6 Sheets—Sheet 1.

P. PLANT.

Ore-Separator.

No. 215,289. Patented May 13, 1879.

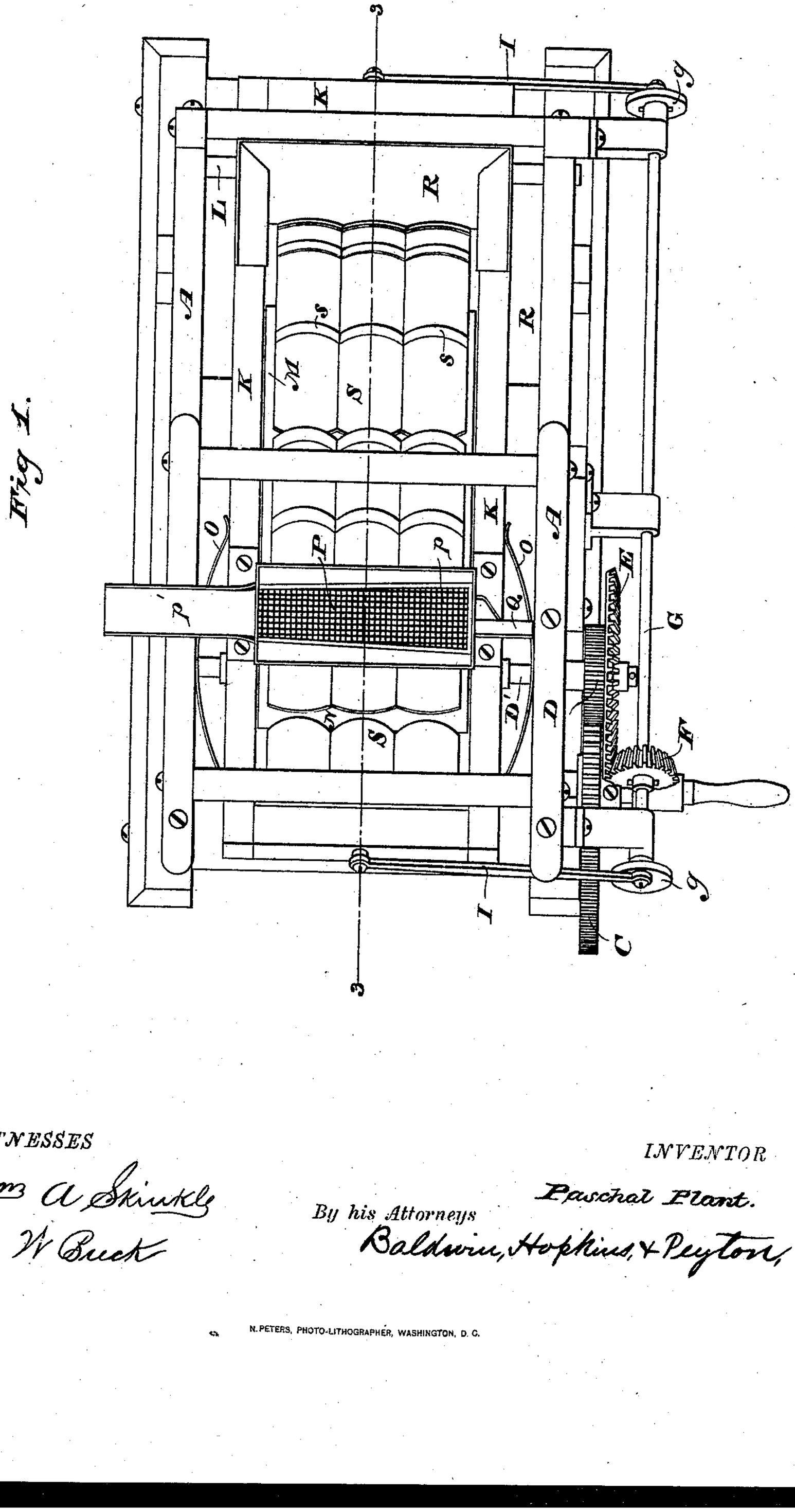


Fig. 1.

WITNESSES

Wm A Skinkle

Geo H Buck

INVENTOR

Paschal Plant.

By his Attorneys

Baldwin, Hopkins, & Peyton,

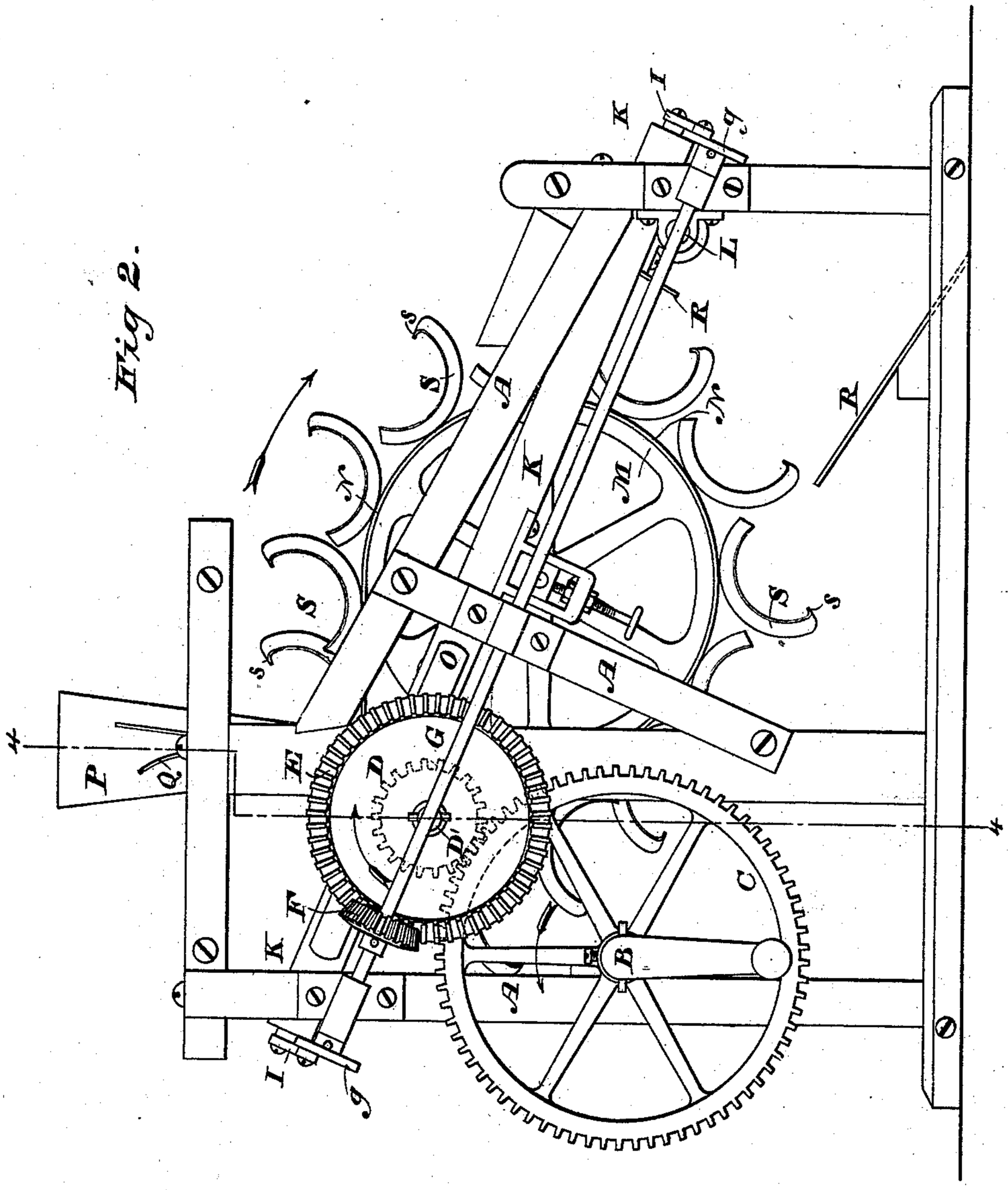
6 Sheets—Sheet 2.

P. PLANT.

Ore-Separator.

No. 215,289. Patented May 13, 1879.

Fig 2.



WITNESSES

Wm A Skinkle

Geo H Buck.

INVENTOR

Paschal Plant

By his Attorneys

Baldwin, Hopkins, & Peyton.

6 Sheets—Sheet 3.

P. PLANT.

Ore-Separator.

No. 215,289. Patented May 13, 1879.

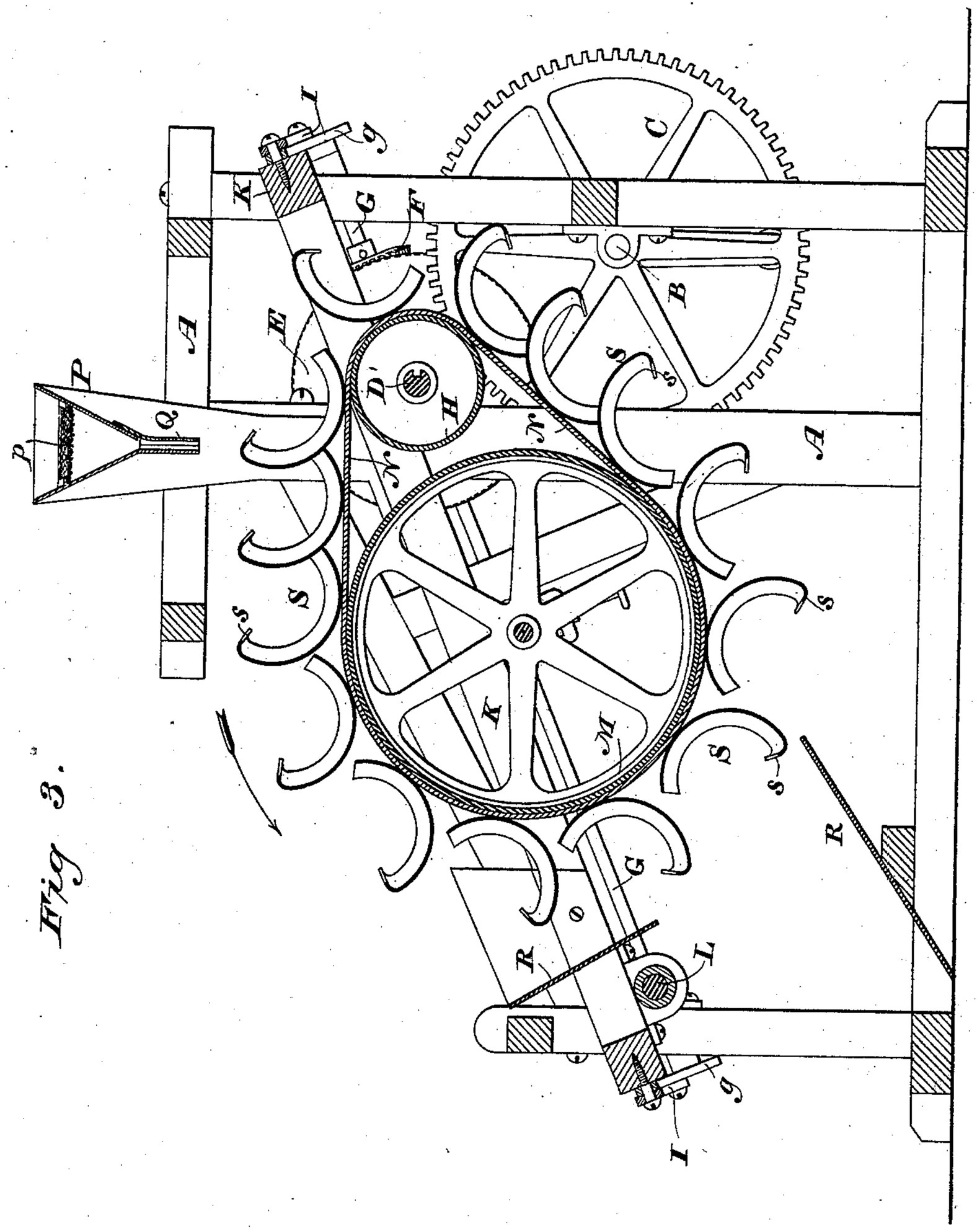


Fig 3.

WITNESSES

Wm A Skinkle

Geo H Breck.

INVENTOR

Paschal Plant.

By his Attorneys

Baldwin, Hopkins, & Peyton.

6 Sheets—Sheet 4.

P. PLANT.

Ore-Separator.

No. 215,289. Patented May 13, 1879.

Fig 4.

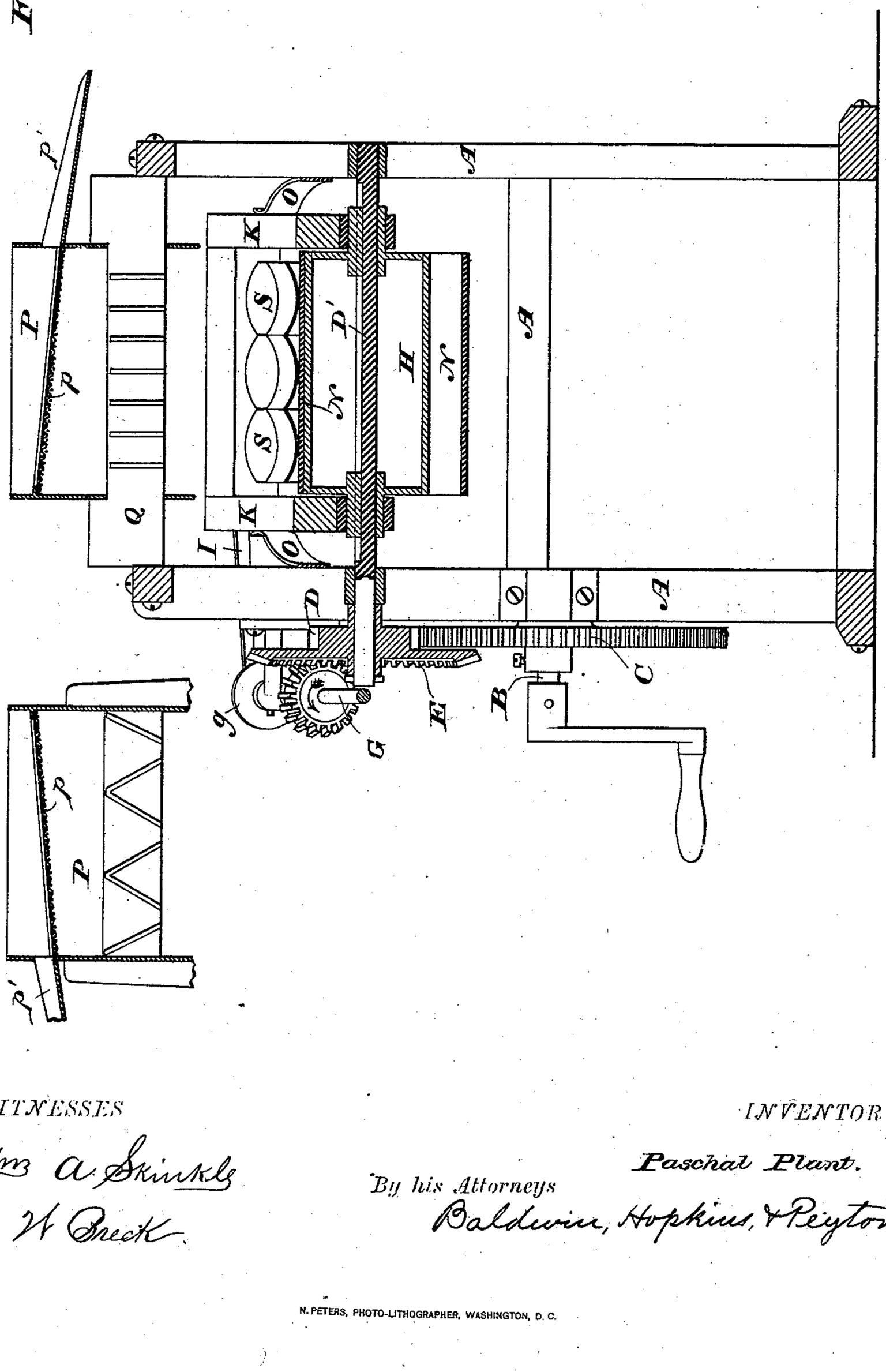


Fig 5.

WITNESSES

Wm A Skinkle

Geo H Breck.

INVENTOR

Paschal Plant.

By his Attorneys

Baldwin, Hopkins, & Peyton.

6 Sheets—Sheet 5.

P. PLANT.

Ore-Separator.

No. 215,289. Patented May 13, 1879.

Fig 6.

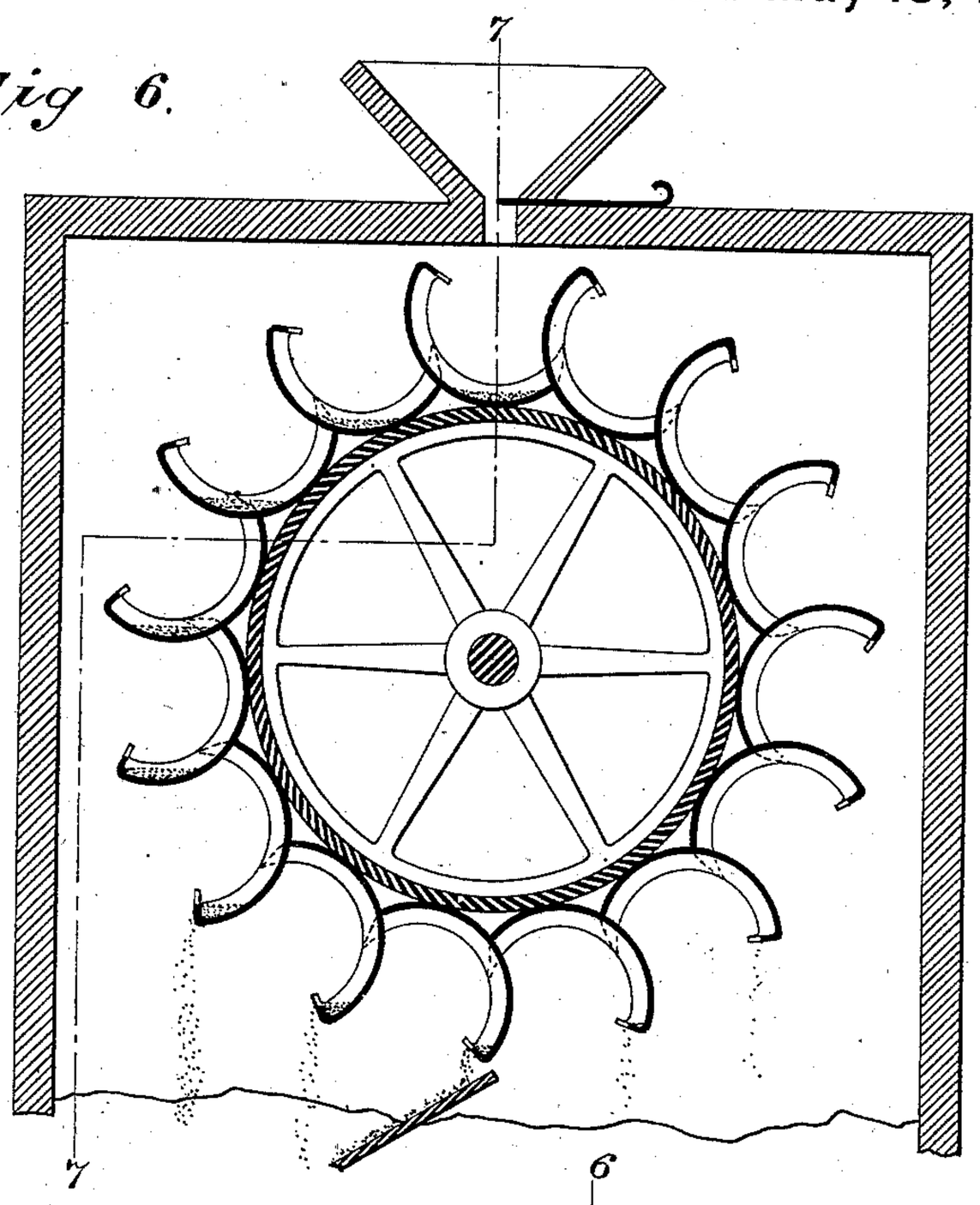


Fig 12

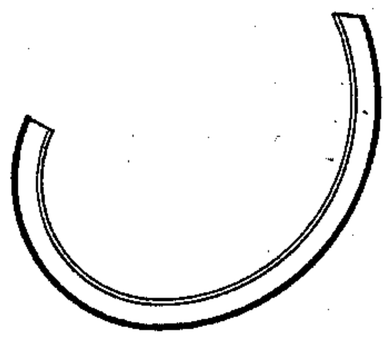


Fig 13.

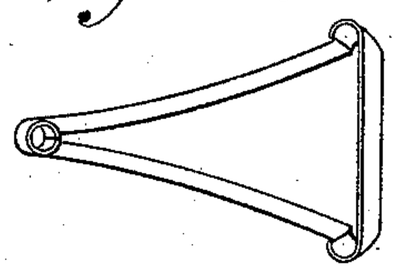
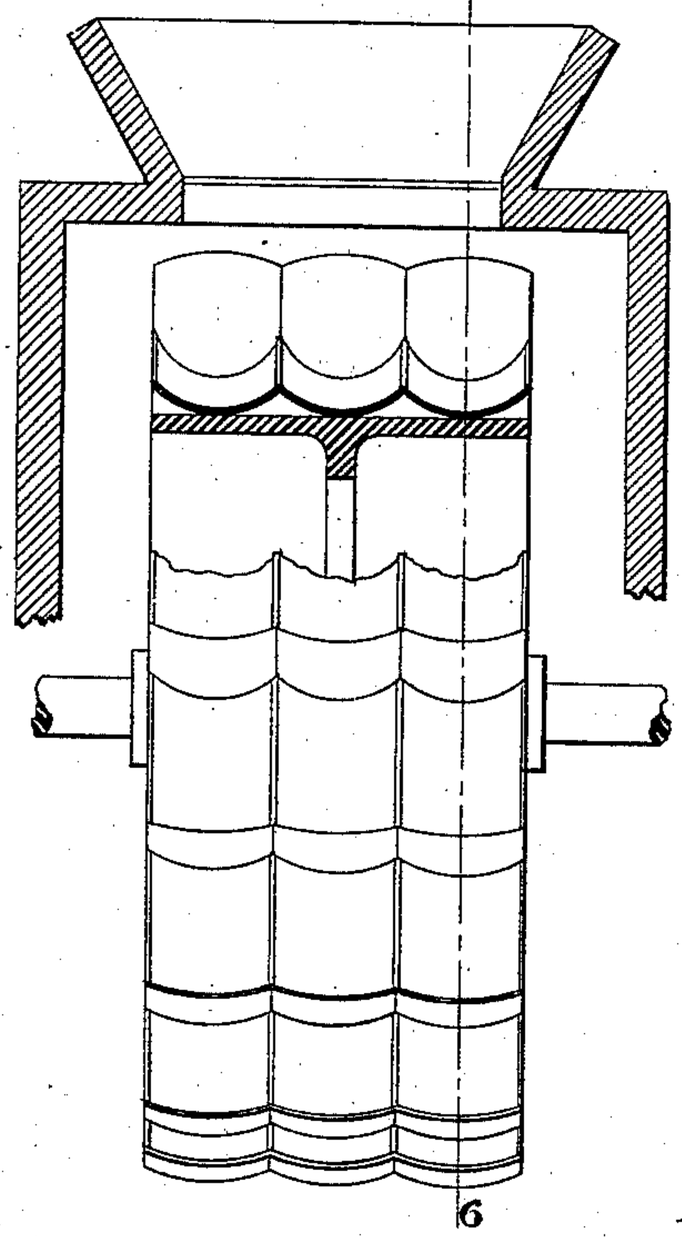


Fig 7.



WITNESSES

Wm A Skinkle

Geo W Breck

INVENTOR

Paschal Plant

By his Attorneys

Baldwin. Hopkins, & Peyton.

6 Sheets—Sheet 6.

P. PLANT.

Ore-Separator.

No. 215,289. Patented May 13, 1879.

Fig 10

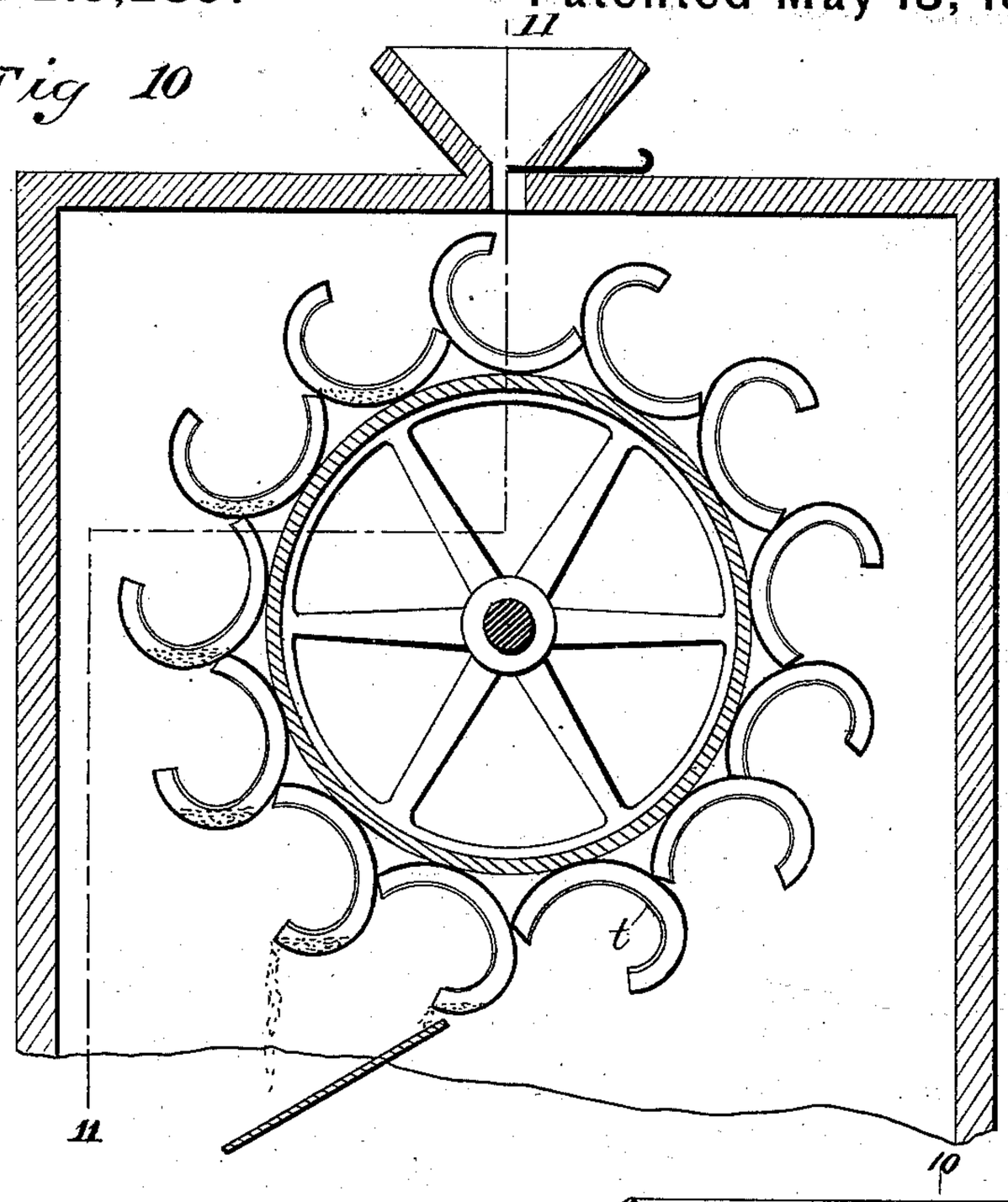


Fig II.

Fig 8.

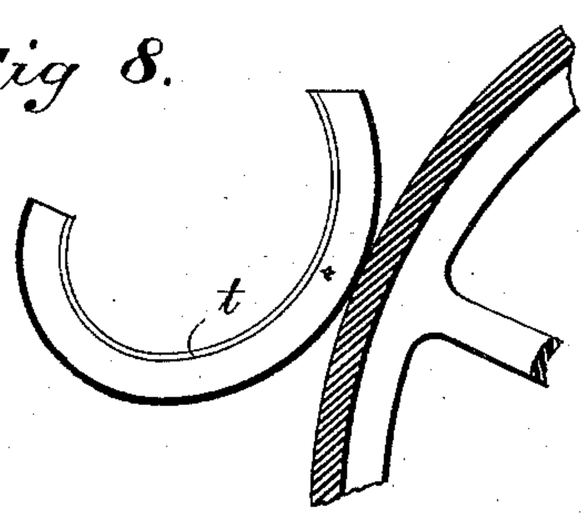
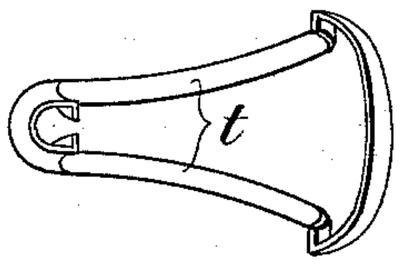
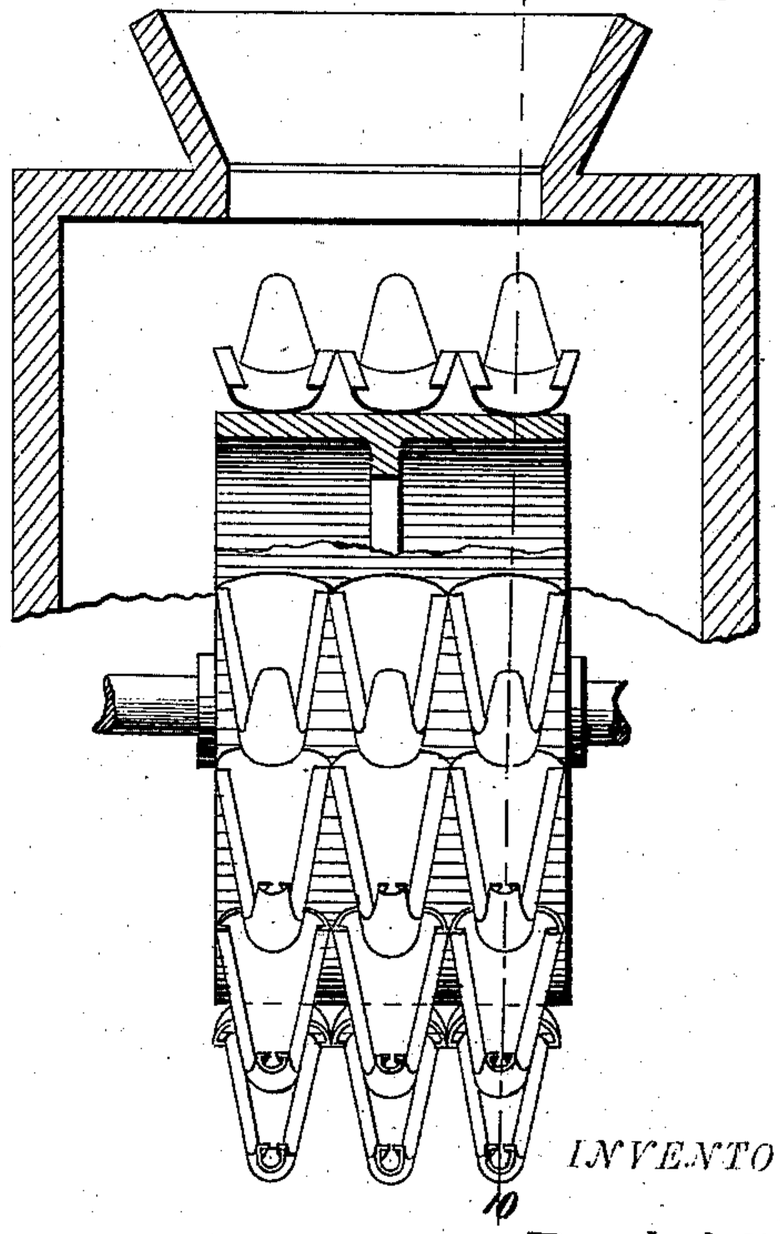


Fig 9.





WITNESSES

Wm A Skinkle

Geo W Breck

INVENTOR

Paschal Plant

By his Attorneys

Baldwin, Hopkins & Peyton.

UNITED STATES PATENT OFFICE.

PASCHAL PLANT, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN ORE-SEPARATORS.

Specification forming part of Letters Patent No. **215,289,** dated May 13, 1879; application filed January 16, 1879.

To all whom it may concern:

Be it known that I, PASCHAL PLANT, of Washington, in the District of Columbia, have invented a certain new and useful Method and Apparatus for Dry-Separating Precious Metals from their Ores, of which the following is a specification.

The object of my invention is chiefly to separate gold from fine ore, auriferous sand, or ground quartz without the use of water or mercury. I have discovered that this is practicable under certain peculiar conditions that I will proceed to explain in detail.

As I have set forth in another patent obtained by me in the United States, numbered 212,051, I have discovered, and practically demonstrated, that when pulverized ore containing precious metals is placed in a receptacle in considerable quantity—such, for instance, that the depth of the layer of ore shall be about half an inch or more—and then agitated, the precious metals, notwithstanding their greater specific gravity than the earth or quartz, tend to rise to the surface. I have also discovered, second, (and it is a fact practically demonstrated,) that when the same material is placed in a suitable receptacle in less quantity—such, for instance, that the depth of the layer of ore shall be from one-eighth to three-sixteenths of an inch—and then agitated, the precious metals will penetrate the earthy matter and be collected at the bottom; but the depth of the thin layer of ore in which this penetration and separation will most successfully take place will be found to be slightly variable with different ores. The lightest particles of metals will generally penetrate about one-eighth of an inch of earthy matter and collect at the bottom, while the heavier particles will penetrate about three-sixteenths, or in some exceptional cases even one-quarter, of an inch, and be similarly collected. It is upon these facts, which I have developed by experiment, that my present invention is predicated.

I have found that if gold-bearing sand, gold mingled with earthy matters in the natural state, pulverized ore, or quartz be placed in thin layers, as described, at the bottom of a receptacle, and there be placed over it dry earthy matter to the depth of one-half inch or more, or such that the weight of the earthy matter shall be appreciable in effect, and the whole be then subjected to agitation, the gold particles will inevitably tend to rise to the top, and will not be separated and collected at the bottom, but will gradually pass away with the discharge of the earthy matter. I therefore deem it very important to use the thin layers only, and the discovery of the advantage of using such thin layers of fine dry metal-bearing substance to be deposited and agitated, without the disturbing effect of any considerable body of matter to be agitated with it, is of the essence of my invention.

The essential condition of practical success in fact is always that the layers shall be so thin that the bulk of earthy matter, as compared with the particles of precious metal, shall be weightless under agitation, and shall leave the fine particles of precious metal unaffected by any moving substance that will cause them to rise, and subject only to their natural downward tendency by gravity, like pure sand in water. Under this condition only is penetration to the bottom of the fine particles and their collection there assured.

I am aware that what might be called, in speaking loosely, without knowledge of my method, "thin layers of ore," have been agitated in receptacles containing recesses, as shown, for instance, in patents heretofore granted to me and to others; but I am not aware that the real method I have adopted, or the reasons for its adoption, have been understood and applied, and hence, so far as my knowledge extends, where water has not been used, either mercury or amalgamators have been employed wherever any substantial degree of success on a practical scale has been attained in dry-separating.

In addition to having receptacles of suitable form, and filling them with thin layers of ore, as described, the agitation given the ore in the receptacles must be of a peculiar character in order to achieve successful separation. Instead of being such as will slide the ore from side to side in an integral mass it must be such as will tend to create, as it were, disintegration of the mass—that is, a disturbance and shifting of the particles one with respect to another in the mass. This is as essential a condition to success as the employment of

the thin layers, and this, so far as I am aware, is a condition that has heretofore been overlooked.

It is a part of my discovery, therefore, that the peculiar sort of agitation, by short and rapid vibrations, that will give tremulous motion to and cause disturbance of the individual particles of ore is vital to be employed in connection with thin layers. If it be employed with layers of ore that are too thick it will not effect separation, but only a mixing of the precious metals with the ore; and if long vibrations are employed with thin layers the same result will follow. The two conditions together—that of thin layers and tremulous agitation—are the only ones by which success can be attained, and their employment or combination constitute the essence of my discovery.

It is immaterial to my new method in what manner the delivery of the earthy matter or the precious metals out of the separators is effected, whether by overflow from their margins, as shown in my patent above referred to, or by overflow from their margins by tilting the separators, as provided for by the mechanism herein described, as either of these ways of delivery, after the separation has been effected by my present method, is practicable.

In carrying out my present invention I provide an endless belt carrying numerous cups or separators, which is worked around pulleys or cylinders continuously, and at the same time reciprocated rapidly at right angles to the direction of traverse of the belt. These separators are of peculiar curvilinear conformation, and they are, in their course, to successively pass under a hopper and receive each a supply of fine ore that will, under the agitation, immediately spread out and form a thin layer.

As the separators gradually turn downward in their course around with the endless belt the earthy matter under agitation is gradually emptied, and the particles of precious metal are collected at the lowest points, which are constantly changing in the separators.

This is, in general, the mode of operation I employ. I will now proceed to a description in detail of the best form of mechanism now known to me for carrying out my invention.

In the accompanying drawings illustrating such mechanism, Figure 1 is a top view of my complete apparatus. Fig. 2 is a side elevation of the same. Fig. 3 is a vertical section through the line 3 3 of Fig. 1. Fig. 4 is a vertical section through the line 4 4 of Fig. 2. Fig. 5 is a section through the hopper. Fig. 6 is a central section on the line 6 6 of Fig. 7, showing a series of separators secured to a cylinder instead of to an endless belt. Fig. 7 is a view of the same, partly in section, on the line 7 7 of Fig. 6. Figs. 8 and 9 are, respectively, a sectional elevation and a plan of a modified form of separator; and Figs. 10 and 11 show this form of separator applied to a drum. Figs. 12 and 13 are, respectively, a sectional elevation and plan of a slight modification of the separators shown in Figs. 8 and 9.

A indicates the main frame, which may be of any suitable form. B is the driving-shaft, having its bearings on the main frame. C is a spur-driving wheel, which gears into a pinion, D, fixed to one side of or made integral with a bevel-wheel, E, and gearing with a bevel-pinion, F, on the shaft G. The pinion D is fixed on the cylinder-shaft D′, and rotates it and the small cylinder H, which is connected to the shaft by means of a spline, so as to admit of reciprocation during its revolutions. At the opposite ends of the shaft G are cranks or crank-wheels *g*, to which are adjustably connected pitmen I, pivoted to the opposite ends of the agitator-frame K. This frame is secured to sleeves which loosely encircle the shafts D′ and G, and it supports the bearings of the large cylinder M. N is the endless band of cups or separators moved by the revolution of the cylinders, and O are springs between the opposite sides of the agitator-frame and the posts of the main frame, to diminish the shocks caused by agitation. The throw or length of reciprocation of the agitator-frame can be regulated by changing the point of connection of the pitmen with the crank-wheels, by providing pin-holes in the wheels at different distances from their axes, as is usual, and this throw should be proportioned somewhat to the size of the separators employed, which size may be considerably varied.

From the foregoing it will be perceived that when motion is imparted to the main drive-wheel in the proper direction the cylinders and endless band will move slowly in the direction of the arrow, and at the same time they will be reciprocated transversely to the direction of their motion of rotation, and the separators will pass successively under the hopper P, from which they will receive a suitable deposit of fine ore, and afterward gradually tilt to pour off the earthy matter, until finally the precious metal itself will be emptied out. This hopper is supported by standards secured on the agitator-frame, and it also is reciprocated in order to better effect feeding. It is, furthermore, of peculiar construction, being provided with a sieve, *p*, and a spout, *p′*, to sift the fine ore before it is delivered into the separators, and to convey off such particles as happen to be too coarse. It is desirable that the sieve should incline a little toward the spout, and that the ore should be delivered on the upper end of the sieve.

The hopper is provided on one of its lower sides, as shown in Fig. 5, with V-shaped projections, and its other lower side is formed in part of a stationary ribbed plate, Q, held in place by the main frame. The purpose of this construction is that as the fine ore falls through the hopper-sieve it will be further pulverized

by the grating or grinding action of the ribs and projections during the reciprocations of the main part of the hopper.

Guide or delivery plates may be employed, as shown in the drawings at R.

The foregoing fully discloses the general construction and mode of operation of my apparatus; but it remains to particularly describe the form of the separators upon which success with this apparatus vitally depends. I have devised several different forms of these separators, all, however, alike in their essential characteristics, the principle on which they are formed being that, whatever position they shall occupy while performing the function of separating their charges of ore under agitation, they shall present a concave or curvilinear bottom to hold the charge, or any remainder of it, up to the point where complete separation will, in practice, have been accomplished and the separated precious metal is ready to be dumped by itself back of the last delivery-plate.

In the first four figures of the drawings I have shown the shallow separators S, composed of thin plates curved longitudinally and transversely—that is, like bent troughs—and provided with little lips *s* at their delivery ends. I form these separators of a depth just sufficient to receive and hold layers of ore of the proper thickness, so that if an excess should accidentally be fed it would immediately be discharged over the sides and not remain to prevent separation, but be carried to the ground by dropping on the guide-plates. This form will collect the gold-dust finally at the point next these lips, and then deliver it as the lips pass to and beyond a horizontal position in the lower part of their revolution, as best illustrated in Fig. 3.

Figs. 8 and 9 illustrate separators curved in both directions, but narrowed toward their delivery ends and then curved quite abruptly, so as to exhibit inwardly-projecting flanges *t*. These separators are designed to deliver the earthy matter over their sides, and they grow more and more shallow as the narrow delivery ends are approached. They, however, will effect complete separation at the point where the abrupt delivery-end curvature begins, and after that there will be no further side delivery; but the gold-dust will be carried out and delivered from the curved ends. The effect of this will be that the deposit of gold-dust will be quite apart from the last droppings of earthy matter.

Figs. 12 and 13 show separators formed on this plan of narrowing and diminishing in depth toward the delivery ends, but curving transversely in an ellipse instead of a circle, and provided with tubular nozzles. This is for some reasons the preferable form of all, in my jugdment.

It is essential, as I have before stated, that the agitation, in order to effect separation, shall be such that the individual particles of ore in the separators shall be disturbed relatively to each other as much as possible. Therefore, in forming my separators, which are somewhat like the bowl of a spoon, it will be found desirable to roughen their bottoms slightly by stamping or otherwise in the process of manufacture, so that they shall be like a small file formed with fine lines of depressions and elevations crossing each other at right angles, in order to prevent the charges from remaining integrally massed and permitting the separators to slide smoothly under them and failing to be agitated; or the bottoms may be roughened by being lined with fine reticulated fabric like wire-gauze, or in any other suitable manner. With this roughening, and by the use of thin layers, and with short and rapid vibrations, so as not to merely slide the body of ore, I am able to attain perfect success.

I am aware that layers of ore have been agitated for separation, and I do not claim that operation, broadly; but I am not aware that the nice conditions, both of mechanical construction and mode of operation, by which alone success, without the use of water or mercury, is attainable, have been heretofore contemplated and provided for.

Any other suitable mechanism than that I have described may be employed to operate my peculiar separators in the manner I have indicated, and I do not confine myself, therefore, to the precise machinery that I have described for the purpose; but,

Having now explained my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The method of dry-separating precious metals herein described, which consists in depositing pulverized ore, auriferous sand, or ground quartz in suitable receptacles in thin layers of about one-eighth to three-sixteenths of an inch in depth, and then agitating them by a tremulous motion, thus causing the suspension of the particles of earthy matter and the deposition of the precious metals at the bottom, substantially as set forth.

2. The combination of a belt or circle of receptacles or separators with mechanism for simultaneously rotating or traveling and tilting, and mechanism for reciprocating them, substantially as described.

In testimony whereof I have hereunto subscribed my name.

PASCHAL PLANT.

Witnesses:
WM. J. PEYTON,
G. H. MAYNADIER.