(No Model.) 4 Sheets—Sheet 1

W. L. CARD.

GOLD SEPARATOR.

No. 347,867. Patented Aug. 24, 1886.

Fig. 1.

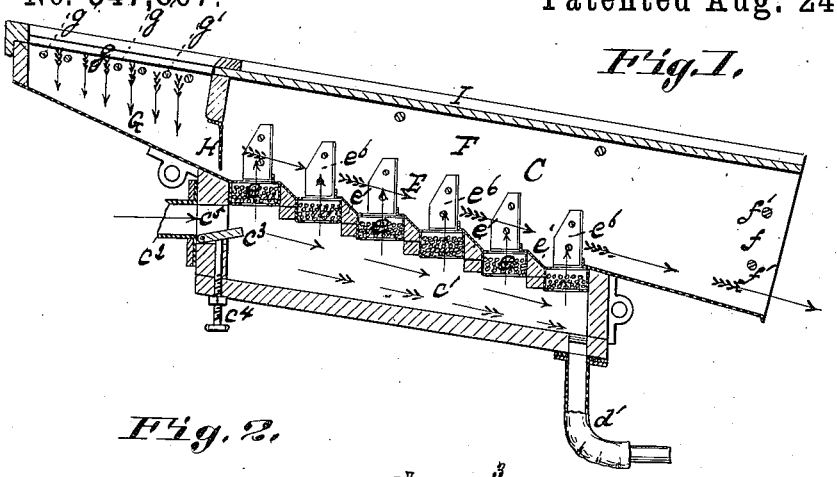


Fig. 2.

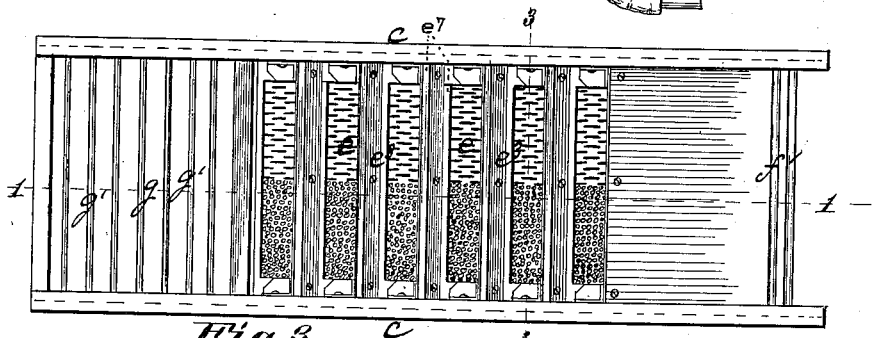


Fig. 3.

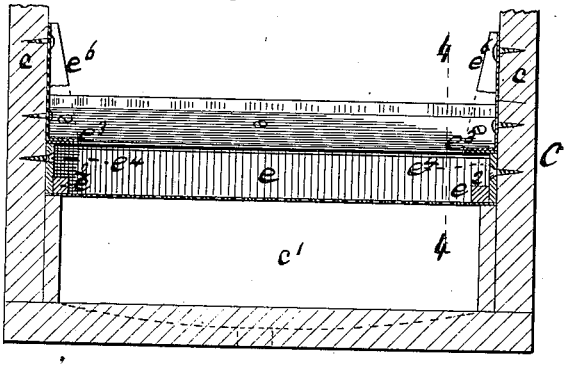


Fig. 4.

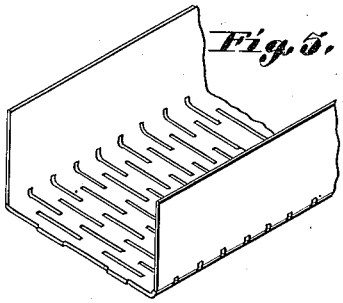
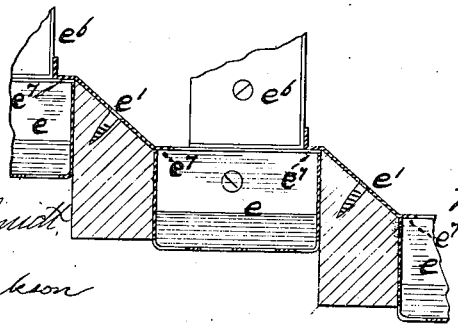


Fig. 5.



Attest:

G. A. Taubenschmidt

Edwin D. Clarkson

Inventor:

William L. Card

by F. W. Ritter Jr

atty

(No Model.) 4 Sheets—Sheet 2.

W. L. CARD.

GOLD SEPARATOR.

No. 347,867. Patented Aug. 24, 1886.

Fig. 6.

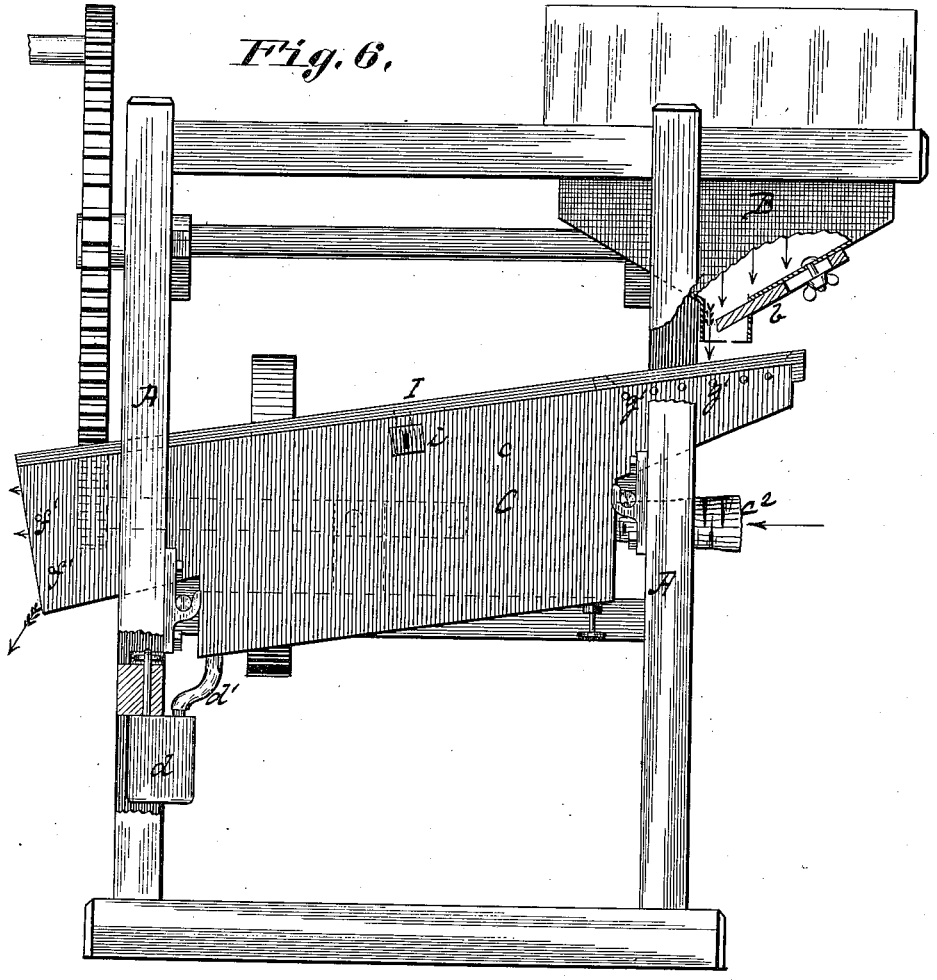
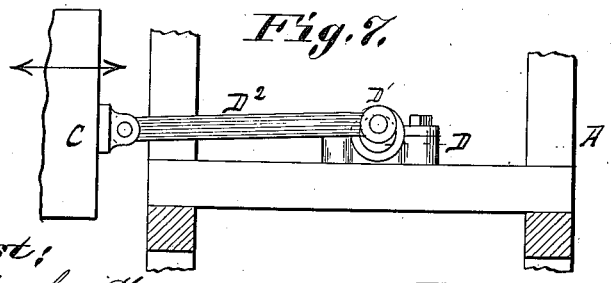


Fig. 7.



Attest:
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(No Model.) 4 Sheets—Sheet 3.

W. L. CARD.

GOLD SEPARATOR.

No. 347,867. Patented Aug. 24, 1886.

Fig. 8.

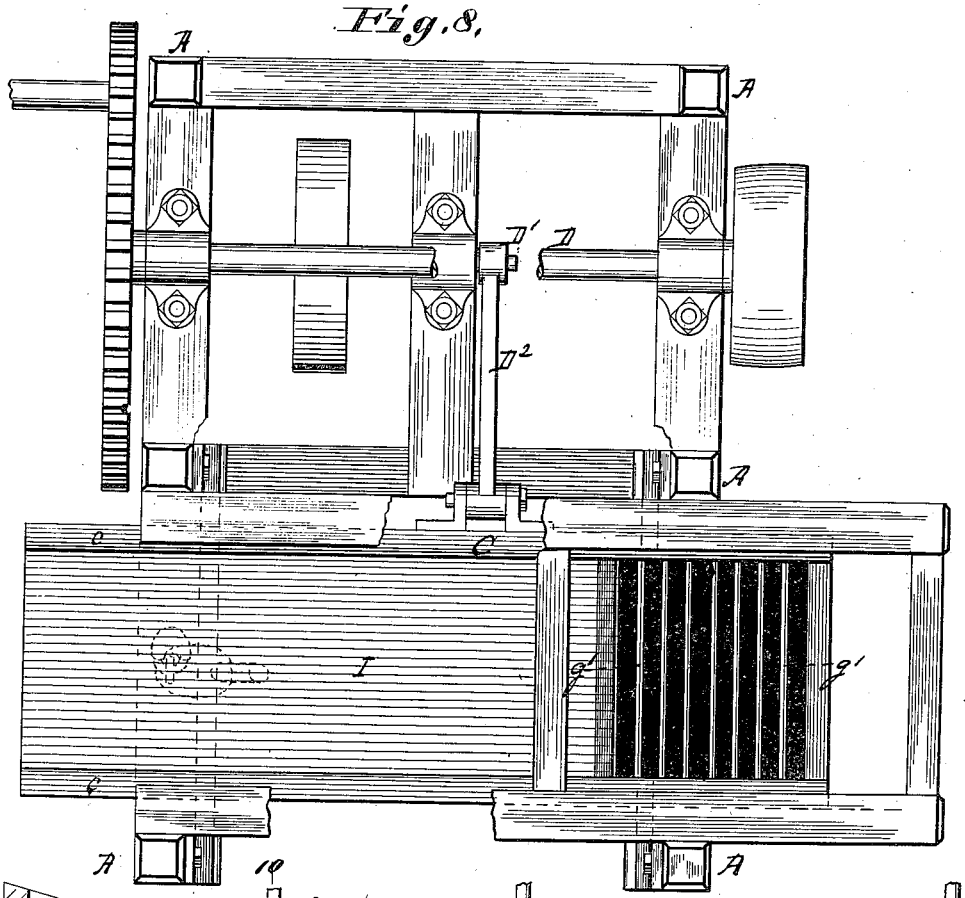


Fig. 9.

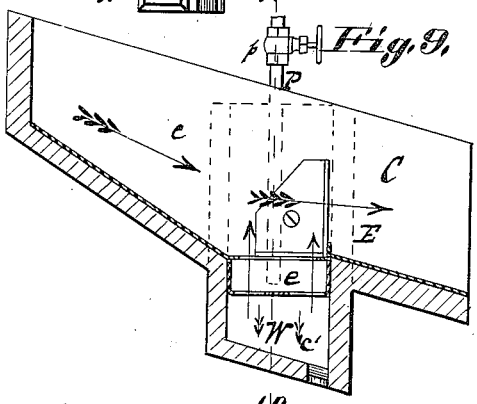
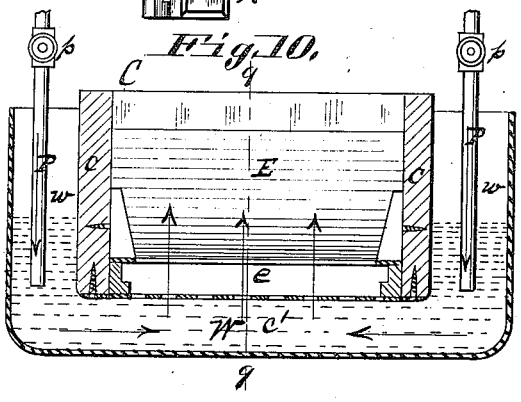


Fig. 10.



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J. A. Taubenschmidt,
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(No Model.) 4 Sheets—Sheet 4.

W. L. CARD.

GOLD SEPARATOR.

No. 347,867. Patented Aug. 24, 1886.

Fig. 11.

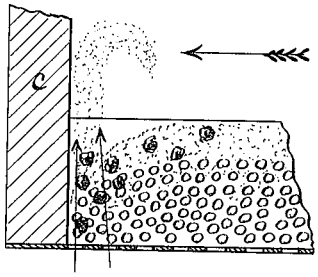


Fig. 12.

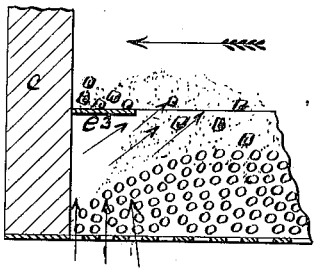


Fig. 13.

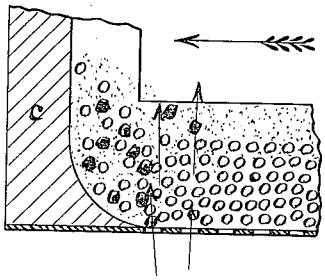


Fig. 14.

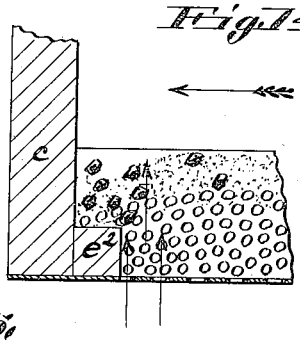


Fig. 15.

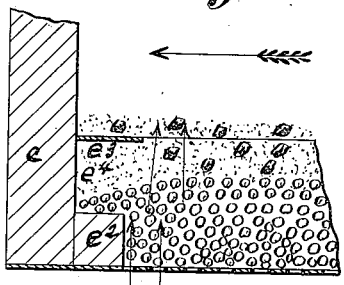


Fig. 16

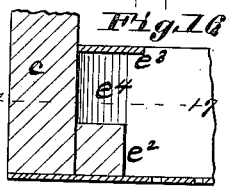
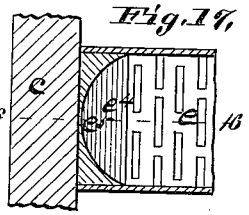


Fig. 17.



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Edwin S. Clarkson

Inventor:

William L. Card

by F. W. Ritter Jr

atty

UNITED STATES PATENT OFFICE.

WILLIAM L. CARD, OF LA CROSSE, WISCONSIN, ASSIGNOR TO THE TIERRA SECA MINING COMPANY.

GOLD-SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 347,867, dated August 24, 1886.

Application filed March 26, 1886. Serial No. 196,732. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM L. CARD, a citizen of the United States, residing at La Crosse, in the county of La Crosse and State of Wisconsin, have invented certain new and useful Improvements in Gold-Separators; and I hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, wherein—

Figure 1 is a longitudinal vertical section of a machine embodying my invention on the line 1 1, Fig. 2. Fig. 2 is a top view of the same, the dust slide or cover being removed to show the interior. Fig. 3 is a transverse section on the line 3 3, Fig. 2. Fig. 4 is a vertical section on the line 4 4, Fig. 3, giving an enlarged transverse view of the pockets of the separator. Fig. 5 is a perspective view of a portion of one of the perforated steel plates for forming the pockets. Fig. 6 is a side elevation of the same. Fig. 7 is a detail showing the means for imparting a lateral vibratory movement to the separator or pocket-chamber. Fig. 8 is a top or plan view of the machine, the hopper, which is shown in Fig. 6, being omitted. Fig. 9 is a longitudinal section of a modification, adapting the separator to use water instead of air. Fig. 10 is a transverse section of the same on the line 10 10, Fig. 9. Figs. 11 and 13 show previous constructions of perforated pockets which have proved defective. Figs. 12 and 14 show steps of the construction devised by me to overcome the deficiencies of the pockets shown in Figs. 11 and 13. Figs. 15, 16, and 17 show the perfected and preferred forms of pockets.

Like letters refer to like parts wherever they occur.

My present invention relates to the construction and operation of gravity-separators for recovering or obtaining the precious metals from their earthy matrices.

In order that the objects and operation of my invention may be more fully comprehended and appreciated, it will be desirable to briefly review the prior state of the art and consider in a general way the existing difficulties and disadvantages, as well as their causes.

The most common processes are the amalgamating, the wet, and the dry processes. In the first or amalgamating process mercury or quicksilver is employed to receive and retain the precious metal, which sinks therein by gravity, or is taken up by the quicksilver while the gangue is floated off. No process has, so far as I am aware, ever been devised for the successful employment of a dry amalgamation process, first, because when the mercury is exposed to the air its surface at once becomes coated with a thin gray film of oxide, which prevents amalgamation, and, secondly, because of the loss of large quantities of floured mercury. This process also demands the use of large quantities of quicksilver not readily obtained and the subsequent treatment of the amalgam to separate the metal and recover the mercury. In the second or wet process, of which the pan and cradle are types, what are termed "jiggers" are most commonly employed to economize water, which is scarce and difficult to procure in many localities. The jigger operates by causing the pulsation of water through a perforated trough or screen, so as to permit the heavier precious metal to be concentrated or sink through the screen into the trough or water-box, while the matrix passes off the screen out of the machine. In the third or dry process an air-blast is substituted for water to produce the pulsations which shall cause the separation of the metal and matrix and permit the heavier precious metal to fall through the screen or separator into the air-box, while the earthy matter or gangue passes off of the screen, as in the wet process. The change from water to air as a medium for causing the pulsations necessitates other changes well known and not necessary to mention here. The sieve or perforated table alone being inefficient, as early as 1860 a stratum of fine gravel or like material, the gravity of which should be less than the heaviest material which was to pass through sieve and greater than the matrix or gangue, was placed on the sieve to act as valves, retard the downflow of the water, and allow of time for the separation of the metal and matrix by the action of gravity.

The varied character of the matrix and condition of the precious metal are well understood. For instance, the precious metal may

be present in the condition of flour, scale, flake, shot, nugget, or common gold-dust in matrices of clay, sand, adobe clay, gravel, decomposed rock, and earthy matter, hard-pan, black sand, iron pyrites, slate, &c., or in any conceivable mixture of any or all of these. It is also well understood that the force of the downward movement of the particles under treatment will under these circumstances vary according to their volumes or according to the cubes of their relative dimensions, while the resistance will vary as their exposed surfaces or the squares of their dimensions. It will therefore be apparent that the only manner by which the present separators or concentrators can be made to operate is by using such an impulse or upward blast as will permit the very finest gold to fall, and by allowing all the precious metal to pass through the sieve or perforated bed into the air or water box, and if this is done then much of the matrix will also follow. Besides, the machine is necessarily so exposed that it can be readily robbed by the workmen. Again, if the material operated on becomes packed or unevenly distributed over the sieve or perforated bed, it follows that the resistance to the upward flow of the air or water is irregular in its force, so that the separation must necessarily be irregular and imperfect, and at times the fine gold may be floated off with the gangue or earthy matter.

From the above and other causes well understood by the skilled operator the larger part of the present known separators have proved failures, while none yet devised meet the requirements of the art or can be economically employed.

The object of the present invention is to overcome the several disadvantages hereinbefore specified, and provide means adapted to separate and retain all or substantially all the precious metal without regard to its character or condition or the nature of the matrix.

As a result of long and careful experiments and observation, I have discovered that in order to make a separator thorough and effective, and accomplish the objects set forth above, the following conditions must be created and maintained:

First. There must be interposed between the medium which gives the impulse (whether the same be air or water) and the material to be separated (or precious metal and its matrix) a mobile permeable mass or strata, which will not only permit the passage of the air or fluid, but will receive and retain the precious metal. For this purpose any loose material—such as fine, heavy, sifted, and sized gravel or shot, or any like material which is substantially lighter than gold and heavier than the matrix or earthy matter—may be used, and for this purpose I have found that copper shot is the best, first, because of its relative specific gravity; and, secondly, because it is less liable to deface the gold and is more durable than lead shot, which is my second choice.

Second. The interposed mobile permeable mass must be maintained of uniform depth or thickness throughout, in order to maintain uniformity of operation and effectiveness.

Third. The size of its individual particles must be regulated according to the resistance to passage of blast or water required, the coarser the material the less the resistance, and vice versa.

Fourth. The resistance to the upward passage of the air (or water) must be greater in the interstices of the interposed permeable mass (ore-bed) than in its passage through the stratum of earth under treatment.

I will now proceed to describe more specifically the best means known to me for carrying out my invention in order that others skilled in the art to which it appertains may apply the same.

In the drawings, A indicates a frame-work adapted to support the hopper B, the separator C, and suitable mechanism for vibrating the separator C.

The hopper B, in the present instance, is provided with a gate or slide, *b*, and the mechanism shown for vibrating or rocking the separator consists of the shaft D, with crank-pin D′ and link-rod D² pivoted to the separator C, so as to vibrate the separator laterally instead of longitudinally, as usual. The special construction of the aforesaid devices is, however, immaterial, as they form no part of the present invention, and may be of any desired character.

The gist of the present invention lies in the construction and operation of the separator C.

c indicates the side walls of the separator; E, the ore-bed, and *c′* the (air or water) chamber below the ore-bed.

The ore-bed E is preferably formed of a series of pockets, *e*, arranged close together in step form, or one slightly lower than the other, to form an incline which facilitates the discharge of the refuse earthy matter or gangue, said pockets being separated by inclines *e′*, which materially assist the precipitation, loosen up the earthy matter, and increase the capacity of the machine for handling the dirt. The inclines or inclined tables *e′* are preferably about the width of the pockets, though they may be narrower, their value being measurably proportioned to their width. The alternate pockets *e* and inclines *e′* divide the bed up into portions where the material is subjected to vibration only, and portions where it is subjected to vibration and air or water currents; consequently the fine gold has a chance to gravitate or sink more rapidly than the lighter fine particles of matrix while passing over the inclines, and as a consequence the fine gold will more readily remain in the pocket, while the fine matrix, being acted upon by the current, will pass or flow toward the tail of the separator. These pockets *e*, which extend transversely of the machine, have pervious bottoms, to permit the upward flow of a current of air or water from the chamber *c′*, and are preferably constructed from slotted

steel plates, as shown in Fig. 5, but may be of wire netting or gauze or any suitable pervious material. At each end of the pocket *e* is provided a dead-plate or dead-block, e^2, to prevent the current from chamber *c'* crossing the ends of the pockets *e*, (see Fig. 14,) and this or equivalent construction should be adopted in order to confine the current to such portions of the pocket as present an ore-bed of uniform depth and resistance to the current. In order to make this feature more apparent, Figs. 11 and 12 have been added to the drawings, showing prior forms, and it will be at once apparent that the vibrations of the ore-bed will disturb the resisting strata so much at the ends of the pocket that the current, meeting less resistance and having greater velocity or force, will carry up and off the finer particles of the metal and matrix. To obtain the best results it is desirable to provide an upper dead-plate or flange, e^3, at or near the top of each and of the pocket *e* or ore-bed, (see Fig. 15,) to form a blind-pocket, e^4, which may be rounded out, as at e^5, if desired, (see Figs. 16 and 17,) and said dead-plate or flange e^3 may extend entirely around the pocket *e*, (see Figs. 2, 3, and 4,) or, in other words, the pocket may have a dead-plate, not only at the ends, as shown at e^3, Fig. 3, but also on both sides of the pockets, as shown at e^7, Fig. 4.

It will be evident that if the above or equivalent construction is adopted that the strata or ore-bed through which the current passes must remain uniform throughout its extent, notwithstanding the vibration of the ore-bed. This, however, will not necessarily be the result when the upper dead-plate or flange, e^3, is used alone or without an equivalent for dead block e^2, as will appear on reference to Fig. 12, which, as stated, has been introduced for purposes of illustration.

Just over the ore-bed, opposite the ends of each pocket *e*, are placed angle-irons or deflectors e^6, which turn or direct the earth under treatment from the dead-plate e^3, and side walls over or back on the operative face of the ore-bed, so that none of the earth shall pass the bed without thorough treatment.

Having specified the preferred construction for the bed-pockets, it next becomes necessary to specify the character of the ore-bed. As hereinbefore stated, any loose material of uniform size, of specific gravity intermediate between the precious metal and matrix, and of a size which will afford a resistance to the air or water current greater than the resistance of the matter to be treated, may be employed to fill the pockets *e* and form the ore-bed; but I prefer copper shot for the following reasons: It is hard and durable, and will not deface the gold, (as would lead shot,) can be obtained and will remain of uniform size and of any desired size, and its gravity with relation to the usual matrix is as eight to two, and with relation to the gold as eight to nineteen, which admirably fits it for the purpose. With one of the materials specified, or any other of like character, the pockets *e* are filled to constitute the ore-bed which is to receive and retain the precious metal, and the size of said material is adapted to the resistance of the passage of the current desired in the ore-bed. Beneath the ore-bed is the chamber *c'*, which will be either an air or water chamber, according as the upward current through the ore-bed is to be air or water. Of course air is preferred, as water is not always obtainable in the quantities desired, and in such case the chamber C is provided with a valved port, c^5, from which a flexible conduit, c^2, leads to a suitable fan or blower for creating an air-blast.

c^3 indicates a valve arranged in the port c^5, and operated by a screw, c^4, or its equivalent, whereby the size of port c^5 may be varied to obtain the desired volume and pressure of the air-current. By means of this valve and the selected material for the ore bed the force of the current of air may be regulated exactly.

d indicates a small safe or strong box, (which should be locked,) connected with the lowest part of the chamber by a suitable flexible pipe, *d'*, though, if desired, the box *d* may be secured directly to the floor of chamber *c'*.

As before stated, almost all, if not all, the gold will will be retained in the ore-bed, and its only in extraordinary cases that the gold will be fine enough to sift into the air-chamber; but, as it is possible for a small percentage of the whole product to be fine enough to sift into the chamber *c'*, I have provided a means for securing it against interference from the workmen.

Where water is available, and it is desirable to use it instead of a blast, each pocket *e* may have its individual well W, (see Figs. 9 and 10,) which extends upon each side of the ore-bed E, as at *w*, and is supplied by a flexible pipe, P, having a valve, *p*—a pipe on each side—by which means the vibration of the ore-bed will not interfere with the steady constant flow of the current, so desirable in this class of machines. The lower ends of the flexible pipes P are submerged in the water of the side chambers, *w*, to prevent the formation of air-bubbles, which, if driven down under and permitted to rise through the ore-bed and earthy matter, would seriously interfere with the successful operation of the machine.

F indicates the dust-chamber above the ore-bed; *f*, the discharge thereof, whence the gangue or refuse escapes; G', the receiving-table which receives the material to be treated in a pulverized condition from the hopper B, which is placed over the feed-opening *g* of the separator; and H indicates a pendent diaphragm which separates the receiving-table G from the dust-chamber F, and tends to prevent the escape of dust and air at the head of the separator.

As before specified, one important feature in

any desirable machine must be such a construction as will prevent the machine from being robbed. For any fine dust which will sift through the ore-bed, I have provided the strong box *d;* but as substantially all of the valuable matter is retained in the ore-bed, (from which it is taken in cleaning up,) it is necessary to guard this ore-bed E, which is done as follows: The feed-opening *g* is guarded by a series of rods or bars, *g'*, and the discharge end *f* is likewise guarded by a series of rods or bars, *f'*, at such distances apart that while not interferring with the work of the machine they will, nevertheless, prevent the introduction of the hand or any instrument, by means of which the ore-bed F could be tampered with. These bars or rods *g' f''* will also serve to brace and strengthen the separator without materially adding to its weight or cost of construction.

In order to obtain access to the ore bed legitimately, the cover I of the dust-chamber F is arranged as a slide, cut away at the feed-opening *g*, and secured by a lock, *i*. Fig. 6; or any equivalent well-known means of removably securing the dust-cover may be adopted.

If the separator is tampered with, the gold can only be obtained by removing the shot or loose material which fills the pocket, and if this is removed the pockets cannot be properly refilled until the locked sliding cover is removed to expose the separator-pockets fully, consequently any tampering with the machine will be positively detected

Having now pointed out the preferred construction, I will describe the manner in which I operate the machine.

The pockets *e* having been filled with material of the character and relative specific gravity hereinbefore specified, and of a size adapted to offer the specified resistance to the passage of the air or water current, or, in other words, the ore-bed E being properly prepared, the valve (*c*³ or *p*, as the case may be,) is adjusted to obtain a current of the volume and pressure best adapted to the material under treatment. The said material, in a pulverized condition, is then fed from the hopper B, through feed-opening *g*, upon the table G. The separator C will have a lateral vibration imparted to it from shaft D and crank-pin D' through link or rod D², or in any other suitable manner. The vibration of the separator C will cause the material under treatment to pass under diphragm H and flow in a thin sheet or stratum over ore-bed E, where it meets the current of air or water flowing up through the ore-bed, and as the resistance is less in the strata of earth than it is in the bed, the earth strata will be so agitated that the separation of the precious metal from the matrix will take place above the ore-bed, and the precious metal will by gravity sink into the ore-bed and be retained therein, allowing the gangue or refuse to flow freely from the bed and out at the discharge *f* of the separator. The lateral vibration of the separator causes the intestine movement in the material in the pockets or ore-bed, and this favors the descent to the bottom of the pockets of the finer particles of precious metal, and thus effectually prevents loss by the same being carried off in the gangue. The lateral vibration of the separator, combined with the upflow of the air divided into minute jets by the ore bed through which it passes, tend not only to lift the material and overcome its specific gravity, but also to divide particle from particle, thus reducing the whole mass into the most favorable condition for permitting the component parts to arrange themselves according to their respective specific gravities. In other words, an artificial quicksand is produced. Only the very finest dust can possibly sift into the chamber *c'*, and this, which is a very small per cent. of the yield, will collect in the safe or strong box *d*, as before specified. On reference to Figs. 11 to 17 the value of the dead-block *e*² and dead-plate *e*³ will be more apparent than at first. The bulk, or substantially all, of the yield will be retained in the ore-bed, so that there is a resemblance to the amalgamating process. At the close of work the separator C may be detached from the frame, the slide I or dust-chamber cover unlocked and removed for "cleaning up," and all the precious metal recovered from the bed material, after which the material may be replaced in the pockets, and the dust-chamber cover I replaced and locked.

It is evident that copper shot will, if used as material for the ore-bed, greatly facilitate cleaning up, as an incline can be used to separate the round shot from the dust, scale, and other irregular forms of precious metal. It is also evident that the proper preparation of the ore bed E or distribution of the shot or like material in pockets *e* necessitates unobstructed access to the ore-bed, and therefore the ore-bed cannot be tampered with by the workmen without being at once discovered.

Among the advantages of my present invention are the thorough manner in which the machine is protected against robbery; the effective manner in which the volume and force of the current through the machine can be controlled; the perfect manner in which the uniform depth of the ore-bed and the force of its resistance to the current can be maintained; and, finally, the capacity of the machine to recover all grades or sizes of the precious metal, and from any or all kinds of matrix, no matter how widely these may vary in the material under treatment.

I do not herein claim the method set forth and involved, as the same forms the subject-matter of a separate application of even date herewith, Serial No. 196,734.

I am aware that in saving gold by amalgamation, amalgamated copper cylinders and balls have been used to facilitate the coating of the gold with mercury, and do not herein

claim copper balls, &c., when amalgamated and so used, as the amalgamation of the copper or other metal ball would render it in a great measure unfitted for use in my machine. My reason for using copper shot is because the gravity of the copper shot comes nearest to equally dividing the difference in gravity between gold and its matrix.

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

1. In a separator, an ore-bed composed of a series of pockets separated by inclines, substantially as and for the purposes specified.

2. In a separator, a series of pockets containing loose material forming an ore-bed and provided with dead-blocks arranged to deflect the current from the sides of the bed or ends of its pockets, substantially as and for the purposes specified.

3. In a separator, a series of pockets containing loose material forming an ore-bed, and provided with dead-blocks at the bottom and dead-plates at the top of the bed, arranged to form blind-pockets, which confine the material and prevent the passage of currents, substantially as and for the purposes specified.

4. In a separator, an ore-bed pocket having a pervious bottom, dead-blocks at its ends, and deflectors arranged above the dead-blocks, substantially as and for the purposes specified.

5. A separator-pocket for an ore-bed, said pocket having a dead-block at each end near the bottom, and a dead plate or flange extending around the pocket at or near the level or top surface of the ore-bed, substantially as and for the purposes specified.

6. In an ore-separator, the combination, with an ore-bed, of a series of rods or bars for guarding the feed and discharge orifices of the separator, and a locked cover for closing the chamber over the ore-bed, substantially as and for the purposes specified.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM L. CARD.

Witnesses:
ALBERT BLAIR,
GEO. WALKER.