(No Model.)

F. R. CARPENTER.

MACHINE FOR CONCENTRATING ORES.

No. 344,720. Patented June 29, 1886.

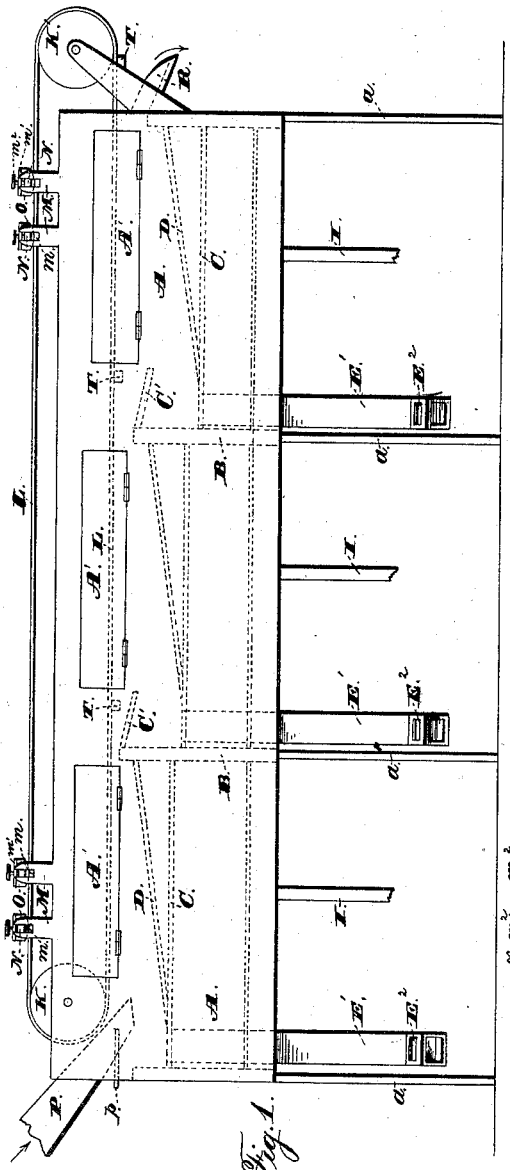

Fig. 1.

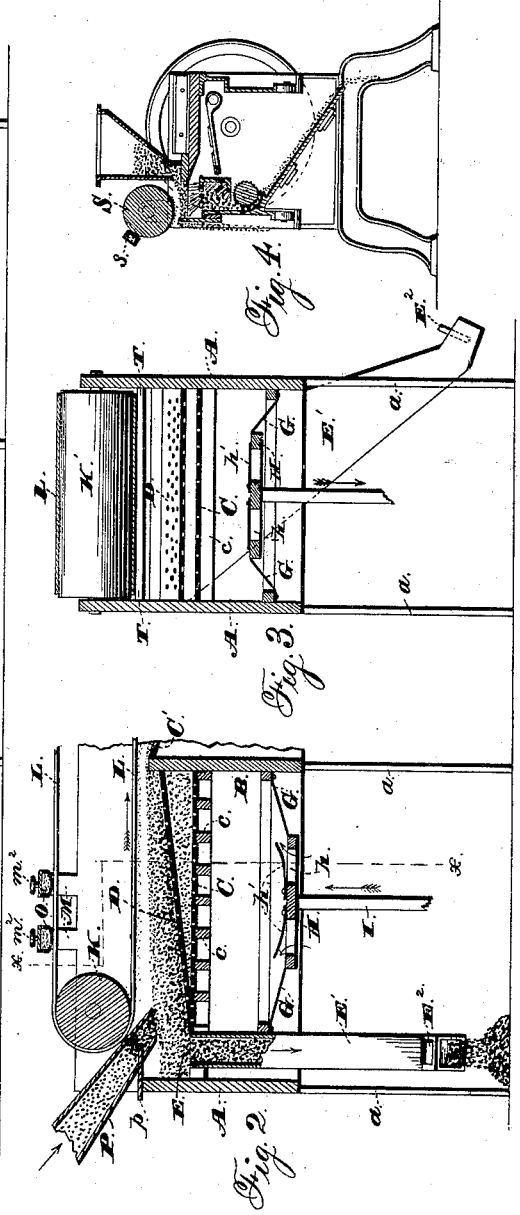

Fig. 2.

Fig. 3.

Fig. 4.

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UNITED STATES PATENT OFFICE.

FRANK R. CARPENTER, OF GEORGETOWN, ASSIGNOR OF TWO-THIRDS TO CHAUNCEY E. DEWEY AND FRANK A. MAXWELL, BOTH OF CLEAR CREEK COUNTY, COLORADO.

MACHINE FOR CONCENTRATING ORES.

SPECIFICATION forming part of Letters Patent No. 344,720, dated June 29, 1886.

Application filed June 14, 1883. Serial No. 98,077. (No model.)

To all whom it may concern:

Be it known that I, FRANK R. CARPENTER, of Georgetown, in the county of Clear Creek, and in the State of Colorado, have invented certain new and useful Improvements in Machines for Concentrating Ores; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which—

Figure 1 shows a side elevation of my invention as applied to a series of ore-concentrators; Fig. 2, a central longitudinal section of the first one of the series of concentrators, as shown in Fig. 1, with my invention applied thereto; Fig. 3, a transverse section of the same, and Fig. 4 a longitudinal sectional view of a Krom ore-separator with my invention applied thereto.

The object of my invention is to make an improvement in the means for concentrating ores; and to this end it consists in the jig or concentrator in which the ore is bedded, and the heavier particles are drawn off at the bottom, provided with means for forcing intermittent blasts of air up through the bed, in combination with an electrified surface above the bed.

It further consists in the concentrator provided with means for forcing intermittent blasts of air up through the bedded ore, and for drawing off the heavier particles from the lower part of the bed, in combination with a traveling electrified surface, situated above the bed; and, finally, it consists in the construction, arrangement, and combination of parts, as hereinafter described, and specifically pointed out in the claims.

In the drawings, A designates the frame of the concentrator, provided with suitable legs or supports, *a a*. The sides of frame are continued up above the ends thereof, for the purpose hereinafter to be described, and are provided with doors A′ A′. Within this box-like frame is divided into three compartments, as shown, by cross-partitions B B. Each compartment is provided with a horizontal partition, C, formed of a sieve supported upon suitable cross-bars, *c c*. Above this is arranged the inclined sieve D. The mesh of the lower sieve is so fine as to prevent the passage of the particles of ore down therethrough. An opening, E, through the partition C is preferably situated at the end of the compartment at which the ore is fed in. This opening extends across the compartment, and a suitable spout or chute, E′, is arranged below it, to gather and properly conduct the ore passing down through said opening. The sieve D is attached to partition C at the edge of this opening, and inclines upward therefrom to the other end of the compartment, and is there fastened to the cross-partition B. Each compartment, except the first, above the opening into its chute is provided with an inclined plate, C′, which serves to carry the material as it is fed into the chamber over and beyond the spout-opening. The spouts E′ are in each case partitioned off from the rest of the chamber, as shown. To this partition and the other sides of the chamber, near the bottom thereof, are fastened the edges of a diaphragm, G, of leather or other strong and flexible material. Attached to the under side of this diaphragm, at the central portion thereof, is the square plate H. This plate is considerably smaller in area than the inside of the lower portion of the chamber, so that it does not strike against the chamber-sides as it is moved up and down. If desired, the diaphragm can have its central portion cut away and the edges of the opening fastened to edges of the plate H. This plate is formed with several openings, *h h*. Upon its upper surface and covering these openings are leather or other flexible flap-valves *h′ h′*. A piston-rod, I, is attached at its upper end to the plate. This rod is to be guided in any desired manner, and is to be actuated to move the plate quickly up and down by any suitable mechanism. The discharge-spout E′ for each chamber is, as indicated above, extended at its upper end to correspond with the length of the discharge-opening in the bottom of the ore-chamber. It is then contracted in size, as shown, so as to be square in cross-section, and inclined or curved over, so as to discharge at one side of the machine. Its lower end is provided with a slide door or valve, E^2, to regulate the flow through the chute.

Journaled in the upwardly-extended sides of the frame-box is the roller K, and in brackets from the sides the roller K′, either one of

which rollers is to be driven by any suitable means. By proper gearing the pistons and the rollers can be driven from the same driving-shaft, so that their movements shall always be properly timed relatively. An endless belt, L, of a width very nearly equal to that of the interior of the casing, passes over these rollers, which are of such a size and so situated as to bring the belt down close to the tops of ore-chambers. This belt is to be made of paper, silk, rubber, a combination of wool and silk, with the silk forming the face, or any other material which is easiest and most highly electrifiable by friction. Upon the tops of the side boards are lugs or upwardly-extending brackets M M. Their upper portions are formed with open-ended slots *m m*, in which fit the squared reduced ends of cross-bars N N, which bars form the backs of cushioned rubbers O O, which can be made of any material most suitable to electrify by friction the belt L, upon whose upper surface they bear. The number of these friction-rubbers can of course be increased or diminished, as desired. The open upper ends of the slots *m m* in the lugs or brackets are closed by plates *m' m'*, in which are threaded the thumb-screws m^2 m^2, whose ends bear upon the reduced ends of the bars N N. By means of these screws the pressure of the rubbers upon the belt can be regulated and the friction upon said belt increased or diminished, as desired. A hopper-spout, P, is provided at the entrance side of the first compartment. A slide-valve, *p*, is arranged near the lower end of the spout, to regulate the inflow of the ore to be concentrated. A discharge-spout, R, is also provided at the outer end of the last chamber, to properly conduct away the lighter particles of rock, which, by the well-known action of the concentrator are caused to pour over the upper edge of the end board of the chamber. In each succeeding chamber the sieves are set lower down than in the preceding one, as shown. Each dividing cross-partition is also made correspondingly lower than the preceding one. The tops of the outlet ends of the boxes or chambers will all be the same height above the upper ends of the respective inclined sieves. The object of this change in the height of the sieves will be fully set forth hereinafter.

In Fig. 4 is shown a longitudinal vertical section of a Krom ore-separator with my invention applied thereto. Above the ore-bed in this machine I place a large cylinder, S, which can be made of sulphur, glass, rubber, paper, or any other material easily electrified by friction. A rubber, *s*, bearing upon the cylinder serves to electrify the same. This rubber can be provided, like those already described, with means for adjusting the friction between it and the cylinder. The rubber can, if the cylinder be revolved, be relied upon to shed off from said cylinder any light particles which may adhere to its surface; or a brush or scraper can be employed for the same purpose. Instead of the cylinder an electrified plate could be placed above the bedded ore, to retard the fall of the lighter particles carried upward from the bed by the blast of air from the fan. Instead of the belt, as shown in drawings, and described above in connection with the ore-concentrating chambers I also contemplate using an electrified plate.

When my concentrator is in operation, the ore is fed into the first box or chamber and bedded upon the inclined sieve. The piston is driven rapidly up and down by the mechanism provided therefor, and a succession of blasts of air are forced up through the sieves and bedded ore. The valves upon the piston-head open as said head descends and close as it rises, so that the air above the diaphragm is positively forced upward, but none is drawn down through the bed of ore. The action of these intermittent blasts of air is, as in the Krom machine, to disturb and lift somewhat the bed of ore, so that it becomes sorted into layers, according to the comparative gravity of the particles, the heaviest being finally brought to the bottom and the lightest to the top of the bed. Some of the heavier particles of material work down through the inclined upper sieve, D, into the space between sieves D and C. As the mesh of C is smaller than that of D, these particles will be retained in this space. They are not removed therefrom, but are intended to remain for the purpose of equalizing the action of the air-blast on the ore-bed above the inclined sieve. If it were not for this bed of material between the sieves, the air from the blast would all escape up through the highest part of the inclined sieve, where the ore-bed thereon is thinnest and lightest, and would not act upon the rest of the bed. The machine would then evidently be useless and inoperative. The material between the sieves prevents this and equalizes the action of the blast over the whole extent of the bedded ore, for where the layer of ore is thinnest and lightest the bed of particles between the sieves is thickest. By the action of the air-blast upon the bed of ore in each chamber the heavier particles thereof are not only brought to the bottom of the bed, but they work down over the inclined sieve to the lower end thereof, and finally are drawn out through the spout at the bottom of the chamber, while the lighter particles are brought into a layer on top of the bed, and are caused to work gradually toward the discharge end of the chamber, and finally to flow over the upper edge of that end into the succeeding chamber, where they are again acted upon and the ore remaining among them concentrated.

It has been found by experience that with the concentrators, as heretofore constructed, and operating with intermittent blasts of air, it has been impossible to so thoroughly concentrate the ore that the upper layer of the bed shall not contain a large percentage of ore in smaller particles, either separate from or combined with the particles of rock.

In order to make the further concentration of the ore in such upper layer possible, some means must be provided for retarding the fall of the lighter particles back upon the bed when they have been raised therefrom by the blasts of air. To gain this end, I place an electrified surface above the bed, so that the particles as they are raised by the air will be attracted and prevented from falling as rapidly as they otherwise would under the action of their gravity. The electrified surface also will attract the lightest particles of rock and hold them for a while in contact with its surface, so that when they do fall it will be upon the top of the bed. Whatever particles of ore are so attracted by the electrified body as to be held suspended in contact with its surface will, because of their weight or metallic nature, be dropped or repelled sooner than the particles of rock. The action of the electrified body in retarding the fall of the particles will obviously be greater upon the lighter particles of rock than upon the heavier ones of ore. The latter will then fall back upon the bed first. The result of the operation of the electrified body, as set forth above, is then obviously to insure the bringing of the light particles of rock in a layer upon the upper surface of the bed, while the particles of ore are brought into a layer beneath. What passes over the discharge end of the concentrator will then be composed almost entirely of rock, with very little ore in free particles mingled therewith. With the arrangement of the series of concentrator-chambers, as shown, in combination with the traveling belt, whatever light particles adhere to the belt will be carried over into the next chamber. I prefer to provide a bar or rubber, T, just beyond the waste gate or spout from the chamber and bearing up against the belt, so as to shed off any adhering particles into the succeeding chamber, to be there subjected to a further concentrating action, together with the overflow from the first chamber. As the material in the second chamber is lighter than that treated in the first, it is not desirable that the action of the electrified belt thereon should be so powerful. The same difference exists between the contents of the third and second chambers, and a corresponding difference in the power of action of the belt is desirable. For this reason the sieves in each succeeding chamber are set lower and farther away from the belt.

In ores where there is a mixture of galena, iron pyrites, and gangue, I contemplate so concentrating by the action of the electrified belt, in combination with the rest of the concentrator, that the heaviest particles, consisting of galena, will remain in the first chamber to be drawn off from the bottom of the bed therein, while the iron is caused to pass over into the second chamber with the particles of gangue, which latter are finally separated from the iron in this chamber and carried over into the third box. To do this most successfully I can use a series of belts with necessary rollers, the first of which belts is to be highly electrified, so as, in connection with the concentration mechanism, to insure the separation of the gangue and the comparatively heavy particles of iron from the still heavier galena. The belt above the second chamber is less highly electrified, and the last belt still less so. The air-blast mechanism is to be made capable of adjustment or regulation in the amount of throw of the lever-arm and piston, so that the force of the blast can be adjusted to the material to be acted upon. The blast in the second chamber is to be less powerful than that in the first, and so on. It is desirable to use air-blasts instead of water in concentrators, because of the greater number of pulsations which can be given the air in a given time. There is the objection to the air-blast, however, that there is not a perfect suspension of particles therein, and their fall back upon the bed of ore is too rapid. With the electrified surface placed above the ore-bed, as shown and described herein, this objection to the air-blast form of concentrator is overcome.

Having thus fully set forth the nature of my invention, what I claim as new is—

1. The combination, with a sieve or perforated support for the ore and blast mechanism, adapted to force intermittent blasts of air up through such support, of an electrified surface above the latter, substantially as and for the purpose described.

2. The concentrator in which the ore is bedded, provided with means for forcing intermittent blasts of air up through the ore, and for drawing off the heavier particles from the lower part of the bed, in combination with an electrified surface above the bed, substantially as and for the purpose described.

3. The concentrator provided with means for forcing intermittent blasts of air up through the bedded ore, and for drawing off the heavier particles from the lower part of the bed, in combination with a traveling electrified surface above the bed, substantially as and for the purpose set forth.

4. In combination with the traveling electrified belt, the series of concentrating-chambers, the inclined bed-bottoms set lower in each succeeding chamber, means for forcing intermittent blasts of air up through the bedded ore, means for drawing off the heavier particles from the lower part of each bed, and means for conducting the overflow from one chamber into the succeeding one, substantially as and for the purpose set forth.

5. In combination with the traveling electrified surface and means for electrifying the same, the series of concentrating-chambers, with the beds set lower and farther away from the electrified surface in each succeeding chamber, means for forcing up through the bedded ore intermittent blasts of air, diminishing in strength as the end of the series of chambers is approached, means for drawing off from the lower part of each bed the heavier parti-

cles of ore, means for conducting the overflow from one chamber into the next one, and means for removing from the traveling surface any particles that may be carried along by the same from one chamber and shedding them into the succeeding one, substantially as and for the purpose set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 14th day of June, A. D. 1883.

FRANK R. CARPENTER.

Witnesses:

JAS. E. HUTCHINSON,

HENRY C. HAZARD.