(No Model.) 3 Sheets—Sheet 1.

M. LANE.

MACHINE FOR SEPARATING AND CONCENTRATING ORES AND METALS.

No. 306,266. Patented Oct. 7, 1884.

Fig. 1

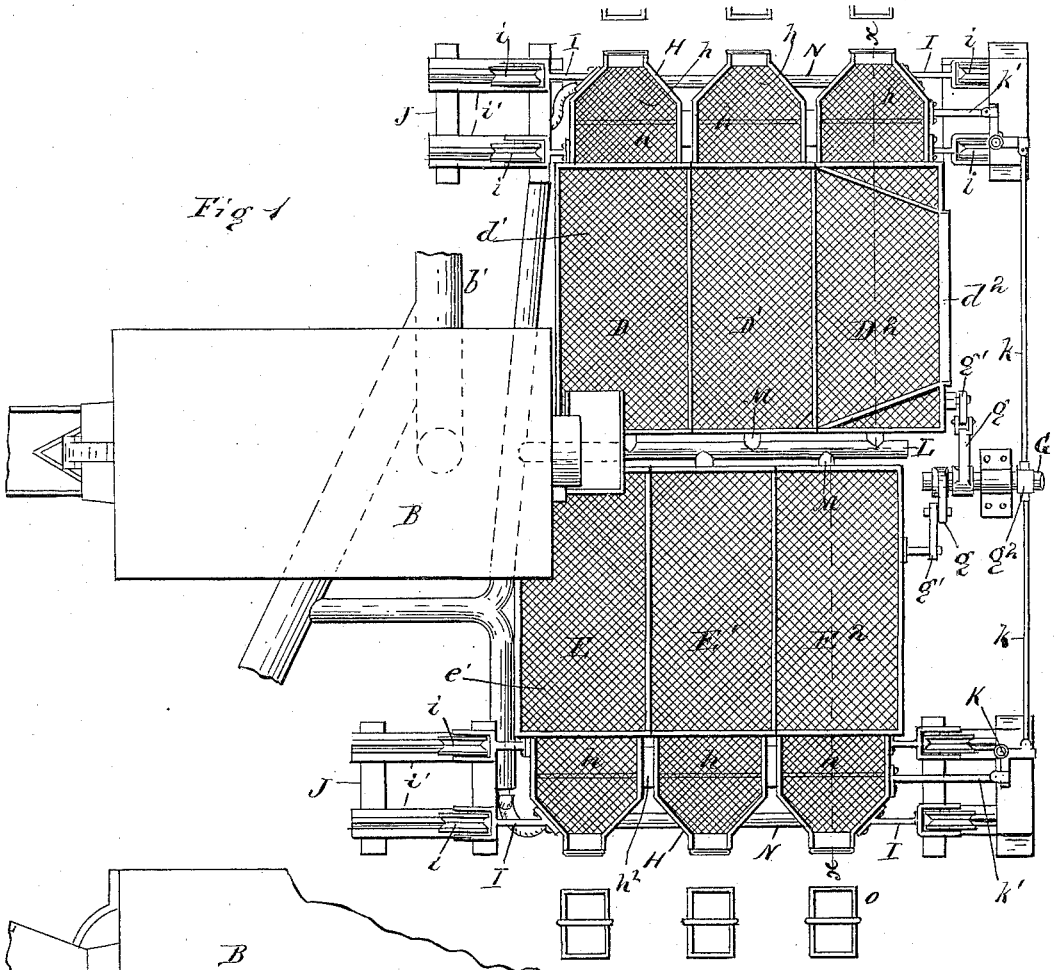
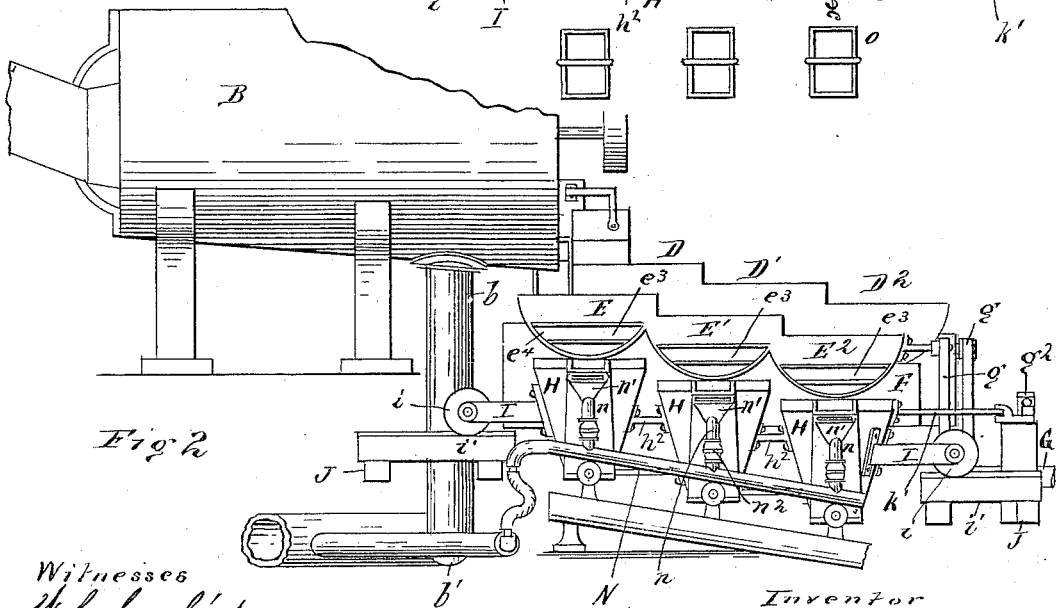


Fig. 2



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(No Model.) 3 Sheets—Sheet 2.

M. LANE.

MACHINE FOR SEPARATING AND CONCENTRATING ORES AND METALS.

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Fig 3

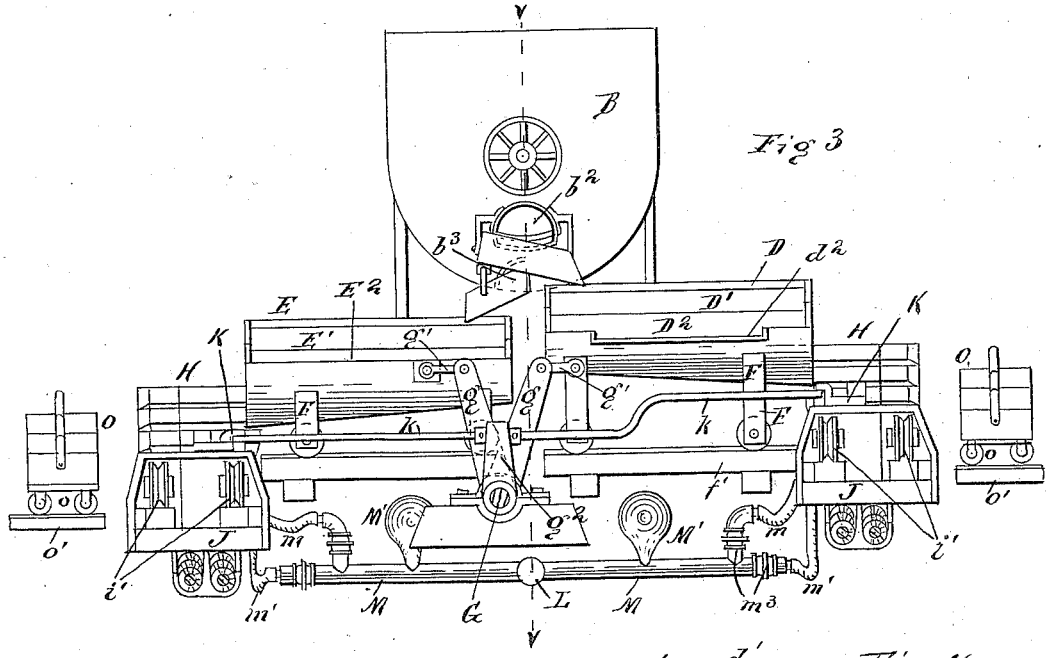


Fig 4

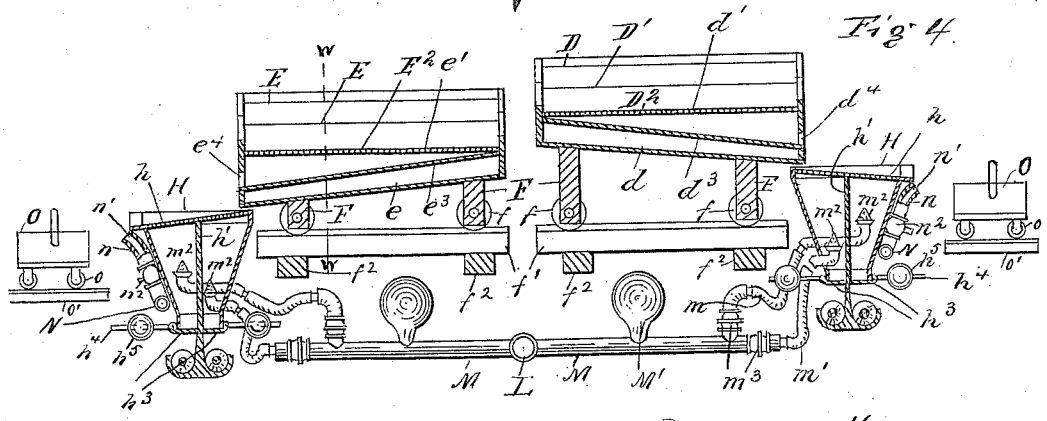


Fig 5

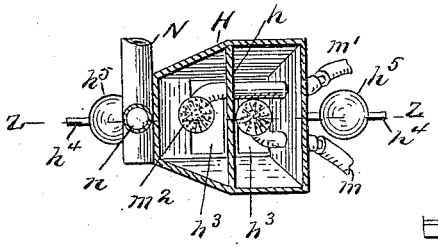


Fig 6

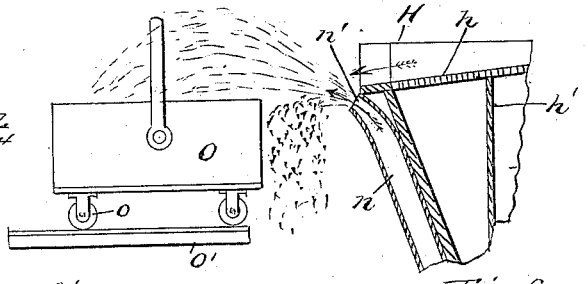
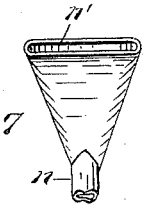


Fig 7



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(No Model.) 3 Sheets—Sheet 3.

M. LANE.

MACHINE FOR SEPARATING AND CONCENTRATING ORES AND METALS.

No. 306,266. Patented Oct. 7, 1884.

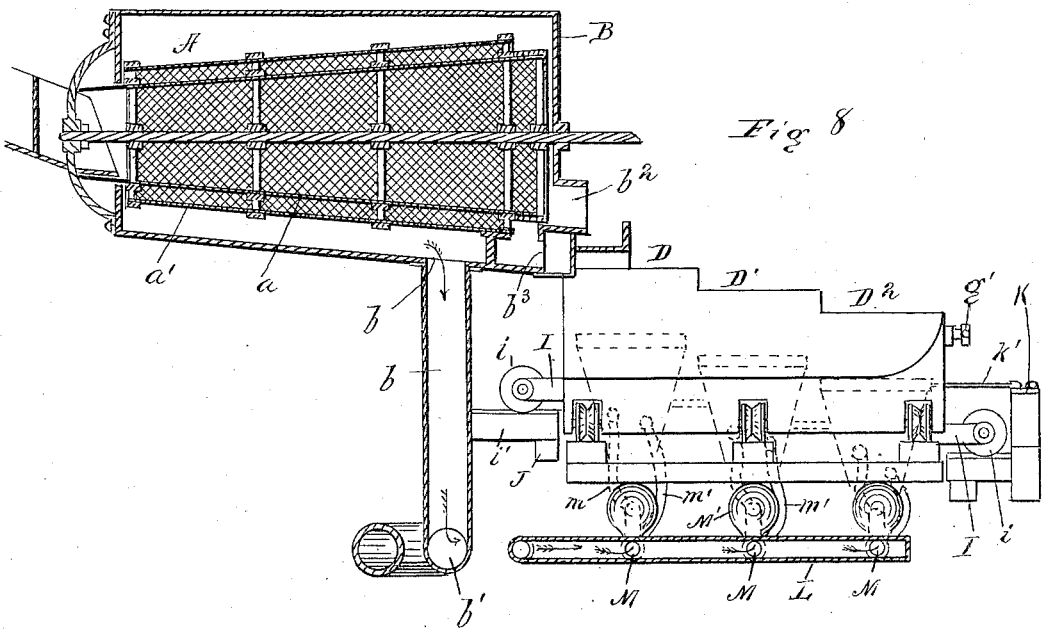


Fig 8

Fig 9

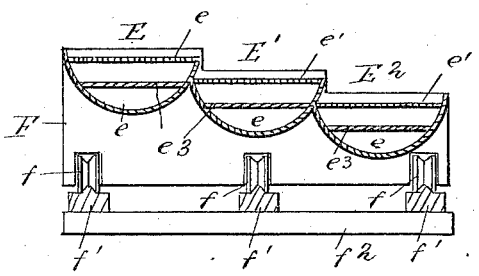
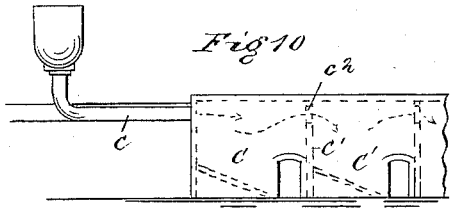


Fig 10



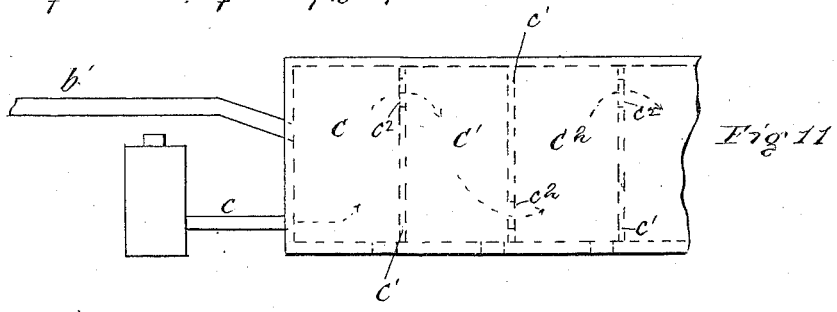


Fig 11

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UNITED STATES PATENT OFFICE

MARCUS LANE, OF CHICAGO, ILLINOIS.

MACHINE FOR SEPARATING AND CONCENTRATING ORES AND METALS.

SPECIFICATION forming part of Letters Patent No. 306,266, dated October 7, 1884.

Application filed December 26, 1883. (No model.)

To all whom it may concern:

Be it known that I, MARCUS LANE, a citizen of the United States, and residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Machines for Separating and Concentrating Ores and Metals, which are fully set forth in the following specification, reference being had to the accompanying drawings, in which—

Figure 1 represents a plan view of a machine embodying my improvements. Fig. 2 is a side elevation of the same, the dust chamber and screen being partly broken away; Fig. 3, an end elevation of the same, looking toward the screen; Fig. 4, a section of the same, taken on the broken line *x x*, Fig. 1; Fig. 5, a detail plan section of one of the concentrating-vessels on an enlarged scale; Fig. 6, a detail section of a part of Fig. 5, taken on the line *z z* of said figure, and on a still more enlarged scale; Fig. 7, a front elevation of the tube shown in Fig. 6; Fig. 8, a section of the machine, taken on the line *v v*, Fig. 3, and on the same scale; Fig. 9, a detail section of the pans, taken on the line *w w*, Fig. 4; Fig. 10, an elevation of a dust-chamber, and Fig. 11 a plan view of the same.

My invention relates to a machine for the concentration of metallic ores or metals in a dry condition without the use of water in any part of the process.

I am aware that various machines have been heretofore produced for a like purpose; but in practice several defects have been developed. In some, clouds of dust are produced which render the operation unhealthy and imperfect, and in the treatment of complex ores there is a great loss, as only the heaviest parts are saved, the lighter but equally valuable metals being rejected and lost with the refuse matter, and also there has been a want of adaptation in the machines to different ores having different component parts and differing in weight.

It is the object of my present invention to overcome these defects, and to produce a machine adapted to work different and complex ores and without the annoyance of escaping dust.

I will proceed to describe in detail the construction and operation of a machine in which in one way I practically embody my invention, and will then point out definitely in the claims the special improvements which I believe to be new and wish to protect by Letters Patent.

In the drawings, A represents a revolving screen, which is mounted within a chamber, B, by which it is inclosed, the latter being as nearly air-tight as possible. The screen is of conical form, the smaller diameter being at the receiving end, and is mounted on a horizontal shaft, and is also constructed with double walls or screening-surfaces *a a'*. It will be seen from Fig. 8 of the drawings that this construction provides virtually two cones, one within the other, and the inner cone, *a*, is somewhat longer than the other, *a'*, and the material is received from any suitable device into the end of the inner cone. The screening-surfaces *a* are somewhat coarser than the surfaces *a'*, so that the coarser parts of the crushed ore are retained by the screen *a*, the finer parts being passed through, but stopped by the surfaces *a'*, which are intended to be of such a degree of fineness as to permit the passage only of fine dust into the chamber around the outside of the screen. At the bottom of the dust-chamber is a passage, *b*, which connects with a passage or pipe, *b'*, running to dust-chambers C C' C², &c. Beyond the point of connection between the pipes *b b'* the latter receives from an ordinary blower a blast of air which, at the point of junction, produces a strong suction through the pipe *b*, and from the chamber B, by means of which the dust is drawn out from the latter and carried forward into the dust-chambers C C', &c. The same result may be accomplished by a suction-fan arranged to operate in the pipe *b*, so as to draw from the chamber B and discharge into the pipe *b'*.

The dust-chambers are separated by partitions *c'*, with openings *c²* arranged alternately on opposite sides of the chambers, so that constant interruptions are presented to the current of air seeking exit through the chambers, and hence the dust is continually falling in the different compartments. This construction and operation of dust-chambers is old and well known, and need not be specially described further. Obviously, the heavier particles will be deposited in the first chamber or compart-

ment, and the lighter ones carried on to the succeeding chambers or compartments. If, for instance, the ore be one containing lead, iron, gold, and silver, the lead will be first deposited in the first chamber with the heavier forms of the royal metals; next, the iron, then the gangue matter, and, finally, such forms of the metals as are lighter than the gangue matter.

The material collected in the dust-chambers from time to time is removed, sampled, and assayed, and when not sufficiently concentrated is brought back and again run through the blast-pipes into the dust-chambers. In this operation the material may be fed to the blast-pipes by a hopper or any common and suitable device, or it may be conveyed by a carrier and fed either into the pipe *b* or the pipe *b'*. Whenever the gangue matter contains flux material, it can by this process be saved for use in the smelting of other ores.

The screen being cone-shaped, as already described, the particles of ore retained therein will of course gradually move to the larger end of the screen, and there is provided a discharge-opening, b^2, in the end of the chamber B, through which the coarser ore retained by the screen *a* is delivered, and also a smaller opening, b^3, through which the finer ore collected by the screen *a'* is delivered. The coarser ore that passes out through the first-named passage falls upon the first of a series of shaking screens, D D' D^2, &c., and the finer ore, that is delivered from the opening b^3, falls upon the first of a series of similar screens, E E' E^2, &c.

The two series of shaking screens just mentioned are graded in fineness, the first of each series being the finest, so that the finer portions of the ore are passed through, while the coarser portions are shaken and delivered to the next screen, which still further separates the material, and in like manner the process is continued through the entire series, it being understood, of course, that the series E, E', and E^2 is finer comparatively than the other series, because it is arranged to treat a finer material coming from the revolving screen. The coarser portion on the first series of screens, D, D', and D^2, finally passes over a lip, d^2, at the outer edge of the last of the series, where it is gathered and returned to the crusher or rolls, to be further reduced and concentrated, as desired. The ore delivered to the other series, E, E', and E^2, is treated in precisely the same manner, the coarser particles being delivered from one screen to the other, the only difference being that the last screen passes all of the material, or substantially all, and there will be no coarse particles for further treatment at the reducing mechanism. These screens are in the shape of concave pans *d e*, arranged one a little below the other in each series, and each provided with a separating diaphragm or sieve, *d' e'*, located a little distance below the tops of the pans. Below each of these diaphragms or screens is an inclined bottom, $d^3 e^3$, extending from end to end of the pans and inclining downward and outward. Obviously, then, the material passing through the screens and falling upon the inclined bottoms will be delivered at the outer ends of the latter by the shaking motion of the screens, where openings d^4 e^4 are made in the ends of the pans for the discharge of the particles of ore. A shaking motion is given to the pans in the direction of their length in the following way: Each series is mounted upon a suitable carriage, F, which is provided with rollers *f* at the lower ends of its supports, which in turn are mounted on ways *f'*, secured to suitable supporting-frames, f^2. A rock-shaft, G, is mounted on suitable supports outside of the pans and at right angles to the length of the latter. Only the inner end, to which the working parts are attached, is shown in the drawings, as this only is necessary, it being understood, of course, that the shaft is suitably supported, and that an oscillating motion is communicated to it by any suitable motor. At the inner end of this shaft are two crank-arms, *g*, secured thereto, and the upper or outer ends of these arms are connected to the respective screen-carriages by means of links *g'*. Obviously, then, the oscillation of the shaft will give a vibratory movement to the carriages, and thereby to the screens, in the direction of their length.

The ore from the shaking screens is delivered from the inclined bottom, as described, into concentrating-vessels H, a series of which is arranged on each side of the shaking screens and just below them, as shown in the drawings. At the top of each of these concentrating-vessels is a screen, *h*, which will pass through all pieces of ore that are delivered to it from the shaking screens above, and each concentrator also has a partition, *h'*, running across it at right angles to the delivery of material from the shaking screens. The top screens, *h*, are inclined downward and outward slightly, so that there will be a tendency of the material delivered to each concentrator to move outward over the screens when the latter are shaken, as will be described. The concentrators in each series are secured together by suitable straps, h^2, or any other device which will connect and support them; and to the outside of each of the outer ones are attached projecting arms I, in the ends of which are mounted rollers *i*, which are arranged to run on ways *i'*, located on suitable supporting-platforms, J, so that each series may be moved back and forth on these supporting-roller ways in a direction at right angles to the movement of the shaking screens.

In the drawings I have shown means for communicating a reciprocating motion to each series of concentrators from the same rock-shaft which imparts motion to the shaking screens. A single crank-arm, g^2, is fastened to the rock-shaft outside of the crank-arms *g*. On the supporting-frames, at the outer ends of the series of concentrators, are mounted bell-crank levers K, arranged to swing horizontal-

ly. A connecting-rod or pitman, k, attaches one arm of each of these levers to the crank-arm g^2, and the other arm of the lever is connected by a rod, k', to the outer concentrator of each series. Obviously, then, the oscillation of the rock-shaft will produce a reciprocal movement of the concentrators across the line of movement of the screens. An air-pipe, L, connected either with the blower to the dust-chambers or with some other blower, is run horizontally between and underneath the series of shaking screens, and from this pipe cross-pipes M are extended to each concentrator, the outer ends communicating with the interior of the concentrators by means of flexible tubes m and m', the former of which opens into the compartment outside of the partition h', and the latter into the inner compartment inside of the same partition, as shown in Figs. 4 and 5 of the drawings. Each branch terminates with a perforated head or nozzle, m^2, and each is provided with a separate stop-cock, m^3, each of the pipes M being also provided with air-chambers M′, to give uniformity to the pressure in connection with the stop-cocks mentioned. At the bottom of each concentrator are hinged valves h^3—one for each compartment—and held in position by levers h^4, on which are sliding weights h^5. An air-pipe, N, connecting with the main air-pipe and blower, heretofore mentioned, is also carried around on the outside of the concentrators, and a branch, n, extends up therefrom in front of each concentrator, terminating in an elongated flaring mouth, n', just below the outer end of the concentrator-screen, as shown in Figs. 4 and 6 of the drawings. Each of these branches is provided with a stop-cock, n^2, by means of which the pressure or air may be regulated.

Just outside of each concentrator, and beyond the air-pipe just described, is a receptacle, O, the top of which is about on a line with the top of the outside air-pipe. This receiver is provided with wheels o, running on ways o', on suitable supports, so that it may be readily moved.

It will be understood, of course, that this apparatus requires an engine or motor of some kind for the purpose of imparting the required motion to the blower or blowers and the screens and concentrators described above. There is no necessity of showing and describing this engine, however, as any motor suitable for the purpose may be employed.

The operation of the mechanism for treating the ore after it is delivered from the revolving screens is as follows: The ore is delivered from the revolving screen to one or the other series of the shaking screens, as described above. It is separated by the screens of these shaking pans, and delivered from the inclined bottoms thereof to the concentrators below their outer ends, falling upon the screens at the tops of the concentrators. The ore thus falling upon the tops of the concentrators would pass through the screens and lie at the bottoms on the valves at the bottoms of the concentrators but for the fact that currents of air are brought into the inside of the concentrators, as described above, and by constant pressure are made to pass up through these compartments, this pressure being regulated by means of the air-chambers and stop-cocks already mentioned, so that it offers resistance to the grains of ore, weighing them in fact, and only allows the heaviest to pass down and fall upon the bottoms of the concentrators. Suppose, for instance, that the ore is one containing lead, iron, gold, and silver, the precious metals being in much smaller quantities than the others, the pressure of air in the first compartment of the concentrator is regulated so that only the heavier metals can overcome its resistance and pass downward; hence the metallic lead and the heavier forms of the royal metals would chiefly be gathered in this first vessel, while the lighter portions and a good portion of the iron would be passed forward over to the second or outer compartment. In this latter compartment there is also an air-pressure, which is regulated, however, so as to be somewhat lighter than that in the first compartment, so as to permit all metallic particles that are heavier than the gangue matter to fall down to the bottom of the compartment, but sufficiently strong to prevent the dropping of the gangue matter and all forms of metal that are still lighter than such matter, and so compelling them to pass on over the lip of the vessel to the waste below; but as the gangue matter and other lighter forms of various metals pass over the lip of the vessel, a strong current of air is discharged up into it through the flaring mouths of the outside pipes. The effect is to impart motion to all the falling matter, blowing the substance of the various metals that are lighter than the gangue matter the farthest away. The receptacles O are arranged at such a distance from the concentrators as to catch these lighter forms of the metals, which are thus saved, while the heavier gangue matter falls to the waste.

It will be noticed that the pressure at different points, both within the compartments and outside the lips of the concentrators, can be regulated very quickly, so as to vary the pressures according to the qualities of different ores by means of the various independent stop-cocks, all working with very fine screw-threads.

The concentrated ore is disposed of as follows: The valves at the bottom of each concentrator are so weighted by the adjustable weights as to just a little more than counterbalance the air-pressure in the vessel. When, therefore, a quantity of concentrated ore has collected on each valve, the weight of the metal, joined to the air-pressure, will open the latter sufficiently to allow a good part of the concentrated metal to escape until the weight on the valve overcomes the resistance and closes the latter. The discharge of the concentrations is therefore both automatic and capable

of regulation, according to the requirements of each case.

The concentrations from the first and second compartments may be kept separate from each other in the delivery, or they may be delivered into a common receptacle.

I prefer in the use of this apparatus to keep the main air-pressure as nearly uniform as possible by means of the supplemental air-chambers on the various pipes; but it is not absolutely necessary to do this, for if the air-chambers are removed, the stop-cocks would still furnish means for regulating the pressure with reasonable success, and the air would be forced in the form of frequent puffs, adding to the motion of the grains of ore, but also rendering the apparatus a little more difficult to adjust with the required delicacy.

I have described one way in which the mechanical parts may be constructed and organized for carrying out my invention in practical form; but I do not wish to be understood as limiting myself to details of construction and arrangement, for, obviously, these may be varied mechanically without departing from the principles of my invention. This is especially true with reference to the mechanism employed for imparting motion to the screens and concentrators. Any proper devices for this purpose may be substituted for those herein described and shown. It is also obvious that one series of shaking screens and concentrators might be used instead of two; but I prefer the two, because the work is distributed so as to relieve the strain upon the screens.

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

1. The dust-screen, in combination with one or more series of shaking pans provided with graded screens, and arranged to receive the ore delivered from the dust-screen, substantially as and for the purposes set forth.

2. The revolving dust-screen, in combination with the shaking screens arranged in series and mounted on roller-carriages, platforms with ways for the roller-carriages, running in the direction of the length of the screens, and a rock-shaft provided with crank-arms connected, respectively, to the roller-carriages of the screens, substantially as and for the purposes set forth.

3. The dust-screen, in combination with one or more series of shaking screens, to which the ore is delivered from the former, a series of concentrators for each series of screens, arranged to receive the separated ore delivered from the shaking screens, and apparatus whereby an air-blast is passed through the concentrators graduated to separate the heavier and lighter materials, substantially as and for the purposes set forth.

4. The concentrators arranged to receive the separated ore, and divided by partitions into front and back compartments, in combination with air-pipes opening separately into each compartment, and devices for regulating the air-pressure in said pipes, whereby it may be made greater in the first compartment and lighter in the second or outer compartment, substantially as and for the purposes set forth.

5. The concentrators arranged to receive the separated ore, in combination with an air-pipe arranged on the outside of each concentrator, and provided with a flaring mouth opening just at the edge of the lip of the latter, whereby a blast of air is brought into operation upon the gangue matter and lighter material discharged over the lip of the concentrator, substantially as and for the purposes set forth.

6. The shaking screens, in combination with the concentrators fastened together in series, and provided with roller-supports, and suitable ways on supporting-platforms for the rollers, arranged to permit a vibration of the concentrators at right angles to the movement of the shaking screens, and mechanism whereby a reciprocating movement is communicated to the concentrators, substantially as and for the purposes set forth.

7. The concentrators secured together in series, and provided with roller-supports at each end of the series, in combination with platforms having ways on which the rollers are mounted, the rock-shaft, the bell-crank levers, and the connecting-rods connecting the latter, respectively, to a crank-arm on the rock-shaft and to the respective series of concentrators, substantially as and for the purposes set forth.

8. The shaking screens provided with rollers mounted on suitable ways, in combination with the concentrators, also provided with rollers mounted on suitable ways at right angles to the former ways, and the rock-shaft connected, respectively, to both the shaking screens and the concentrators, whereby the single shaft imparts a reciprocating motion to both screens and concentrators, substantially as and for the purposes set forth.

9. The shaking screens, in combination with the concentrators composed of two compartments arranged one in front of the other, air-pipes opening, respectively, into each compartment, and provided with devices for regulating the pressure in each, and an air-pipe arranged on the outside of the concentrator and terminating at the edge of the lip of the latter, substantially as and for the purposes set forth.

10. The concentrators, in combination with air-blast pipes entering the concentrators, discharge-valves at the bottoms of the concentrators, and adjustable weights for closing the valves, whereby a pressure of air is produced inside the concentrators, and the force operating to close the valves may be adjusted to slightly exceed the said air-pressure, so as to make the discharge from the concentrators automatic, substantially as described.

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