No. 706,302.

Patented Aug. 5, 1902.

L. B. DARLING.

MEANS FOR EXTRACTING PRECIOUS METALS FROM ORES.

(Application filed Nov. 1, 1901.)

(No Model.)

2 Sheets—Sheet 1.

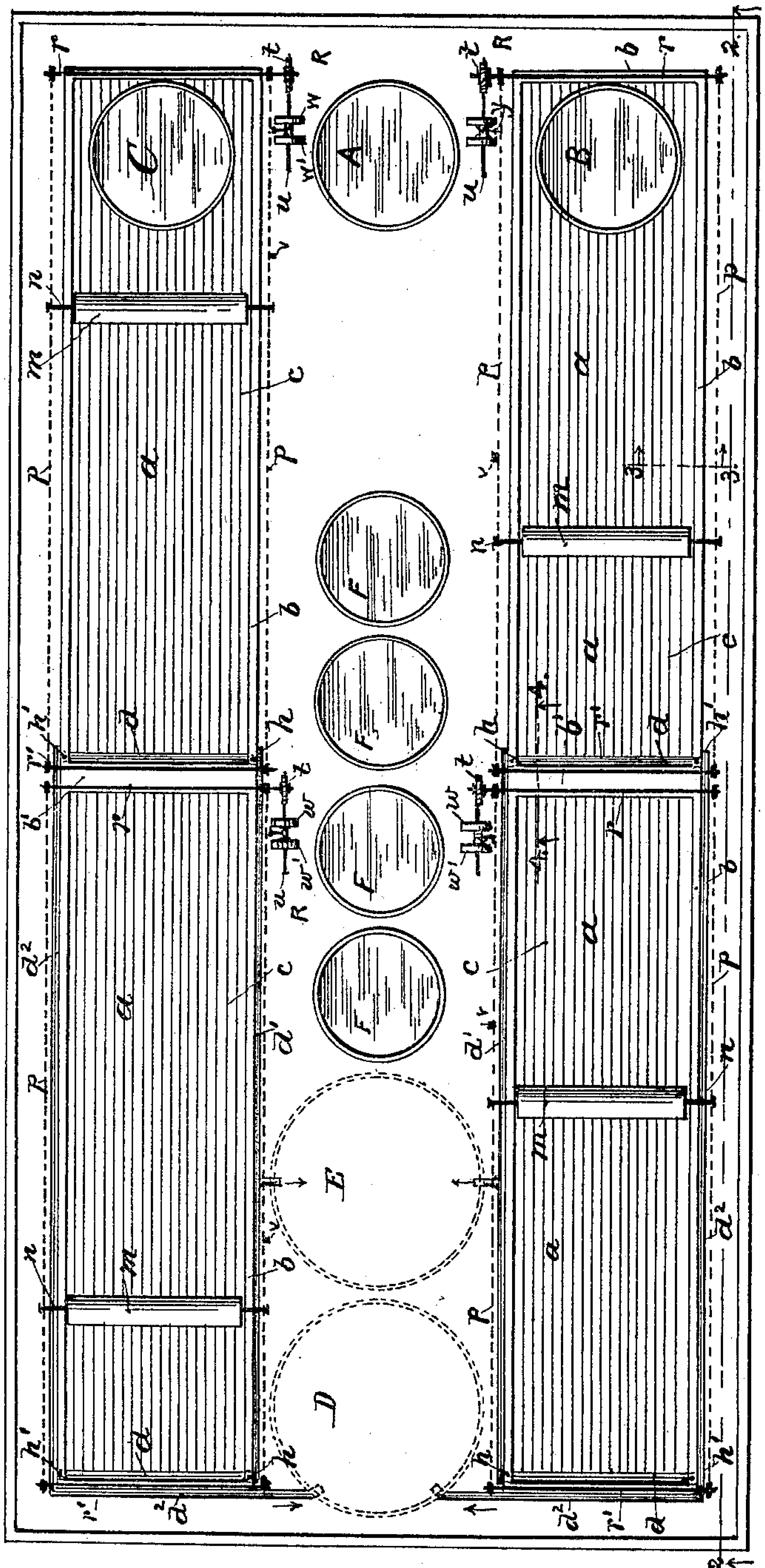

FIG. 1.

WITNESSES.

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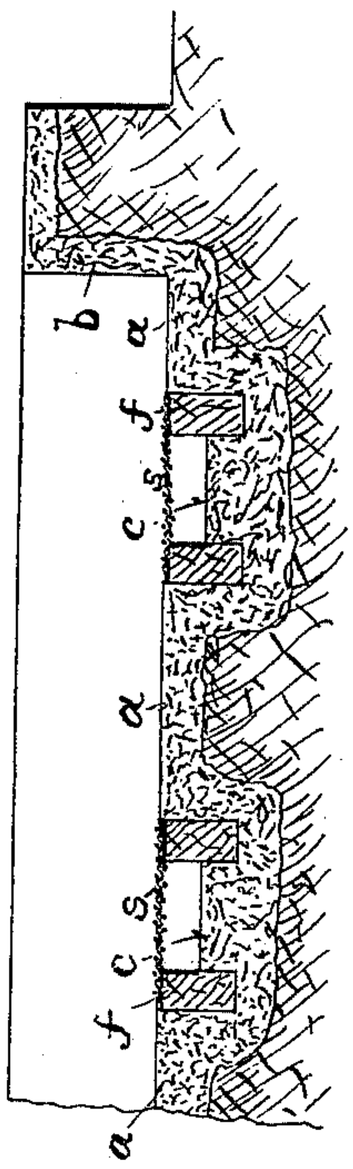

FIG. 3.

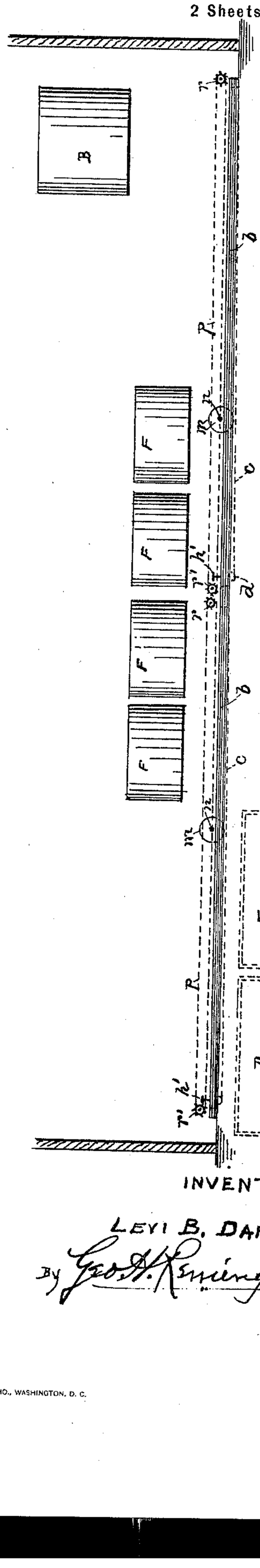

FIG. 2.

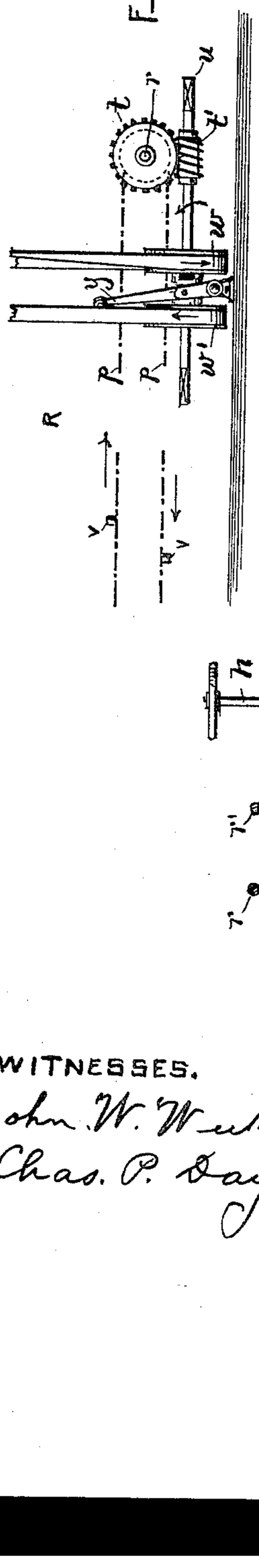

FIG. 5.

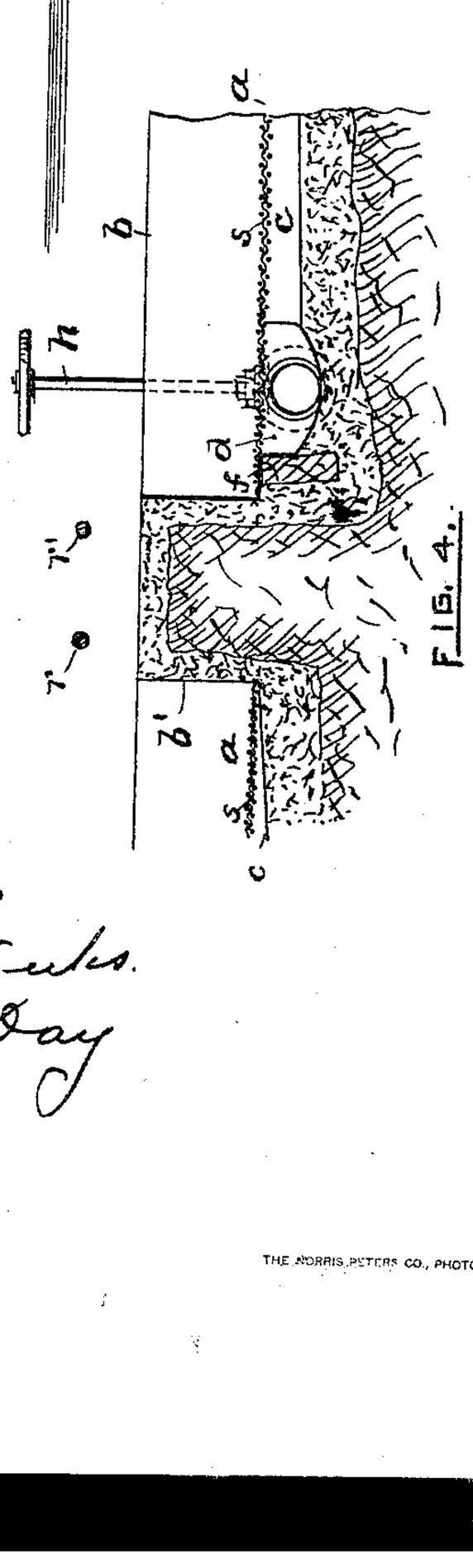

FIG. 4.

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UNITED STATES PATENT OFFICE.

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MEANS FOR EXTRACTING PRECIOUS METALS FROM ORES.

SPECIFICATION forming part of Letters Patent No. 706,302, dated August 5, 1902.

Application filed November 1, 1901. Serial No. 80,768. (No model.)

To all whom it may concern:

Be it known that I, LEVI B. DARLING, a citizen of the United States of America, and a resident of the city and county of Providence, in the State of Rhode Island, have invented certain new and useful Improvements in Means for Extracting Precious Metals from Ores, of which the following is a specification.

My invention relates to improvements in means for the extraction of gold and other precious metals from pulverized or finely-divided ores or materials; and it consists in the novel construction and combination of the several parts, as well as in the improved manner of treating the ores while contained in the plant or device embodying my invention, all as will be more fully hereinafter set forth and claimed.

The object I have in view is to provide improved means for treating and agitating pulverized auriferous ores, whereby they may be more thoroughly acted upon by a solution of cyanid of potassium or other suitable chemical solvent of the precious metals, so that the oxygen of the atmosphere may act or cooperate with the solvent to hasten the metal-dissolving process.

I am of course aware that means and processes for agitating pulverized ores, so as to combine oxygen therewith, have been devised prior to my invention. In one case, for example, the pulp was fed into a deep tank provided with mechanically-revolving arms adapted to agitate the material and expose it to the atmosphere. An objection to that arrangement was that it necessitated the use of great power to actuate the arms, since the volume of pulp in the tank would usually weigh several tons. Moreover, if the mechanism should be suddenly stopped, owing to breakage or other accidental cause, the pulp soon becomes "set" or hardened, thus causing further delay and requiring a much greater degree of power to operate the arms. In another case or device compressed air is forced through the bottom of the tank by means of pipes perforated with small holes, through which the air is discharged, the air in such case rising upwardly through the pulp and keeping the latter more or less agitated thereby. An objection to this is that the air-holes soon become clogged by the fine pulp, thereby seriously impairing the efficiency of the device. It is true that the pipes may be cleaned or blown out by the use of high-pressure steam; but such operation causes trouble and annoyance and consumes much time, thereby correspondingly increasing the length of time that otherwise would be normally required to treat the pulp.

As before stated, by means of my invention all delays are reduced to a minimum, while at the same time the precious metals are dissolved out in a much more expeditious and thorough manner, owing to the fact that the pulp is kept continuously agitated while being spread out over a large flat surface, thus subjecting it to the atmospheric air, so as to absorb a greater amount of oxygen therefrom, the operation being accomplished in much less time and with less power than is usually required in treating pulp of this character.

In the accompanying drawings, Figure 1 is a plan view of a gold-extracting plant embodying my improvement. Fig. 2 is a longitudinal sectional view taken on line 2 2 of Fig. 1. Fig. 3 is a transverse sectional view, enlarged, taken on line 3 3 of Fig. 1, showing the channels and strainers or filters. Fig. 4 is a sectional view, enlarged, taken on line 4 4 of Fig. 1; and Fig. 5 is a partial side elevation, enlarged, showing portions of the mechanism for actuating the pulp-agitating roll.

In carrying out my improvement I provide a series of substantially level floors *a a*, made, preferably, of cement or artificial stone. The floors are provided each with a series of longitudinally-extending grooves or channels *c c*, spaced, say, about eight or nine inches apart or as desired. The sides of the grooves may be faced with strips *f* of wood. (See Fig. 3.) The bottom of the grooves *c* are slightly inclined and terminate at their lower ends in a larger groove *d*, extending transversely of the floor or working surface *a*, termed a "launder." (See Fig. 4.) Over the top of all these channels are fastened pieces of fabric, as duck or other suitable material, the same forming a filter or strainer *s* for the dissolving solution, the arrangement being such that the liquid passes through the filters while excluding the ore and other material comprising the pulp. I may or, in fact, I prefer to place the top of the filter substantially flush or even or slightly below the floor's surface. (See Fig. 3.)

In the drawings, Fig. 1, I have represented a series of four rectangular-shaped floors *a*.

These are bounded by circumscribing walls *b*, having a height, say, of ten inches and are covered with cement or other suitable material, so as to prevent the absorption of the solution containing the dissolved precious metals. The said floor may be arranged so as to form two double floors each having a transverse dividing or bridge wall *b'*, as clearly shown. (See also Fig. 4.) Each of the lower floors (being the ones at the left) has a longitudinally-extending launder *d'*, arranged just exterior of the inner side walls *b* and communicating with the sump-tank E, containing the strong solution. Parallel with the other or outer side wall is arranged another launder d^2, the same extending to and across the lower end of the floor, but exterior of it, and communicates with the sump-tank D, containing the weak solution. A valved connection *h* is interposed between the ends of the launders *d'* and the adjacent ends of the corresponding cross-launders *d*. A similar connection *h'* is located between the ends of the opposite launder d^2 and the other ends of the said cross-launders, as clearly shown in Fig. 1. The valved connections pass through the adjacent walls *b* and form water-tight joints therewith. The bottom of each launder *d'* is inclined so as to direct the flow of the saturated solution toward the center, at which point it is in open communication with the sump-tank E, containing strong solution. The other launders d^2 are each inclined throughout their length and in open communication with the corresponding sump-tank D, containing weak solution.

In a plant embodying my improvement and adapted for the chemical extraction of the precious metals from slime-pulp the ground plan may be, say, one hundred and twenty-eight feet by sixty feet and having at one end thereof the elevated tanks A B C for water, strong solution, and weak solution, respectively, each tank being, say, fourteen feet diameter by ten feet deep. At the opposite end of the plant and located between the two series of double floors *a a* are placed two sunken sump-tanks D E for the weak and strong solutions, respectively, each tank being twenty feet diameter by six feet deep. There are also employed four slightly-elevated "salt-leach" tanks F, (one for each floor *a*,) each tank being, say, twelve feet diameter by six feet deep and adapted to contain some fifteen tons of pulverized ore. The said tanks F are charged with the pulverized ore and form reservoirs, from which the ore is shoveled or discharged onto the treating-floors *a*.

I may state here that I prefer to arrange the several floors, tanks, &c., so as to form a duplex or double plant or system, substantially as represented in Fig. 1 of the drawings, the arrangement being such that while the ore is being treated on the floors of one half of the plant the other half of the plant may be cleaned up, thus working the mechanism, &c., alternately. By means of my invention the charge of ore, spread evenly over one double floor, may be thoroughly agitated and treated during a continuous run, say, of twelve hours, the other double floor meanwhile having the solution drawn therefrom into the respective tanks, followed by removing the treated material or ore from the floor onto the waste-dump and recharging with fresh ore from the supply-tanks F, substantially as before stated.

In the drawings I have represented the rolling or ore-agitating mechanism R as consisting of a suitable roll *m*, extending transversely of the floor *a*, and means for slowly propelling the roll to and fro along the floor. The roll is secured to a shaft *n*, the latter being above and extending beyond the side walls *b* and adapted to revolve in suitable bearings secured to the two endless side chains or driving connections *p p*. These latter are mounted on suitable sprocket-wheels secured to the two end shafts *r r'*, revolving in bearings located at the upper and lower ends, respectively, of each floor. An end of one shaft—say the upper one *r*—is extended and carries a worm-gear *t*, meshing into and actuated by a worm *t'* of the short driving-shaft *u*. On the latter shaft are mounted two loose clutch-pulleys *w w'*, adapted to be revolved in opposite directions by open and crossed driving-belts in a well-known manner. A sliding clutch member is mounted on and revolves the pulley-shaft—that is, when the shipper-arm *y*, connected with the clutch, is swung to the left the clutch engages the corresponding pulley w^2, thereby causing the shaft to revolve in one direction. By moving the shipper to the right the clutch is withdrawn from pulley *w'* and engages pulley *w*, thus adapting the shaft to be revolved in the opposite direction. It is obvious that the driving mechanism just described is adapted to propel the chains *p* simultaneously and in unison in either direction, thereby correspondingly actuating the roller *m* and agitating the pulp or material beneath it. The action of the roll serves not only to stir up or agitate the pulp, so that it becomes thoroughly aerated or exposed to the atmosphere, but it at the same time forces some of the metal-charged solvent or solution downwardly through the screens *s* and into the channels or ducts *c*, communicating with the end launder *d*.

In order to automatically reverse the direction of the traveling chains *p* when the roll arrives at the end of the floor or at any other predeterminded point as desired, the chain contiguous to the clutch mechanism may be provided with two dogs *v v*, arranged or disposed with respect to the roll so that at or about the instant the latter arrives at the end of the floor or run the corresponding dog will engage the shipper-arm *y* and swing it to the opposite extreme, thus clutching the shaft *u* to the other driving-pulley, and since

the latter pulley revolves in a reverse direction to that of its fellow pulley it follows that the chain's movement will be correspondingly changed thus propelling the roll back again, the operation being continued as long as desired. By placing the shipper in the central or vertical position the clutch will be inactive or disengaged from both pulleys, the roll then being rendered inoperative.

The manner of extracting the precious metals from ores by means of my invention is substantially as follows: The auriferous chloridized ore in a finely-divided state is first delivered into the leach-tanks or salt-leach tanks F. After the ore is thoroughly leached it is discharged therefrom onto one of the empty double treating-floors *a a* and leveled off, the quantity of material forming a charge being sufficient to make a layer, say, three inches deep. This is followed by covering the surface of the said material with a strong solution drawn from tank B until the liquid attains a mean depth of about one inch. The solution contained in said tank B carries the proper amount of cyanid of potassium or other suitable chemical dissolving agent for the precious metals. After the solvent-supply to the floor has been cut off the said rolling mechanism R is set in motion, whereby the heavy rolls *m* are drawn back and forth alternately and longitudinally of the floors, the action of the rolls being to thoroughly agitate the material thereunder, so that all the ore is brought into intimate contact with the solution and with the atmospheric air, while at the same time some of the solution is forced through the screens or strainers *s* into the grooves *c* beneath. This rolling operation is continued uninterruptedly, say, for twelve hours, at the end of which time it will be found that practically all the precious metals previously contained in the ore in a free state have been dissolved out and combined with the solution then lying in the grooves *c* and launders *d*. The two valved connections *h* are next opened, thus permitting the charged or strong solution to flow freely from the said grooves and launders into the sump-tank E. From the latter the solution is pumped into the storage-tank B. The two valves *h* are next closed and weak solution from tank C admitted to the material lying on the two treating-floors, followed by rerolling the pulp a short time, the result being to thoroughly wash out any solution remaining therein. After completing the rolling operation the valves *h'* are opened, and the solution thus washed from the pulp flows from the end launders *d* into the outer launder d^2 in open communication with the sump-tank D, and from the latter the weak solution is pumped into the elevated tank C. The residue or washed pulp is now removed from the treating-floors, thus practically completing the operation, the entire time consumed being, say, twenty-four hours for one charge. During this time the other pair of treating-floors *a a* has been suitably charged with ore and solvent, the combination or pulp being kept continuously agitated by means of the corresponding rolling device, all substantially as hereinbefore described.

After a sufficient quantity of the saturated or strong solution has been collected in the tank B it is drawn off and treated in the usual manner to separate the metals therefrom.

I do not claim, broadly, as my invention the use of atmospheric air as an oxidizing agent for dissolving gold contained in slime-pulp carrying pulverized auriferous ore, nor do I claim, broadly, means for agitating the pulp whereby the air, in conjunction with the solvent, operates to hasten the gold-dissolving process.

I claim as my invention and desire to secure by United States Letters Patent—

1. In a gold-extracting plant provided with a substantially flat treating-floor *a*, of non-absorbent material, a series of longitudinally-extending channels *c* formed therein, a transverse groove or end launder *d* in direct communication with said channels, fixed screens or strainers covering the top of said channels and launder, side launders or ducts, and valved connections interposed between and uniting the said end and side launders, substantially as described.

2. In a gold-extracting plant, the combination with the treating-floor *a* having screen-covered grooves *c* and end launder *d*, of a mechanically-actuated rolling device adapted to be continuously propelled forth and back longitudinally of the floor, substantially as hereinbefore described and for the purpose set forth.

3. In a gold-extracting plant, the combination of the grooved treating-floor *a*, adapted to receive thereon a comparatively thin layer of finely-divided ore and treating solution constituting the pulp, a mechanically-actuated rolling device arranged to be continuously propelled forth and back to agitate the said pulp or material lying on the floor, suitable launders or ducts communicating with the grooved portion of the floor, and sump-tanks into which the metal-charged solution is discharged from the launders, substantially as described.

4. In a gold-extracting plant, two laterally-separated double floors, *a*, *a*, provided with suitable grooves and launders, rolling or agitating mechanism adapted to be propelled forth and back longitudinally of the floors, sump-tanks into which the metal-carrying solution is discharged, and suitably-arranged water, leach and solution tanks, substantially as described.

Signed at Providence, Rhode Island, this 31st day of October, 1901.

LEVI B. DARLING.

Witnesses:
GEO. H. REMINGTON,
JOHN W. WEEKS.