No. 657,553. Patented Sept. 11, 1900.

J. S. LODER.

ORE CLASSIFYING APPARATUS.

(Application filed Apr. 29, 1893.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

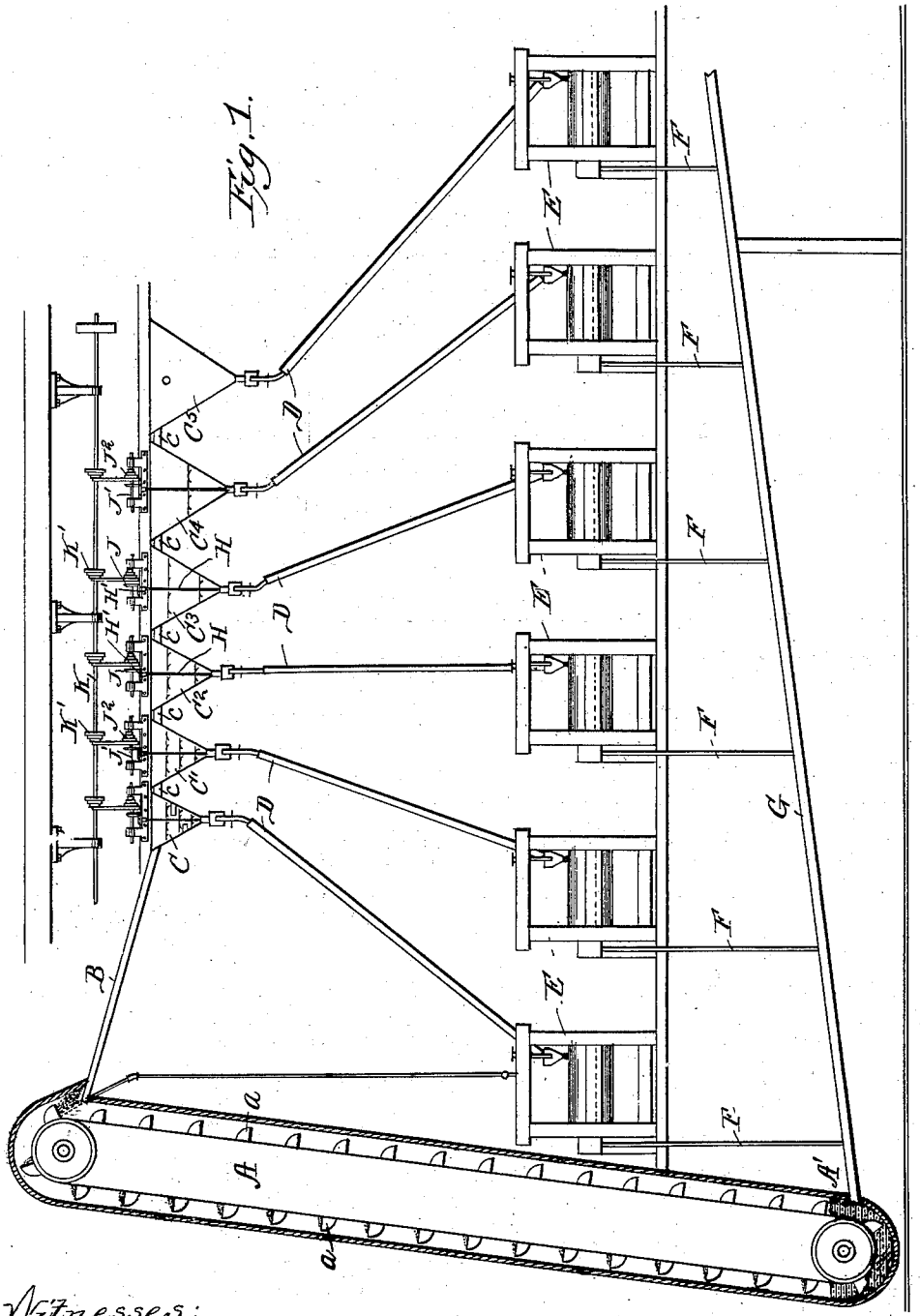

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Fig. 2.

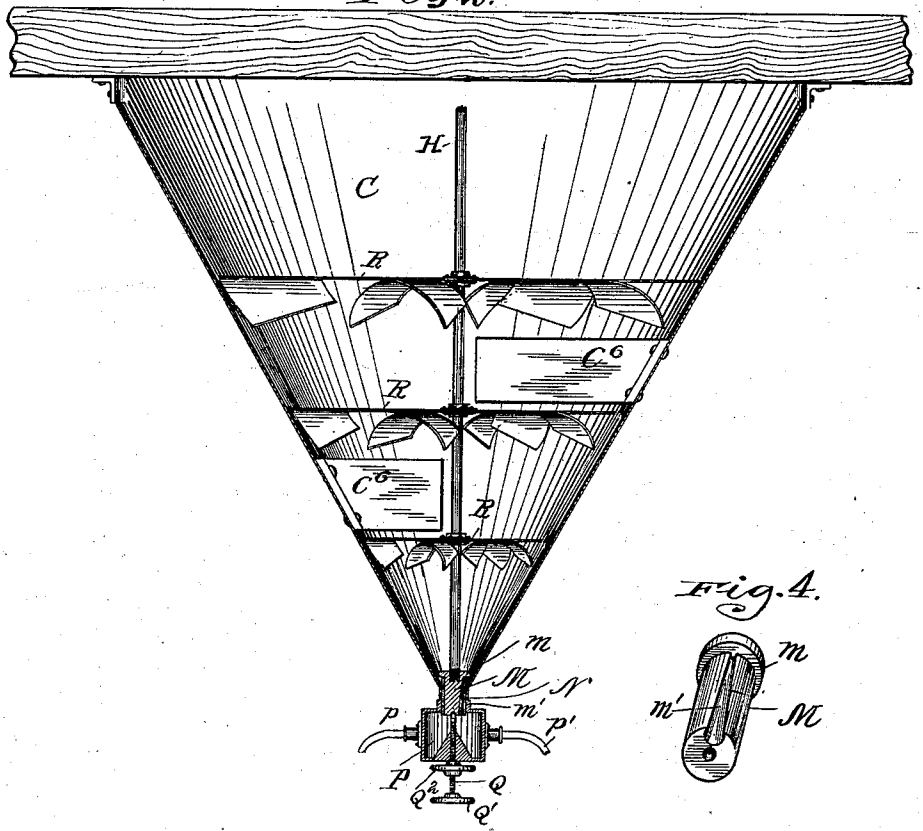
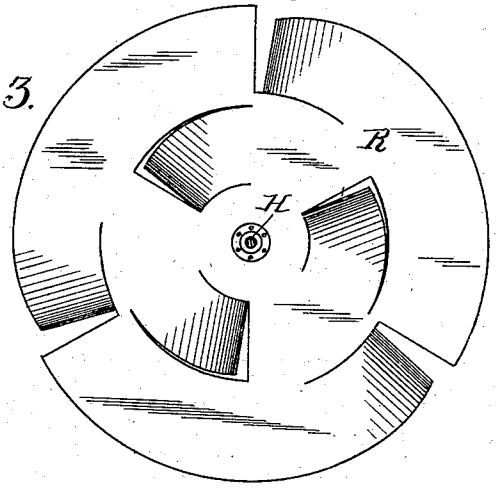


Fig. 4.

Fig. 3.



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UNITED STATES PATENT OFFICE.

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ORE-CLASSIFYING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 657,553, dated September 11, 1900.

Application filed April 29, 1893. Serial No. 472,306. (No model.)

To all whom it may concern:

Be it known that I, JOHN S. LODER, a citizen of the United States, residing at Ouray, county of Ouray, State of Colorado, have invented a certain new and useful Improvement in Ore-Classifying Apparatus; and I declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

In the concentration and separation of mineral ore it has heretofore been customary to reduce the ore by a crusher to the requisite degree of fineness and then introduce the mass or "pulp," as it is termed, into the separator, using, of course, the usual amount of water to produce the pulp. This pulp must, however, necessarily contain all sizes and weights of particles from the finest up to the size to which the crusher is expected to reduce, it as well as minerals of various specific gravities, and this being introduced into a single separator the latter cannot of necessity accomplish the separation as effectually as though the particles were of substantially the same size or substantially the same specific gravity, since where with one adjustment of the machine maximum efficiency could be attained on the mineral of one specific gravity it requires another adjustment to attain a maximum efficiency on mineral of another specific gravity.

My invention has for its object the production of an apparatus whereby the ore or pulp is classified before being introduced into the separator or concentrator—that is to say, the particles of a certain range of specific gravity are separated from the entire mass and run to one concentrator, the particles of the next adjacent range of specific gravities are separated and run to another concentrator, and so on until the entire volume has been divided and each class carried to its respective concentrator.

The invention has also for its object certain other novel features hereinafter described and claimed.

In the drawings, Figure 1 is a part sectional elevation of an apparatus embodying my invention. Fig. 2 is a detail of the separating-hopper. Fig. 3 is a plan view of the circulating-diaphragm. Fig. 4 is a detail of the valve or shaft seat.

In carrying out my invention, A represents a suitable bucket elevator of any desirable construction, provided with the buckets *a*, and B a chute into which the contents of the buckets are dumped, said chute leading to a hopper or V-shaped receptacle C. In the apparatus illustrated are six of these receptacles or hoppers C C′ C^2 C^3 C^4 C^5, connected together by the conduits *c*. Connected with the lower end or point of each hopper is a conduit D, each one extending to a separator or concentrator E. From each of the latter extends an outlet-conduit F to a common conduit G, leading to the base of the elevator.

I will now describe the construction of the hoppers C C′, &c.

Extending vertically through each hopper is a shaft H, Fig. 2, provided on its upper end with a beveled gear H′, which meshes with a beveled gear J on the shaft J′. The shaft J′ is provided with cone-pulleys J^2. Above the shaft J′ is another shaft K, driven from any suitable source and provided with cone-pulleys K′. By a belt connection between the shafts J and K any desired speed may be given to the former, and consequently to the vertical shaft in the hopper. In the lower end of each hopper is a plug or shoe M, which performs the double function of a valve and a seat or bearing for the lower end of the shaft.

Surrounding the plug M is a lining or valve-seat N. The plug is provided with a rim or flange *m* on its upper end adapted to bear on the seat N, and its body is provided with a longitudinal groove or recess *m*′, larger at the lower end than at the upper. The purpose of making this longitudinal groove tapering or larger at the lower than at the upper end is to prevent the clogging of such opening, which would occur if the arrangement were the reverse or if the opening were of uniform diameter throughout its length, for with the groove constructed as I have described any particles large enough to pass through the upper end of the groove will be immediately discharged therefrom, because free from con-

tact with the surrounding walls, and hence there is no tendency to choke or clog the discharge-groove.

Below the plug is a chamber P, with the outlets p p' communicating with the conduit D. A set-screw Q, operated by the hand-wheel Q' and locked by the wheel Q^2, operates to raise or lower the plug M. On the shaft H are keyed diaphragms R. Each of the diaphragms has downwardly-projecting wings cut from the metal to leave openings above, so that when the diaphragms are revolved the pulp is agitated, circulated, and elevated.

I will now describe the general operation. The pulp is admitted to the elevator at A', carried up and dumped into the chute B, by which it is conveyed to the first hopper C. The revolution of the circulators R stirs up and circulates the mass, and the smaller and lighter particles will naturally work toward the center and be forced upward, while the larger and heavier particles will work down the sides to the bottom. This result is due to the fact that the blades of the diaphragm are so curved and so arranged with relation to the plane of revolution of the diaphragm as to cause the blades to scoop up and lift the material, thus effecting a mechanical elevation of the particles of material and also establishing an upward current which tends to force the lighter particles upward, the heavier particles falling by gravity between the peripheral edges of the diaphragm and the wall of the hopper, the spaces between the peripheries of the diaphragm and the wall of the hopper being sufficiently wide for this purpose. The spaces between the edges of the diaphragm and the hopper will be of sufficient width to allow of the passage of the particles, and these spaces may be varied by adjusting the plug M, which carries the shaft. The plug or valve M and with it the shaft H have been raised sufficiently to allow the desired amount of pulp to pass between the outer edge or periphery of the circulators and the hopper-casing, and the same elevation of the plug raises the rim m away from its seat and allows the pulp to pass to the chamber P and from thence to the concentrator. This is of course the pulp containing those particles of the greatest weight. The balance has been elevated to the top of the hopper, and as new material is added will pass through the conduit c to the next adjacent hopper, where the same process is undergone and the coarser particles separated, and so on until the last hopper C^5 is reached. This is the finest grade of mineral in the pulp and runs directly to its concentrator. The construction of the concentrators is immaterial in this application. Suffice it to say that on each may be provided a receptacle containing that portion of the pulp from which the dross or tailings have not been thoroughly separated. This receptacle is connected by the conduit F with the conduit G and by the latter with the elevator, so that such of the pulp as has not been thoroughly separated in its passage through the concentrator may be again passed through the classifying apparatus.

It will be observed that the hoppers are graded in size from C, the smallest, to C^5, the largest, the purpose of this arrangement being to equalize the work to be performed in each of the hoppers or receptacles. In other words, when the pulp is delivered to the first receptacle it contains the heaviest particles, and as these particles will settle to the bottom of the first hopper more quickly than the lighter particles will settle to the bottom of the succeeding hoppers I have found that by varying the size of the agitating and elevating diaphragms or disks R the work of each hopper may be readily adjusted to the condition of the pulp at the time it is operated upon in the various hoppers. It will also be observed that the hoppers C C' contain three of the circulators R, the hoppers C^2 C^3 contain two, and the hopper C^4 but one. It will also be observed that each shaft H can be given any desired speed. By these various adjustments the pulp is thoroughly classified and each grade or class delivered to a concentrator adapted and adjusted to separate that particular class most effectually.

For the purpose of insuring the emptying of the buckets a of the elevator A, and incidentally for the purpose of adding water to the pulp to insure its flow along the chute B and through the various hoppers or receptacles C, I propose to direct a jet of water into the buckets just before they reach the receiving end of the chute, which jet, assisted by gravity, will serve to thoroughly cleanse and remove all of the pulp from the buckets. This result may be accomplished in many different ways, the simplest construction known to me being a water-pipe B', arranged as shown in the drawings, for the accomplishment of the above-mentioned object.

It will thus be seen that by the above-described apparatus the ore-pulp is so separated or classified that a maximum efficiency may be attained in the concentration of the ore when it reaches the concentrator, since each machine has particles or minerals of a stated weight with which to deal. It will also be seen that by the classification of the ore as above described the use of a large amount of water is obviated and the amount of water introduced into the pulp is gradually reduced. To prevent the contents of the hoppers from circulating to too great an extent in the same direction as the circulators R, one or more of the hoppers can, if desired, be provided with stationary wings or dasher-boards C^6, extending inwardly from the walls.

While I have shown the use of six hoppers in my present apparatus, yet the number might be increased or diminished as desired, the number depending on the number of classes of mineral contained in the pulp.

It is obvious that many details of my apparatus might be altered to fit the exigencies

of each particular case where it is used without departing from the spirit of my invention.

What I claim is—

1. An apparatus for classifying ore-pulp, consisting of a series of V-shaped receptacles connected at their upper ends by suitable conduits and each provided with an outlet at its lower end, a vertical shaft extending into each receptacle and one or more horizontal diaphragms carried by said shaft, each of said diaphragms being provided with downwardly-projecting wings, located out of radial alinement with each other, and means for adjusting said shaft to vary the space between the diaphragms and the walls of the receptacles, substantially as described.

2. In an apparatus for classifying ore-pulp, the combination with a V-shaped receptacle provided with a discharge-opening at or near its bottom of a vertical shaft extending into the receptacle, horizontal diaphragms mounted on the shaft and a valve for said discharge-opening constituting a bearing for the lower end of the shaft, said diaphragms, shaft and valve being vertically adjustable to simultaneously vary the space between the diaphragm and the walls of the receptacle, and the size of the discharge-opening, substantially as described.

3. In an apparatus for classifying ore-pulp the combination of a V-shaped receptacle provided with a vertical shaft for carrying means for agitating and elevating a portion of the contents of the receptacle, and a seat for the lower end of said shaft consisting of a plug having a valve-opening adapted to be opened by the elevation of the plug, and means for elevating the plug, substantially as described.

4. In an apparatus for classifying ore-pulp the combination with the V-shaped receptacle and vertical shaft of a seat for the lower end of the shaft, said seat being in the form of a plug, filling the lower end of the receptacle, said plug provided with a rim on its upper end and a longitudinal recess in its side, said recess being larger at the lower end than at the upper end, substantially as described.

5. An apparatus for classifying ore-pulp, consisting of V-shaped receptacles into which the pulp is introduced successively, each receptacle being provided with a vertical shaft rotating at a speed different from that of the other shafts and carrying diaphragms provided with blades, and means for adjusting said shaft vertically to vary the space between the walls of the receptacle, and the diaphragms, substantially as described.

6. An apparatus for classifying ore-pulp, consisting of a series of V-shaped receptacles graduated in size and each provided with a valved discharge-opening at or near its bottom, the smallest receptacle receiving the supply for the series through which the ore is passed, an adjustable shaft in each receptacle carrying mechanism for agitating, means for varying the space between the diaphragms and walls of the receptacles, and means for giving the shaft of each receptacle a different speed from that of the receptacle next adjacent, substantially as described.

7. In an apparatus for classifying ore-pulp, the combination of an elevator for elevating the pulp, a conduit leading therefrom to the first of a series of V-shaped separating-receptacles each of said receptacles containing a vertically-adjustable shaft carrying revolving diaphragms for agitating and elevating the lighter particles of the receptacle, and each provided with a valved discharge-opening at or near its bottom, a conduit leading from the lower end of each receptacle to one of a series of concentrators, and a conduit leading from the upper end of each receptacle to the receptacle next adjacent, substantially as described.

8. In an apparatus for classifying ore-pulp, the combination with a V-shaped receptacle provided with a discharge-opening at or near its bottom, of a vertical shaft extending into the receptacle, one or more horizontal diaphragms mounted on the shaft, each of said diaphragms being provided with a downwardly-projecting wing and an opening above each wing, said wings being out of radial alinement, substantially as described.

9. In an apparatus for classifying ore-pulp, the combination with a series of receptacles suitably connected together, a bucket elevator and a chute leading from the upper end of said elevator and discharging into one of said receptacles, of a fluid-nozzle located at the head of said chute and directing a stream of fluid into each bucket of the elevator as it passes the chute, substantially as described.

10. In an apparatus for classifying ore-pulp, the combination with a series of receptacles into which the ore is successively introduced, of a bucket elevator, a chute leading from the upper end of said elevator and discharging into one of the said receptacles, and a fluid-nozzle adapted to discharge a stream of water upward and into each bucket as it passes the chute and discharges its contents therein, substantially as described.

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