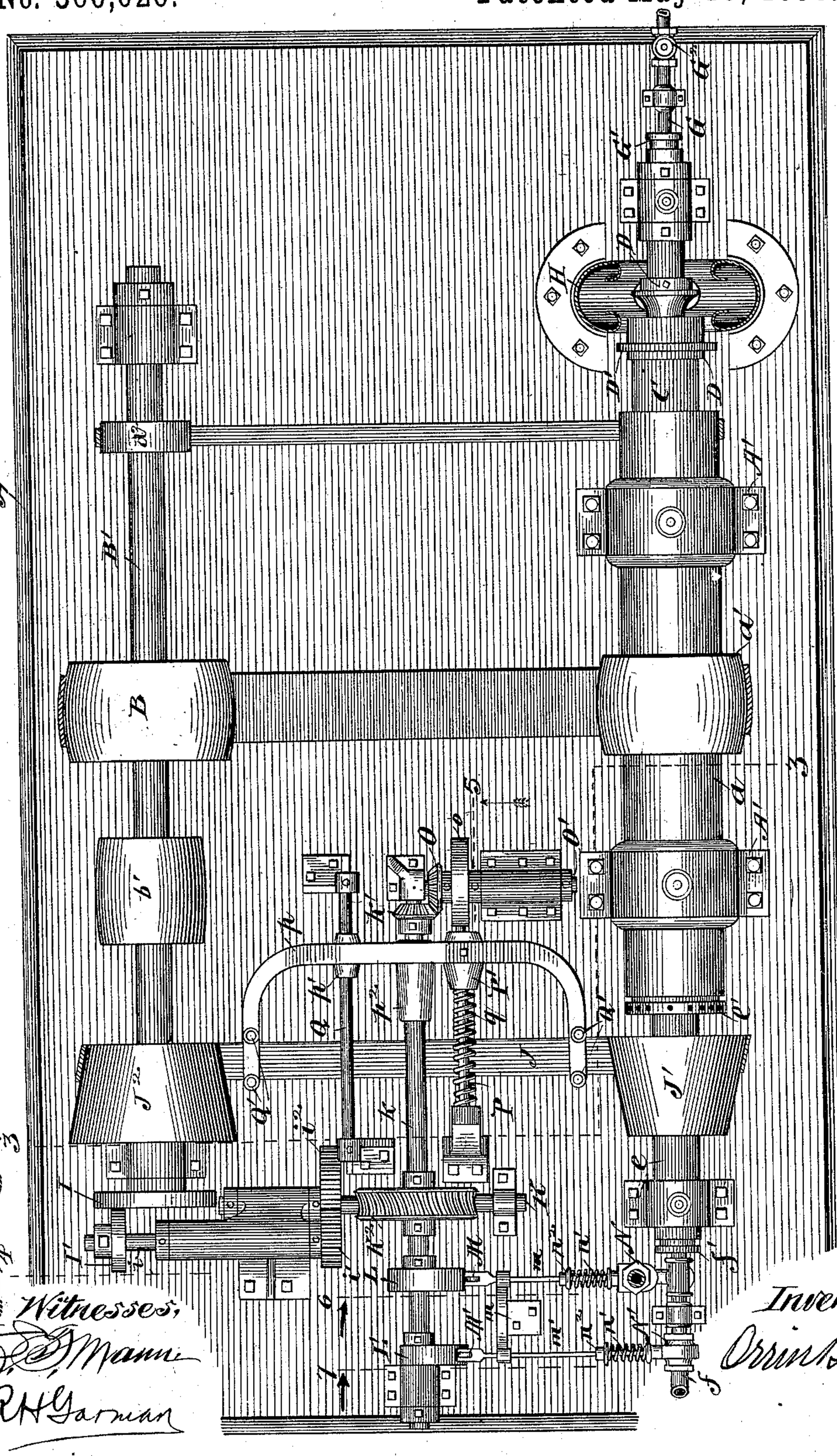
(No Model.) 3 Sheets—Sheet 1.

O. B. PECK.

CENTRIFUGAL SEPARATOR.

No. 560,626. Patented May 19, 1896.



Witnesses;
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(No Model.) 3 Sheets—Sheet 2.

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CENTRIFUGAL SEPARATOR.

No. 560,626. Patented May 19, 1896.

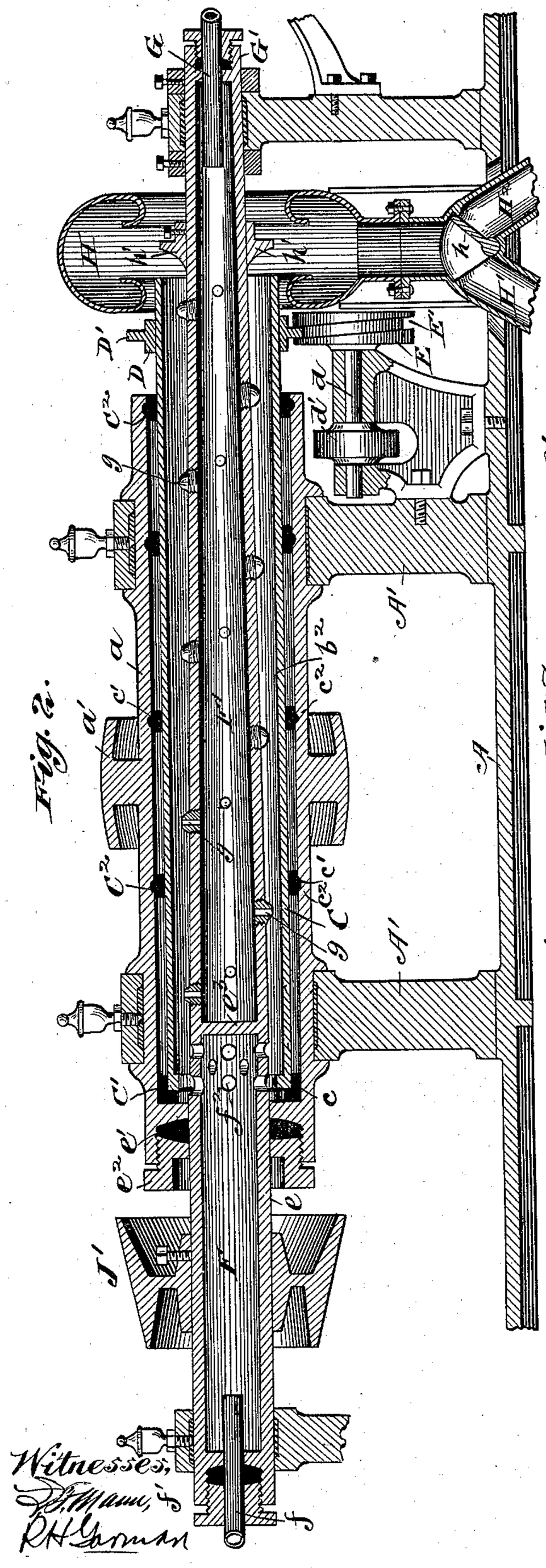

Fig. 2.

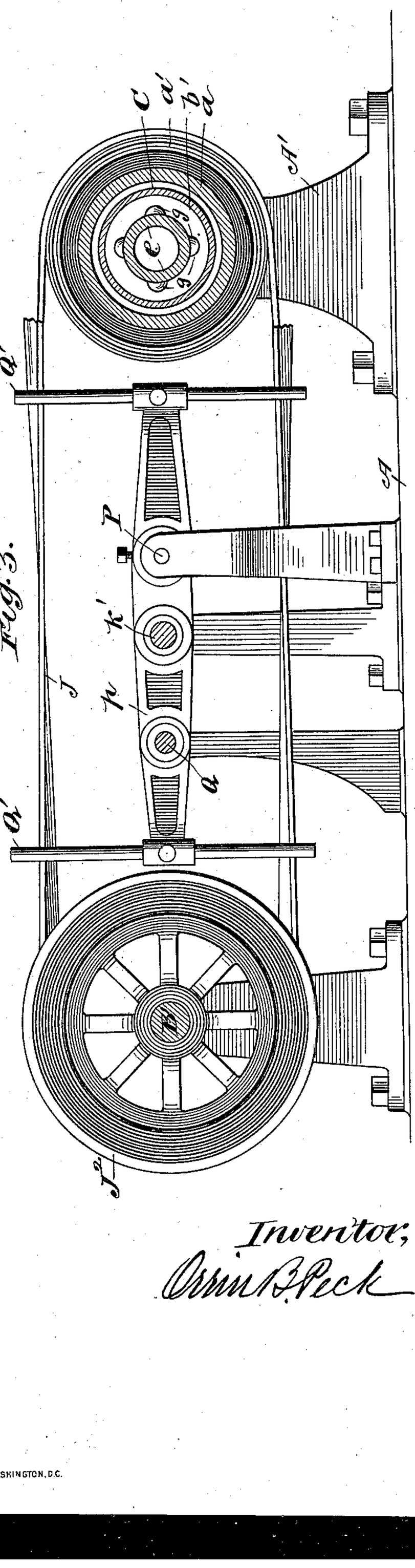

Fig. 3.

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(No Model.) 3 Sheets—Sheet 3.

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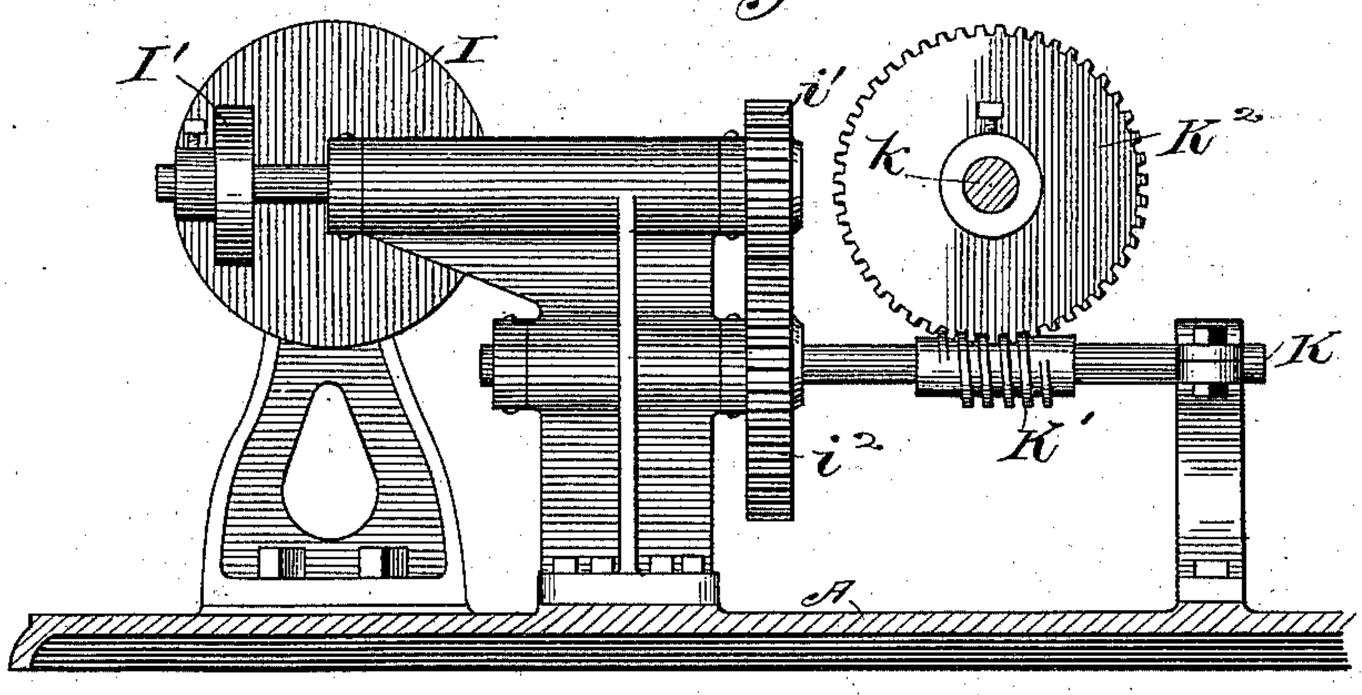
CENTRIFUGAL SEPARATOR.

No. 560,626. Patented May 19, 1896.

Fig. 4.



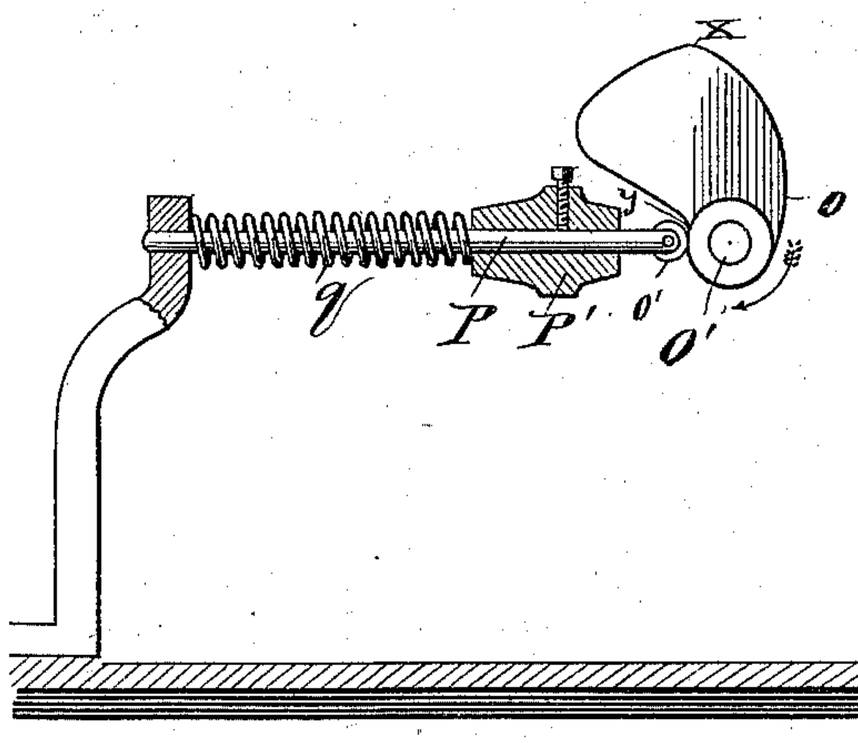


Fig. 5.

Fig. 6.

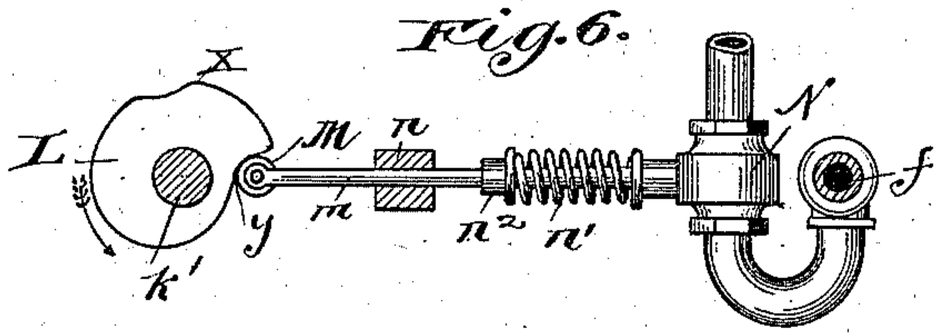
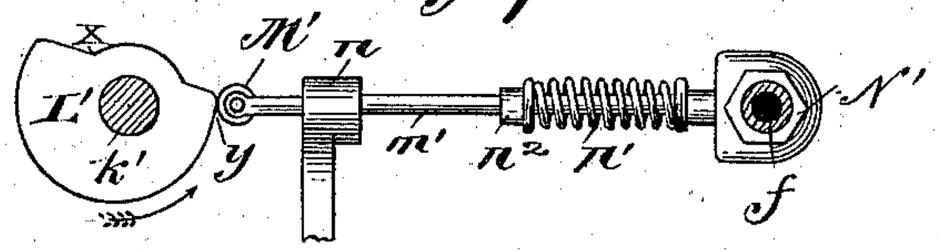


Fig. 7.



Witnesses,
D. D. Mann
R. H. Garman

Inventor,
Orrin B. Peck

UNITED STATES PATENT OFFICE.

ORRIN B. PECK, OF CHICAGO, ILLINOIS, ASSIGNOR TO MELINDA PECK, OF SAME PLACE.

CENTRIFUGAL SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 560,626, dated May 19, 1896.

Application filed March 28, 1894. Serial No. 505,416. (No model.)

To all whom it may concern:

Be it known that I, ORRIN B. PECK, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Centrifugal Separators, of which the following is a specification.

My invention relates more particularly to centrifugal ore-separators, and has for its principal object the provision of a process and machine for obtaining a more perfect separation of lighter from heavier material while in a finely-divided state by subjecting it to centrifugal force, varying liquid flow, and other forces and maintaining the relative degree or proportion of the centrifugal and liquid forces approximately constant during the operation.

As is well known, in the passage of a constant quantity of water through a channel or passage whose sectional area is varied the velocity of the flow will vary inversely as the area of the channel, and its kinetic energy will consequently be varied as the square of its velocity. Therefore if a separating vessel having its separating-surface forming one wall of a channel or passage is rotated with sufficient rapidity to develop a minimum desired intensity of centrifugal force and, as the material under treatment accumulates on the separating-surface, a constant quantity of water or other liquid is introduced therewith, which at the beginning of the operation developed by its velocity of flow the impulse necessary to carry away lighter material and allow the heavier to be precipitated and accumulate, the latter will decrease the area of the channel, resulting in an increased velocity of flow and largely-increased impulse of the liquid, thus destroying the ratio of intensity of the liquid and centrifugal forces, and in consequence causing some of the heavier material to be carried off with the lighter. To overcome this difficulty, the flow of liquid to the treatment vessel is decreased in the same degree or proportion as the area of the channel or passage is decreased by the accumulation of heavier material. This reduces the velocity of flow, and consequently the impulse of the liquid, and maintains the ratio of intensity of the forces approximately constant throughout the operation, thereby preventing the heavier substances from being carried away and discharged with the lighter. At the same time the material is subjected to other varying forces to insure its more perfect separation. I attain these results by mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a top plan view of the entire machine. Fig. 2 is a central vertical longitudinal section through the treatment vessel. Fig. 3 is a transverse section on the line 3 of Fig. 1. Fig. 4 is a transverse section on the line 4 of Fig. 1. Fig. 5 is a sectional detail on the line 5 of Fig. 1, showing the belt-shifting cam. Fig. 6 is a sectional detail on the line 6 of Fig. 1, showing the mechanism for operating the material-feeding valve; and Fig. 7 is a similar view on the line 7 of Fig. 1 of the liquid-feeding valve. All sections are taken in the direction indicated by the arrows.

Similar letters refer to like parts throughout the several views.

A designates a base-plate, upon which, in standards A′ A′, is journaled a supporting-frame *a*, preferably of cylindrical form, and having upon its exterior a belt surface or pulley *a′* by which it is rotated by means of a belt passing over a pulley B on the counter-shaft B′, preferably supported on standards on the base-plate, said counter-shaft being driven by a pulley *b′* belted to any source of power.

Within the outer cylindrical frame is preferably a light vibratable intermediate or separating cylinder C, provided with a separating-surface b^2 and yieldingly supported by means of elastic rings C′ C^2 C^2, preferably of rubber, interposed between the exterior of the intermediate cylinder and the interior surface of the supporting-cylinder. The ring C′ at the feed end has an annular inside groove *c*, into which the end of the separating-cylinder projects, forming a practically water-tight joint and thus preventing the material and liquid from passing between the cylinders. The rings C^2 C^2 have upon their outer surface an annular projection *c′*, which engages an annular groove c^2 in the interior of the supporting-cylinder, thus preventing the longitudinal displacement of the ring during the

vibration of the separating-cylinder, which is permitted by the elasticity of the supporting means. These rings are compressed between the cylinders to a sufficient degree to insure their rotating together at approximately the same speed, yet allowing the longitudinal vibratory movement of the separating-cylinder.

At the discharge end of the treatment vessel the separating-cylinder projects beyond the supporting-cylinder and has secured upon its exterior a ring D, on which is an annular projection D′. Below the treatment vessel is a short shaft *d*, supported in a bracket bolted to the base-plate. This shaft has a pulley *d*′, by which it is rotated by a belt from the pulley *d*² on the counter-shaft B′. Upon the other end of the shaft is a wheel E, having upon its surface a cam-groove E′, which engages the projection D′ during its rotation, causing the separating-cylinder to be rapidly slightly reciprocated, imparting thereto shocks or vibrations, thus assisting in the separation of material.

Within the separating-cylinder extends the inner preferably hollow agitating cylinder or shaft *e*, supported in standards on the base-plate and extending through an adjustable stuffing-box *e*′, whose packing may be compressed by the threaded gland or plug *e*², forming a practically water-tight joint at the feed end of the supporting-cylinder. It is rotated at a different speed from the separating-surface by a cone-pulley J′, over which passes a belt J from the cone-pulley J² on the counter-shaft B′. This cylinder is divided by a partition *e*³ into two sections F and F′. Into the section F extends a non-rotatable pipe *f* through a stuffing-box *f*′ similar to *e*′. Through this pipe the material to be separated in a finely-divided state and mingled with a liquid, preferably water, is introduced into the section and from there by the orifices *f*² into the separating-cylinder at or near the feed end.

At the opposite end of the inner cylinder into section F′ extends a non-rotatable pipe G, through a similar stuffing-box G′. Through this pipe a liquid, preferably water, is introduced, which passes, preferably, through the hollow projections or tubes *g*, screwed or otherwise secured in orifices arranged along the inner cylinder, and flows in jets against the material accumulated on the separating-surface. The impact of these jets aids in separating lighter from heavier material and wholly or partially causing it to become suspended in the liquid for the purpose of discharge, this action being assisted by the agitation imparted to the material by the direct contact of the tubes as they pass through it. The flow of water into the section F′ is controlled and regulated, as desired, by means of a valve G².

The inner cylinder is slightly tapered from the feed to the discharge end of the treatment vessel, being smallest at the latter point, thus maintaining practically constant velocity of flow throughout the entire length thereof by increasing the area of the channel or passage in approximately the same ratio as the quantity of liquid is increased by the added number of jets. It also permits the lighter material to expand or move more freely in this portion of the channel at which it is about to be discharged, and also decreases the agitation produced by the impact of the jets of liquid and the action of the tubes upon accumulated heavy substances by removing them farther from the surface upon which they rest, thus preventing the remingling of the material and insuring more perfect separation.

About the discharge end of the separating-cylinder is a hood H to receive the material flowing therefrom, and to this are connected branch pipes H′ H² for receiving the lighter and heavier material, respectively, the entrance thereto being controlled by a valve *h*, which may be operated as desired. Within this hood upon the inner cylinder is preferably placed a circular plate *h*′, secured thereto by a set-screw and being so arranged in proximity to the end of the separating-cylinder that the material discharged therefrom is deflected into the hood, and at the same time the flow from said cylinder is so checked as to allow the material to be submerged in the liquid to attain the suspension of the lighter portion.

For the purpose of varying the feed of liquid and material to the separating-surface and the degree of agitation imparted, the automatic mechanism is preferably used, which will now be described. These actions might, however, be otherwise effected—manually, if desired.

Upon the extremity of the counter-shaft B′ is fixed a friction-disk I, against which bears a friction wheel or roll I′, adjustably secured by a set-screw to a short shaft *i*, supported in a standard bolted to the base-plate, carrying upon its opposite extremity a gear *i*′, which meshes with a gear *i*² upon the shaft K, suitably supported. Upon this shaft K is a worm K′, which engages a worm-wheel K² upon a longitudinally-extending shaft *k*. To this shaft are secured a bevel-gear *k*′ and two cams L L′. The cams L L′ have bearing against their surface-rollers M M′ upon the ends of the stems *m m*′ of the material and liquid feeding valves N N′, respectively. The valve-stems are supported by the intermediate bracket *n* and have embracing them spiral springs *n*′ *n*′, which bear against the valves and adjustable collars *n*² *n*², secured by set-screws to the stems for the purpose of adjusting the tension of the springs, maintaining the rollers in constant contact with the face of the cams, thus permitting the valves to be periodically opened and closed as the same rotate.

The bevel-gear *k*′ engages a bevel-gear O upon the end of a stub-shaft O′, supported in a bracket on the base-plate. This shaft also carries a cam *o*, against the surface of which

bears a roller o' upon the end of a rod P, passing through a bracket bolted to the base-plate. Upon this rod is a sleeve P', secured thereto by a set-screw which carries the belt-shifting bar p, the latter being further supported by a sleeve p', sliding on the rod Q, and a sleeve p^2, sliding freely on the shaft k. This belt-shifting bar has at its outer extremities vertically-extending rods Q', which engage the opposite sides of the belt J, causing it to be shifted from one end of the cone-pulleys to the other, thus varying the speed of rotation of the agitating-cylinder as the rod P is moved back and forth by the rotation of the cam. The roller is held constantly against the face of the cam by a spiral spring q, encircling the rod and bearing against the sleeve P' and the supporting-bracket. To vary the rate at which these parts are actuated, the friction-wheel I' may be adjusted toward or from the center of the friction-disk I, thus varying its speed of rotation, and consequently the frequency and length of the periods during which material and liquid are fed, and also the rate of change in the speed of rotation of the agitating-cylinder.

When a separating vessel or cylinder is used of sufficiently large diameter to permit an accumulation or head of liquid at the receiving end to secure the desired force through the same, the packing-boxes are preferably dispensed with.

The operation of the machine is as follows: In the position in which the elements are shown in the drawings the period of separation has just begun. The valve N is open to its fullest extent, allowing a proper amount of material to be introduced into the treatment vessel, which is being rotated at a speed sufficient to develop the desired centrifugal force, causing it to move toward a position about the outer diameter of said vessel and to be there separated, while the valve N' is opened sufficiently to allow liquid enough to flow in with the material to submerge it and allow the lighter to be held in suspension for the purpose of discharge. At the same time the driving-belt J is at the largest diameter of cone-pulley J', rotating the inner cylinder or shaft at its lowest speed. As the separation proceeds and the cams rotate, the material-valve is gradually closed, and as the material accumulates on the separating-surface, decreasing the area of the channel or passage and thus tending to increase the velocity of flow therethrough, the liquid-valve is also gradually closed by the increasing radius of its cam, decreasing the quantity fed in the same ratio as the area of the channel or passage is being decreased during the operation and thus maintaining the relative degree or proportion of the centrifugal force and the impellent force of the flowing liquid approximately constant, thereby preventing the heavy material from being carried away and discharged with the lighter. The belt J during this period is allowed to remain at the largest diameter of pulley J' by the uniform portion of its actuating-cam which is of least diameter, maintaining the speed of rotation approximately constant, and therefore the agitation produced by the motion of the tubes and the impact of the jets therefrom. By this means the lighter is partially or wholly separated from the heavier material, suspended in the liquid, passed through the treatment vessel without frictional contact with the separating-surface, and discharged without carrying heavy substances with it. When the points x on each of the cams have come under the rollers on the valve-stems and the belt-shifting bar, this occurring simultaneously, the separation and discharge of the lighter material will have been accomplished and the material-valve is abruptly closed, the liquid-valve widely open and the rapidity of rotation of the agitating means greatly increased, resulting in increased agitation and impellent force of the flow of liquid, dislodging the heavier material and discharging it into the pipe H^2, the valve being properly adjusted to receive it. This condition and operation of elements continue uniform until the points y on the cams come under the rollers, when the initial condition in the vessel is restored and the period of separation again recommences.

Although the term "cylinder" has been applied throughout to the three portions of the treatment vessel for the sake of brevity, this form is not absolutely essential to the operation of the machine, and any other might be employed by which the desired result would be obtained. It is to be understood in this generic sense in both description and claims.

It is obvious that many changes and modifications in the details of construction of the various parts of the mechanism herein described may be made as desired by the constructor, or to best suit the varied conditions under which the machine is operated, without departure from my invention.

In my applications, Serial Nos. 505,410, 505,413, and 505,418, filed March 28, 1894, I claim certain features shown and described but not claimed herein.

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

1. In a centrifugal separator, the combination of a cylinder adapted to be continuously rotated at an approximately constant speed, a rotatable agitator therein, and automatic means for varying the speed of said agitator, substantially as described.

2. In a centrifugal separator, the combination of a cylinder adapted to be rotated at an approximately constant speed, a shaft or cylinder therein, belt-shifting mechanism for controlling the speed of rotation of said shaft, and a cam for actuating the same, substantially as described.

3. In a centrifugal separator, the combination of a cylinder adapted to be rotated at an approximately constant speed, a shaft or cyl-

inder therein, belt-shifting mechanism for controlling the speed of rotation of said shaft, a cam for actuating the same, and adjustable speed-gearing for rotating said cam, substantially as described.

4. In a centrifugal separator, the combination of an outer rotatable cylinder, pipes for supplying material and a liquid thereto, a rotatable shaft or cylinder within said outer cylinder, cams for controlling the supply of material and liquid and speed of rotation of the shaft, and a common adjustable speed-gearing for actuating all the cams, substantially as described.

ORRIN B. PECK.

Witnesses:
M. L. ALLEN,
R. H. GARMAN.

Correction in Letters Patent No. 560,626.

It is hereby certified that Letters Patent No. 560,626, granted May 19, 1896, upon the application of Orrin B. Peck, of Chicago, Illinois, for an improvement in "Centrifugal Separators," were erroneously issued to Melinda Peck as sole owner of the invention; whereas said Letters Patent should have been issued to *The Patent Title Company, of same place*, said The Patent Title Company being assignee, by mesne assignments, of the entire interest in said invention, as shown by the assignments of record in this Office; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 23d day of June, A. D. 1896.

[SEAL.]

JNO. M. REYNOLDS,
Assistant Secretary of the Interior.

Countersigned:

S. T. FISHER,
Acting Commissioner of Patents.