No. 849,379. PATENTED APR. 9, 1907.

J. VAN N. DORR.

ORE CLASSIFIER.

APPLICATION FILED MAY 18, 1906.

2 SHEETS—SHEET 1.

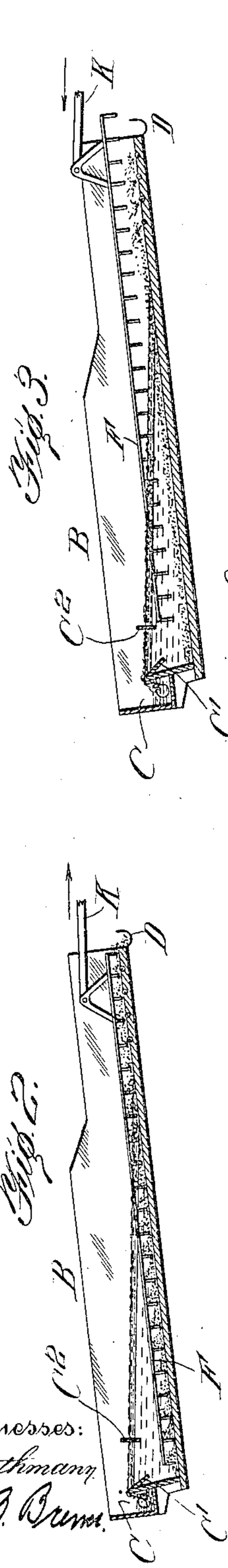

Fig. 3.

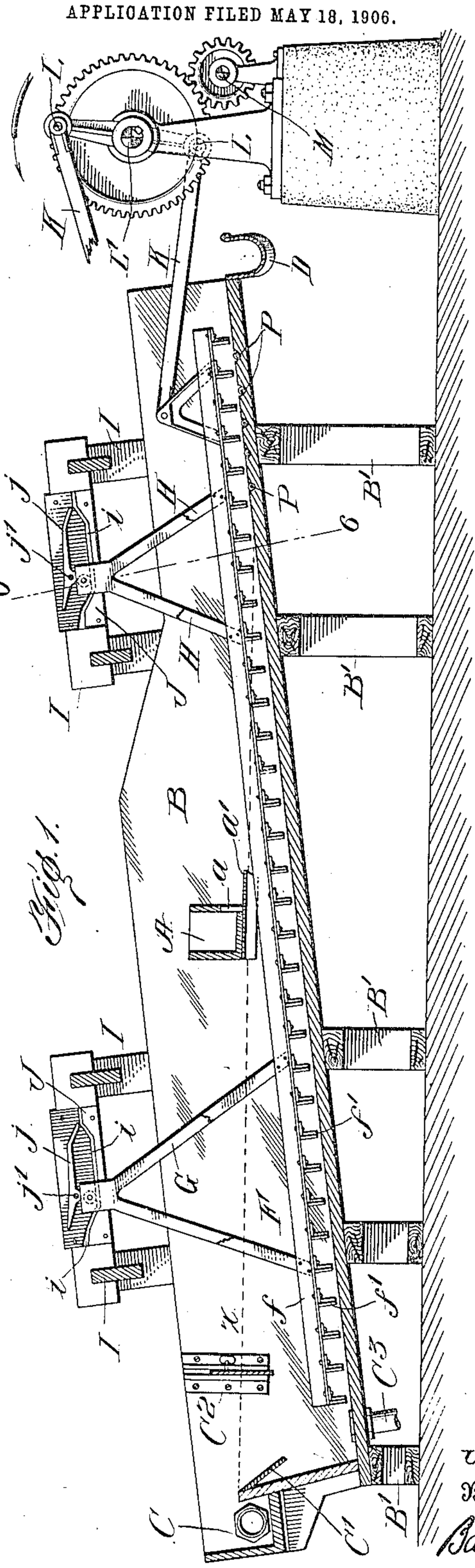

Fig. 1.

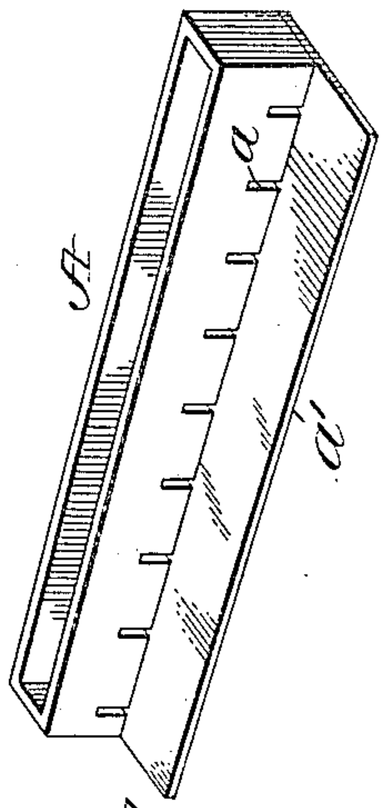

Fig. 4.

Fig. 2.

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By his Attorneys:
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2 SHEETS—SHEET 2.

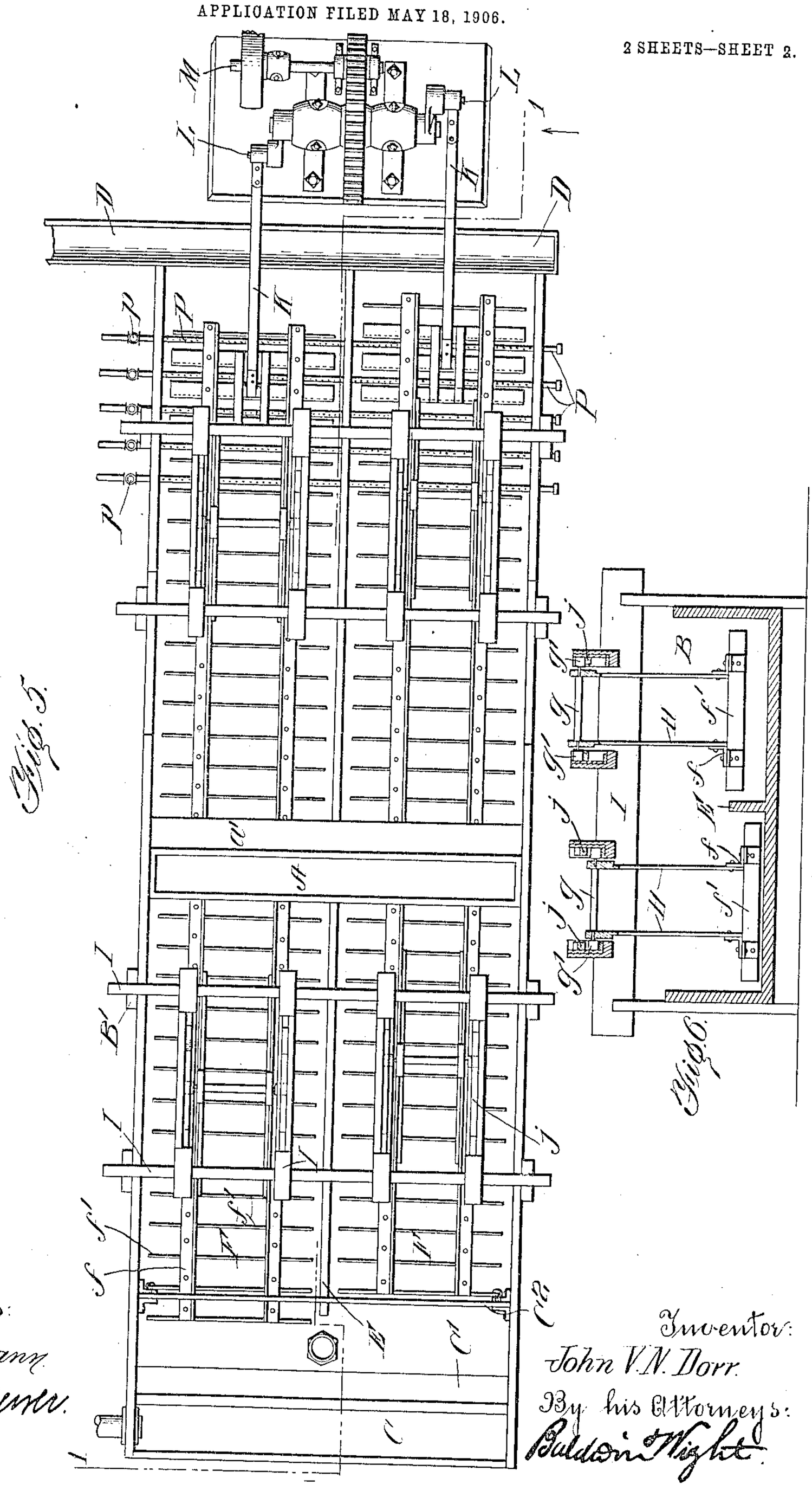

Fig. 5.

Fig. 6.

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UNITED STATES PATENT OFFICE.

JOHN VAN NOSTRAND DORR, OF LEAD, SOUTH DAKOTA.

ORE-CLASSIFIER.

No. 849,379. Specification of Letters Patent. Patented April 9, 1907.

Application filed May 18, 1906. Serial No. 317,583.

To all whom it may concern:

Be it known that I, JOHN VAN NOSTRAND DORR, a citizen of the United States, residing in Lead, in the county of Lawrence and State of South Dakota, have invented certain new and useful Improvements in Ore-Classifiers, of which the following is a specification.

My present invention relates to certain improvements in apparatus for separating and classifying materials which have different settling rates in liquid, whether such difference is caused by a variation in the specific gravity of the particles, as in the concentration of ores, or in the size of the particles when homogeneous, as in the separation of sands and slimes.

The primary object of my invention is to provide an apparatus which, while simple in construction and easily operated, will thoroughly separate the sands or rapidly-settling particles in wet crushed pulp from the slimes or slowly-settling particles therein and will separately deliver the slimes and the clean leachable sands.

My improved apparatus is especially designed for classifying the sands and slimes in wet crushed pulp for cyaniding, and for convenience I will assume in the following description that the pulp is being treated for that purpose.

Ore pulp, as is well understood, contains sands with which metallic values are mixed and which is readily leachable and also slimes which contain values which cannot be economically leached and which if mixed with the sands prevents or impedes the leaching thereof. Such slimes may be treated to recover their values; but it is very desirable that the process for recovering the values from slimes shall be separate and distinct from the treatment of the sands to recover the values therefrom.

Various forms of apparatus have been devised for classifying sands and slimes; but they have not proved satisfactory in all particulars or under all conditions. For instance, the "hydraulic cones" heretofore most generally used for the purpose were open to the objection that where the pulp contained much earthy material, producing a large amount of slimes, it was necessary to employ a strong upward current of liquid in the cones, resulting in the carrying over with the slimes of a great portion of the fine sands which would be readily leachable if allowed to remain with the coarser sands, or it was necessary to use several cones in series, making a large amount of fall or requiring increased mill height.

According to my invention the wet pulp from a suitable crusher or pulverizer is continuously conveyed to a settling-trough, where the sands settle to the bottom by gravity, while the slimes remain in suspension in the liquid. The slimes flow over into a launder, which conveys them away to a suitable receptacle removed from the classifier, while the sands are moved upwardly along the inclined bottom of the trough and delivered to another launder, which conveys them to the leachers or other suitable receptacles. For the purpose of moving the sands out of the trough I employ rakes or scrapers, which are reciprocated back and forth above the bottom of the trough in such manner as to move the sands toward the upper end of the trough on the outstroke, but which are elevated above the plane of the sand on their instroke. This raking operation is effective not only in moving the sand as fast as it falls toward the sand-receiving launder, but it also serves to loosen or agitate the sand by first forming it into small piles and then allowing it to settle, while at the same time progressively moving it upward and outward along the inclined bottom of the trough. The rakes, while effectively removing the sands, do not so agitate the liquid in the upper stratum of the bath as to interfere with the settling of the sands. The operation results in keeping the slimes in suspension and allowing the sands to settle out, and as the sands are spread out in a thin layer the liquid has a better chance to act upon them.

While the greater portion of the slimes are separated from the sands in this way, there are still some present in the settled sands which must be removed. To accomplish this, I provide means for washing the settled sands after they emerge from the settling-bath and just before their delivery to the launder which conveys them away. For this purpose perforated pipes are located near the sand-delivery end of the trough, through which clear liquid is forced upwardly through the sand as it passes over them, resulting in the elimination of the remaining slimes, which are carried back with the incoming liquid to the settling-bath, very little of such clear liquid being allowed to pass out with the sands.

I preferably divide the settling-trough into

two parts, using two sets of rakes operating alternately in opposite directions, whereby the weight of the moving parts is counterbalanced, and the overflow of the liquid into the slime-receiving trough is made more uniform and even.

In the accompanying drawings I have illustrated the way now best known to me of carrying out my invention; but changes may be made without departing from the novel features of my improvements. The subject-matter deemed novel is specified in the claims.

Figure 1 shows a longitudinal section of my improved classifier on the line 1 1 of Fig. 5 looking in the direction of the arrow. Fig. 2 is a longitudinal section of part of the classifier, illustrating how the sand is raked up into piles during the outstroke of the rake. Fig. 3 is a similar view showing how the sands settle during the instroke of the rake. Fig. 4 is a perspective view of the feed-launder. Fig. 5 is a plan view of the classifier. Fig. 6 shows a transverse section on the line 6 6 of Fig. 1.

The wet pulp is conveyed by a feed-launder A to a settling-trough B, which is inclined as shown, the liquid-level in the trough being indicated by the dotted line *x*. Suitable supports B′ are employed to hold the trough at the desired inclination. The feed-launder is preferably of the form illustrated in Fig. 4 and extends entirely across the trough, being formed with slots *a*, through which the wet pulp passes on to a distributing-plate *a′*. Preferably the launder is located about midway between the upper and lower ends of the trough. A launder C for carrying away the slimes, and a launder D for carrying off the sands, are located, respectively, at the lower and upper ends of the trough. Preferably the trough is divided into two parts by a partition E, which is high enough merely to prevent the sands from spreading from one part or division of the trough to the other. In each division of the trough is located a rake or scraper F, comprising longitudinal bars *f* and a series of transverse plates *f′*, attached to the bars in any suitable way. The rake-bars *f* are supported by hangers G and H, which at their upper ends are attached to cross-bars *g*, provided with rollers *g′* at opposite ends, each roller being adapted to travel in a track *i*, applied to a plate J, secured to a frame I, arranged at a slight elevation above the top of the trough. Over the tracks *i* are arranged gravity-switches *j*, which are pivoted at *j′* and which are so operated, as will be readily understood from an inspection of Fig. 1, that when the rollers move upwardly, or to the right as viewed in Fig. 1, they will travel along the inclined track *i*. After reaching the end of the tracks the rollers will lift the switches and then allow them to drop, and on the return movement of the rakes the rollers will travel on top of the switches until they reach the rear or lower ends thereof, when they will pass from the switches and again rest on the tracks *i*. In this way as the rakes are moved back and forth they are made to rise and fall at the proper times, being lowered to a position close to the bottom of the trough on the outward or upward stroke and being elevated some distance above the inclined bottom on the instroke, as illustrated in Fig. 3, but are not entirely withdrawn from the bath.

It will be observed that by the construction shown there is no chance for wear on the bearings of the rakes. The supports and parts which move in contact with each other are entirely above the liquid-level. If they were below the liquid-level, they would be exposed to the action of grit and sand, which would soon wear them out.

The rakes in the two compartments or divisions of the trough are similar in all respects, and to each one is joined a connecting-rod K, the outer end of each of which is attached to a crank L on a shaft L′, geared to a driving-shaft M. It will be observed that the cranks radiate in diametrically opposite directions, so that as the rake in one division of the trough moves upward and outward the rake in the other division of the trough moves inward and downward. This arrangement serves to counterbalance the weight of the moving parts, and it also serves to make the overflow into the launder C more steady and uniform.

Near the launder C, I preferably locate an inclined board C′, which serves to direct the slimes into the launder, and I also preferably employ a baffle-board C^2, which may be adjusted vertically to regulate the flow of liquid toward the overflow. The position of the lower edge of the baffle-board determines the cross-section of the stream of slimes passing under it, and therefore its velocity and carrying power for fine material. Any suitable means for adjusting the board C^2 may be employed. The devices shown need not be described as their construction and operation are obvious. The trough may be cleaned out when necessary through the pipe C^3 at the lower or inner end of the trough.

For the purpose of cleaning the settled sands after their emergence from the liquid and just before their delivery to the launder D, I provide a series of perforated pipes P. These pipes are preferably located in recesses in the bottom of the settling-trough, as indicated in Fig. 1, and they are provided with numerous perforations, so as to deliver clear liquid, such as clear cyanid solution under pressure, to the sands as the latter pass over them. The pipes are provided with valves *p*, by which the flow of the clear liquid may be regulated. As the liquid is forced upward through the sands in the manner indi-

cated in Figs. 2 and 3 the latter will be elevated slightly and agitated, while the contained slimes are separated and flow back into the bath in the manner indicated in Fig. 3. The same effect could not be produced by spraying liquid onto the top of the sands after emergence from the bath because such action would not so efficiently act on all the particles of sand and would tend to wash the sands back into the trough.

It will be observed that the settled sand is in motion only half the time, but is exposed to the action of the upward flow of clear liquid from the pipes P both while in motion and also while at rest, thus giving the liquid ample opportunity to keep the settled sand loose and open and to allow the escape of the slimes. This action of the upward current through the settled sand is quite different from the action of the upward current in the hydraulic cones and much more efficient, as the amount of clear liquid required is much less, and there is no chance of currents moving in both directions, which would carry down slimes with the sands. The inward movement of the rakes causes an agitation of the particles in suspension in the lower stratum of the bath, and thus tends to free the settling particles of sand from the adhering slime and keeps the latter in suspension.

Actual experience has demonstrated that perfectly clean leachable sands are obtained, while the slimes are entirely free from sands. Practically all of the liquid from the bath or from the cleaning-pipes can be prevented from passing into the sand-receiving launder, and the sand can be drained so as to be handled by mechanical conveyers, if desired.

My improved classifier possesses many advantages over others. It is compact, requiring but little space and no elevators. It necessitates little attendance, no matter how much the ore may vary in its nature, and both clean sand and clean slimes are made in one operation. The sand is delivered practically free from water and most of the clear liquid for cleaning the settled sand is saved, as before stated.

Although my apparatus was especially designed to give the greatest amount of clean leachable sand from wet crushed pulp for cyaniding, it may also be used to advantage to replace the spitzkasten for removing the coarser sand from the product of a stamp-mill for delivery to regrinding-mills, where an excess of water is objectionable. It may also be employed to deliver clean leachable sand in condition to be drained and conveyed moist to leaching-vats, thus providing all the aeration needed and doing away with the expensive double treatment, and it may also be used for separating fine sands from slimes in concentration.

In the foregoing description I have referred to the rapidly-settling particles as "sands" and to the slowly-settling particles as "slimes;" but it will be understood that the apparatus may be employed to classify materials not ordinarily thus designated, and I wish it understood that both in the specification and in the claims I do not wish to confine my invention to apparatus for separating sands and slimes.

I claim as my invention—

1. An apparatus for classifying crushed ores, comprising a stationary settling-trough to which the pulp is delivered and in which the sand settles by gravity, means for conveying the settled sands to one end of the trough, means for forcing a clear liquid up through the settled sands at the sand-delivery end of the trough to separate the slimes therefrom, and means for conveying slimes away from the bath.

2. An apparatus for classifying crushed ores, comprising an inclined stationary settling-trough to which the pulp is delivered, and in which the sand settles by gravity while the slimes remain in suspension, means for conveying the settled sands upwardly along the inclined bottom of the trough, and means for forcing a clear liquid up through the settled sands to separate slimes therefrom at the sand-delivery end of the trough and to cause said slimes to pass back to the settling-bath.

3. An apparatus for classifying crushed ores, comprising an inclined stationary settling-trough in which the sands settle and the slimes remain in suspension, a reciprocating rake for moving the settled sands upwardly and outwardly in the trough, and means at the sand-delivery end of the trough for forcing clear liquid up through the sands after their emergence from the settling-bath, and while being conveyed away from the bath.

4. An apparatus for classifying crushed ores, comprising an inclined stationary settling-trough in which the sands settle to the bottom while the slimes remain in suspension, a reciprocating rake engaging the settled sand on its outstroke and moving it toward the upper end of the trough, means for lifting the rake out of engagement with the sand on the instroke, and means for washing the sand to remove the slime therefrom arranged at the sand-delivery end of the trough and acting upwardly through the settled sand.

5. An apparatus for classifying ore-pulp comprising a settling-trough, two rakes arranged side by side in the trough, a partition in the lower part of the trough, the upper edge of which is below the liquid-level, for dividing the sands under one rake from the sands under the other rake, mechanism for reciprocating the rakes alternately in opposite directions whereby the weight of the

moving parts is counterbalanced and the overflow from the trough is equalized, a launder for receiving slime at the lower end of the trough, a launder for receiving sand at the opposite end thereof and a feed-launder for the pulp arranged intermediate the ends thereof.

6. An apparatus for separating and classifying materials of different settling rates, comprising a stationary settling-trough, a launder for receiving materials remaining in suspension in the trough, a launder for receiving the settled material, means for conveying the settled material toward its receiving-launder, and means for forcing a clear liquid up through the settled material as it emerges from the settling-bath and before its delivery to its receiving-trough.

7. An apparatus for separating and classifying materials of different settling rates, comprising a stationary trough containing a settling-bath, a launder at one end of the trough for receiving material remaining in suspension in the liquid, a launder at the opposite end of the trough for receiving the settled material, a reciprocating rake moving outward while engaging the settled material, means for elevating the rake above the settled material on the instroke without withdrawing it entirely from the bath mechanism for operating the rake and means for forcing a clear liquid up through the settled material as it emerges from the settling-bath and before its delivery to its receiving-launder.

8. An apparatus for classifying crushed ore comprising a stationary settling-trough to which the pulp is delivered and in which the sand settles by gravity while the slimes remain in suspension, means for conveying the sands from the trough without disturbing the settling action in the upper portion of the bath, and means for forcing clear liquid up through the settled sands after their emergence from the bath.

9. An apparatus for separating and classifying material of different settling rates, comprising a stationary settling-trough, a launder for receiving material remaining in suspension in the trough, a launder for receiving the settled material, means below the liquid-level of the bath for conveying the settled material toward its receiving-launder, means above the liquid-level for supporting the conveyer, and means for operating the conveyer.

In testimony whereof I have hereunto subscribed my name.

JOHN VAN NOSTRAND DORR.

Witnesses:
GEO. B. THOMPSON,
C. L. GILLIS.