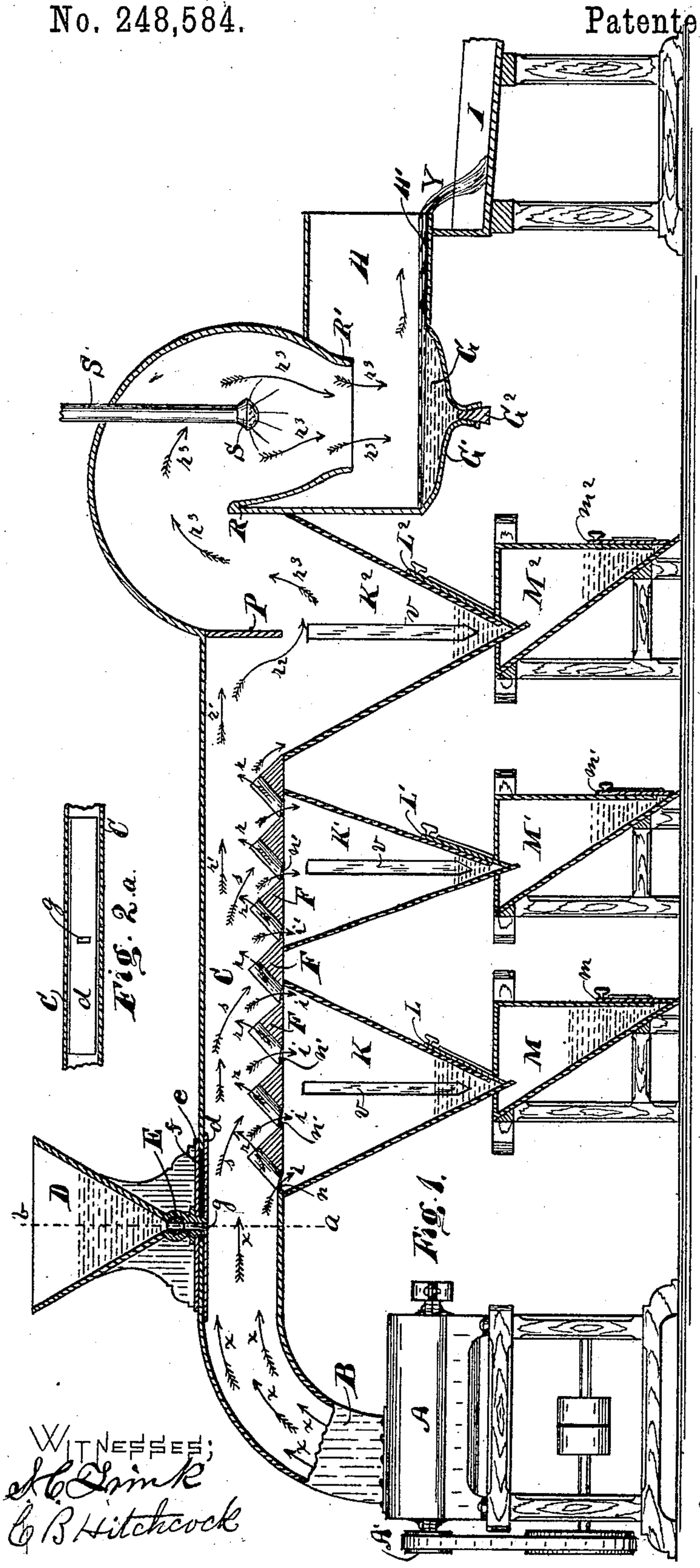
(No Model.)

E. O. FRINK.

AIR BLAST APPARATUS FOR THE SEPARATION OF COMMINUTED ORES, &c.

No. 248,584. Patented Oct. 25, 1881.



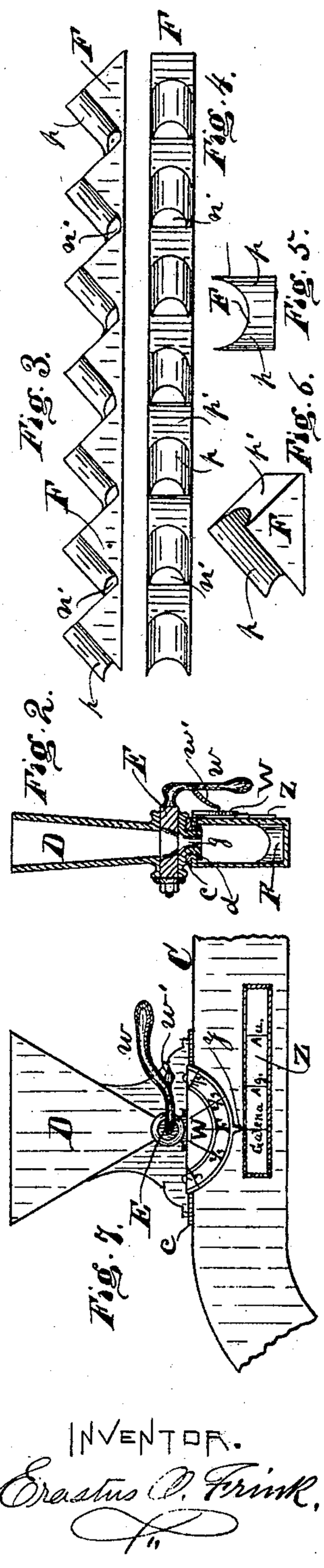


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 2.

Fig. 7.

Fig. 1.

Fig. 2.a.

WITNESSES;
H. C. Frink
C. B. Hitchcock

INVENTOR.
Erastus O. Frink.

UNITED STATES PATENT OFFICE.

ERASTUS O. FRINK, OF INDIANAPOLIS, INDIANA, ASSIGNOR TO THE INDIANAPOLIS DRY PLACER AND ORE CONCENTRATING COMPANY, OF SAME PLACE.

AIR-BLAST APPARATUS FOR THE SEPARATION OF COMMINUTED ORES, &c.

SPECIFICATION forming part of Letters Patent No. 248,584, dated October 25, 1881.

Application filed April 28, 1881. (No model.)

To all whom it may concern:

Be it known that I, ERASTUS O. FRINK, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented a new and useful Air-Blast Apparatus for the Separation of Comminuted Ores and of Free Metals from Dry Sand, of which the following is a specification.

My invention relates to a new concentrating and separating apparatus, in which an air-blast operates in conjunction with the comminuted ore, or with free metals in dry sand, and the peculiarly-constructed parts of the apparatus for separating and concentrating the free metals or metalliferous portion of the sand or ore from the rock and earthy matter according to their respective specific weights and sizes.

In the accompanying drawings, Figure 1 represents a longitudinal section of the entire device. Fig. 2 is a cross-section taken at the line *a b*. Fig. 2ª is a view of the under side of the hopper-plate in a section of the air-blast chamber. Fig. 3 is a perspective view of a series of ore gatherers, separators, and projectors. Fig. 4 is a top view of Fig. 3. Fig. 5 is a front view of one of the ore gatherers, separators, and projectors. Fig. 6 is an enlarged perspective view of the same; and Fig. 7 is a view of the adjustable hopper and a portion of the air-blast chamber, showing the indicators for regulating the feed, and for adjusting the hopper for various ores.

Similar letters refer to like parts throughout the various views.

A represents a forced blast-blower, preferably a Root blower, owing to the slight but rapid vibrations or quivering of the blast, which causes a more rapid separation of the heavier from the lighter particles of metal or ore than can be produced by the unvarying monotonous blast common to fans.

B is the discharge-pipe of the blower, which connects at its discharge end with the horizontal air-blast chamber C of the separator. Near the connection of the blast-pipe B with the air-blast chamber C, and at the top of the chamber C, is an opening, *f*, in which is fitted a slide, *c d*, to which is attached the hopper D, said hopper having at its lower end a gate or cock, E, which, when open, forms a discharge from the hopper into the chamber C through the opening *g*, as shown in Figs. 1, 2, and 2ª. Thus the hopper D and its discharge-opening *g* are adjustable forward or backward on the front end of the chamber C.

The upper slide, *c*, of the hopper is provided, preferably, on the front side, with a graduated plate, W, and the key *w* of the cock E is provided with an indicator-point, *w'*, by means of which and the graduated scale W the size of the discharge-opening of the key is determined. Thus the scale W is divided by radial lines, which may indicate that the key is one-third, two-thirds, or full open, or it may indicate that one or more tons or fractions of a ton of pulverized ore or sand is passing through the gate into the chamber C per day of twenty-four hours or less, as the case may be. The lower edge of the scale W, which is movable with the hopper D, is provided with a point, *y*, and the scale Z below, which is on the side of chamber C, also indicates where the hopper D should be moved to in order to accommodate it to various ores—such, for instance, as galena, silver, and gold.

The chamber C is horizontal, and has a height, preferably greater than its width. A portion of its bottom is cut away or perforated with holes *n*, Fig. 1, to correspond with the openings *n'* of the gatherers, separators, and projectors F. If the bottom of the chamber C is perforated with holes *n*, then the gathering, separating, and projecting devices F may be inserted singly or united together, as shown, respectively, in Figs. 6, 3, and 4.

The device F is made in the form shown. Various other forms—such as conical, concaved fronts, V-shaped, with slightly curved or rounded bottom, a flat incline with raised inclined sides, converging or diverging toward the bottom, and various other analogous forms—have been used by way of experiment, some with fair results; but the device F is preferable. The front inclines backward at an angle of about forty-five degrees, and is concaved, as shown at *p p*. The rear side, *p'*, also is inclined from the base forward, with an angle, and the base

is horizontal, thus forming a triangle with a flat bottom, inclined rear, and a concave front, while the ends are parallel and perpendicular to fit the sides of the chamber C, as shown.

A series of the ore gatherers, separators, and projectors are arranged at the bottom of the chamber C, and the first four openings *n'* (in the case illustrated) open into a chamber, K, below, while the last three openings *n'* enter a separate chamber, K', as shown in Fig. 4. This exact number of openings *n'* entering their respective chambers K K' may be varied, and separate chambers may be employed for each opening, if desired, so that each chamber will form a pocket to receive such metals and minerals as may be deposited therein; but for galena, free gold, free silver, and heavy sulphurets I prefer to have several openings *n'* discharging into one pocket, as shown.

The pockets or receptacles K, K', and K^2 and others, if used, should be closed at the bottom by valves—such, for instance, as those shown at L L' L^2, or others of different construction—because in separating no free-air opening should be between the interior of the separator and the outside, except at the discharge end of the machine, owing to the fact that if a free uninterrupted opening does occur the metals and sand or quartz will immediately seek it and be discharged in a mixed condition; but when the chambers K K' K^2 are kept closed, or the gate is opened sufficient to allow the concentrates caught to flow out gradually, then the separation goes on in a satisfactory manner. Again, if the chambers K connect with other chambers, as at M, having no free-air outlet, then the gates L may be freely opened and permit the concentrates to flow into the lower chamber as fast as they are formed; but when the concentrates are taken from the lower receiver or box, M, care should be exercised to prevent the whole of the concentrates from running out, unless the gate L above is temporarily closed, otherwise some sand or quartz will be deposited therein. These chambers K K' K^2 are each provided with a vertical opening at the side in which is fitted a glass or other transparent substance, to indicate when the concentrates are at their proper height to prevent an air-leak at the gate. The chambers K K' K^2 may be worked with the gates L closed until they become partially full of deposits, and then the gates may be opened until the greater portion has run out, and in case the feed has been shut off then all the deposits in the chamber may be withdrawn.

Immediately over and near the center of the chamber K^2 is a deflector, P, which is secured to the top and sides of the chamber C, either stationary or adjustable, as desired. This deflector P forms an abutment for the air-blast to strike against, and turns the blast downward into the chamber K^2, also carrying downward all particles of sand, quartz, earthy matter, and mineral which have not been caught before. The heavier particles of quartz, earthy matter, and sometimes a trace of mineral or metal, will be caught in this chamber as tailings, while the fine floury dust and mineral pass over the deflector R to the discharge end R' of the air-separator proper. The fine particles, which are discharged at R', may pass into the dust box or chamber H dry, which with many minerals, especially sulphurets, is desirable; but when free gold and silver ores or sulphates are treated, the wet process should be used, which consists of a sprinkler, S S', arranged to carry the dust downward into the water Y which has accumulated over the quicksilver G in the receptacle G' of the dust-box. Here the water becomes agitated by the force of the blast, and the fine particles of metal are forced in contact with the quicksilver and are caught thereby. The water gradually overflows and runs off at the end of the box, but any particles of gold and silver which are not caught by the quicksilver in the receptacle G' are caught on the amalgam-plates H' at the bottom of the box H, while the slime and fine sand wash off and are discharged into the sluice I.

When it becomes necessary to remove the quicksilver in the receptacle G', it is done by removing the plug G^2 and catching the quicksilver in a receptacle placed below. The quicksilver may then be squeezed and the amalgam retorted in the usual manner.

It is obvious that all apparatuses employed for the separation of the richer portions of pulverized ore from the gangue and other matter which it is not desired to work, are essentially based upon the fact of the different specific gravities of the substances to be separated. This would at first blush seem to be a simple affair, and so it would be if all the particles under treatment were of precisely the same size and shape; but this is not the case. The great variety of size and shape prior to my invention has complicated the problem and rendered the separation of the valuable portion of the ore from that which has no value very difficult, because the particles of ore which are of different specific gravities, but of actual weight, will, if of the same shape and under certain conditions, go together. Thus a small particle of metal having the same actual weight and shape as a larger particle of rock, but differing in specific weight, will in still water fall through the same distance in a given time; but in a horizontal blast of air, the larger body, presenting more surface to the action of the blast, is moved farther along while falling through the same height. Again, particles of ore which are of different specific gravities, but of actual weight and of different shapes, will in an air-blast go to a variety of distances in a curved line before coming to rest at a given fall. Thus flake metal, or that which is flat and thin, will be moved farther in a horizontal blast than the same weight of the same metal having a spherical or cubical form. Again, the fine particles of impalpable metallic dust, always produced in greater or less quantities when ore is pulverized, will naturally float along in the slightest air-current, owing to its

flaky condition. This dust is, in many instances, of great value, and is frequently lost in large quantities by the old methods of concentrating.

Before entering into a description of the operation of my new concentrator, it is deemed advisable to set forth approximately the different specific gravities of some of the elements to be encountered and separated in the concentration of argentiferous and auriferous ores. Thus, vitreous quartz has a specific gravity of 2.65, and limestone has a specific gravity from 2.721 to possible 3. The above are the two heaviest earthy elements to be contended against. Galena has a specific gravity of 7.4 to 7.6, average 7.5. Free silver has a specific gravity of 10.3 to 10.5, average 10.4, and native gold has a specific gravity of 19.20 to 19.36, average 19.30. The difference in specific gravity between galena and quartz is 4.85; between silver and quartz, 7.75, and between gold and quartz, 16.65.

The following is a description of the operation and results produced by my new separator and concentrator, based upon actual experiments with a machine having a capacity of treating two tons of galena ore per day of twenty-four hours, to wit: Galena ore, containing twenty-five per cent. galena and seventy-five per cent. of quartz, crushed and screened through a sieve of fifty meshes to the lineal inch, was placed in the hopper B, the hopper being adjusted with the point *y* of the indicator on the galena-mark of the scale Z. The blower A was then set in motion and revolved slowly. The gate E was then opened by moving the handle *w* down until the pointer *w'* indicated the opening to the passage *g* to be two-thirds open, by the scale W. The comminuted ore was thus admitted into the chamber C, not in a broad stream extending across the chamber, but through the opening *g*, which in length is about one-third, a little more or less, of the width of the chamber G. Here the stream of pulverized ore encounters the blast from the blower, and the sand and lighter particles of metal are blown forward, while the heaviest cubes of galena, as they drop, pass through the first opening *n* in the bottom of the chamber C, in the direction of the arrow *i*, into the chamber or pocket K below. If any large particles of quartz fall in front of the first ore gatherer, separator, and projector F, it is drawn toward the center by the curve-trough face *p p*, and is blown upward by the blast, in the direction of the arrow *r*, into the main chamber C. The next size particles of galena pass through the second hole *n'*, the next size through the third hole *n'*, and the next through the last hole *n'*, into the chamber K below, the quartz being reprojected upward centrally into the chamber C, together with such particles of flake or floury galena as have not sufficient shape and specific weight to cause them to fall through the first four holes into the chamber K. The galena deposited in the chamber K through the first four holes *n n'*, at the base of the gatherers, separators, and projectors F, was pure galena, with no traces of quartz; but the sizes and shapes of the particles of galena so collected were various. The last three holes *n'*, which discharge into the chamber or pocket K', permit a mixture of large particles of quartz and smaller particles of galena to pass. This compound is a very rich concentrate, at least two-thirds of the mass being galena. The last pocket, K^2, catches a majority of the pulverized quartz and shows a trace of the fine dust of galena, all of which dust is readily separated from the tailings by screens or bolts, having meshes fine enough to prevent the quartz from passing through, which was demonstrated to be a fact, by placing the tailings into a silk handkerchief and dusting out the fine floury galena, leaving the quartz in the handkerchief without a trace of galena. There will be a small quantity of the fine galena-dust which will pass over the deflector R, and this is collected in the dust-chamber H. With galena, however, if water is employed through the pipe and sprinkler S S', the quicksilver in the tank G may be dispensed with and the tank filled with water, when the galena-dust and fine quartz are blown into the water in the tank G. The metalliferous portion settles immediately to the bottom, while the sand and dirt pass off with the overflow. The water principle, however, may be dispensed with in treating galena and other sulphurets, if desired, and the fine dust may be collected in the chamber H dry and afterward quickly and easily separated by suitable screens or bolts.

In the treatment of free gold-ores the hopper B is adjusted so as to discharge almost directly over the first opening, *n*, into the pocket K. The action of the air-blast is precisely the same as for galena, and the results produced are the same—that is, the coarser particles of gold pass through the first hole *n*, the next heaviest through the next hole, until the separation is complete—nothing in the shape of gold except the finest flour or flake gold passing over the stop R, and such particles of fine gold as do pass the stop R are caught in the quicksilver G in the tank G' below, while the quartz or other earthy matter passes off with the overflow into the sluice I.

The floor of the dust-box H, between the tank G' and end of said box, is slightly inclined and provided with amalgam-plates H', for catching any fine gold which may be forced along with the water Y.

It will be observed that the blast and ore to be treated at first pass through the space between the tops of the parts F and the top and sides of the chamber C, and after passing through this small space the size of the air-passage is increased, so as to reduce the force of the blast after the metalliferous portion of the ore has been graded in size and separated from the rock. This increase in size of the discharge end of the machine may be

of any size desired. The larger it is the less action the wind has on anything which may pass through it.

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

1. The longitudinally adjustable hopper D, combined with the slide-plates *c* and *d*, having discharge-opening *g* through them, and the chamber C, having in its top an oblong opening or hole, *s*, for the lower end of the hopper to be adjusted either forward or backward, substantially as and for the purpose specified.

2. The ore gathering, separating, and projecting device F, with concave inclined front, substantially as shown and described.

3. The ore gathering, separating, and projecting device F, with concave inclined front *p p* and angular back *p'*, substantially as shown and described.

4. A series of ore gathering, separating, and projecting devices, F, having concave inclined fronts and angular backs *p'*, and discharge-openings *n n'* at their bases, combined with the chamber C above and chambers K below, substantially as and for the purpose specified.

5. A series of ore gatherers, separators, and projectors, F, having inclined concaved fronts with holes *n n'* at their bases, combined with the chambers K below, substantially as and for the purpose specified.

6. The chamber C, having a series of ore gatherers, separators, and projectors, F, with concaved inclined fronts, and provided at its rear end with a stationary vertical deflector, R, substantially as and for the purpose specified.

7. In an air-blast apparatus for separating ores, the dust-box H, provided with a tank, G', under the discharge end R' of the separator for holding quicksilver or water, combined with the discharge end R' of the separator, substantially as and for the purposes specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ERASTUS O. FRINK.

Witnesses:
GEORGE H. RENNETT,
L. L. FORD.