No. 898,314. PATENTED SEPT. 8, 1908.

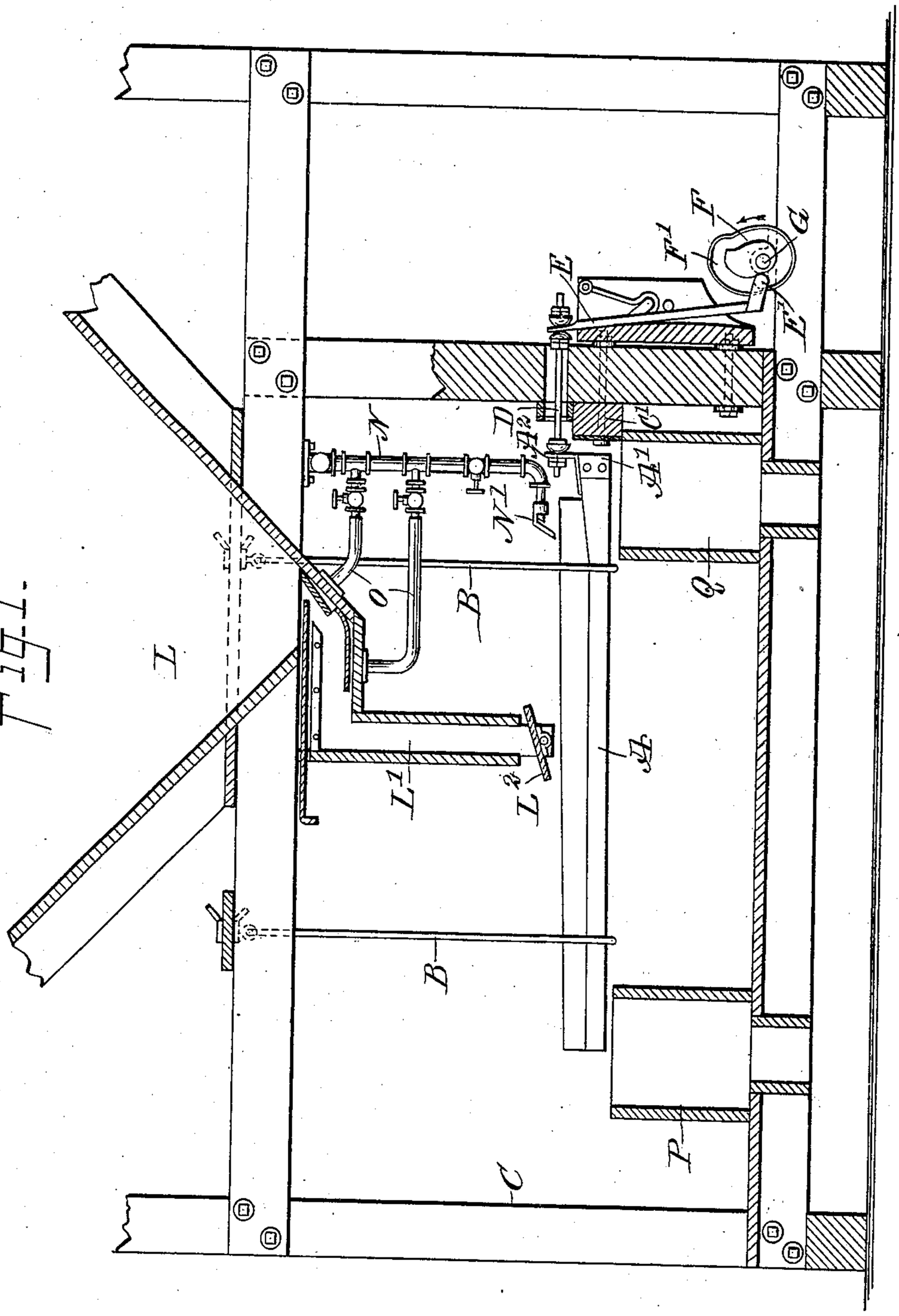
A. C. CAMPBELL.

COAL WASHER AND ORE CONCENTRATOR.

APPLICATION FILED AUG. 4, 1906.

3 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

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3 SHEETS—SHEET 2.

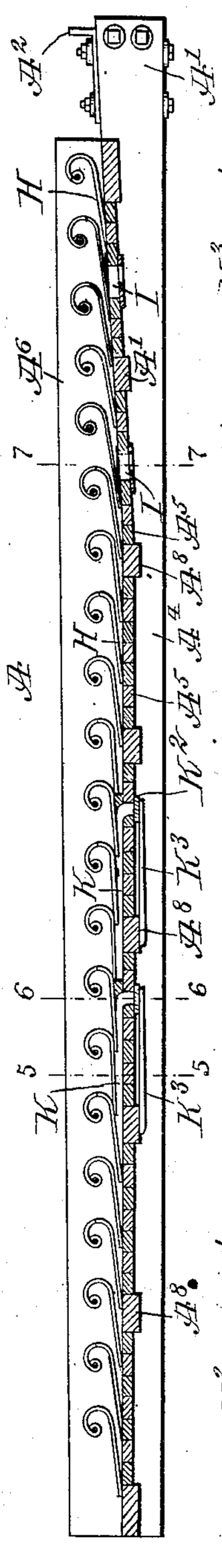

Fig. 2.

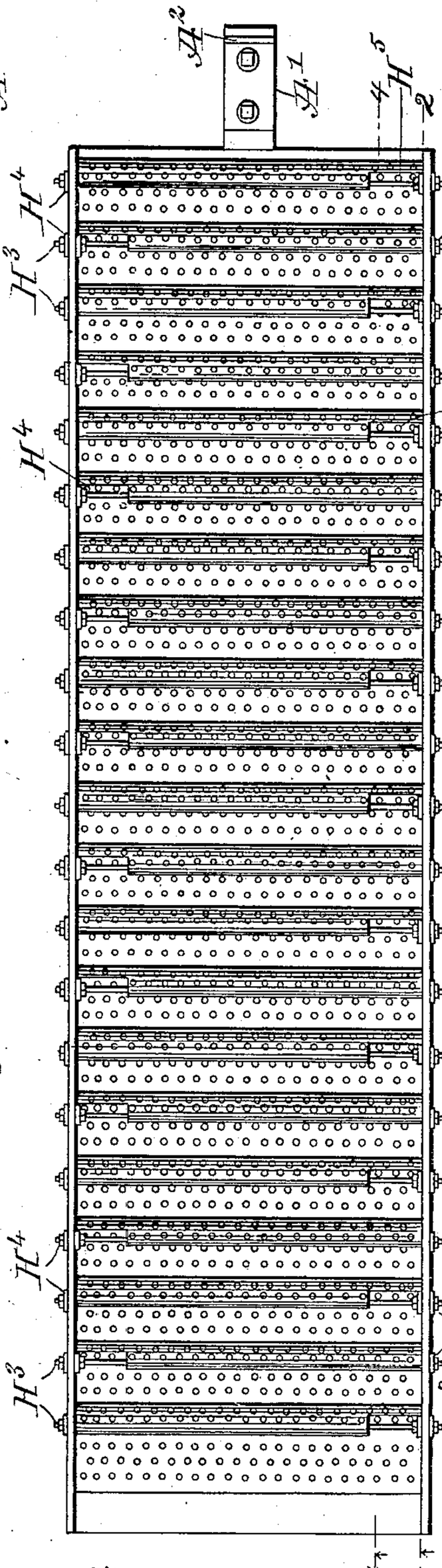

Fig. 3.

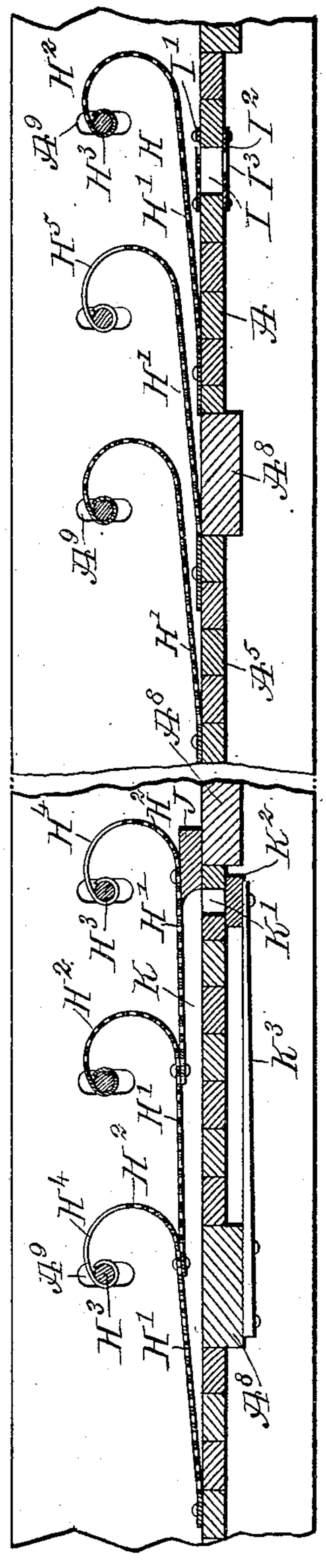

Fig. 4.

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3 SHEETS—SHEET 3.

Fig. 5.

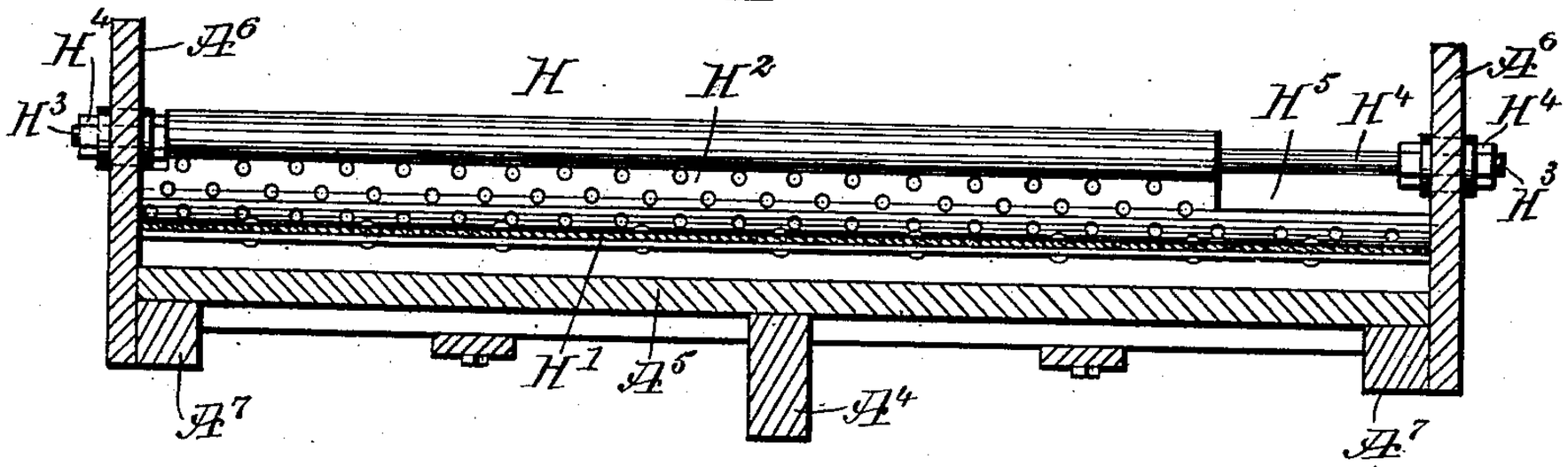


Fig. 6.

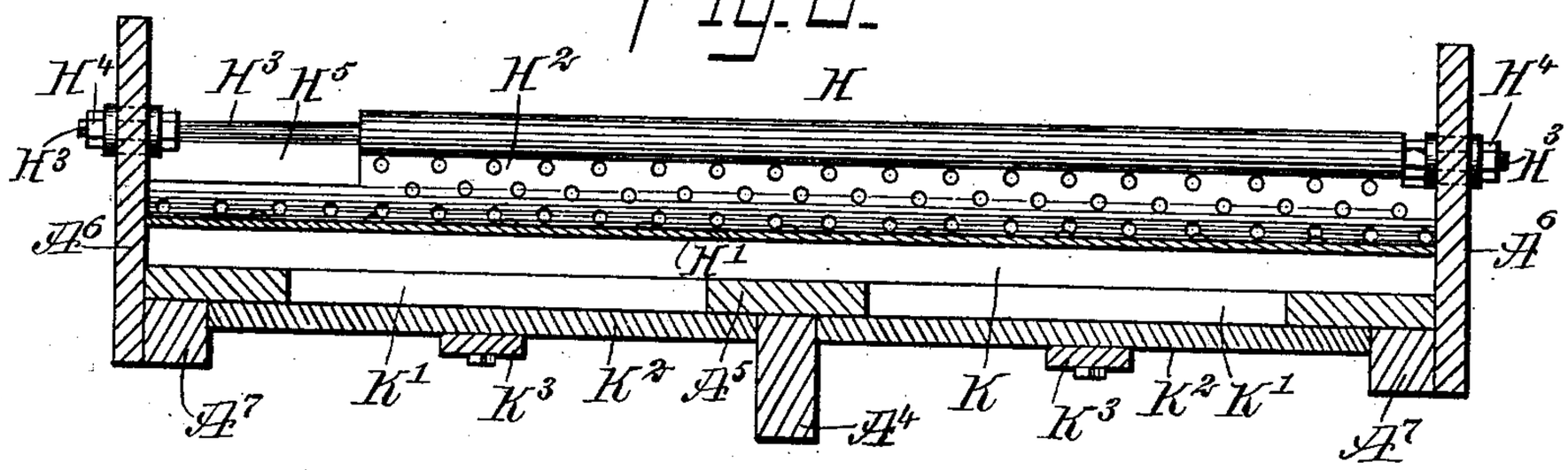


Fig. 7.

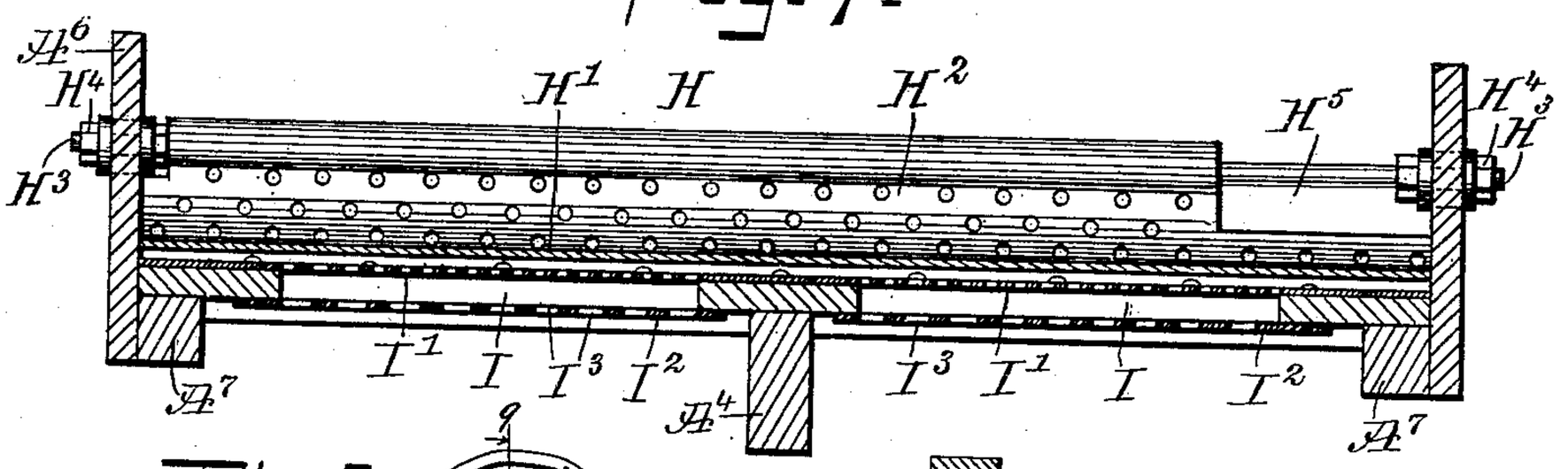


Fig. 8.

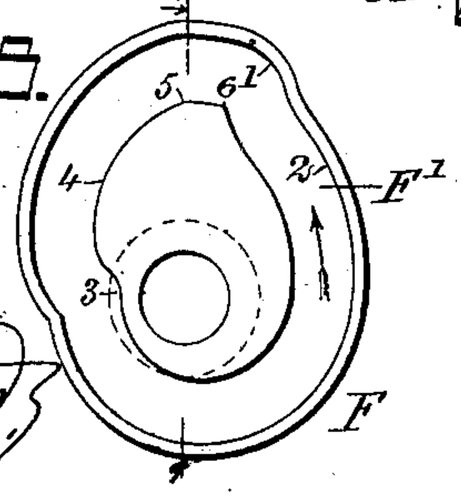
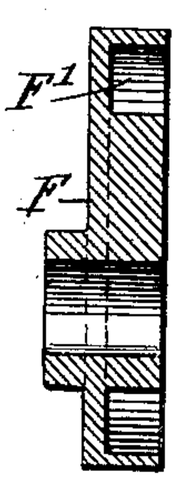


Fig. 9.



WITNESSES

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UNITED STATES PATENT OFFICE.

ALONZO C. CAMPBELL, OF ASHEVILLE, NORTH CAROLINA.

COAL-WASHER AND ORE-CONCENTRATOR.

No. 898,314. Specification of Letters Patent. Patented Sept. 8, 1908.

Application filed August 4, 1906. Serial No. 329,241.

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 coal washers and ore concentrators, such as shown and described in Letters Patent of the United States, No. 695,790, granted to me March 18, 1902, and in the application for Letters Patent of the United States, Serial No. 228,705, filed by me on October 17, 1904.

The object of the present invention is to provide a new and improved coal washer and ore concentrator for readily separating and discharging individually the fine dense slimes of concentrates or of coal, the fine granular dense stuff, and the coarse and massive concentrates of ore or refuse of coal, the arrangement of the parts being such that both a panning and jigging takes place conjointly and interchangeably.

The invention consists of novel features and parts and combinations of the same, which will be more 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, the section being on the line 2—2 of Fig. 3; Fig. 3 is a plan view of the same; Fig. 4 is an enlarged sectional side elevation of the same on the line 4—4 of Fig. 3; Fig. 5 is an enlarged transverse section of the pan on the line 5—5 of Fig. 2; Fig. 6 is a similar view of the same on the line 6—6 of Fig. 2; Fig. 7 is a like view of the same on the line 7—7 of Fig. 2; Fig. 8 is an enlarged face view of the cam wheel for imparting motion to the pan, and Fig. 9 is a transverse section of the same on the line 9—9 of Fig. 8.

The pan A is hung on suspending rods B depending from the main frame C of any approved construction, and the said pan A is provided with a head block A′ adapted to bump against the bumping block C^1 held on the main frame C; and the said head block A^1 is provided with a flange A^2 connected by a connecting rod D with the upper end of a vibrating lever E carrying at its lower end a friction roller E^1 engaging the cam groove F^1 in the cam wheel F attached to the main driving shaft G journaled in suitable bearings on the main frame A and connected by pulleys and belt or other devices with machinery for imparting a continuous rotary motion to the said shaft G.

The detailed construction of the vibrating lever E is approximately the same as the one shown and described in the Letters Patent of the United States above referred to, so that further description of the same is not deemed necessary.

The pan A is constructed in detail as follows, special reference being had to Figs. 2 to 7. The head block A^1 previously mentioned forms part of a longitudinally extending rib A^4 supporting the bottom A^5 of the pan, and which bottom A^5 is preferably made of transverse slats terminating at the sides A^6 connected at their lower ends by angle pieces A^7 with the bottom A^5, as plainly indicated in Figs. 5, 6 and 7. The sides A^6 are also rigidly connected with each other at intervals by transverse beams A^8 forming parts of the slatted bottom A^5, as plainly indicated in Fig. 2. Within the pan A are arranged transversely extending perforated riffles H, each having a straight body portion H^1 adapted to be fastened at its lower end and terminating at its upper end in upwardly and rearwardly curved heads H^2 attached at its end to a transverse rod H^3 adjustably secured in the sides A^6 of the pan A by the use of suitable nuts and washers H^4, as plainly indicated in the drawings, it being understood that each rod H^3 is fitted to slide up and down in vertical slots A^9 formed in the sides A^6. The heads H^2 have cut out portions H^5 alternately on opposite sides, so as to form a zig zag passage for the material from the head of the pan to the tail end thereof.

In the upper portion of the bottom A^5 of the pan A are produced transverse openings forming seep cells I below the body H^1 of a corresponding riffle H, and each seep cell I is closed on the top by a perforated plate I^1 and its bottom I^2 is formed by a plate having restricted outlet openings I^3. Some of the riffles H have their bodies H^1 riveted or otherwise secured to the ends of the body H^1 of the adjacent riffles, as plainly indicated in Fig. 2 and the left hand end of Fig. 4, and the uppermost riffle H of the said connected riffles

is attached near its head H^2 to a barrier block J arranged on the upper face of the bottom A^5. The lowermost riffle of the said connected riffles is attached to the slatted bottom A^5, and the said connected riffles are thus a distance above the upper surface of the bottom A^5 to form a compacting passage K provided at its upper end with an outlet K^1 formed in the bottom A^5, the outlet being closed at the under side by a valve K^2 secured on spring arms K^3 attached to the cross bar A^8, as will be readily understood by reference to Figs. 2 and 4.

The material to be treated is placed into a hopper L mounted on the frame C, and having an outlet spout L^1 provided with a pivoted tilter L^2 for delivering the material to the pan A at or near the middle thereof. A water supply pipe N, connected with a suitable source of water, is provided at its outlet with a spreader N′, to distribute the water at the head of the pan A. A portion of the water is also passed by branch pipes O to the hopper L.

When the machine is in operation the pan is oscillated and receives a percussive action by the mechanism shown and described, and by this action of the pan a separation of the more dense stuff and the less dense stuff in two layers takes place, the top layer being floated away by the escaping water and is discharged over the tail end of the pan A and drops into a sluice P, while the lower layer or more dense stuff (concentrates or the like) is discharged at the head of the pan A and drops into a sluice Q. The reciprocating and percussive action imparts an agitation to the mass of stuff that is fed with water onto the table. The mass thoroughly intermingled with water, classifies into various sizes and densities. There being plain and perforated areas constituting the total working surface, the process is in part panning, and in part jigging, and these processes operate conjointly and interchangeably. The dense fines are urged by the percussive action, to the head. The light fines, the coal or the gangue of ore, are urged, by the natural flow of the water, to pass through the perforations in the opposite direction, toward the tail. Water that is homogeneously loaded with dense fines, will partake of the mechanical percussive action, and resist the down flow tendency of the water, since it seeks the lowest places, and by its excessive density, clings to the wood bottom, as a dense fluid, where it accumulates and persistently advances toward the head. It is an object to retard the too rapid advance of this fine dense stuff, whether it is compacted or whether it be in the state of a liquid pulp. It is a further object to subject this accumulated mass to a continuous and active process of enrichment, that it may be thoroughly disengaged from all lighter slimes or sludge that properly should go with the tailings. The improved riffles and their grouping, are designed to retard the flow, and to shelter these dense fines that they may not escape with the tailings, and thus be lost.

The intermittent lurching of the mass pocketed by the deep riffles, together with the buoyant effect of the water, that in part flows and in part seeps through the perforations, and the porous mass, are the means for disengaging the sizes and densities, the coarse dense riding immediately on the perforated areas, the coarse light floating on the dense coarse, and the dense fine permeating the mass, and finally settling upon the true bottom A^5. As the true bottom is made up of jointed slats of wood it affords a clinging surface to the dense fines.

It will be observed that each individual riffle H, in general, has its lower margin close in contact with the true bottom and opening out toward the head, the intention being that there can be no compacting of fines under the riffles, or above the riffles, the water at all times having its sufficient buoyant effect. The groups of connected riffles are arranged to produce just the opposite effect, namely, to compact the dense fines,—slimes, sludge, etc., the object being to impound these materials, and to be able to recover them in a compacted and greatly enriched state. A barrier J is interposed so that the percussive action cannot clear the spaces under the connected riffles, the mass thus becoming compacted to any desirable degree, which is regulated by the adjustable spring valve K^2 that must be opened by the compacting force. This compacting and enriching passage can further be gaged by its variable length.

The excessive fines are of that peculiar nature that they are too sensitive to excess of water and agitation that they cannot be retained or enriched except by its exclusion in proper degree. In its more compacted state the dense clings to itself, while the lighter fines are oozed out by well directed agitation. There is another grade of fines that must be provided for, that are more granular, and require the more buoyant effect of water and agitation, yet, at the same time cannot follow the excessive coarse dense to the head discharge. These fines are not of a compacting nature, since the interstitial spaces are larger, and retain more water; they do not diffuse in water like the slimes of concentrates, however. Provision is made for this class of fines, in all its different grades, by the use of the seep cells I, at variable stations, approaching the head of the table. The fines referred to are persistently crowded out by compacting slimes, and cannot traverse the head, so it naturally falls between these two classes. The dense stuff makes its way into the cells I

through the pervious covering I^2, and masses to a degree, and eventually escapes through the small hole I^3, having such capacity as the case demands. The cells I are at all times filled with water, which has a buoyant effect, and gages the flow or seepage of the class of stuff that naturally gravitates to its place of discharge. When all the grades of dense fines have thus been removed, there is left only the coarse dense stuff that is constrained to follow the maze of riffles in a long circuitous zig zag course to the one restricted port of escape.

Having thus described the process as pertaining to the concentrates, I will now describe the course of the tailings,—coal or gangue. The lighter materials, both coarse and fine, partaking of the flow of the water, keep to the surface, and in large degree, overflow the riffles. The heavier portions follow the maze of riffles to the port of discharge at the tail. Much of the fine stuff flows through the perforations, and, in general, follows the water in its many passages to the tail.

The appliances in this invention are to retard, in very great degree, and in that prolonged period of time, to continuously and effectuously work the total mass of concentrates till every trace of coal or of gangue has been crowded out and replaced by more dense material. The means to this end are,

First: the excessively high barrier riffles, so high, that only at the feed, can there be any overflow. The purpose is to turn the flow into the maze or zigzag passage as effectually as possible, and to give such restricted lateral passage, and such size and height of port as will give a safe harbor for the constantly accumulating concentrates.

Second: the riffles are so disposed individually that the percussive action shall have a clearance effect in contradistinction to the compacting effect, except in the specially devised compacting passages K, with the purpose to discharge the compacted mass as a finished product. The mass of stuff in the sheltered space that is closed on one margin, is lurched forward by the percussive action, and there is a vacuous space behind, and nothing to fill in but the seepage through the perforated shelter. This affords a retarding as well as a clearance effect. This clearance is very effective, in that the mass of fine stuff never loses its mobility,—is always sufficiently tempered with water that the enrichment may go on. At the instant of the reverse motion, the mass will lurch forward in slight degree, the effect being to force the water back through the perforations, and carry with it the lighter materials that have been disengaged from the concentrate. This process varies in slight degree, and takes effect on different classes of materials, as the latter pass from one riffle to another, next in order. Even the last riffles, nearing the tail, hold a mass of dense material of fines, and they are exceedingly sensitive to water and agitation, and, in general, are too intermixed to undertake to save at once, yet much that is caught and massed at these last riffles finally reaches the more advanced riffles, eventually discharging at the first compacting station. The bed of overlying stuff is much deeper nearing the tail, which favors the gathering of the more sensitive fines.

Third: the barrier riffles and the restricted ports exercise such a retarding effect on the advancing concentrate, that the pan can be more elevated at the tail, thus giving the minimum inclination or fall. This leveling up is very helpful in that the flow of the water and its carrying effect is greatly reduced, and there is a larger yield of concentrates or refuse of coal. Again, these conditions favor a great reduction of water at the head, since it is held to do its maximum of service, in its progressive flow through the perforations and by way of the circuitous maze and alternating marginal ports. In the practice heretofore the inclination of the pan and the volume and the force of the head-water were gaged by the character of the headings, which, invariably, carried too much coal, or gangue of ore, that could not be kept back except by this excessive violence of action.

Fourth: the seep cells with their volume of water and pervious covering constitute a further selective process that serves as intermediary stations for the discharge of that class of densities that cannot find exit either at the compacting stations or at the head discharge. These cells operate selectively also upon the stuff that falls to them. The body of water that fills the cells, lurches to and fro and gives a panning effect on the bottom, and a jigging effect on the pervious area above, and each individual cell has its own most fitting classified product, and the multiple cells coöperate to bring this most favorable condition about.

In the process of panning, the material masses in such a way that the very finest and most dense settles through the coarse materials and masses at the bottom, where it fills the interstitial spaces of the coarser grades. If there is but a small proportion of this accumulation of fines, it cannot hold its place there, under the effect of excessive water and agitation; but if it is sheltered and in every way protected from the violence, then it will accumulate and assert itself, driving out or buoying up the coarser grains, so they have no footing whatever. The liquid dense pulp acts as a dense fluid, like mercury, and is a perfect barrier to the settling of the coarser grains even though they be most dense. Thus the finer dense pulp or slime of ore has the first choice of compacting, and the finer dense granular has the second of massing,

and so on, in the order of the increasing size of the grains, and there are adequate provisions at the series of stations for their exit at the opportune time. The remaining coarser dense material must needs seek refuge by the circuitous maze and discharge at the head, being most completely filched of all that is fine or buoyant.

Having thus 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 percussive action to the same, the said pan being provided with inclined perforated transverse riffles having upwardly extending heads, said riffles being secured at one end to the bottom of the pan and having their heads provided with cut out portions located alternately in opposite ends of succeeding riffles to form a ziz-zag passage in the pan.

2. A machine of the class described, provided with a pan and means for imparting a percussive action to the same, the said pan having perforated transverse riffles fixedly secured at their lower ends to the bottom of the pan and inclining upwardly and forwardly and provided with curved heads having cut out portions located alternately at opposite ends of succeeding riffles to form zigzag restricted regurgitating passages in the pan.

3. A machine of the class described, provided with a pan, means for oscillating the pan and imparting a percussive action to the same, the said pan having transverse perforated riffles having their lower ends fixed to the bottom of the pan and having their upper ends in the form of upwardly and rearwardly curved heads, and means for raising and lowering the said heads.

4. A machine of the class described, provided with a pan, means for oscillating the pan and imparting a percussive action to the same, the said pan having transverse perforated riffles having their lower ends fixed to the bottom of the pan and having their upper ends in the form of upwardly and rearwardly curved heads, each head having a rod extending through elongated slots in the sides of the pan, and nuts and washers for receiving the terminals of each rod to the sides of the pan.

5. A machine of the class described, provided with a pan, and means for oscillating the pan and imparting a percussive action to the same, the said pan having transverse perforated riffles fixedly secured at the lower ends to the bottom of the pan and inclining upwardly and forwardly, said pan also having interlocked barrier riffles, at intervals, forming with the bottom of the pan a percussive compacting passage.

6. A machine of the class described, provided with a pan, and means for oscillating the pan and imparting a percussive action to the same, the said pan having transverse perforated riffles fixedly secured at the lower ends to the bottom of the pan and inclining upwardly and forwardly, sundry of the riffles at intervals being connected together and forming impounding and compacting passages in a resulting direction to the force of the impact, and having a discharge port.

7. A machine of the class described, provided with a pan, and means for oscillating the pan and imparting a percussive action to the same, the said pan having perforated transverse riffles fixedly secured at the lower ends to the bottom of the pan and inclining forwardly and upwardly, said pan also having interlocked barrier riffles forming a compacting and enriching passage in a resultant direction to the force of the impact and having a resistant discharge port at the head of the passage.

8. A machine of the class described, provided with a pan, and means for oscillating the pan and imparting a percussive action to the same, the said pan having perforated transverse riffles fixedly secured at the lower ends of the bottom of the pan and inclining forwardly and upwardly, the said pan also having interlocked barrier riffles for forming a covered percussive compacting passage, a barrier block at the head of the compacting passage, and a discharge valve at the head, said valve being actuated by the inertia of the compacted mass, a passage being arranged at intervals in the pan alternately with the first named riffles.

9. A machine of the class described, provided with a pan, transverse perforated riffles having curved heads, said riffles being secured to the bottom of the pan and inclining upwardly and forwardly, and means for oscillating the pan and imparting a percussive action to the same, the said pan having a seep cell provided with a cover finely and sparsely perforated and having restricted discharge at the bottom, the cell extending transversely from one side of the pan to the other.

10. A machine of the class described, provided with a pan, and means for oscillating the pan and imparting a percussive action to the same, the said pan having transverse perforated riffles fixedly secured at the lower ends to the bottom of the pan and inclining forwardly and upwardly, perforated riffles in the pan, sundry of the riffles being connected together to form with the bottom of the pan compacting passages at broken intervals in the lower half of the pan, the said pan having discharge ports for the passages and seep cells at intervals at the upper half of the pan, the cells being provided with finely perforated covers and a restricted discharge, forming a shallow water space between them.

11. In a machine of the class described, a pan, means for oscillating the pan and imparting a percussive action to the same, a transverse barrier on the bottom of the pan, and perforated riffles in the pan, sundry of the riffles being connected together and secured to the barrier and bottom of the pan and forming therewith a compacting passage having a discharge port at its upper end.

12. In a machine of the class described, a pan, means for oscillating the pan and imparting a percussive action to the same, a transverse barrier on the bottom of the pan, transverse perforated riffles in the pan, sundry of the riffles being connected together and secured to the barrier and the bottom of the pan and forming therewith a compacting passage having a discharge port at its upper end, and a spring supported valve for said port.

13. In a machine of the class described, a pan having seep openings, means for oscillating the pan and imparting a percussive action to the same, a series of perforated riffles having their lower ends secured to the bottom of the pan and inclined upwardly and forwardly, a transverse barrier in the bottom of the pan, and a second series of perforated and connected riffles, one of the riffles being secured to the bottom of the pan and another to the barrier forming with the barrier and the bottom of the pan a compacting passage having a discharge port and a spring actuated valve controlling said port.

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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CHARLOTTE RILSON.