(No Model.) 4 Sheets—Sheet 1.

B. HERSHEY.

ORE CONCENTRATOR.

No. 259,983. Patented June 20, 1882.

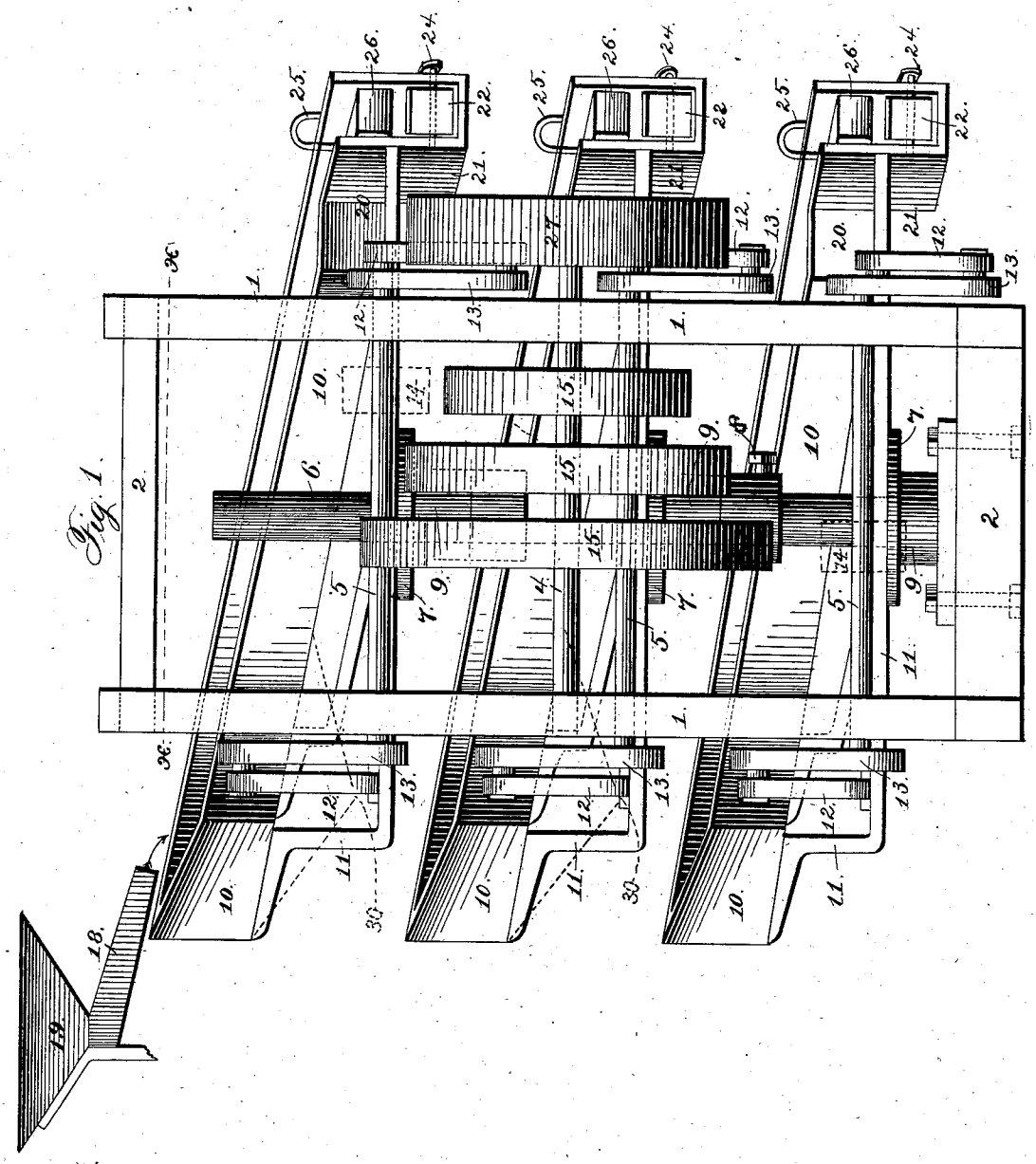

Fig. 1.

Witnesses.

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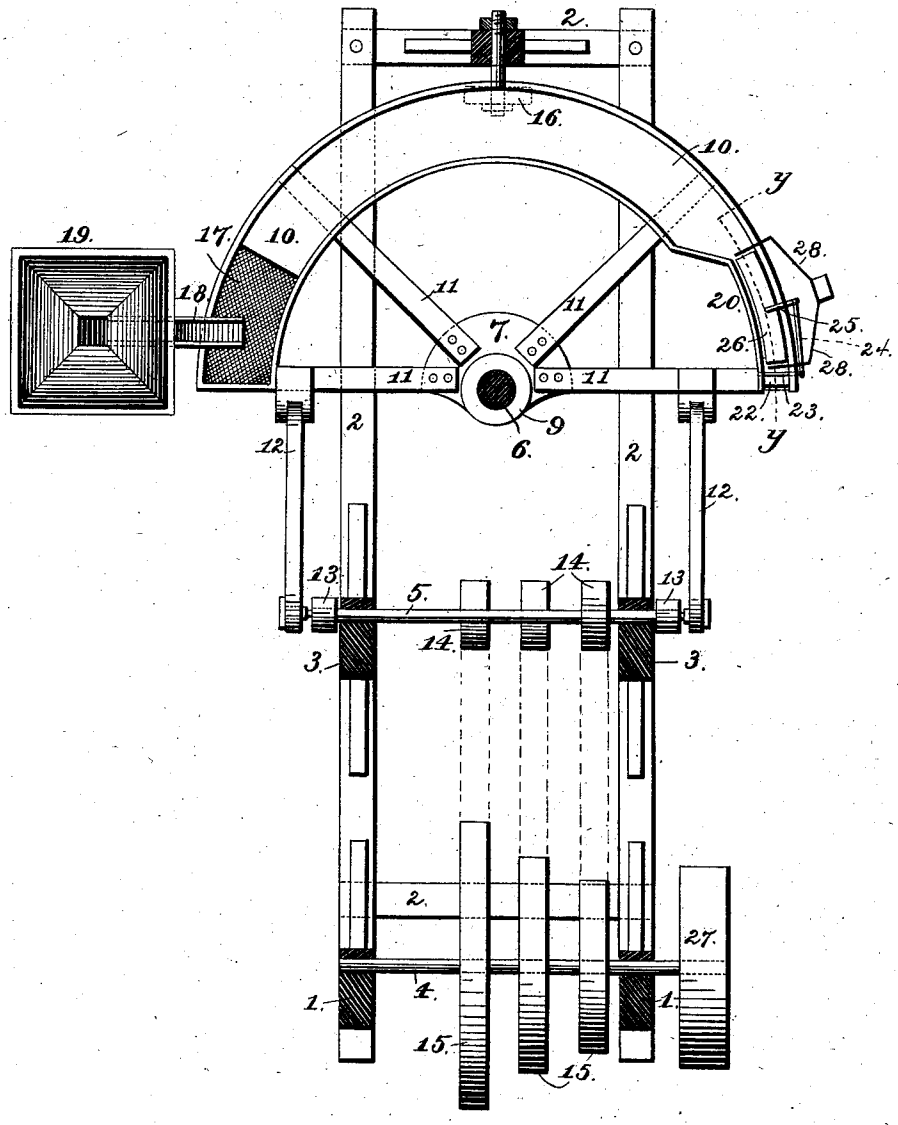
(No Model.) 4 Sheets—Sheet 2.

B. HERSHEY.

ORE CONCENTRATOR.

No. 259,983. Patented June 20, 1882.

Fig. 2.



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(No Model.) 4 Sheets—Sheet 3.

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ORE CONCENTRATOR.

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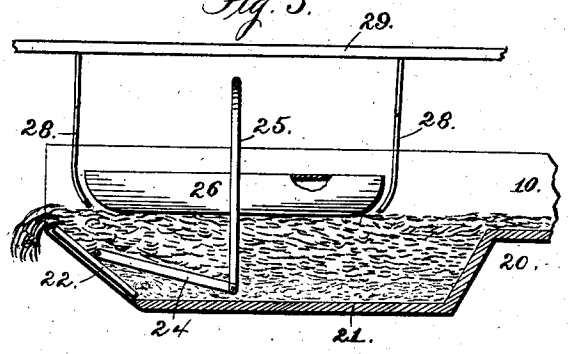
Fig. 3.



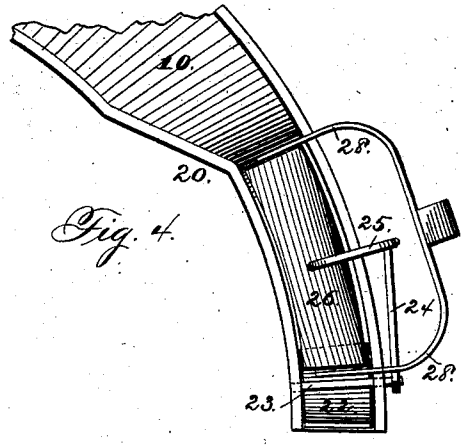
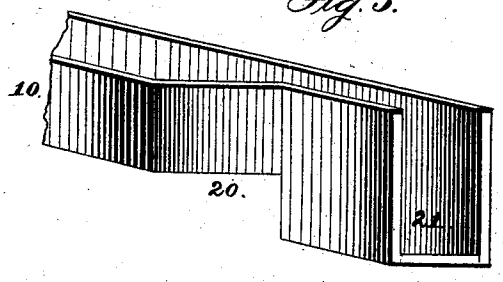


Fig. 4.

Fig. 5.



Witnesses.

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(No Model.) 4 Sheets—Sheet 4.

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ORE CONCENTRATOR.

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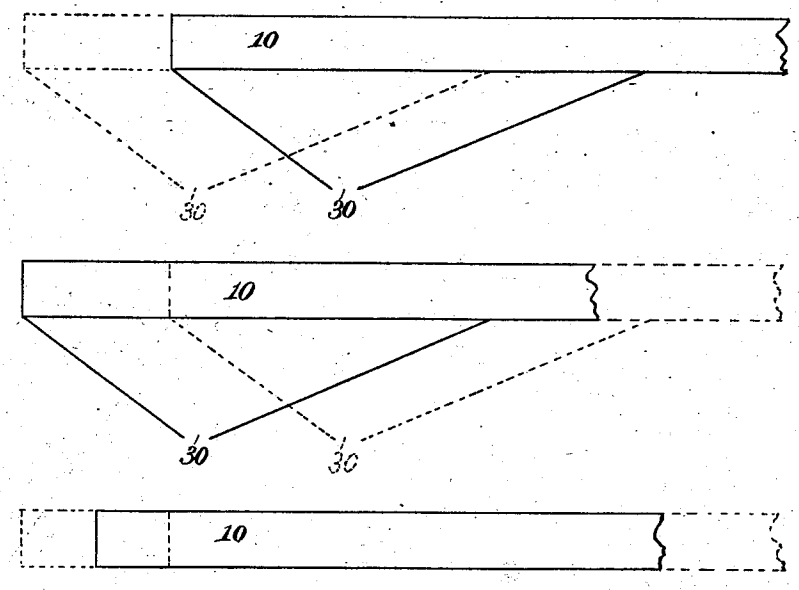
Fig. 6.



Witnesses.
Robert Everett.
J. A. Rutherford.

Inventor.
Benj. Hershey.
By James L. Norris.
Atty.

UNITED STATES PATENT OFFICE.

BENJAMIN HERSHEY, OF ERIE, PENNSYLVANIA, ASSIGNOR OF THREE-FOURTHS TO CHARLES HITCHCOCK, JOSEPH A. EGE, AND BENJAMIN THORNTON, ALL OF BRADFORD, PENNSYLVANIA.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 259,983, dated June 20, 1882.

Application filed February 25, 1882. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN HERSHEY, a citizen of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented new and useful Improvements in Ore-Concentrators, of which the following is a specification.

This invention relates to dry ore concentrators, and the improvements are such that the use of an air-blast is rendered unnecessary, such air-blast being usually employed to blow off the powdered particles to a greater or less distance, according to their comparative richness, the quantity of metal in each particle determining the relative weight.

It is well known that apparatus for concentrating ore usually employ either an air-blast or a current of water or other liquid for effecting the desired separation, and as a large percentage of precious metal exists in quartz and sand in very fine or microscopic particles, it has been found that the currents of either air or water will carry off such fine particles, and considerable loss is the result. It will be obvious, therefore, that such class of ore-concentrators are objectionable, as not being capable of saving all the fine particles of precious metal; and it is the object of my invention to remedy the objection and provide an apparatus for concentrating ore in which I avoid the necessity for using either currents of water or other liquid or blasts of air, and which will assort the mass of material to be treated into different grades, and only such particles as are of approximate or equal size will undergo treatment together to effect the desired separation, such mode of treatment resulting in the lighter particles rising to the top of the mass being treated and the heavier particles falling or settling to the bottom thereof.

I accomplish the objects of my invention by the apparatus illustrated in the accompanying drawings, in which Figure 1 is an end elevation of an apparatus constructed in accordance with my invention; Fig. 2, a plan or top view, partly in section, taken on the line *x x* of Fig. 1; Fig. 3, a sectional view taken on the line *y y*, Fig. 2, at the discharge end of one of the troughs or tables, the valve and float and their connections being in elevation; Fig. 4, a plan or top view of Fig. 3; Fig. 5, a broken perspective view of the discharge end of one of the troughs or tables; and Fig. 6 is a diagram of the receiving ends of the troughs or tables, illustrating by dotted lines their extent of movement and their discharging-chutes under the sieves or screens.

The supporting-frame for the various parts of the apparatus may be of any desired construction; but, as shown, it is composed of end uprights, 1, connected at the top and bottom by longitudinal and transverse bars 2, and of intermediate uprights, 3, which uprights afford bearings for horizontal shafts 4 and 5, for driving the operative parts of the apparatus, as hereinafter explained.

A vertical shaft, 6, is suitably supported by the frame-work of the machine, and on said shaft, at different heights, are arranged collars securely fastened to the shaft by set-screws 8, or otherwise. The upper ends of these collars serve as supporting-bearings for hubs 9, connected with the curved troughs or tables 10, said hubs being arranged loosely upon the shaft, so as to turn or rotate thereon.

The troughs or tables may be of any desired form in outline; but, as shown, they are semicircular in shape, and are connected with the flanges 7 on the hubs 9 by means of radial arms or rods 11, to the outer ones of which are attached the ends of pitmen 12, the other ends of which are connected with the cranks 13 on the ends of the shafts 5, each of the latter being provided with an attached pulley, 14, by which it is revolved through the medium of a belt or band passing around it and one of the pulleys 15 on the driving-shaft 4.

As shown in the drawings, there are three troughs or tables, and each is connected by radial arms with a flanged hub on the vertical shaft, and each is driven by bands and pulleys, as set forth, from pulleys on the driving-shaft 4; but the number of the troughs or tables is not material, and may be increased or diminished as desired.

The bottom walls of the troughs or tables are supported and travel or move on friction-wheels or rolling bearings 16, and they serve to pre-

vent the hubs 9 from binding on the vertical shaft. The troughs or tables are inclined, as shown in Fig. 1, and at the upper end of each of the same, excepting the extreme lower one, is arranged a screen or sieve, 17, of any desired construction, the screen or sieve in the top trough being the coarser, while the screens or sieves in the other trough or table are of a finer grade—that is, each succeeding screen or sieve is finer than the one directly above it. The screen or sieve in the top trough or table is arranged to receive the material from the spout 18 of a feed-hopper, 19, said hopper being suitably supported and arranged to discharge the material upon the screen or sieve 17, and, if desired or necessary, the hopper may be provided with means for automatically feeding regulated and uniform quantities of the material to the screen.

The lower end of each trough is contracted, as shown at 20, to about one-half of its width, and is depressed below the main portion of its bottom wall to constitute a separating-chamber, 21, which is about equal to double the height of the main portion of the side walls of the trough.

The discharging-mouth of the depressed chamber in each trough or table is controlled by a valve or gate, 22, centrally hung on a pintle, 23, one end of which is attached to a lever, 24, which is pivoted at its other end to a vertical rod, 25, the latter being extended upward and around the upper edge of the side wall of the trough or table, and having its end attached to a float, 26, this arrangement of parts being such that when the material being treated fills up the depression-chamber 21, as hereinafter more fully explained, the float 26 will be raised or elevated, carrying with it the rod 25, and hence the lever 24 will be operated and the valve or gate 22 will be turned so that its lower horizontal edge is raised and a discharge opening or throat created for the escape of the heavier particles accumulating in the depressed chamber, and at the same time the upper edge of the valve or gate will be lowered to facilitate the escape of the overflowing lighter particles. The connection between the lever and rod will, in practice, be adjustable, so that the area of the discharge opening or throat can be varied as circumstances may require.

The float 26 must be constructed as light as possible, and preferably hollow, and is provided with upwardly-curved ends to permit the material to freely pass under it and make it more buoyant. It is guided at its ends in its rising and falling movements by means of a stationary guide or strap, 28, at each end, which are supported by a suitable support, as at 29, and held in fixed positions, whereby the float is free to rise and to open and close the valve 22; but it is prevented from moving longitudinally or horizontally in the separating-chamber through the medium of the aforesaid guides or straps. The said guides or straps are curved or extended inward at their lower ends to afford a supporting-seat for the float and prevent it from falling below a given or determined point.

I will now proceed to describe the mode of operation of the apparatus.

The driving-shaft 4 is revolved by any suitable power, as by a pulley, 27, which operates the crank-shafts 5 through the medium of pulleys 14 and 15 and belts, or otherwise, and the pitmen 12 will be reciprocated in reverse directions, owing to the arrangement of the crank-arms on the shafts 5, which arms are at right angles to the axes of the shafts and extend in opposite directions therefrom. These movements of the pitmen will vibrate or oscillate the troughs or tables in the arc of a circle. The material in the feed-hopper is then permitted to discharge (through the medium of suitable feeding devices, if desired) upon the sieve or screen in the upper trough or table. The first finer particles of material will pass through the sieve or screen into the table or trough immediately below it, and the still finer particles will pass through the sieve or screen of the second trough or table into the third trough or table. The material remaining in each trough or table will gradually pass down the same toward the lower end thereof, and the separate particles of the entire mass undergoing treatment are kept in constant rolling motion on each other by means of the vibrating or oscillating movements of the troughs or tables, whereby the heavier particles will, by their greater gravity, be able to take advantage of the moving or rolling of the particles on each other and sink or settle to the bottom, there forming a layer or stratum distinct from the lighter particles above it. These heavier particles are the ones that first reach the contracted and depressed portions 20 and 21 of the trough or table; but the discharge valve or gate will not be operated until the depressed separating-chamber 21 is filled on a line with the bottom of the main portion of the trough 10, because the upper edge of the valve or gate is as high as the lowest point at which the float 26 commences to operate the devices connecting it with the valve or gate. The current of material now being delivered upon and passing over the particles which have filled the separating-chamber has the effect of raising the float, which movement elevates the rod 25 and lever 24 and turns the valve-gate 22, thereby lifting the lower edge of the latter from the bottom of the trough and creating an opening or throat, through which the heavy particles of material in the separating-chamber are discharged by the pressure of the incoming material. The raising of the lower edge of the valve or gate has the effect of lowering the upper edge of the same, thereby facilitating the escape or discharge of the upper stratum or layer of lighter particles of material, which is supposed to be the refuse matter. It will be evident that this automatic operation of the valve or gate will provide for the discharge of the lighter and the heavier particles at two

different points, and they can be separately delivered in any suitable manner to receiving-vessels.

The operation of all the troughs or tables is the same, and hence the material will be accurately and efficiently assorted and separated; and, further, the entire mass treated is practically separated into approximately equal proportions and assorted into a series of grades, each of which will contain particles of approximate or equal size. This result is accomplished without reference to the uniformity of the feed, as the float and valve or gate are especially designed to provide for the variations of feed which may, in practice, occur.

The contraction of the discharging end of the trough or table and the arrangement of the float therein are of considerable importance, because the movement of the float is more quickly effected by a given quantity of material in a narrow space than if the same quantity were spread over a wide space.

In practice the vibrations or oscillations of the troughs or tables should be timed according to the varying size of the particles in the respective troughs or tables—that is to say, the trough containing the smaller particles should be vibrated or oscillated more rapidly than the trough containing the larger particles. To effect this, and to impart to the several troughs or tables a differential movement, so that the vibrations or oscillations of the troughs or tables, commencing with the upper one, will be successively more rapid, I provide the driving-shaft with pulleys of gradually-increasing diameter, the smaller pulley imparting motion to the upper trough or table, the next larger pulley imparting motion to the next trough or table, and the largest pulley imparting motion to the bottom trough or table, whereby the bottom trough will be oscillated more rapidly than the trough or table immediately above it, and the latter will be oscillated more rapidly than the upper trough or table. In order to permit these variable movements of the troughs or tables, and yet provide for the certain discharge of the material sifted through the screen of one trough into the trough below it, I provide the two upper troughs with inclined chutes, to form contracted discharge-throats 30, located below the screens or sieves. It will be observed that these contracted throats are located at a distance from the ends of the troughs, and therefore each throat will always be over some part of the trough below it, notwithstanding the varying speed at which the troughs oscillate, which will be clearly understood by reference to the diagram Fig. 6.

The bottoms of the troughs are inclined transversely—that is to say, their outer edges are slightly higher than their inner edges—the object of which construction is to prevent the material passing through the trough from assuming an uneven depth as to the two sides of the trough, which would occur by reason of centrifugal force were the bottoms of the trough not inclined transversely, as stated.

The troughs or tables can be made straight instead of curved, and any desired number can be employed, as circumstances require. They can also be otherwise supported than as shown; but the construction and arrangement shown will be found to afford satisfaction, and produce an apparatus which is efficient in operation, and by the use of which all the finer particles of precious metal can be saved as well as the coarser ones.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. An apparatus for concentrating ores, combining in its structure a series of vibrating or oscillating troughs or tables arranged one above the other, and each provided at or near one end with a screen or sieve and at the other end with a separating-chamber having its discharge mouth or throat controlled by an automatically-operated gate or valve.

2. In an ore-concentrator, a vibrating or oscillating trough or table having at or near its receiving end a screen or sieve and at its discharging end a separating-chamber, combined with a valve or gate adapted to open and close the delivery mouth or throat of the separating-chamber.

3. In an ore-concentrator, the combination of a trough or table having at or near its receiving end a screen or sieve and at its discharge end a separating-chamber, an automatically-operated valve or gate controlling the delivery mouth or throat of the separating-chamber, and mechanism for vibrating or oscillating the trough or table.

4. In an ore-concentrator, the combination of a trough or table having at one end a separating-chamber, a valve or gate for controlling the delivery mouth or throat of the separating-chamber, and devices operated by the accumulation of material in the separating-chamber to automatically open the valve or gate and permit the escape of the separated particles of material.

5. In an ore concentrator, the combination of a series of troughs or tables having screens or sieves at or near one end and separating-chambers at the other end, and valves or gates automatically operated by the accumulation of material in the separating-chambers to open the delivery mouths or throats of the latter and permit the escape of the separated particles.

6. In an ore-concentrator, the combination of a series of troughs or tables having screens or sieves at or near one end and separating-chambers at the other end, valves or gates automatically operated by the accumulation of material in the separating-chambers to open the delivery mouths or throats of the latter, and mechanism for vibrating or oscillating the troughs or tables.

7. In an ore-concentrator, the combination of a series of inclined troughs or tables arranged one above the other, and provided with screens and separating-chambers, automatically-operated valves or gates controlling the

delivery mouths or throats of the separating-chambers, and mechanism, substantially such as described, for imparting differential vibratory movements to the respective troughs or tables.

8. The combination, with the trough or table having a separating-chamber at one end, of a valve or gate in the delivery mouth or throat of the same, a float within the separating-chamber, and connecting devices between the float and the valve or gate.

9. The combination, with the series of troughs or tables having screens or sieves at one end and separating-chambers at the other end, valves or gates controlling the delivery mouths or throats of the separating-chambers, floats arranged in the latter, and connecting devices between the floats and the valves or gates.

10. In an ore-concentrator, a trough or table having one end contracted and depressed, combined with a float, a valve or gate, and connecting devices between the float and valve or gate for controlling the delivery mouth or throat of the separating-chamber.

11. The combination of the driving-shaft, the crank-shaft, the oscillating trough, the vertical shaft, the hubs thereon, the arms connecting the trough with the hubs, and the pitmen connecting the arms with the crank-shaft.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

BENJAMIN HERSHEY.

Witnesses:

JAMES L. NORRIS,

JAMES A. RUTHERFORD.