

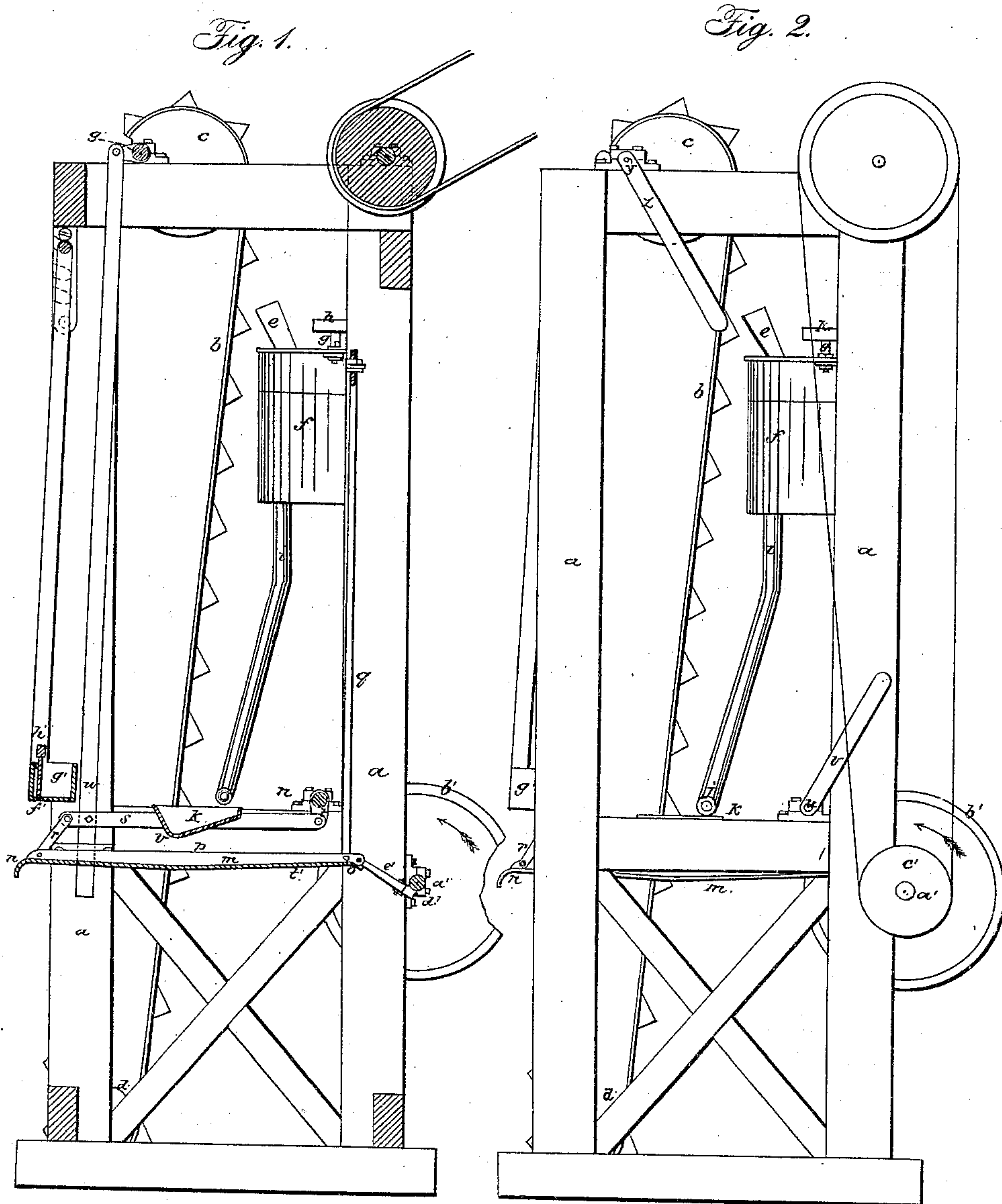
BRADFORD & FITZGERALD.

2 Sheets—Sheet 1.

Ore Separator.

No. 9,590.

Patented Feb. 22, 1853.



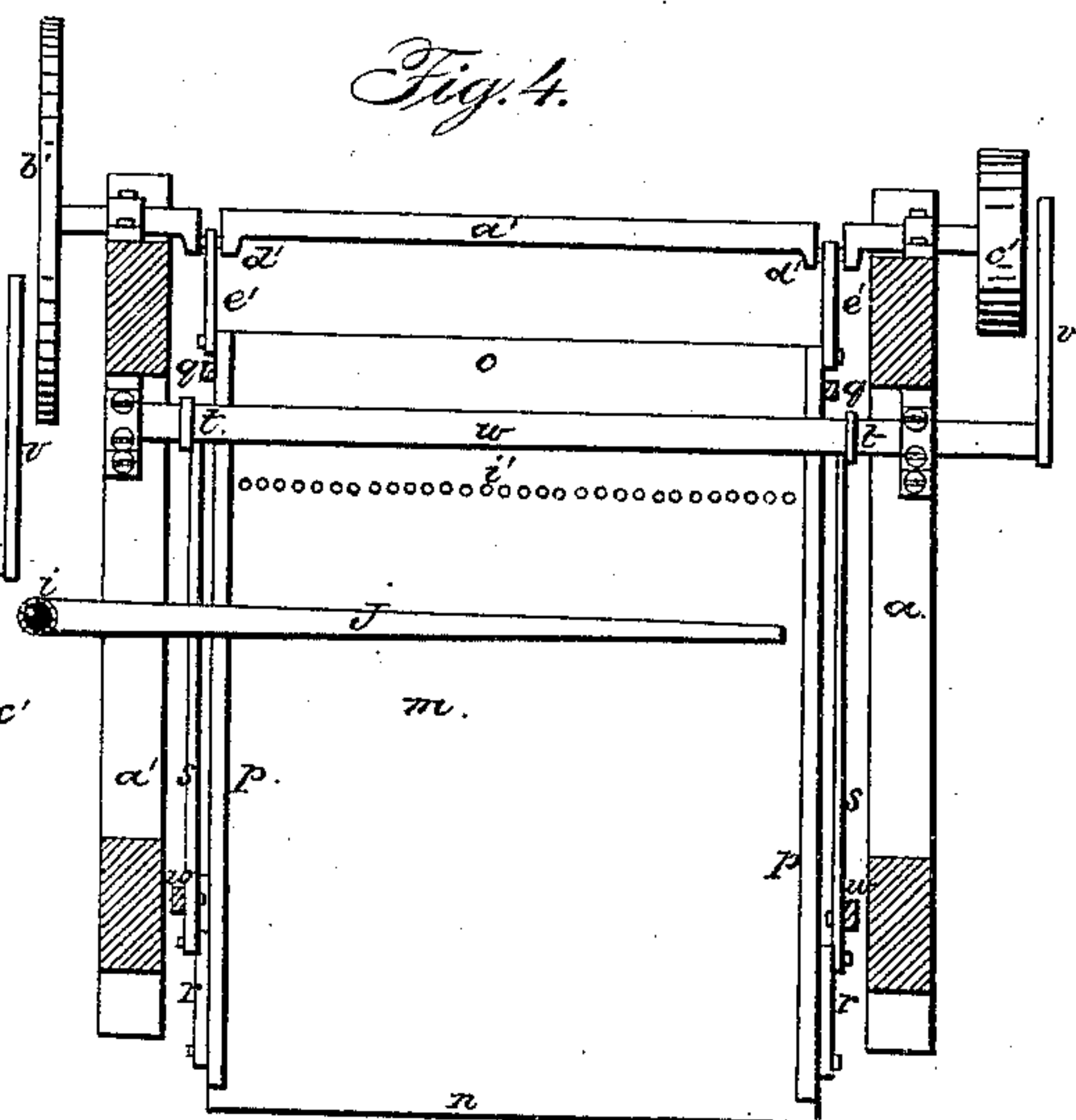
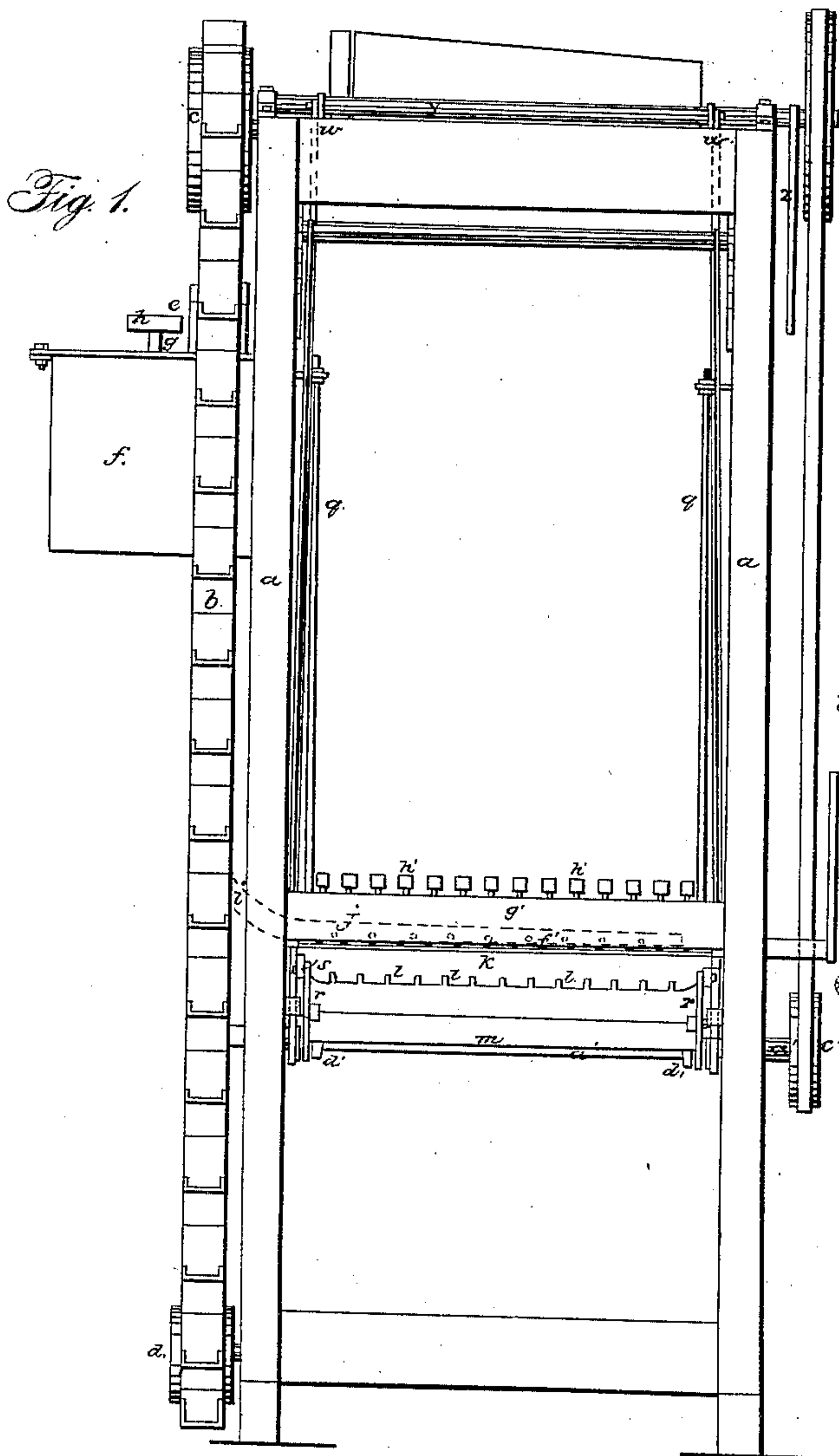
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UNITED STATES PATENT OFFICE.

H. BRADFORD AND E. FITZGERALD, OF NEW YORK, N. Y.

APPARATUS FOR SEPARATING ORES OR OTHER SUBSTANCES OF DIFFERENT SPECIFIC GRAVITIES.

Specification of Letters Patent No. 9,590, dated February 22, 1853.

To all whom it may concern:

Be it known that we, HEZEKIAH BRADFORD and ELISHA FITZGERALD, of the city, county, and State of New York, have invented a new and useful Apparatus for Separating Substances of Different Specific Gravities, and that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1 is a front elevation. Fig. 2 a side elevation; Fig. 3, a vertical section, and Fig. 4 a horizontal section representing the separating pan in plan.

The same letters indicate like parts in all the figures.

Our invention is specially intended for separating ores from the gangue and other substances with which they are mixed, after the same have been pulverized or reduced by grinding or otherwise. And our said invention is equally applicable to the separation of any other article from other substances of different specific gravity, but not the separation of different substances of the same specific gravity.

We will describe our said invention as we have applied it successfully to the separation of copper ores from the other substances of different specific gravity with which they are mixed.

Our invention depends on the difference of specific gravity between the different substances to be acted upon to effect their separation; it is preferable that the substances should be of equal or nearly equal size, and therefore when applied to the separation of copper ore it is necessary that the ore as it is taken from the mine or otherwise found should be first pulverized or reduced to particles of equal or nearly equal size, which is to be effected in any known or proper manner, such as crushing or grinding and screening.

The nature of our invention consists in giving by a mechanical arrangement to a pan which is slightly inclined or curved upward toward the front, a motion resembling that given by hand in separating copper ore on a shovel in the operation called vanning, and such as will be generated by having the rear end of such pan suspended to two long

pendulous rods, and the front end suspended or jointed to two short rods inclined upward and backward to their points of suspension, so that the front shall rise as it moves forward, and descend as it moves back; or by having the back end suspended in the same manner as the front, and the rods having the same or nearly the same inclination, so as to give an upward and forward motion, and then a backward and downward motion. And our invention also consists in giving the reciprocating motion to such pan, so that it shall make its back movement in a shorter space of time than its forward movement, with the view to carry forward the substances as the pan is moved forward and upward and in part leave them by causing the pan to descend as it moves back, which movement we obtain by a crank or cranks whose axis of motion is below or above the plane of motion of the rear end of said pan or any equivalent therefor. And the nature of our said invention also consists in employing in combination with a pan substantially such as above described, a current or currents of water or other fluid supplied to, and descending on, the inclined or curved surface of the front end of the pan, so as to meet the substances to be separated (and which are supplied with water farther back) as they are impelled forward by the motions of the pan, and to carry back the lighter substances which have, by reason of their inferior specific gravity, less momentum than the heavier particles to be separated; the force of the current or currents being so proportioned to the momentum given by the motion of the pan, that the heavier particles shall overcome the force of the current or currents of water while the lighter particles shall be overcome by the force of such current or currents, and thus effect the separation.

Our invention also consists in giving to the back end of such pan operated as above described a slight curve or inclination upward, so that a sufficient quantity of water shall be kept within the pan to facilitate the separation; the presence of such water having the effect to keep the particles of the substances to be separated more equally distributed and more free to move and yield to the force applied to effect the separation,

while at the same time it admits of the separating of such particles as may float on the water. And our invention also consists in making such pan, operated substantially
 5 as above described, with a series of holes back of the place on which the substances to be separated are supplied, for the purpose of discharging such of the substances as are of less specific gravity. And finally our in-
 10 vention consists in making the ends of said pan—either or both—with a gradual curve downward for the more ready discharge of the substances after the separation.

In the accompanying drawings (*a*) represents an appropriate frame which may be
 15 varied at the pleasure of the constructor, and *b* an endless belt of elevators which passes around two pulleys *c* and *d*, receiving motion in any adequate manner from some
 20 first mover. These buckets take the pulverized ore from a proper vessel into which the lower end of the belt runs, and discharge it into a hopper *e* of a tub *f*, in which there is a vertical spindle *g*. This spindle
 25 has a pulley *h* near the upper end to receive a driving belt from some adequate motor to rotate it rapidly, and it is also provided with arms within the tub to agitate the ore in and keep it properly mixed
 30 with water, which is to be supplied to the tub in any proper manner. The arms are not represented as they are similar to those usually employed in mixing tubs. The ore thus kept properly mixed with water so
 35 that it will flow freely, runs down a pipe *i* from the lower end of the tub and is discharged through holes along the horizontal part *j*, of the said pipe into a trough *k*
 40 which has an inclined bottom down which the ore and water runs to the lower end, where it is perforated with holes or slots *l*, made at equal distances apart and of sufficient size to deliver the ore with the re-
 45 quired velocity. The ore and water fall from the said trough into the shaking pan *m*, at about one-third of the distance from the front edge thereof, but this position may be varied. The said shaking pan is
 50 best made of sheet copper, but may be made of other substances. In the direction of its breadth it is straight and horizontal, and in the direction of its length it is the segment of a large circle with the front end *n*,
 55 and the back end *o*, curved over and downward to facilitate the flowing over of the water and the substances separated. It is provided with side flanches or ribs *p*, *p*.
 60 Near the rear end this pan is suspended to two long pendulous rods *q*, *q*, one on each side, and near the front end to two short rods *r*, *r*, about one fifteenth the length of the rear rods.

The rear rods are jointed at their lower ends to the pan, and at their upper ends
 65 pass through staples and are secured by

adjusting nuts, by means of which the elevation of the rear end of the pan can be adjusted. And the short front rods at their lower ends are jointed to the pan near the front end, and run back and up at an angle
 70 of about 45°, and are at their upper ends jointed to the front ends of two rods *s*, *s*, the rear ends of which are in turn connected with two short arms *t*, *t*, on an arbor *u*, provided with a hand lever *v*, by the moving of
 75 which the connecting point of the rods *r*, *r*, can be set farther forward or back to increase or decrease the inclination of the said rods. And the said rods *s*, *s*, are also jointed
 80 near their front ends to two suspension rods *w*, *w*, which at their upper ends are jointed to two short arms *x*, *x*, on an arbor *y*, also provided with a hand lever *z*, by the turning of which the forward end of the pan can be elevated or depressed. By drawing
 85 the points of attachment of the rods *r*, *r*, back or forward the motion of the forward end of the pan can be modified; if drawn back it will leave a greater range of motion up and down,—that is to say, more of a toss-
 90 ing motion, and if they be moved forward the motion will be less so. By means of the hand lever the operator can adjust the motion to suit the condition of the substances to be separated; in like manner by means
 95 of the other hand lever the operator can elevate or depress the front end of the pan relatively to the back end.

Behind and a little below the plane of the motion of the rear end of the pan, there is
 100 a shaft *a'*, with a fly wheel *b'* on one end and a driving pulley *c'* at the other, to receive a band from some first mover. This shaft has two cranks *d'*, *d'*, with connecting
 105 rods *e'*, *e'*, jointed to the sides of the pan near the back edge by which the shaking motion is given.

From the manner in which the pan is hung, it will be obvious that the rear end will vibrate in the arc of a large circle,
 110 while the front end will vibrate in the arc of a small circle; and its forward movement will be upward and its back movement downward. And the axis of motion of the cranks which give the vibratory motion be-
 115 ing placed below the plane of motion of the rear end of the pan, if the shaft turns in the direction of the arrow its back movement will be performed in less than one half the rotation, and its forward movement in more
 120 than one half,—hence its back motion will be more rapid than its forward motion, which taking place as the pan descends will leave the heavier particles which have been carried upward by the forward and upward
 125 motion, for the particles must bear more on the pan as it rises than when it descends. The lighter particles will receive less of this action, and will be washed back by the
 130 water in the proportion of the difference

between their specific gravity. Instead of placing the crank below, the same result may be obtained by placing it above the plane of motion of the pan, and reversing the direction of rotation.

As the ore mixed with water falls on the pan, the vibratory motion given to it forces the ore forward toward the front end, and the upward motion of the front end throws it slightly upward, and in this condition the substances are met by a current or currents of water discharged onto the highest part of the front end of the pan through holes f' along the bottom of a trough g' , and as the water descends along the inclined or curved bottom of the pan it meets the particles of ore, &c., which are being impelled forward by the force of the vibration, and these particles being of equal or nearly equal size, the lighter ones are carried back by the force of the current, which not being strong enough to overcome the momentum of the heavier particles permits them to move on until they are delivered over the summit of the front end of the pan where they fall into a bin or other receptacle.

The quantity of water discharged onto the front end of the pan can be increased or decreased by screw plugs h' which govern the apertures through which the water is discharged into the pan.

The water falling on the summit of the front end of the pan which is curved keeps it constantly covered with water, and thus assists the discharge of the heavier particles; and the curved form of the rear end of the pan prevents in a great measure the surface of the water from being agitated, which agitation, if not avoided, would greatly impede the separation and the delivery.

If the current of water be not sufficient to effect the separation, then the front end of the pan is to be elevated to give a greater force to the downward current, and at the same time make the ascent to be overcome by the particles greater. Or the arbor u , can be turned to draw the short rods r, r , back, that the motion of the front part of the pan may be more upward, which will present the ore and other substances in a more loose and separated condition to receive the action of the current of water.

It will be seen on examination that the peculiar manner of suspending and vibrating the pan, gives to it by machinery a motion resembling that given by hand in separating ores by vanning on a shovel,—which motion impels forward the substances to be separated, and throws them up slightly that the descending current or currents of water may have a fair action on them, and carry back such as have less momentum than the par-

ticles of the greatest specific gravity, which overcome the current and are discharged over the front end. And it will also be observed that the lighter particles which are carried back by the current of water will be discharged through a series of holes i' in the bottom, and about mid-way between the back end of the pan and the place where the ore mixed with water are delivered onto the pan. These holes should not be so large as to disturb the surface of the water, and by suction draw down the particles that float on the surface, for it is well known that particles of certain descriptions of ore do not get fully or entirely wet, or that ore in thin flakes will float on the water although of greater specific gravity than water, or the substances from which the ore is to be separated.

The particles that float on the surface will be carried back and discharged with the water over the rear end where they can be collected. The pan instead of being a regular curve which is believed to be best may be composed of inclined surfaces, although a regular curve or segment of a circle will be found to be best in practice.

The peculiar motion of the pan obtained as above described by having it suspended to the long pendulous and the short inclined rods, or by having the rear end suspended in the same manner as the front, may be obtained by other equivalent means, such as having rollers or wrists attached to the sides of the pan, and running on ways or in grooves of the required form to generate the same motion in kind as that above described. And therefore we do not wish to be understood as limiting ourselves to the obtaining of this motion by means of the jointed rods as above described. Nor do we wish to limit ourselves to the mode of giving the unequal forward and back motion to the pan by means of the cranks, the shaft of which is placed below or above the plane of motion of the rear end of the pan, as the same motion can be given by other and equivalent mechanical means, such as cams.

Having thus described the invention as it has been applied to the separation of copper ores, any competent machinist will be enabled to apply it to the separation of other substances of different specific gravity from each other.

What we claim as our invention and desire to secure by Letters Patent is—

1. The giving to the reciprocating pan, substantially such as above described, the peculiar motion above described, and by the means substantially as herein described.

2. We also claim giving the back movement to the said pan in a less period of time than the forward movement by means of a crank or cranks whose axis of motion is be-

low or above the plane of motion of the rear end of said pan, or by equivalent means as described, and for the purpose specified.

3. We also claim in combination with a pan having the motions, or either of the motions, substantially such as specified and on which the ore, &c., mixed in water, is supplied at some point toward the middle or back, the employment of a current or currents of water descending the inclined or curved surface of the said pan, in the manner and for the purpose substantially as specified.

4. We also claim making the rear end of the said pan with an inclination or curve upward, substantially as specified and for the purpose set forth.

5. We also claim making the said pan operated as specified, with apertures back of the place where the substances to be separated are supplied, for the purpose and in the manner substantially as set forth.

6. And finally we claim making the front and rear ends, or either, of the pan having a vibrating motion, with a gradual curve downward substantially as specified, when the same is employed in combination with currents of water, substantially as and for the purpose specified.

HEZEKIAH BRADFORD.

ELISHA FITZGERALD.

Witnesses:

WM. BISHOP,

CHARLES N. BAMBURGH.