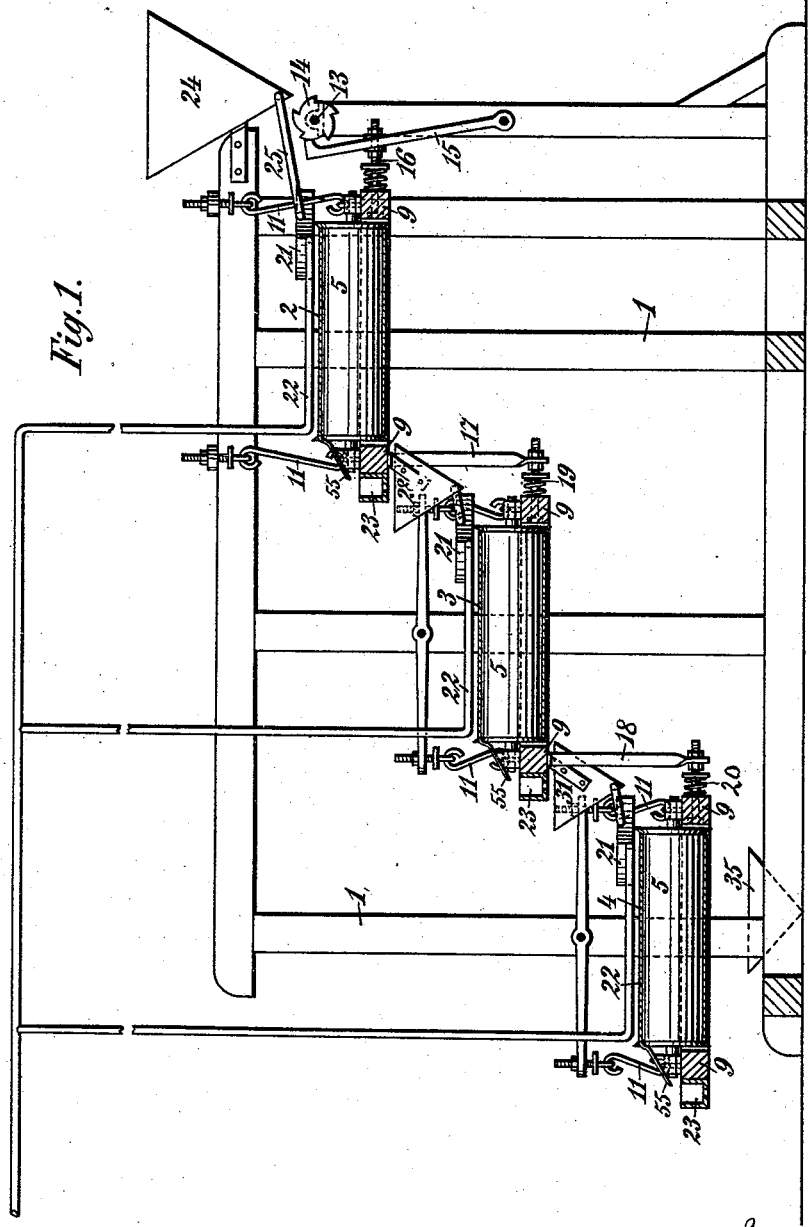
(No Model.) 5 Sheets—Sheet 1.

W. KRUG.

ORE SEPARATOR.

No. 490,911. Patented Jan. 31, 1893.

Fig. 1.



Witnesses:
E. C. Duffy
Chas. M. Werle'

Inventor
Wilhelm Krug
per
O. E. Duffy
Attorney

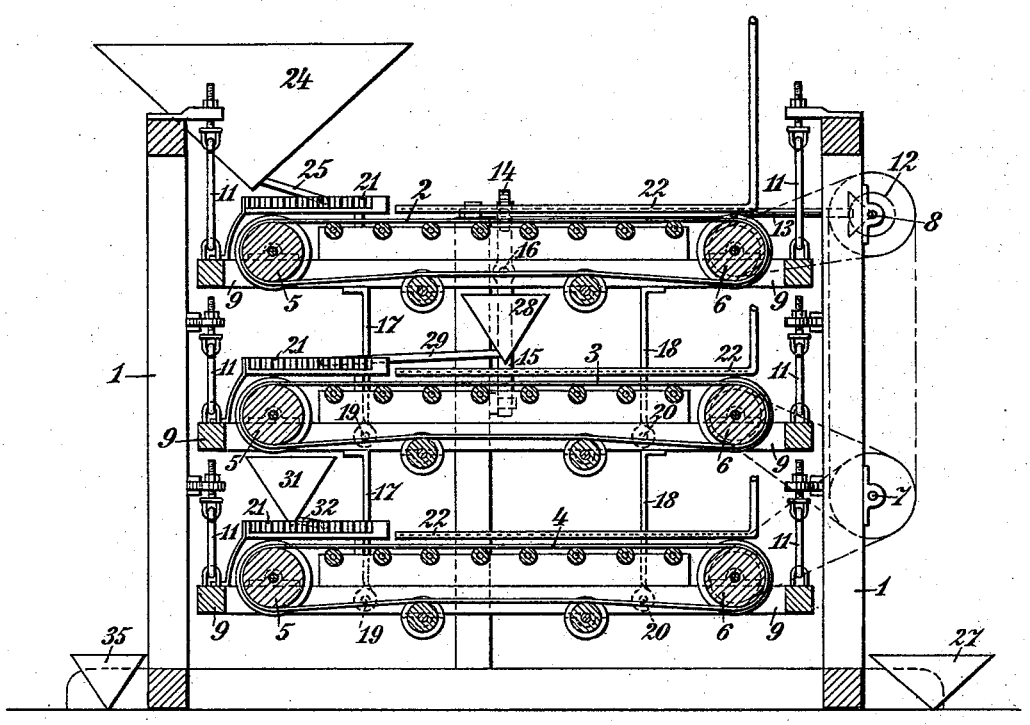
(No Model.) 5 Sheets—Sheet 2.

W. KRUG.

ORE SEPARATOR.

No. 490,911. Patented Jan. 31, 1893.

Fig. 2.



Witnesses:
E. C. Duffy
Chas. M. Wells

Inventor
Wilhelm Krug
per
E. C. Duffy
Attorney

(No Model.) 5 Sheets—Sheet 3.

W. KRUG.

ORE SEPARATOR.

No. 490,911. Patented Jan. 31, 1893.

Fig. 3.

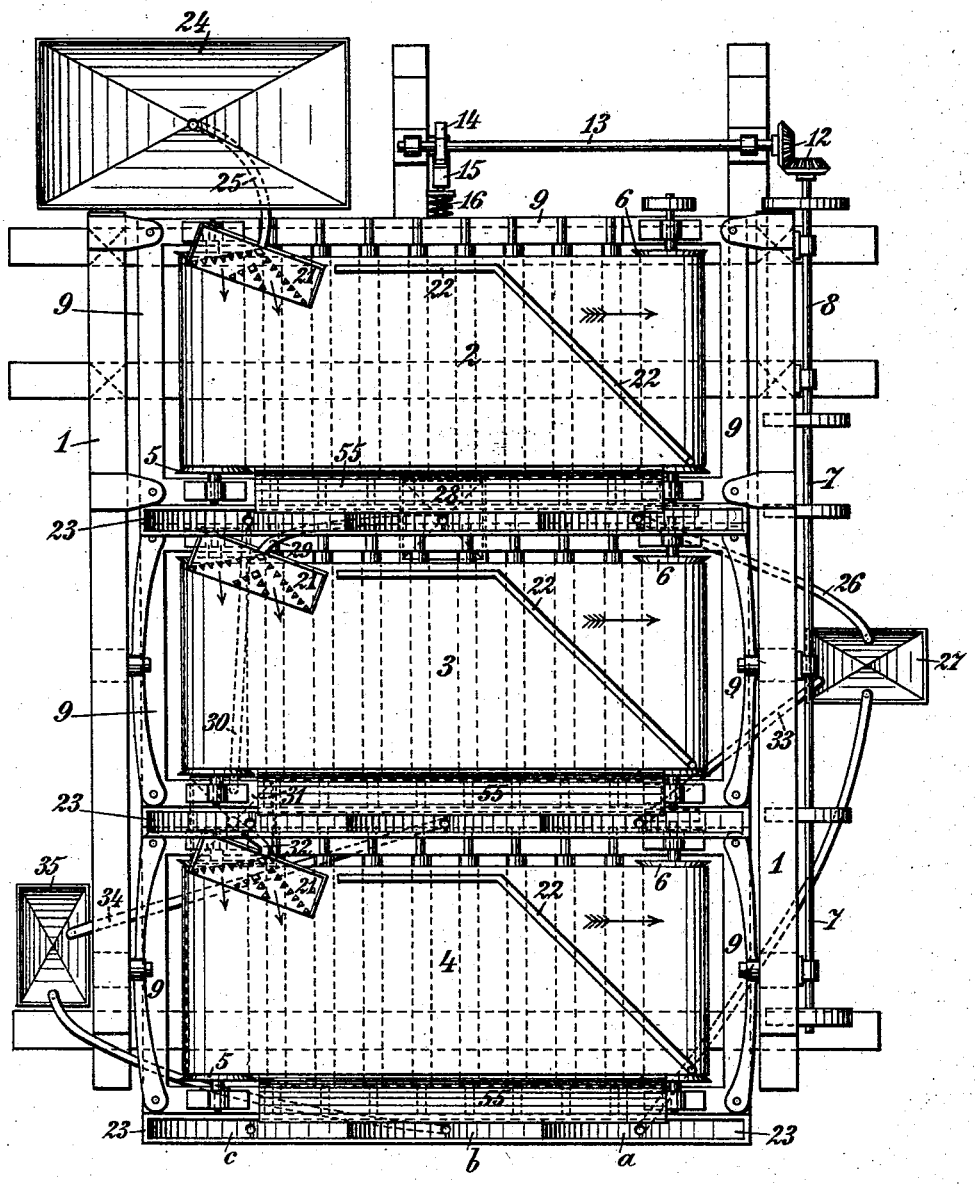
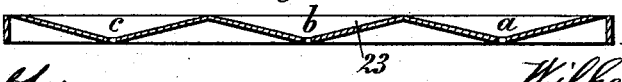


Fig. 3a.



Witnesses:
E. C. Duffy
Chas. M. Wells

Inventor
Wilhelm Krug
per
E. C. Duffy
Attorney

(No Model.) 5 Sheets—Sheet 4.

W. KRUG.

ORE SEPARATOR.

No. 490,911 Patented Jan. 31, 1893.

Fig. 4.

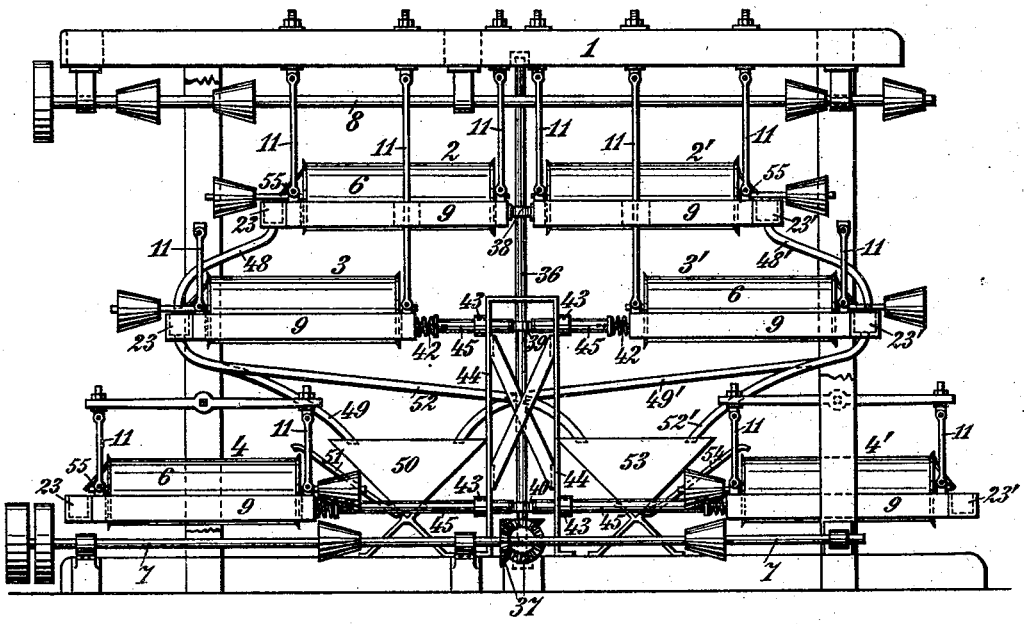
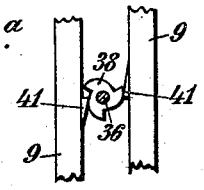


Fig. 4ª.



Witnesses
C. C. Duffy
Chas. M. Wiede

Inventor
Wilhelm Krug
per
C. C. Duffy
Attorney

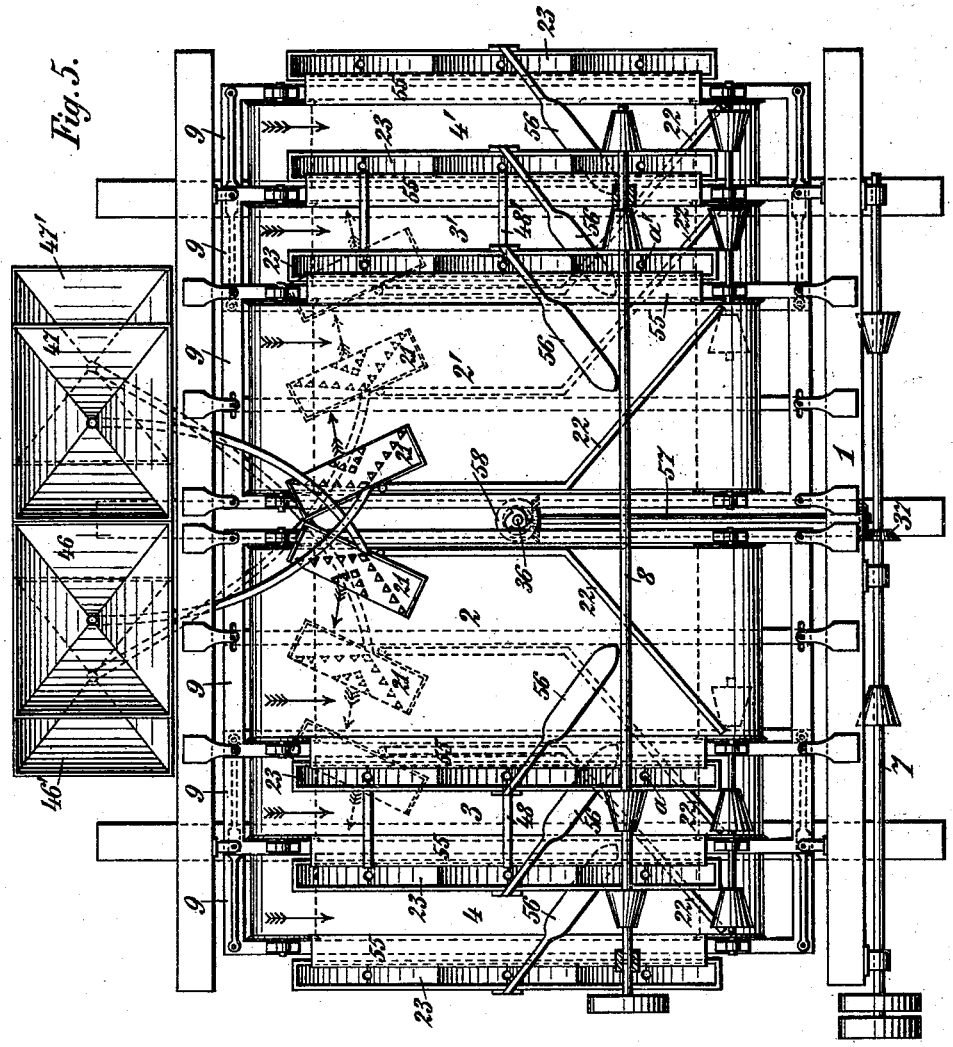
(No Model.) 5 Sheets—Sheet 5.

W. KRUG.

ORE SEPARATOR.

No. 490,911. Patented Jan. 31, 1893.

Fig. 5.



Witnesses;
O. E. Duffy
Chas. M. Wedd

Inventor
Wilhelm Krug
per
O. E. & O. Duffy
Attorneys

UNITED STATES PATENT OFFICE.

WILHELM KRUG, OF KRIES SIEGEN, GERMANY.

ORE-SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 490,911, dated January 31, 1893.

Application filed October 26, 1891. Serial No. 409,842. (No model.)

To all whom it may concern:

Be it known that I, WILHELM KRUG, of Kries Siegen, Westphalia, in the German Empire, have invented certain new and useful Improvements in Ore-Separators; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures and letters of reference marked thereon, which form part of this specification.

The object of the present invention is a graded concussion table receiving continuously any kind of ooze or slicks of ores, sorting them according to the purity and gravity of the particles, delivering directly the sorted material or receiving it again for a repeated treatment. The concussion table is therefore employed according to the quality of the ore slicks to be treated either in simple or double execution. This concussion table is composed of several single floors, arranged in a frame, which are formed of belts of convenient width and material, led over rollers supported in suspended frames and which may be arranged in more or less grades being superposed like steps. One of these tables, arranged in grades above each other, receives from the driving shaft a swinging motion which is transferred from floor to floor by appropriate means so that the ore material settling on these traveling aprons is sorted according to gravity, while the aprons themselves are moved on continuously, whereby the sorted material is allowed to drop into a spout arranged laterally, wherefrom it is conducted either into convenient pans or led again upon another table in case that the repeated treatment should be necessary. This concussion table is represented in the accompanying sheets of drawings in two different forms.

The simple form of the concussion table is shown by Figure 1 in front elevation, being partially in section. Fig. 2 is a cross section, and Fig. 3 is a plan view of the same. Fig. 4 gives the front elevation of a double concussion table and Fig. 5 is the corresponding plan view thereof.

The graded concussion table, shown in Figs. 1, 2 and 3 is composed of three floors 2, 3 and 4, arranged in a frame 1 beside each other and above each other, formed of traveling belts of linoleum or rubber of the necessary width, guided over rollers 5 and 6, the said belts having a continuously advancing motion in the direction as indicated by the arrows in the drawings. This motion is transferred upon the single floors 2, 3 and 4 by means of pulleys and can be made constant when common belt pulleys are employed or may be varied by employing cone pulleys. The rollers with the traveling aprons are supported by rectangular frames 9 of which the first frame is suspended in the main frame 1 directly by hangers 11 while the hangers of the other frames are hung to the ends of levers, oscillating on the main frame. The floor 2 receives a constantly vibrating motion from a shaft 13, driven by shaft 8 and the bevel gear 12; a cam wheel 14 fixed on the shaft 13 acts upon a lever 15, connected to the bolt 16 which projects laterally from the frame 9 and which is provided with spiral springs. This vibrating motion is transferred upon the floors 3 and 4 placed below, by means of the bars 17 and 18 attached to the frames 9 and acting upon the bolts 19 and 20, which are also provided with springs. The jars of this motion are in a certain way weakened by the spring bolts from one floor to the following. The bolts 16, 19 and 20, being screw threaded and provided with nuts, admit of varying at will the jar transferred by the lever 15. In the same way the inclination of each floor, laterally, can be very accurately adjusted as all hangers 11 are provided with nuts. At the side of each floor and above the bolt a guide plate 21 is arranged and fixed to each one of the frames upon which the material to be sorted on each floor is uniformly conducted. Such a guide plate is made of wood or other material being of triangular or quadrangular form and is provided with sharp edged wood studs in several rows, which form together an angle, so that the pulp running on the plate on one side is broken by these studs and is led in form of a thin sheet slowly upon the floor. A pipe 22 perforated with small holes on one side and which is bent in an angle, is placed above each floor, said pipe being in connection with a conduit of water or

any water reservoir; thereby the process of separating the particles of the pulp is accelerated, and also the particles sticking to the floor are washed away. The perforations in those parts of the pipes 22 which are inclined to the direction of motion of the floors are provided with larger perforations than those parts parallel with the motion of the floor in order to produce upon the different parts of the floors the effect of roses of different strength. The spout 23 arranged on each frame of a floor is composed of three compartments *a b c* (Figs. 3 and 3[a]) which receive the sorted ore, washed down from the floors by the pipes 22, whereupon it is led into pans or if necessary upon a new floor in order to be acted upon once more. Slanted metal sheets 55 are used to lead the material from the floors over into the spouts 23. The funnel 24 arranged at the side of the frame 1 receives the ore pulp which is to be sorted by the apparatus, which is appropriate to all kinds of pulps and slicks.

The working of the apparatus for lead ores for instance is the following: The slick poured into the funnel 24 flows through a pipe 25 upon the guide plate 21 and is spread out on the upper floor 2 wherefrom it flows off in the direction of the arrows on the slightly inclined floor, being meanwhile exposed to the jars which are imparted to the floor in short intervals by the lever 15, whereby a separation of the particles is effected, as the lighter parts (the sulphurets and the gangue) are more powerfully shaken than the heavier parts (lead slick); the heavier parts are thereby settled on the floor. But as the same slowly and continually advances with the ore upon it, receiving the jars from the side all the time, the water streaming from the part of pipe 22 parallel to the direction of the floor, washes all the still adhering lighter parts side wise into the spout 23, while the heavier and less movable particles of the ores, (lead slick) are washed away from the stronger acting jets of water pouring forth from the holes of the oblique part of the pipe 22. The result obtained on the first floor is therefore the following: First. The part of the floor, being acted upon the oblique part of pipe 22 furnishes ready material, *i. e.* pure material (lead slick) into the division *a* of the spout 23 Fig: 3, wherefrom it flows through pipe 26 into the bottom pan 27. Second. The middle part of the floor, being acted upon by the part of pipe 22, parallel to the floor, gives a kind of medium product (lead slick and sulphuret) which collects in the middle part *b* of spout 23, whence it flows through an opening into the reservoir 28, in order to be delivered through pipe 29 upon the floor 3, to be again acted upon. Third. The part of the floor, which leads the lightest particles (the gangue mixed with some sulphuret, and light lead-ore) into the division *c* of the spout 23, lets them flow through a pipe 30 into the reservoir 31, whence they are brought through pipe 32 and guide-plate 21 upon the floor 4. The medium product from floor 2, after having been treated again on floor 3, gives lead-slick and sulphuret. The former is led through a pipe 33 into the bottom pan 27 while the latter through pipe 34 goes into another bottom-pan 35. The remaining substance, composed of sulphuret and gangue, flows into the reservoir 31, and is finally treated upon the floor 4, where still a small quantity of lead-slick and sulphuret is obtained; the greater part, being pure gangue, goes off as waste.

Such an arrangement of a concussion table, admits of a strong feed of pulp upon the first floor 2, for the particles of ore or sulphuret, being taken along by the stronger current of the pulp, are not lost, as they are passed over the other floors 3 or 4. This apparatus furnishes therefor in all its parts from the on-fed pulp ready material and the tedious repetition of the treatment of medium products and gangue is totally dispensed with.

The graded combustion table shown by Figs: 4 and 5 differs from the one represented by Fig: 1, 2 and 3 by an arrangement of two such apparatus, combined into one group, each having three graded floors as above described, 2, 3 and 4 and respectively 2′ 3′ and 4′. Fig: 4 is the front elevation, and Fig: 5 is the plan thereof. Similar parts are designated by the same numerals and letters. Each floor is here also formed by endless belts, the rollers 5 and 6 of which revolve in a frame 9, adjustably and movably suspended by hangers 11 on the main frame 1. All the floors receive from the driving shaft 7 or shaft 8 by means of belt pulleys their motion, and means are provided, that all six floors receive a laterally oscillating motion from a common vertical shaft 36; this arrangement produces a considerable economy in power and the six floors occupy comparatively little space. This shaft receiving motion from the main shaft 7 by means of bevel gear 37, shaft 57, and bevel gear 58, is provided with three cams 38, 39 and 40 keyed upon the shaft in convenient places. The jars upon the two upper floors are direct acting, without springs, but the strength can be made adjustable by means of interchangeable projections 41 (Fig: 4[a]) with which the frames 9 are provided. The lateral swinging motion of the four lower floors however is weakened by springs and is made adjustable by nuts which can be more or less tightened; 44 is a supporting frame carrying the sleeve 43 wherein the bolts 45 are moved, which are provided with the springs 42 and the above mentioned adjusting nuts. The inclination of the single floors can also be adjusted by means of nuts, with which the hangers 11 of the frames 9 are provided.

The mode of operation of the double concussion-table is as follows: From the funnels 46 and 47 the pulp is running simultaneously upon the two upper floors 2 and 2′, and from the funnels 46′ and 47′ simultaneously upon the two next floors 3 and 3′ upon which it is spread

out by a guide plate 21 with which each floor is provided; the vibratory motion from the side produces the separation absolutely in the same way as on the simple concussion table. The lead slick obtained on the four floors is washed off by the oblique part of pipe 22 and led over the inclined metal sheets 55 into the spouts 23 wherefrom it flows through openings a a' respectively into a lower pan. The obtained medium product is led from the floors 3 and 3′ over the sheet metals 55 directly into the second division of the spouts 23 and 23′ which also receive (through pipes 48 and 48′) the medium product of the two upper floors 2 and 2′. Being thus collected it runs through pipes 49 and 49′ into the funnel 50 in order to flow through pipe 51 upon the floor 4 where it is submitted again to the same treatment, and where some more pure slick and sulphuret are obtained.

The waste from the pulp, fed upon the four upper floors in a somewhat strong charge, will never be pure gangue, but will always be mixed with pulp flowing over; for this reason it is led with the pulp flowing over from the four upper floors into the third compartments of spouts 23 and 23′, and from there it is conducted by the pipes 52 and 52′ into the funnel 53, wherefrom it is led through pipe 54 upon the floor 4′ in order to be acted upon once more. Here again some slick, some sulphuret and gangue are obtained.

In order to present the grains being in suspension in the pulp, to the jets of water from pipe 22 in the thinnest and most even sheets, a flat brush 56 may be used in addition above each floor, as shown by Fig: 5.

The concussion table may also be transformed in a double arrangement into two floors or one floor, which changes nothing in the nature of my invention.

Having thus described my invention, what I desire to secure by Letters Patent, is:—

1. In an ore separator the combination of a supporting frame, a series of swinging frames suspended therefrom one below the other, belts mounted in said frames forming floors, spring connections between said floors to vibrate all the floors in unison, means substantially as described to operate said belts, and gearing connected to one of said floors to vibrate the same and vibrate all of said floors, substantially as and for the purposes set forth.

2. In combination, a supporting frame, a series of swinging frames mounted in different horizontal planes, connections between said frames, means substantially as described arranged to vibrate the upper frame and thereby vibrate all of said frames, said swinging frames provided with movable floors, means for distributing water thereon, a receptacle for each floor to catch the material washed therefrom, and vessels arranged to discharge on the floors, substantially as described.

3. In combination, a supporting frame, a series of vibrating frames arranged in different horizontal planes and provided with movable floors, means for vibrating said floors, water pipes arranged to wash the materials on the floors toward an edge of each, a receptacle at said edge of each compartment, divided into different compartments, receiving vessels, corresponding compartments of said receptacles connected to discharge into said vessels, and connections from other compartments of said receptacles discharging on lower floors, substantially as described.

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

WILHELM KRUG.

Witnesses:
JEAN GRUND,
FRANK H. MASON.