elevator and permits its arrest, substantially as set forth.

3. In a separator, the combination, with a U-shaped water-chamber, a reciprocating plunger, a water-supply pipe, a water-regulating valve, and a material-feeding device, of a perforated diaphragm, a transverse discharge-trough, an elevator that removes the material which passes below the discharge-trough, and a ratchet mechanism which permits the arrest of travel of the elevator at the will of the operator, substantially as set forth.

4. In a separator, the combination, with a water-chamber, a plunger, two draft-rods, and a perforated diaphragm-plate, of two revoluble crank-disks which are pivoted to the draft-rods and loosely connected to the plunger by the draft-rods, substantially as set forth.

5. In a separator, the combination, with a feeding device comprised of a hopper, an adjustable gate and a revoluble roller, a water-chamber, a plunger, and a perforated diaphragm, of a transverse trough for the discharge of light material located to produce a throat for the passage of heavy material under it, an elevator adapted to transfer rejected material, and a ratchet-and-pawl mechanism which is attached to the actuating-lever of the feeding device and receives motion therefrom, substantially as set forth.

6. In a separator, the combination, with a water-chamber, a water-supply pipe, and a water-regulating valve, of a plunger adapted to reciprocate, a perforated diaphragm, a ratchet-and-pawl-actuated feed-roller, a hopper, a transverse discharge-trough, an elevator, and mechanism which moves the elevator when the plunger reciprocates and the feed-roller revolves, substantially as set forth.

7. In a separator, the combination, with a water-chamber, a reciprocating plunger, draft-pitmen, a feeding device which moves in harmony with the reciprocations of the plunger, and a perforated diaphragm, of a transverse discharge-trough which removes washed and graded material, an elevator that transfers rejected material which passes below the transverse discharge-trough, and a ratchet-and-pawl mechanism that is operated by the plunger-moving mechanism and actuates the elevator, substantially as set forth.

8. In a separator, the combination, with a water-chamber, a plunger, and means to reciprocate the plunger, of a material-feeding device, a perforated diaphragm which receives the material fed, a discharge-trough located crosswise of the machine, a discharge-throat having end walls which reduce its length, an elevator, and mechanism connected with the elevator and feeding device which will move the elevator with the feeding device and permit its arrest while the feed movement progresses, substantially as set forth.

9. In a separator, the combination, with a water-chamber made U-shaped and provided with a water-supply, a discharging water-valve, a crank-shaft, two crank-disks, two pitmen which connect the crank-disks with a plunger, and a plunger, of a perforated diaphragm, a material-feeding device, a transverse discharge-trough, a discharge-throat which is contracted endwise by its walls, an elevator-belt having affixed buckets, and a ratchet-and-pawl feeding device which is adapted to move the elevator in unison with the feeding device and permit arrest of the elevator while the feed movement continues, substantially as set forth.

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