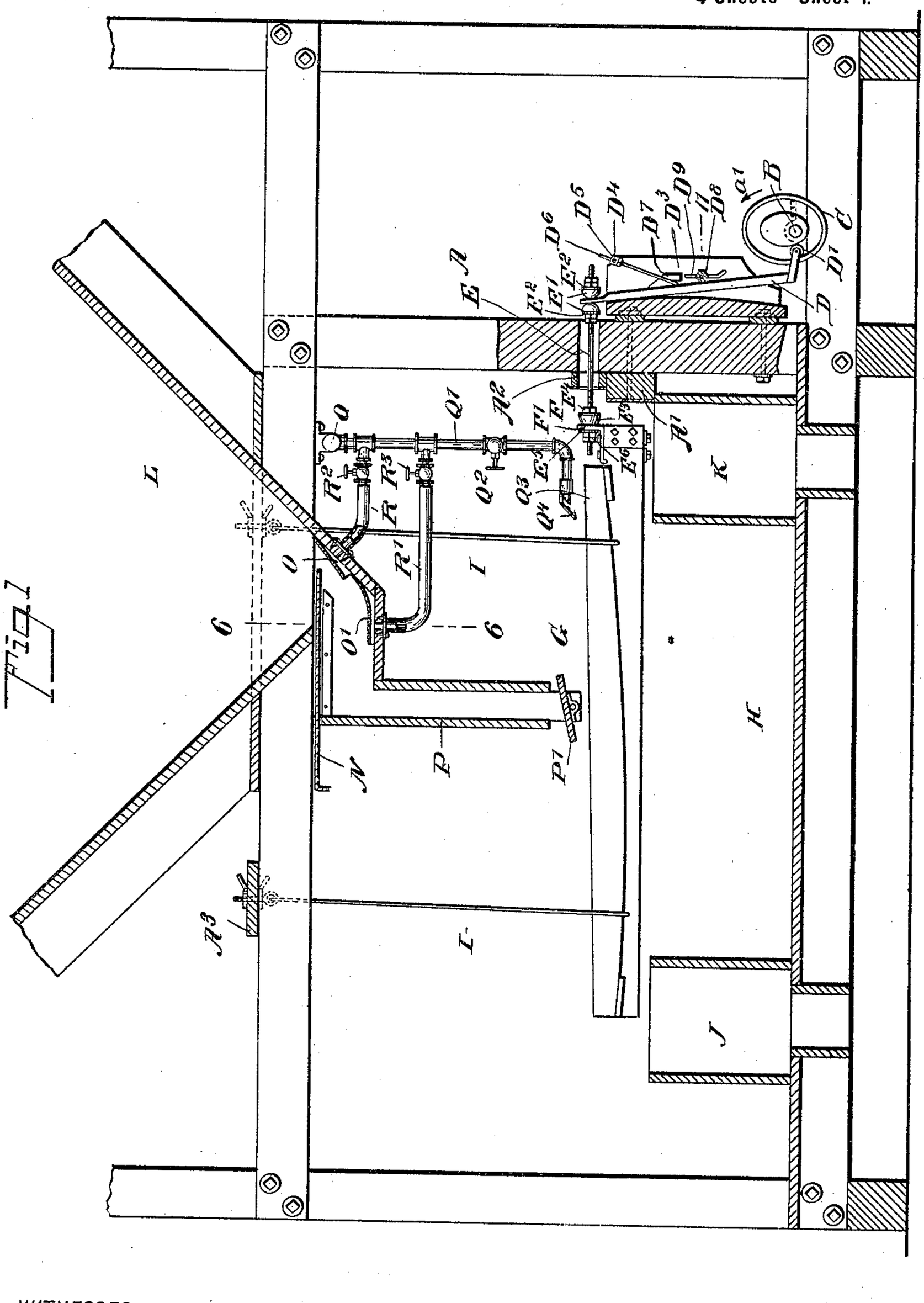
No. 695,790. Patented Mar. 18, 1902.

A. C. CAMPBELL.

COAL WASHER AND ORE CONCENTRATOR.

(Application filed Mar. 30, 1901.)

(No Model.) 4 Sheets—Sheet 1.



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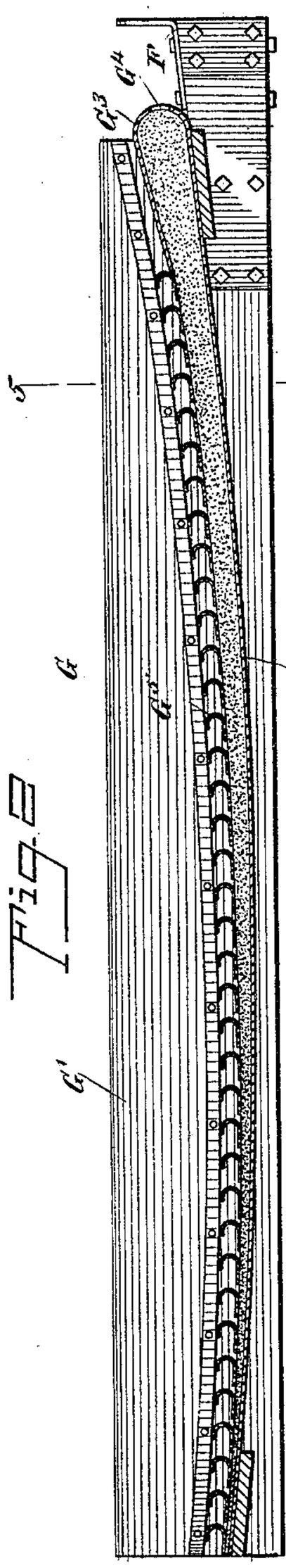

FIG. 2

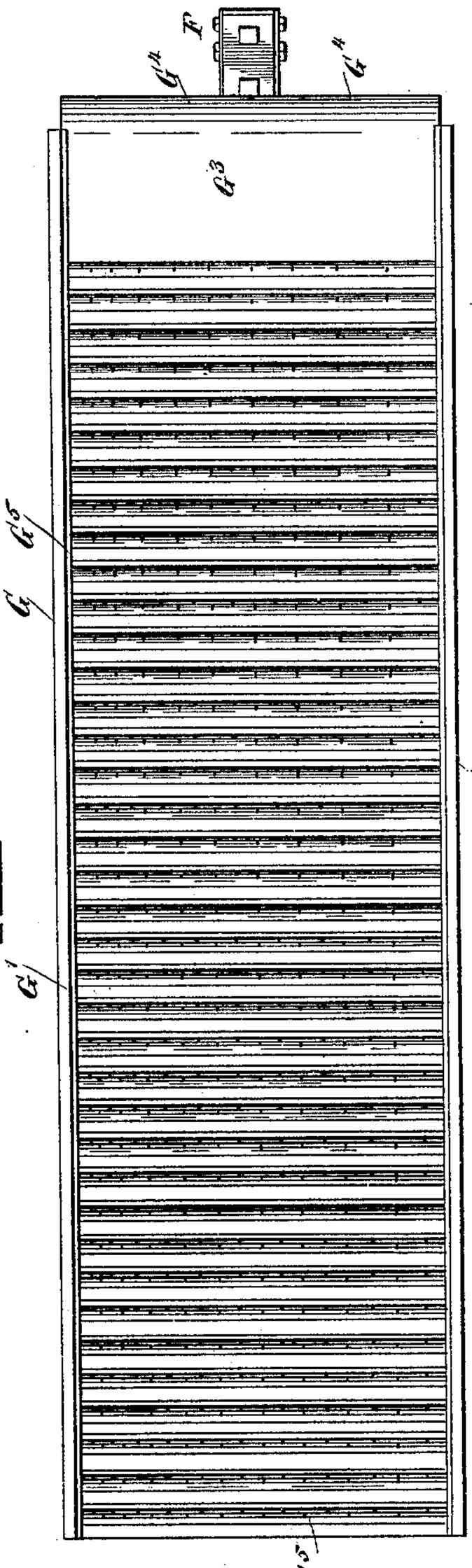

FIG. 3

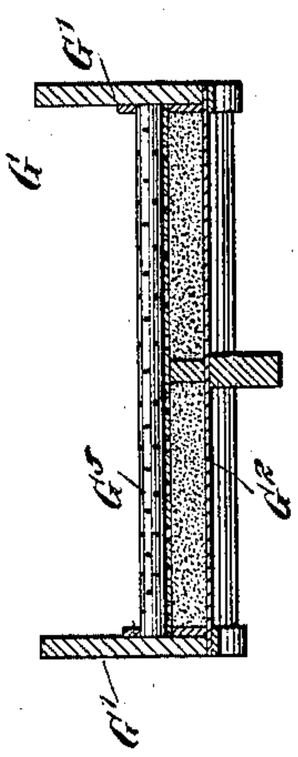

FIG. 5

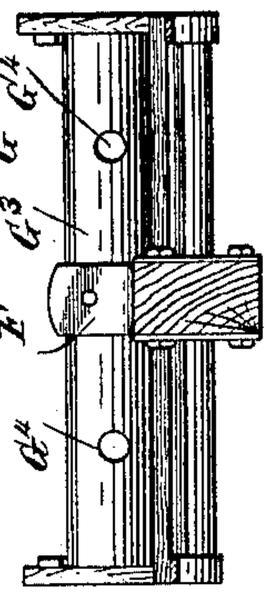

FIG. 4

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(No Model.) 4 Sheets—Sheet 3.

Fig. 6

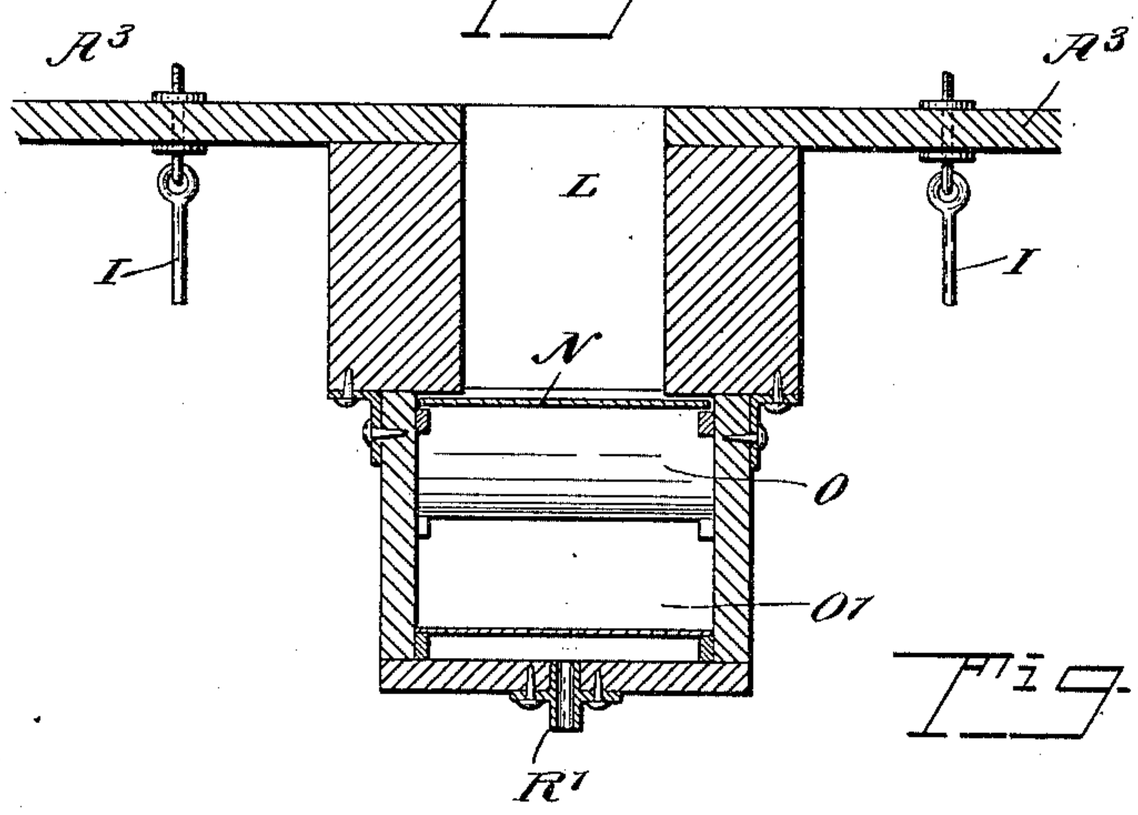


Fig. 8

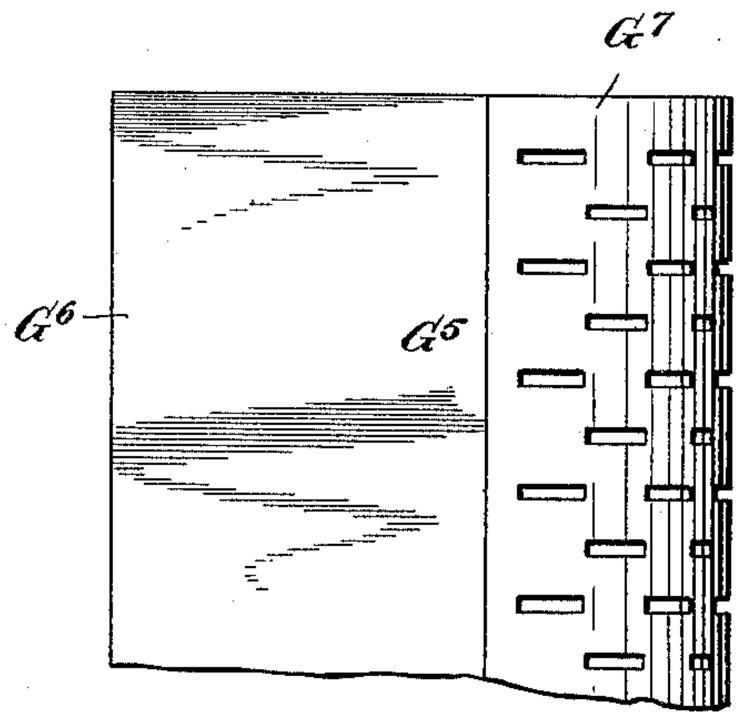


Fig. 7

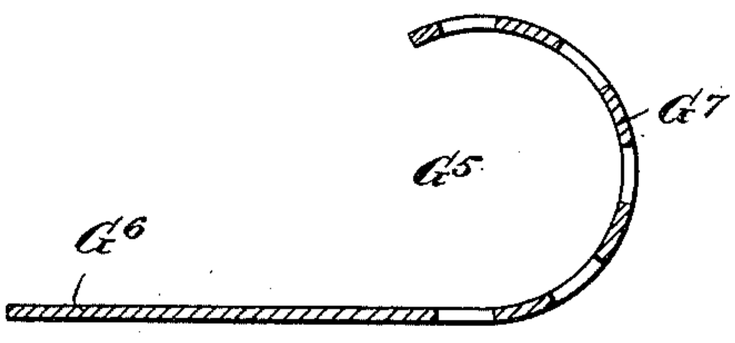


Fig. 9

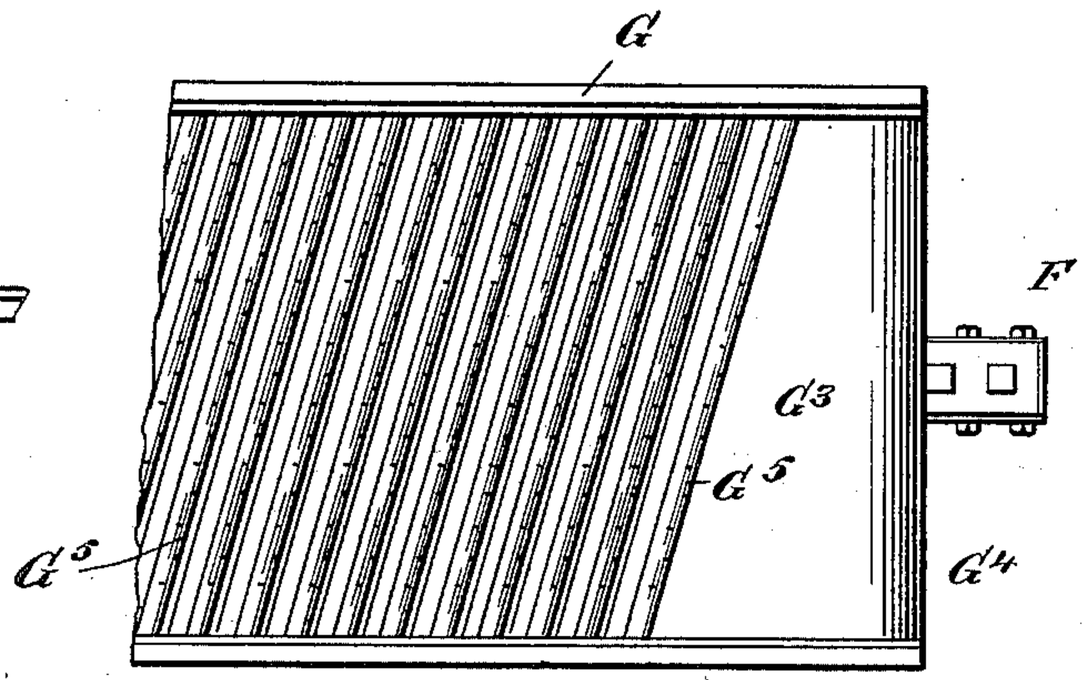
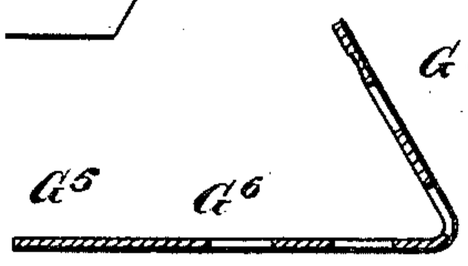


Fig. 10



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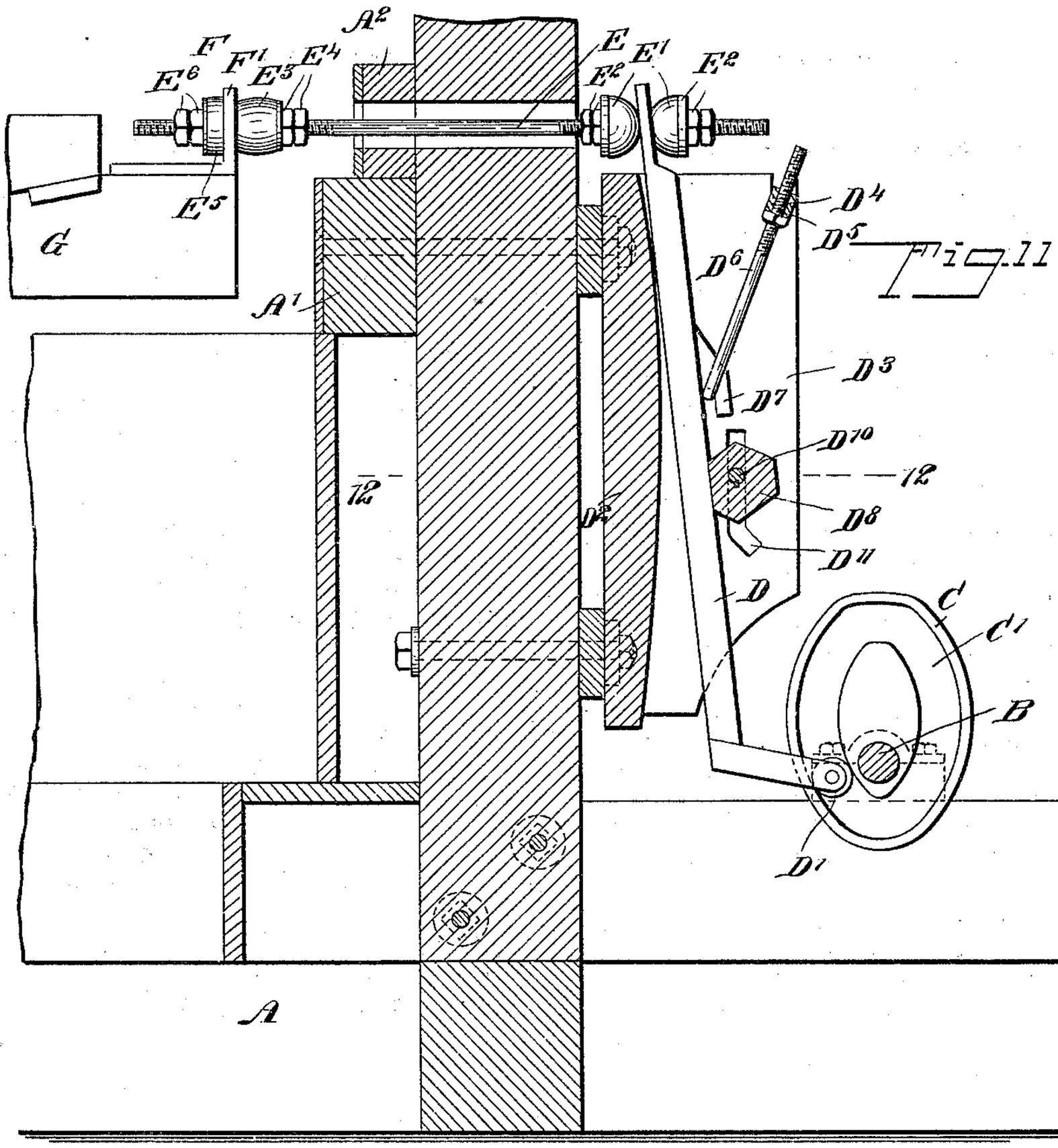

Fig. 11

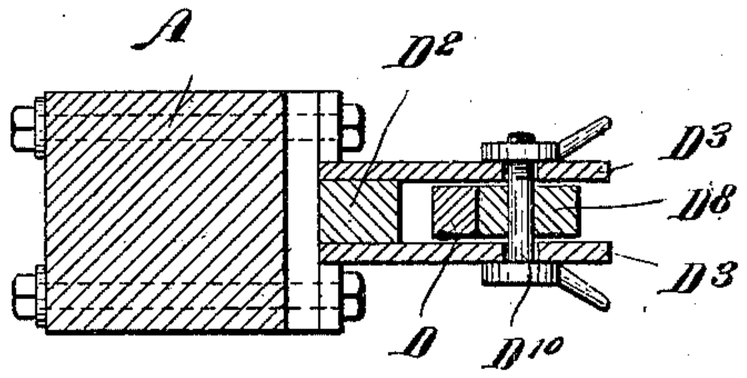

Fig. 12

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UNITED STATES PATENT OFFICE.

ALONZO C. CAMPBELL, OF ASHEVILLE, NORTH CAROLINA.

COAL-WASHER AND ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 695,790, dated March 18, 1902.

Application filed March 30, 1901. Serial No. 53,628. (No model.)

To all whom it may concern:

Be it known that I, ALONZO C. CAMPBELL, a citizen of the United States, and a resident of Asheville, in the county of Buncombe and State of North Carolina, have invented a new and Improved Coal-Washer and Ore-Concentrator, of which the following is a full, clear, and exact description.

The invention relates to ore-separators such as shown and described in the Letters Patent of the United States No. 506,976, granted to me on October 17, 1893.

The object of the present invention is to provide a new and improved machine, arranged for use as a coal or ore washer and concentrator, to thoroughly and readily separate the more dense stuff from the less dense stuff in a very effective and simple manner.

The invention consists of novel features and parts and combinations of the same, as will be fully described hereinafter and then pointed out in the claims.

A practical embodiment of the invention is represented in the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a sectional side elevation of the improvement. Fig. 2 is an enlarged sectional side elevation of one form of the pan. Fig. 3 is a plan view of the same. Fig. 4 is an end view of the head of the pan. Fig. 5 is a transverse section of the pan on the line 5 5 in Fig. 2. Fig. 6 is an enlarged transverse section of the improvement on the line 6 6 in Fig. 1. Fig. 7 is an enlarged sectional side elevation of one of the riffles. Fig. 8 is a plan view of the same. Fig. 9 is a plan view of my preferred form of the pan. Fig. 10 is an enlarged sectional side elevation of a modified form of riffle. Fig. 11 is an enlarged sectional side elevation of the bumper mechanism, and Fig. 12 is a sectional plan view of the same on the line 12 12 in Fig. 11.

The improved machine illustrated in Fig. 1 is mounted on a suitably-constructed frame A, in which is journaled a driven shaft B, carrying a cam-wheel C for actuating a vibrating lever D, engaging a connecting-rod E, extending over a fixed bumper-block A' and through a block A^2 and attached to the head-block F of a pan G, located over a floor H and hung on suspending-rods I, carried by the overhead cross-beams A^3 of the main frame A. When the shaft B is rotated, a reciprocating motion and a percussive action is given to the pan G to cause the separation of the more dense stuff and the less dense stuff into two principal layers, the top layer of which is floated away by the escaping water and is discharged over the tail end of the pan G to drop into a sluice J, while the lower layer or more dense stuff (concentrates or the like) is discharged at the head of the pan and drops into a sluice K.

The pan G consists of the sides G', supporting a curved bottom G^2, terminating at the head of the pan in a pocket G^3, having openings G^4 for the discharge of the dense stuff to drop into the sluice K, and above said bottom G^2 is arranged a false bottom consisting of riffles G^5, extending transversely either at right angles to the sides G', as illustrated in Fig. 3, or obliquely, as indicated in Fig. 9. Each of the riffles G^5 consists of a horizontal bottom portion G^6, which is solid, and a perforated pocket at the end of the riffle facing the head of the pan, as will be readily understood by reference to Fig. 2, said riffles being spaced apart, so as to form openings between adjacent riffles. The false bottom formed by the riffles is so arranged and spaced from the true bottom G^2 that a water-chamber is formed between the two bottoms, increasing in depth from the tail end of the pan to the head G^3. (See Fig. 2.)

When the machine is in operation, the reciprocating motion of the pan, together with the percussion, causes the separation of the more dense and less dense stuff into two principal layers, discharged at the tail and head ends of the pan, as above mentioned. The fine dense stuff that accumulates in the chamber between the false and the true bottom cannot pack or clog the successful working of the pan, it being understood that the successful working of the pan is dependent mainly upon a free and uninterrupted flow of water through the joints between the spaced riffles G^5. The fine dense stuff is further not liable to pack, owing to the bumping action of the pan, which action gives a lurch to the

mass of fine dense stuff in the chamber, so that said stuff gains a clearance by the travel of the total mass toward the head or discharge end or pocket G^3 of the chamber. This clearance keeps the perforations or open joints between adjacent riffles thoroughly open, and at the same time a suction is caused along the entire length and breadth of the chamber. The vacuum formed by the lurch of the wedge-shaped material is filled with water loaded with the fine dense stuff passing downward through the spaces or joints between adjacent riffles.

The bumping action of the pan G, as above mentioned, causes the more dense material to be driven toward the head of the pan; but the forward movement of the material is somewhat retarded by the pockets G^7 on the riffles, as the material which passes into a pocket is temporarily held therein and is prevented from lurching forward when the bumping action occurs. Consequently the bumping action that urges the mass forward cannot give a moving impetus to the material held in the pockets of the riffles. When the pockets are filled to overflowing, then the travel of the stuff is above and tangential to the riffles. The rough or coarse stuff will keep at the surface, while the fine dense stuff will settle in the pockets of the riffles. As these pockets are perforated, it is evident that the finer material will pass through the perforations and finally pass through the space between adjacent riffles into the chamber below. Thus the pockets of the riffles will at all times be charged or filled with choice dense material, and this material will act as a bed, like that of a jig, to keep above and afloat the less dense material. The fine dense material that can penetrate through the bed and thence through the space between adjacent riffles finds its way into the chamber, as above described, and the accumulating fine dense stuff gradually works to the head of the pan and finally discharges through the openings G^4. It is understood that the reciprocating motion of the pan keeps the beds of stuff on the riffles thoroughly agitated, and the bumping action causes the said beds of material to turn over and over, so that a thorough separation of the fine dense stuff from the coarse dense stuff takes place. It is understood that the constant agitation of the entire mass in the pockets of the riffles works to the surface the less dense stuff, which in part floats away to the tail end of the pan, while the stuff of second-grade density passes through the spaces between adjacent riffles, and this second-grade stuff, in the case of coal, would be shale or thin flakes, which, although it may be sufficiently dense as to specific gravity, cannot penetrate the mass in the pockets, but can only pass through the spaces between adjacent riffles to reach the chamber between the true and the false bottom. The second-grade material is always most difficult to provide for. The spaces between the riffles serve another purpose—namely, to allow egress of any coal that should properly escape and be floated away with the balance of the coal.

It will be understood that the multiple of riffles and pockets extending the total length of the pan will be as many miniature operations, each pocket operating on a different grade of material. All of the pockets will be kept filled to the brim; but there will be a graduation of average densities from the head of the pan, where it is most dense, to the tail end of the pan, where it is least dense. The riffles near the head of the pan readily hold the slate, dirt, pyrites, &c., free from coal. The intermediate riffles—that is, those at or near the middle of the pan—hold the lighter-grade material, having some coal intermixed, while the riffles at or near the tail end of the pan hold coal which is nearly free from dirt or slate, and this latter material may be such light chaffy material that it would not hold a place with the more dense material. The material of different grades of density finds lodgment at points along the series of pockets as the conditions favor. The multitude of pockets in succession may be considered as so many miniature jigs that are "bedded" and fed most favorably with the "classified" materials. The water flows to and fro through the perforations around the curvature of the riffles, so as to permeate intermittently the stuff contained thereon.

The pockets G^7 may be formed by curving the heads of the riffles upwardly and backwardly, as shown in Fig. 6, or the pockets may be formed by bending the end portions of the riffles into angular shape, as shown in Fig. 10.

It is understood that in the operation of the machine the higher grades of density crowd out the lower grades of density, like densities clinging together.

By arranging the riffles diagonally, as shown in Fig. 9, there is a resultant movement and classification, due to two forces: first, the bumping action gives inertia to the mass, and, second, the resistance of the diagonal riffles thrusts the mass to the left, and hence there is an accumulation and grading of the more dense material at the left of the pan, while the second-grade dense material retains a position at the right side of the pan. Now in this arrangement it is evident that the discharge at the openings G^4 is a graded one, as the fine dense material goes through the perforations G^4 near the left-hand side of the pan, while the coaser material goes through the perforations G^4 near the opposite side.

The detail construction of the mechanism for actuating the pan G is as follows: The cam C on the driven shaft B is formed in its face with a cam-groove C′, engaged by a friction-roller D′, journaled on the lower end of the lever D, and the said cam-groove C′ is formed with oppositely-disposed pulling and pushing portions for imparting a rocking mo-

tion to the lever D and with intermediate concentric portions for the friction-roller D′ to pass through without imparting motion to the lever D, so that the rocking motion of the lever D is intermittent.

The inner face of the lever D rocks on the curved surface of a rocker D^2, fastened to the frame A and provided with side plates D^3, carrying the trunnions D^4 of a nut D^5, in which screws the threaded end of the suspension-link D^6, engaging a lug D^7 on the lever D. (See Figs. 1 and 11.)

The lever D rests with its outer face against a side of an irregularly-shaped block D^8, having an eccentric opening D^9, through which extends a bolt D^{10}, adjustable in L-shaped slots D^{11}, formed in the side plates D^3. The upper end of the lever D engages the connecting-rod E between the elastic washers E′, held in place by metal washers and nuts E^2, screwing on the outer threaded end of the rod E. On the inner threaded end of the rod E is held an elastic bumper E^3, resting with its inner face on the flange F′ of the head-block F, and the outer face of the said bumper is engaged by a metal washer and nut E^4, screwing on the inner threaded end of the connecting-rod E. The inside of the said flange is engaged by an elastic washer E^5, held in place on the rod E by nuts E^6, screwing on the extreme inner end of the connecting-rod E.

When the shaft B is rotated in the direction of the arrow *a′* and at a desired speed, then the cam C imparts an intermittent rocking motion to the lever D, the latter bearing against the rocker D^2 as a fulcrum and following the curvature of the rocker from the top to the bottom. As the lever is rocked the rod E is caused to move in an outward direction to swing the pan G to the right, and when the head of the pan G is within a short distance of the block A′, fixed to the main frame A, and the elastic bumper E^3 is tight against the block A^2, also fixed to the frame A, then the friction-roller D′ passes into a concentric portion of the cam-groove C′, and the lever D is thus free from further action of the cam-wheel C, and the pan G by its own momentum moves farther to the right, and the elastic bumper E^5 is now compressed against the fixed block A^2, and consequently the speed of the pan G is somewhat retarded and finally arrested by impact of the head F of the pan G against the fixed block A′. The elastic bumper E^3 now reacts and causes a quick and short rebound of the pan G.

The elastic washers E^5 and E^2 produce an elastic non-wearing joint for the flange F′ and the upper end of the lever D, while the iron washers protect the rubber bumper and the elastic washers.

The object of the elastic bumper E^3 is two-fold—namely, to lessen and gage the force of impact of the head F of the pan G against the fixed block A′ and to give a lurch and a more effective discharge to the slate and fine dirt from the pan into the chute. After the roller D′ has passed through the concentric cam-groove portion and into the pulling portion of the cam-groove C′, then the lever is swung in the opposite direction to move the pan G to the left. During this return movement the lever does not follow the curvature of the rocker D^2, but bears against the fulcrum-block D^8. The latter can be adjusted up or down or turned to bring any side toward the lever D to suit any length of stroke desired to be given to the lever D and pan G. The bolt D^{10} may be moved into the lower angular portion of the slot D^{11}, so that the block D^8 is out of possible contact with the lever D to allow a free swinging of the lever D with the rod E as the fulcrum at the time it is desired to hold the pan G stationary. The loop-rod D^7 serves to suspend the lever D, and this rod can be readily removed whenever desired.

In order to feed the material to be treated onto the pan G, the following arrangement is provided: On the overhead portion of the frame A is arranged a hopper L for containing the material, and in the throat of the hopper is arranged a gate N under the control of the operator to govern the amount of material passing from the hopper over the inclines O and O′ to the depending spout P, discharging the material over a pivoted tilter P′ onto the pan G. A water-supply pipe Q has a depending arm Q′ with a valve Q^2, a spout Q^3, and a spreader Q^4 to distribute the water over the head end of the pan G. From the arm Q′ extend branch pipes R R′, having valves R^2 R^3, respectively, to the under side of the inclines O and O′, respectively. When the machine is in operation, a small amount of water is allowed to flow under the incline O from the branch pipe R and a larger amount of water is permitted to pass under the incline O′. The water passing from under the lower end of the incline serves to undermine the material on the incline to give it a sluggish downward flow over the incline O′ for the material to be finally washed by the water passing from under the incline O′ and down to the spout P to the pan G.

The water which passes by the spout Q^3 and spreader Q^4 onto the pan G cleans the slate of all coal preparatory to the slate being discharged. This head-water also to a certain extent passes through the joints and perforations of the riffles and likewise keeps the fine coal back that would otherwise go to waste with the dirt.

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

1. A machine of the class described, provided with a pan, and means for oscillating the pan and imparting a percussive action to the same, said pan having a true bottom and a false bottom, a chamber being between the bottoms and increasing in depth toward the discharge end and in the direction in which the percussion takes place, said false bottom consisting of spaced riffles having perforated

pockets at the forward ends, substantially as shown and described.

2. A machine of the class described, provided with a pan, and means for oscillating the pan and imparting a percussive action to the same, said pan having a true bottom and a false bottom, a chamber being between the bottoms and increasing in depth toward the discharge end and in the direction in which the percussion takes place, said false bottom consisting of diagonally arranged and spaced riffles having perforated pockets at the forward ends, substantially as shown and described.

3. A machine of the class described, provided with a pan having a true bottom and a false bottom of which the true bottom terminates at the head end of the pan in a pocket having discharge-openings, said false bottom forming with the true bottom a water-chamber increasing in depth from the tail end of the pan to the head end thereof, the false bottom being formed with spaced slats having perforated pockets at the top, forward end, substantially as shown and described.

4. A machine of the class described, having an actuating device for the pan, comprising a cam-wheel, a lever engaged by the said cam-wheel, a connecting-rod engaged by the said lever and connected with the pan, a fixed rocker engaged by said lever, a fixed bumper-block and an elastic bumper on the said connecting-rod, and a suspending adjustable loop for the said lever, as set forth.

5. A machine of the class described, having an actuating device for the pan, comprising a cam-wheel, a lever engaged by said cam-wheel, a connecting-rod engaged by the said lever and connected with the pan, a fixed rocker engaged by the said lever, a fixed bumper-block and an elastic bumper on the said connecting-rod, and a polygonal block provided with a pivot eccentric to the center thereof and adjustable relatively to said pivot, thus forming an adjustable fulcrum for the said lever, as set forth.

6. A machine of the class described, provided with a pan, and means for oscillating the pan and imparting a percussive action to the pan, said pan having a working surface consisting of spaced riffles having perforated pockets at the forward ends, as set forth.

7. A machine of the class described, provided with a pan, and means for oscillating the pan and imparting a percussive action to the pan, said pan having a working surface consisting of diagonally-spaced riffles having perforated pockets at the forward ends, as set forth.

8. A machine of the class described, having an actuating device for the pan, comprising a cam-wheel, a lever engaged by said cam-wheel, a connecting-rod engaged by said lever and connected with the pan, a fixed rocker engaged by said lever, a polygonal fulcrum-block, and a bolt adjustable in L-shaped slots, as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ALONZO C. CAMPBELL.

Witnesses:
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PETER YOUNG.