(No Model.) 2 Sheets—Sheet 1.

H. P. FAIRFIELD & L. A. SHEAD.

ORE SEPARATOR.

No. 295,992. Patented Apr. 1, 1884.

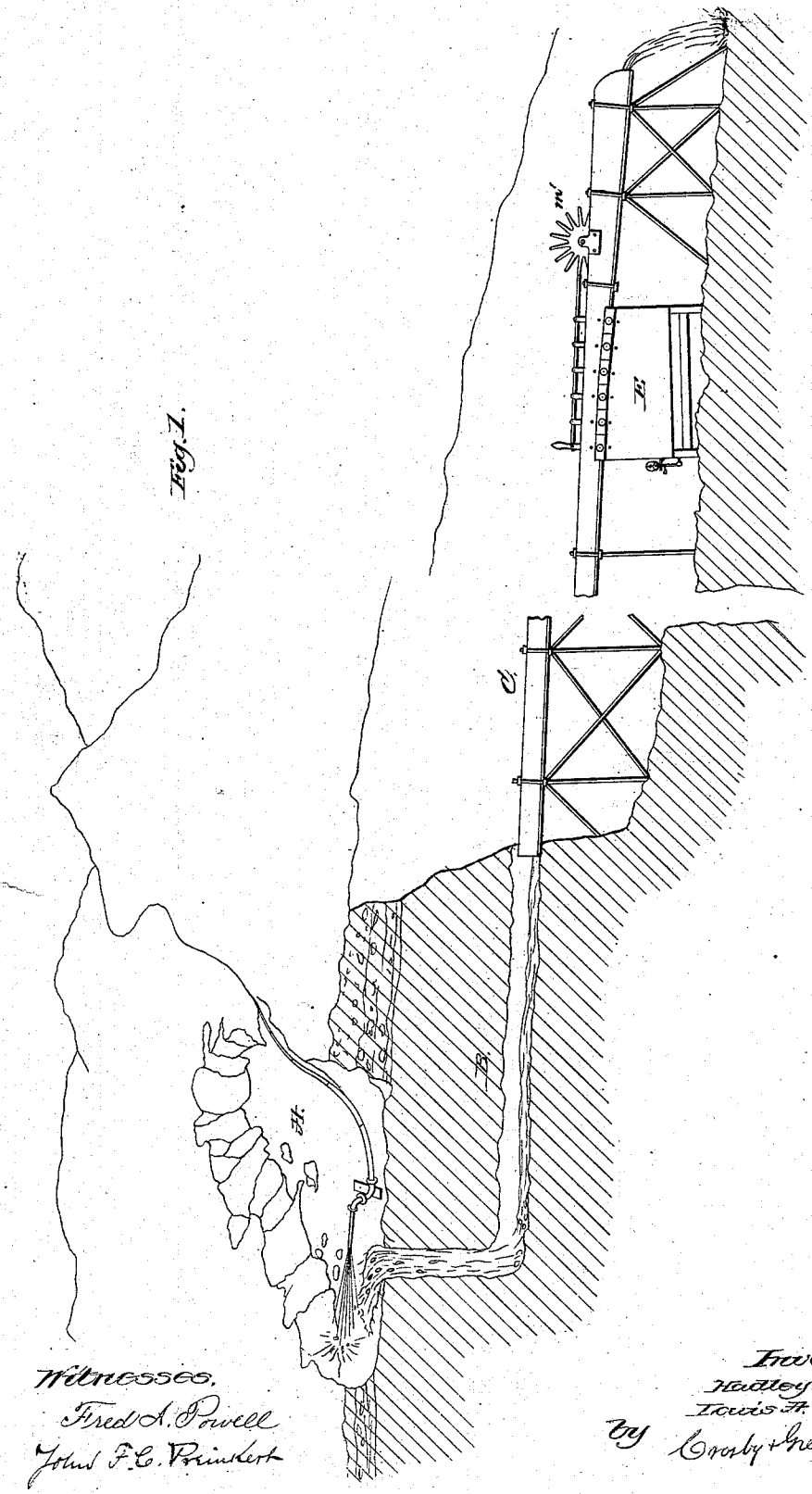


Fig. 1.

Witnesses.
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John F. C. Brinkerhoff

Inventors.
Hadley P. Fairfield and
Louis A. Shead.
by Crosby & Gregory attys.

N. PETERS. Photo-Lithographer, Washington, D. C.

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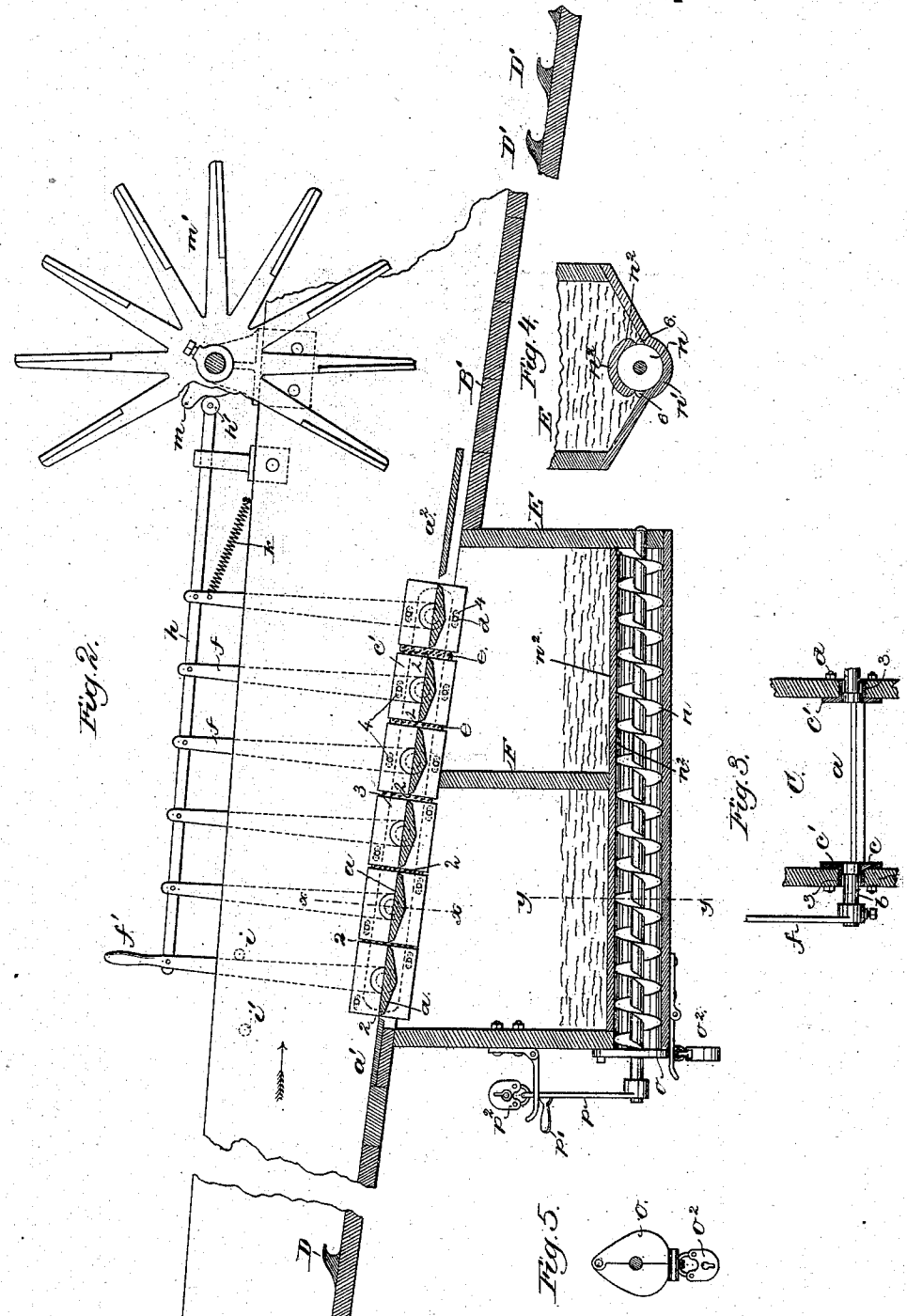


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Witnesses.
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UNITED STATES PATENT OFFICE.

HADLEY P. FAIRFIELD, OF WEST MEDFORD, MASS., AND LOUIS A. SHEAD, OF ALAMEDA, CAL., ASSIGNORS TO GORDON McKAY, TRUSTEE.

ORE-SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 295,992, dated April 1, 1884.

Application filed May 10, 1883. (No model.)

To all whom it may concern:

Be it known that we, HADLEY P. FAIRFIELD, of West Medford, county of Middlesex, State of Massachusetts, and LOUIS A. SHEAD, of Alameda, county of Alameda, State of California, have invented an Improvement in Ore-Separators, of which the following description, in connection with the accompanying drawings, is a specification.

The same letters of reference represent the same parts of the invention in the drawings.

Our invention relates to that class of ore-separators in which materials of different specific gravities are acted upon by a running stream flowing through a sluice or conduit.

Sluices have been made having their bottoms provided with narrow transverse slits, through which a portion of the valuable material of high specific gravity fell into a receptacle placed beneath the sluice to receive it, the said portion of valuable material being thus separated from the lighter worthless material, which was carried on over the slits with the stream; but in no such apparatus heretofore invented, so far as we are aware, was it possible to separate all, or even a large proportion, of the valuable from the worthless material. In our apparatus the bottom of the sluice is provided with narrow transverse slits of different widths, varying (as hereinafter described) from perhaps about one one-hundredth to one-sixteenth of an inch or more, whereby almost the whole of the valuable material may be saved in a highly concentrated state, the finer particles passing through the narrower slits and the coarser particles through the wider slits. In such a sluice, if the materials are caused to pass along the bottom of the sluice in a layer so thin as to be practically without ripples, the separation is much more readily accomplished. In order to permit the finest particles of heavy material to drop through the narrowest slits, instead of being swept over them, the stream is caused to pass very slowly over the said slits, the velocity, however, being sufficient to sweep the equally fine but lighter worthless particles over the said slits; and in order to have the larger particles of different specific gravity properly separated at the wider slits, the stream has imparted to it a greater velocity, causing it to operate in a similar manner—namely, sweeping the lighter ones over the slits and permitting the heavy ones to pass through. This variable velocity may be produced, as shown in the drawings, by making the bottom of the sluice of variable inclination, and we purpose to so proportion the velocity of the stream to the width of the slits that each width shall be washed by that velocity of stream which shall most effectually operate to separate the heavier from the lighter particles of a given size, and to provide for every given velocity of current a sufficient number of slits of a width adapted to said velocity to save all of the heavy valuable material of that size. For preventing the slits from becoming clogged by grains of such form as may enter but not pass through them, means are provided operating to push back such grains from beneath—that is, in the direction from which they entered. This is accomplished in this instance by making the parts of the bottom in which the slits are formed in movable portions, which are agitated from time to time to dislodge such grains as may have become wedged in between the edges of the slits. The operation of clearing the slits is performed by mechanism wholly outside of the stream flowing through the sluice, and consequently not disturbing the said stream, and itself not being exposed to the wearing effects of the said stream, or endangered by the heavy masses of rock carried by it.

The invention, to these several ends, consists in various details of construction, hereinafter specified and claimed, whereby the width of the slits may be adjusted and the movable bottom operated automatically to keep the slits clean; and also in the construction of the receptacle for the valuable material or concentrate, and means for ejecting its contents, and for preventing unauthorized persons from tampering with the said receptacle.

Figure 1 represents a portion of a mine having a bed-rock tunnel and a sluice leading therefrom, provided with an ore-separating apparatus embodying this invention; Fig. 2, a longitudinal section of the separating apparatus on a larger scale; Fig. 3, a partial transverse section on line *x x*, Fig. 2; Fig. 4,

a partial transverse section on line *y y*, Fig. 2; and Fig. 5, a detail of the device for closing and securing the discharging-passage of the receptacle for the concentrate.

The apparatus forming the subject of the present invention is shown in Fig. 1 as used in connection with a hydraulic mine, A, in which the gold-bearing deposits are disintegrated by the action of a powerful jet of water, and carried by the stream of water through a tunnel, B, cut in the bed-rock. The stream on issuing from the tunnel passes through a sluice, C, provided with the usual riffles, (see Fig. 2,) in which the larger-sized particles of valuable material collect in the usual manner, the stream being also passed through suitable gratings or grizzlies, in order to remove the larger rocks and coarse worthless gravel. When material is treated in this manner, there is usually a considerable quantity of valuable material which passes by the riffles D and is lost; and in order to prevent such waste, and to effectually separate all the heavier valuable materials from the lighter worthless materials, the stream is passed through a portion of the sluice, the bottom of which is composed of a series of transverse pieces or plates, *a*, having small open slits 2 between them. The said slits at the higher end or farther up the stream are narrower, and those lower down of increasing width, the actual width varying in accordance with the nature of the material being treated, but usually being from about one one-hundredth of an inch to perhaps one-sixteenth of an inch, more or less. The stream, with the materials therein, may be further passed over another set of the usual riffles, D′, arranged at the lower end of the sluice, to collect any valuable particles which might have passed the riffles D and slits 2.

Transverse slits have been used in ore-separators previous to this invention, and are not in themselves claimed as a part of this invention; and in considering any one of the said slits it is possible that its operation upon certain portions of the material passing over it is substantially the same as in apparatus before employed, permitting heavier valuable particles to pass through the said slits, while the lighter worthless particles are swept over them by the stream.

In practicing our invention the sluice is made of such width and inclination, as it approaches the portion provided with the slits, that the stream sweeps the material over the said slits with a comparatively small velocity, and the materials carried by the stream are so distributed as to pass along the bottom in a thin layer without tumbling one over the other, and upon arriving at the uppermost narrowest slits the finest material of comparatively high specific gravity will pass through the said slits, while the equally fine material of lower specific gravity is carried along with nearly the same speed as the water and will be swept over the said slits, which thus operate to separate the fine and heavy from the light material, while the coarse materials are too large to pass through the said narrow slits. As the stream passes on toward the lower and wider slits, it has imparted to it a greater velocity by making the inclination of the bottom steeper, and in this manner the larger particles, which are of too great size to have passed through the upper narrow slits, are acted upon in a similar manner at the wider slits—viz., the heavier materials dropping through the said slits—while the lighter materials of the same size and smaller are swept over the said slits by the force of the stream, and thus at each slit a portion of the material the particles of which are of a size proportioned to the size of said slit is acted upon, the heavy particles of that size passing through, while the lighter particles pass over. The actual variation in pitch or inclination of the bottom of the sluice is quite small, so that it is hardly perceptible to the eye in a drawing made to scale, as shown in Fig. 2, and it is shown somewhat exaggerated in Fig. 1.

In order to prevent the slit 2 from being clogged by intruding material too large to pass through, we have provided mechanism for operating the plates for dislodging the particles or clearing the slits; and in order to protect the mechanism by which the cleaning operation is performed from being broken or displaced, or itself clogged by the gravel or stones which may pass down through the sluice C, we have placed the said mechanism entirely outside of the stream flowing through the said sluice.

As shown in this instance of our invention, the portions *a* of the bottom, the edges of which constitute the sides of the slits, are made movable, they being in this instance pivoted upon arbors *b*, turning on bearing-blocks *c*, having flanges *c′* resting against and secured to the face of the side walls of the sluice C, while the said arbors *b* pass out through longitudinal slots 3 in the sides of the sluice. The said bearing-blocks *c c′* are fixed upon the sides of the sluice by bolts *d*, the shanks of which pass through slots 4 in the sides of the sluice, or in the flanges *c′* of the blocks, as may be preferred, thus enabling the said blocks to be adjusted in relation to one another to thereby vary the width of the slits 2, formed between the edges of the portions *a* of the bottom. The spaces between the flanges *c′* of the bearing-blocks may be fitted with rubber or other suitable packing, as shown at *e*, Fig. 2, to prevent the escape of water and other materials through the slots 3 in the sides of the sluice. The bottom pieces, *a*, are thus adapted to have an oscillating movement, which may be produced by rocking their arbors *b*, having actuating-arms *f* connected therewith, the said arms being shown as connected together at their ends by a connecting-rod, *h*, to thus enable the arbors and connected bottom pieces or plates, *a*, to be moved simultaneously. One of the said arms

f is shown as provided with a handle, f', to enable the series of bottom pieces to be moved simultaneously by the hand of an operator when desired. The movement of the said arms f is limited by stops $i\,i'$, they being normally held in engagement with the said stop i by a suitable spring, k, or equivalent, the said bottom pieces, a, then being in their normal position, so that the lower edge of one is about opposite the upper edge of the next lower one, to thus properly define the slits 2. In the movement of the arms f between the stops $i\,i'$ the lower edge of each bottom piece, a, is raised and the upper edge is lowered, and the said bottom plates are pivoted to turn upon an axis substantially in the same plane with both their edges, so that in the said movement their edges immediately recede from one another, thereby releasing the particles which may have become wedged between them without punching or crushing the said particles, and consequently with the least possible amount of wear to the said edges. This movement of the bottom pieces to clear the slits formed between them should be of short duration, in order to interfere as little as possible with the separating operation; and it may be produced automatically, if desired, at suitable intervals of time. As herein shown, one such automatic mechanism consists of the connecting-rod h for the arms f, provided at its end with a cam-roller, h', which is acted upon by a cam projection, m, actuated by a suitable wheel, m', turned by the stream passing through the flume. The materials passing through the slits 2 enter a tight, strong receptacle, E, below the sluice, it having, if desired, one or more partitions, F, to separate the materials passing through the different slits. The said receptacle E is provided with an ejecting device, n—shown in this instance as a worm—fitting a suitable socket, n', in the bottom of the receptacle, and provided with a cap or cover nearly inclosing the said worm, openings or longitudinal slots 6 being left to permit the concentrate to pass in and fill the spaces between the threads of the worm. The bottom of the receptacle is inclined, as shown in Fig. 4, to facilitate the entrance of the concentrate through the slots 6 into the discharge-passage formed between the portions $n'\,n^2$, occupied by the worm n, the end of the said passage being closed by a suitable door or cover, o, made in two portions to embrace the shaft of the worm n. The said door is provided with a suitable lock, o^2, to prevent it from being opened except by the proper person.

When it is desired to remove the concentrate from the receptacle E, the door o is opened, and the ejecting device n is operated in this instance by a crank, p, with a handle, p', which is provided with a suitable lock, p^2, to prevent it from being operated except at proper times. The ejector should only be operated when the concentrate has filled the lower portion of the receptacle E to a considerable depth, so that when the cover o is opened the water will not escape to any great extent, the concentrate then filling the discharge-passage and covering the slots 6, leading thereto, so as to make it practically water-tight. A fixed plate, a', set in the bottom of the flume, co-operates with the upper one of the movable bottom pieces, a, to make a slit, and a stationary plate, a^2, in a similar manner forms one side of the lowermost slit. The said plate a^2 extends for a short distance over the bottom B′ of the sluice below the receptacle E, thus affording an overflow-passage between the plate a^2 and the bottom B′ for the receptacle E, and guiding the worthless materials down below the said receptacle.

We do not herein broadly claim, in an ore-separating apparatus, a sluice having a portion of its bottom provided with narrow transverse slits of different widths, whereby particles of heavy material of various sizes may be separated from particles of lighter materials of various sizes, the same being reserved for the application for Letters Patent having Serial No. 114,782, filed December 17, 1883.

We claim—

1. In a sluice for separating materials of different specific gravity, movable bottom plates, the edges of which form the sides of narrow transverse slits of different widths through the sluice-bottom, substantially as described.

2. In a sluice for separating ore, movable bottom plates arranged to form narrow transverse slits of different widths, each of said bottom pieces being pivoted to turn on an axis in the plane of its edges, whereby the slits may be cleared of intruding particles, substantially as set forth.

3. A sluice having a portion of its bottom provided with narrow transverse slits, and made of varied inclination or steepness, whereby a varied speed is imparted to the stream flowing over it, substantially as described.

4. A sluice having a portion of its bottom of varied inclination or steepness, and provided with slits of different widths, substantially as and for the purpose described.

5. A sluice having a portion of its bottom composed of plates having narrow transverse slits of different widths between them, the said plates being bodily adjustable with relation to one another for regulating the width of the slits, substantially as described.

6. In a sluice for separating materials of different specific gravity, pivotal adjustable bottom plates, the edges of which form the sides of narrow transverse slits of different widths through the sluice-bottom, combined with mechanism, substantially as described, to rock said plates to dislodge particles from the slits to keep said slits in operative condition, as set forth.

7. In a sluice for separating materials of different specific gravity, pivotal bottom plates, the edges of which form the sides of narrow

transverse slits of different widths through the sluice-bottom, combined with mechanism, substantially as described, to rock said plates, to dislodge particles from the slits to keep said slits in operative condition, as set forth.

8. A sluice having openings through its bottom, and a receptacle, E, arranged below it, combined with an ejecting-worm, *n*, and lock therefor, to prevent the same from being operated, substantially as described.

9. The sluice having a series of openings through its bottom, and a receptacle below it, having a discharge-passage provided with a suitable opening, 6, combined with an ejecting device consisting of a worm adapted to rotate in the said passage, substantially as described.

10. The sluice having a series of openings through its bottom, and a receptacle below it, having a discharge-passage provided with a suitable opening, 6, combined with an ejector to clear the said passage from material deposited therein through the said opening 6, substantially as described.

11. The sluice provided with movable bottom pieces arranged therein to form slits of different widths, and arms connected with said plates, combined with means to actuate the said arms, substantially as described.

12. The sluice and receptacle below it, having a discharge-passage provided with openings 6, the bottom of said receptacle being inclined toward said passage, to facilitate the entrance of the concentrate into the said passage, combined with an ejector to clear the said passage of concentrate, substantially as described.

13. The sluice and the receptacle E, and the fixed plate a^2, located a short distance above the bottom of the sluice, and with its upper edge located above the said receptacle, combined and in line with a movable bottom plate, the edge of which co-operates with the edge of the said fixed plate to form a slit, substantially as described.

14. The sluice and movable bottom pieces and their bearing-blocks, combined with packing to close the spaces between the adjacent ends of the said bearing-blocks, substantially as described.

15. The sluice, the receptacle having a discharge-passage, and an ejector operating in the said passage, combined with a door or cover, *o*, for the said passage, and a lock for the said door, substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

HADLEY P. FAIRFIELD.
LOUIS A. SHEAD.

Witnesses:
E. H. THARP,
T. H. DIXON.