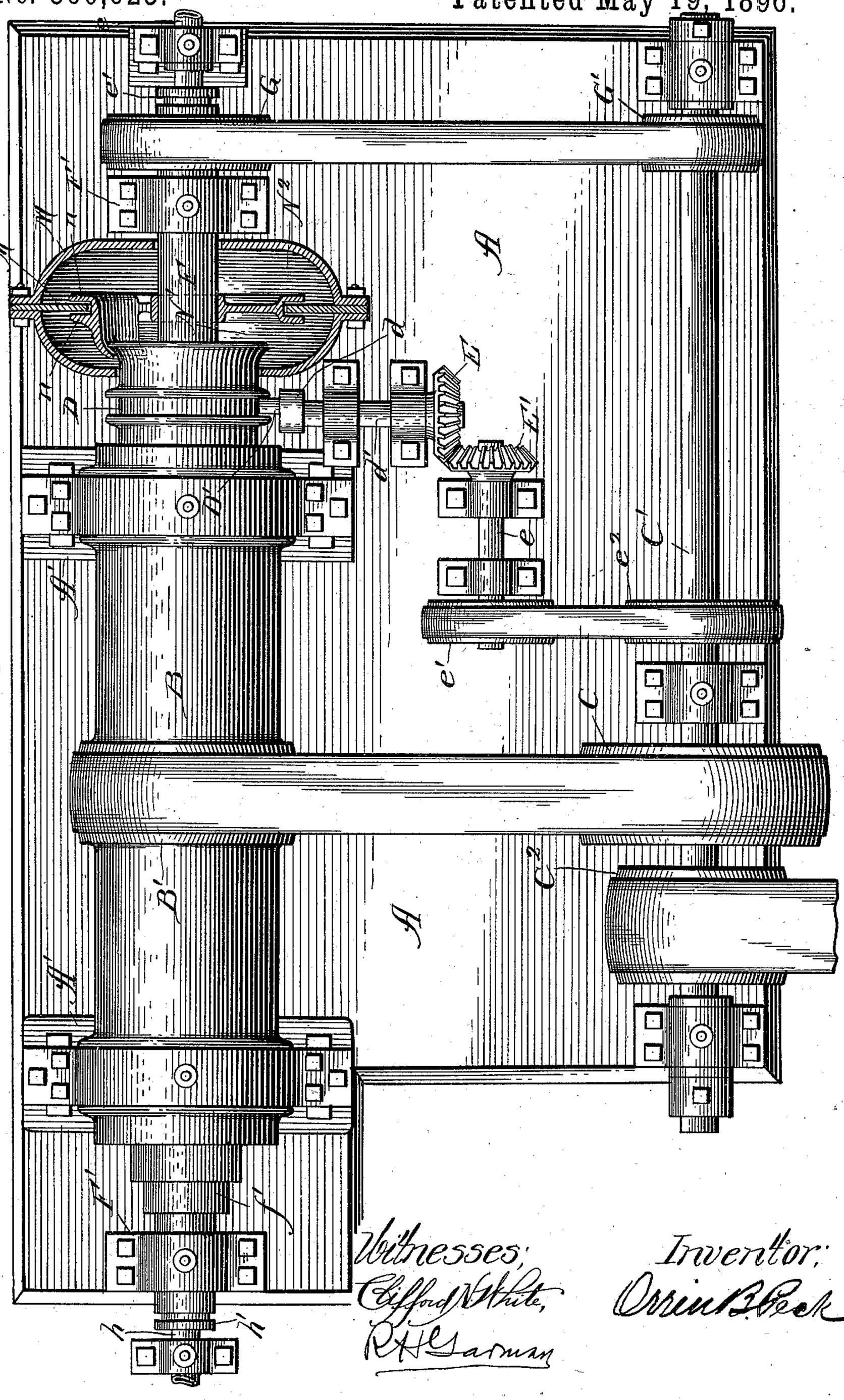
(No Model.) 3 Sheets—Sheet 1.

O. B. PECK.

CENTRIFUGAL SEPARATOR.

No. 560,625. Patented May 19, 1896.



Witnesses;
Clifford N. White,
R. H. Parmar

Inventor:
Orrin B. Peck

(No Model.) 3 Sheets—Sheet 2.

O. B. PECK.

CENTRIFUGAL SEPARATOR.

No. 560,625. Patented May 19, 1896.

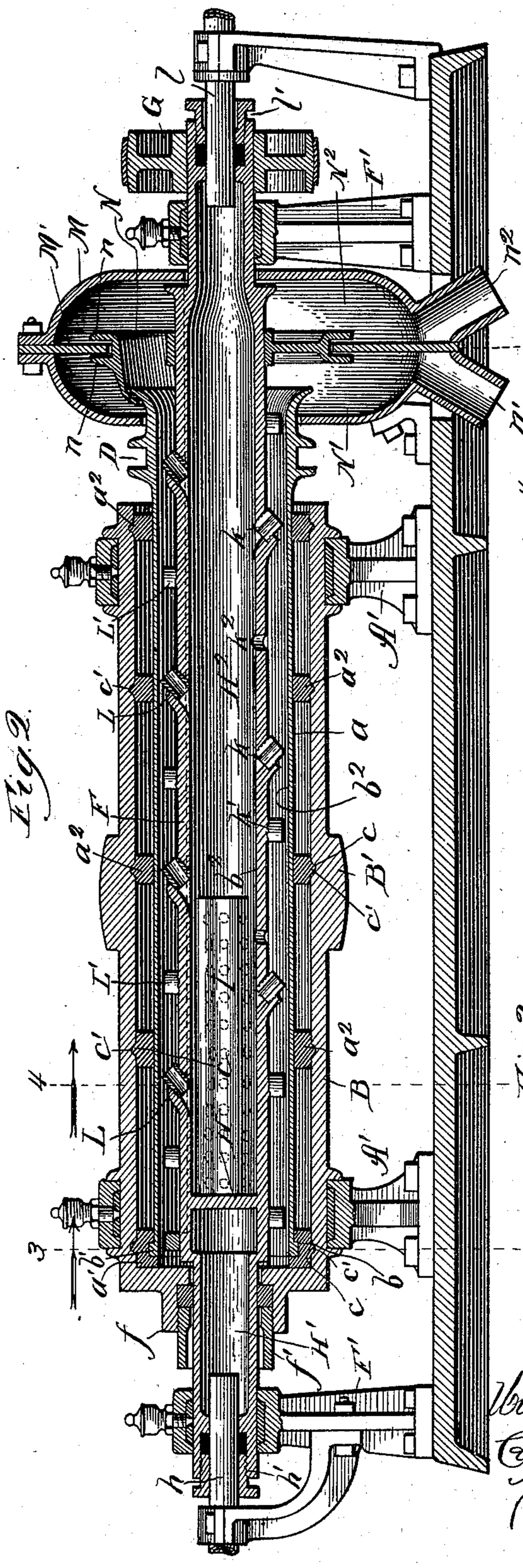


Fig. 2.

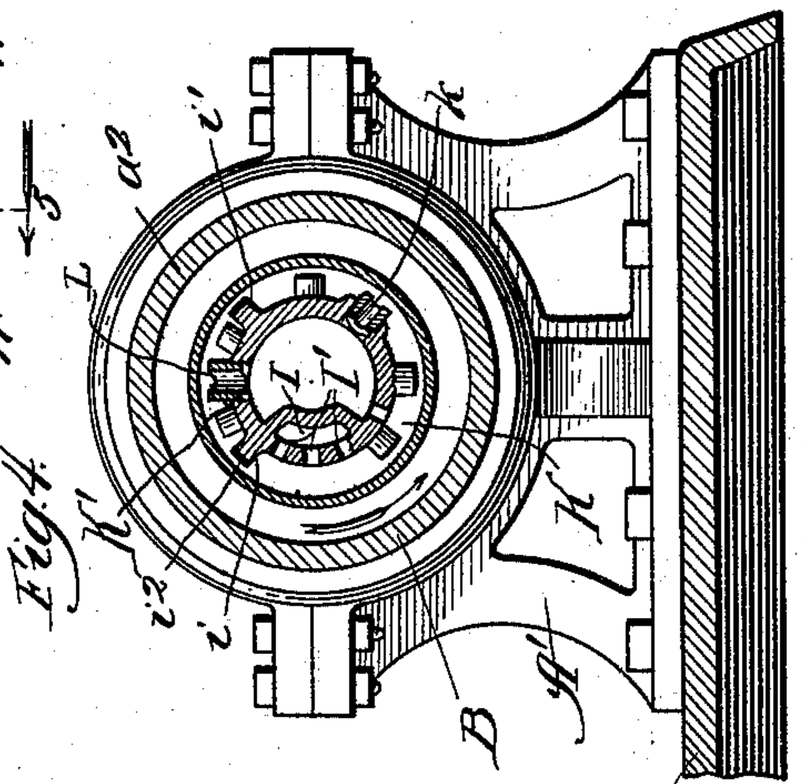


Fig. 4.

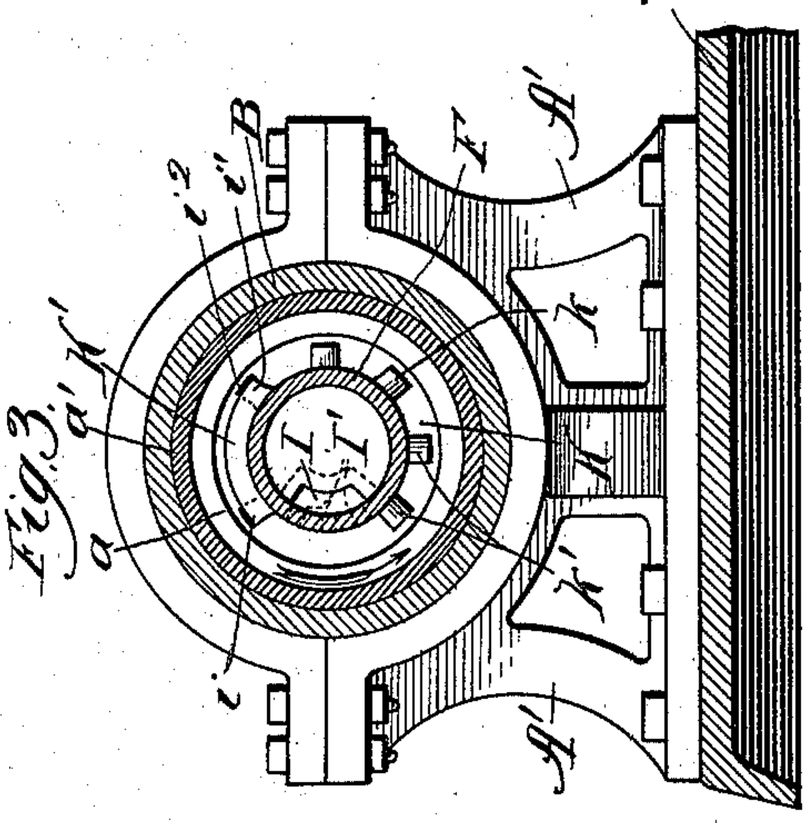


Fig. 3.

Witnesses;
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R. H. Garman

Inventor;
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(No Model.) 3 Sheets—Sheet 3.

O. B. PECK.

CENTRIFUGAL SEPARATOR.

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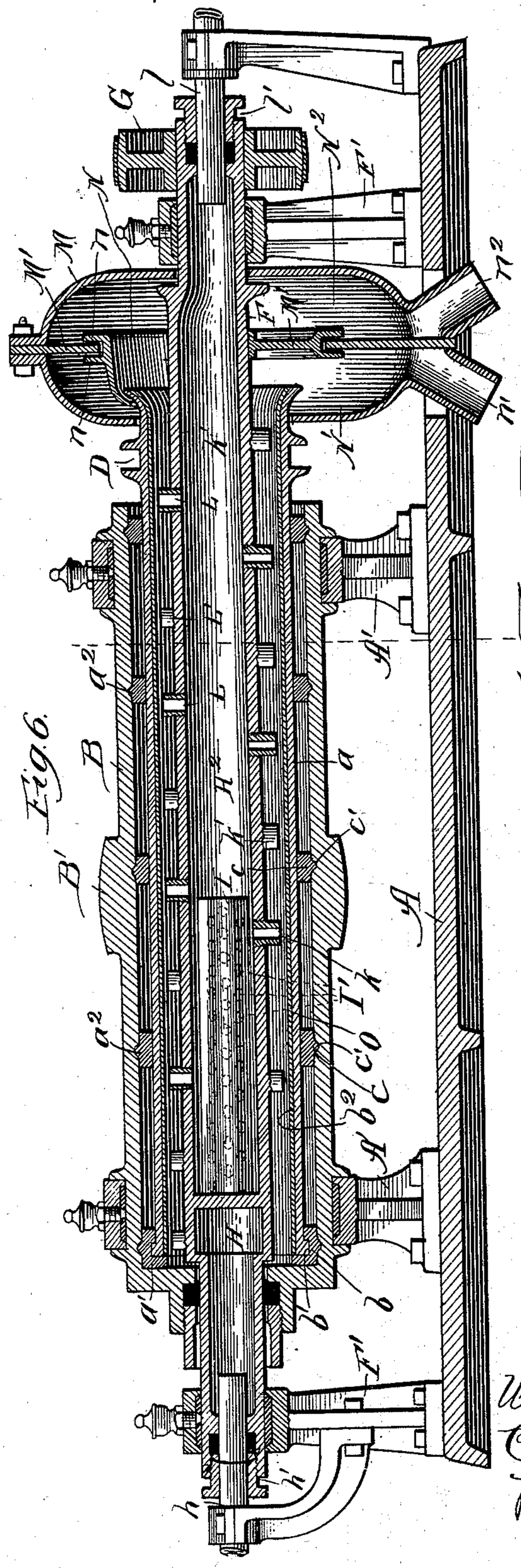

Fig. 6.

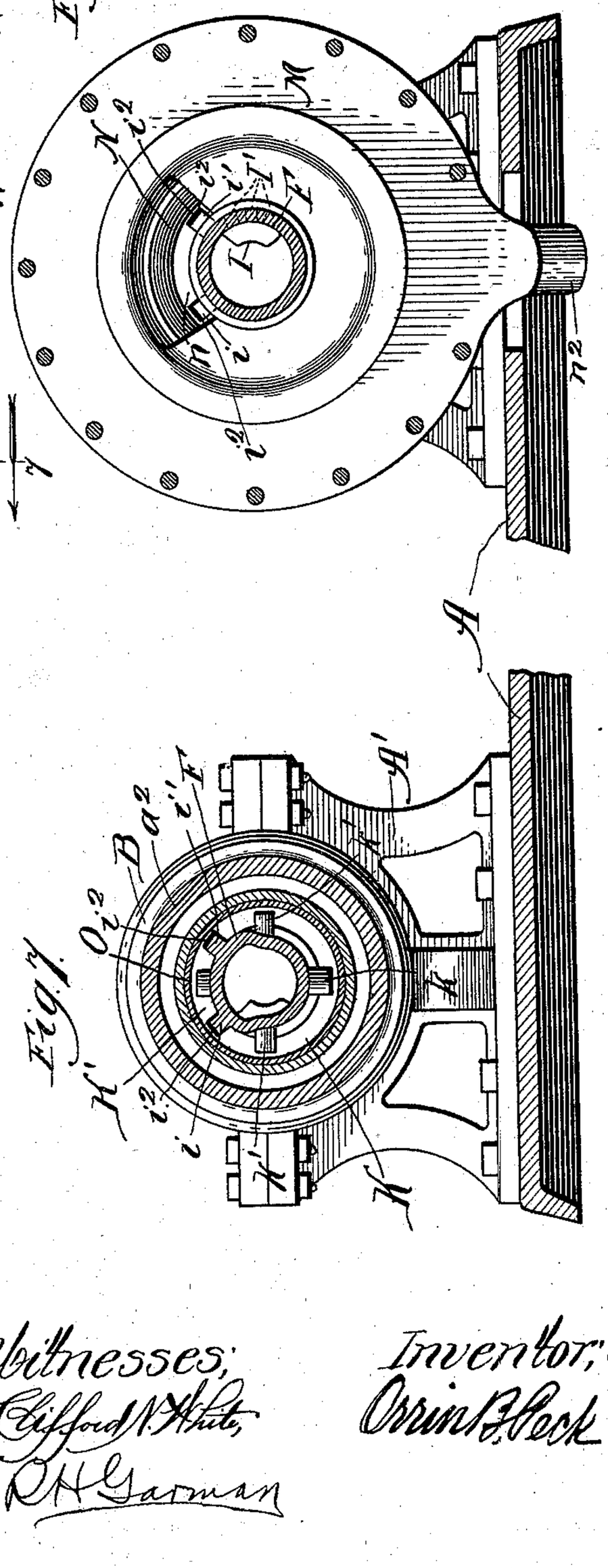

Fig. 5.

Fig. 7.

Witnesses;
Clifford N. White,
D. 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. 560,625, dated May 19, 1896.

Application filed March 23, 1894. Serial No. 505,415. (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 machine for effecting the separation of materials of different degrees of specific gravity, when in a finely-divided state, and a separate and continuous discharge thereof from the treatment vessel in which they are being subjected to centrifugal force and certain opposing forces. I attain this result by the use of the 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. 2. Fig. 4 is a transverse section on the line 4 of Fig. 2. Fig. 5 is a transverse section on the line 5 of Fig. 2. Fig. 6 is a central vertical longitudinal section of another form of the device, and Fig. 7 is a transverse section on the line 7 of Fig. 6. All sections are taken in the direction indicated by the arrows.

Similar letters of reference denote like parts throughout the several views.

A designates a base-plate upon which, in standards A′, is journaled the supporting-frame B of the treatment vessel, preferably of cylindrical form. This supporting-frame has upon its exterior a belt surface or pulley B′, by which it is rotated by means of a belt from a pulley C on the counter-shaft C′, journaled in standards on the base-plate. The counter-shaft is driven by pulley C^2, belted to any suitable source of power. Within the cylinder B is supported a vibratable intermediate or separating cylinder *a*, of comparatively light material and provided with a separating-surface b^2, by means of rings a' a^2 a^2 of elastic material, preferably rubber. The ring a' at the feed end of the treatment vessel is provided with an annular groove *b*, into which extends an annular flange b' on the end of the separating-cylinder in such a manner as to insure a practically water-tight joint during the movement of said cylinder hereinafter described, thus preventing material and liquid from passing between it and the supporting-cylinder. The rings a' and a^2 are provided with annular projections *c*, which engage annular grooves c' in the interior of the supporting-cylinder to retain the rings in place during the motion of the intermediate cylinder through them. They are tightly enough compressed between the two cylinders to insure their rotating together at substantially the same speed and still allow this movement.

At the discharge end of the treatment vessel the separating-cylinder projects beyond the supporting-cylinder, and at this point is provided with an annular groove D, formed between two projecting flanges on the outer surface of the cylinder. A crank-pin D′ on a crank-disk *d*, mounted upon the end of a transverse shaft d', extends into the groove. This shaft d' is suitably supported in standards on the bed-plate, and is rotated by means of the engagement of a bevel-gear E with a bevel-gear E′ on a longitudinal shaft *e*, the latter being driven by a belt passing over pulleys e' and e^2 upon the shaft *e* and counter-shaft C′, respectively. The resulting movement of the crank-pin D′ causes the rapid and preferably slight reciprocation or vibration of the intermediate cylinder, which is permitted by the elasticity of the supporting means, imparting shocks or vibrations to the separating-surface. Extending through the separating-cylinder is the inner cylinder or hollow shaft F, which serves to feed material to the separating-cylinder and to subject said material to aqueous and other forces for the purpose of separation and discharge, and also as a deflector to guide the material along in proximity to the separating-surface. This inner cylinder is journaled in the standards F′ F′ upon the base-plate and at the feed end of the treatment vessel extends, preferably, through a stuffing-box *f* in the supporting-cylinder, this stuffing-box having a threaded gland or plug f', by which the elastic packing material may be compressed, insuring a practically water-tight joint and preventing the passage of material and liquid. Upon the other extremity of the

inner cylinder is a pulley G, of smaller size than the pulley on the supporting-cylinder, which is driven by a belt passing over a pulley G′ on the counter-shaft C′. The size of these pulleys is so proportioned that a differential speed will be imparted to the inner and outer cylinders, so that any point on the surface of cylinder F has a circumferential movement or travel with relation to a fixed point on the separating-surface.

The inner cylinder F is divided by a partition H into two sections H′ and H². Into the section H′ projects a non-rotatable pipe *h* through a stuffing-box *h′*, similar to *f*. This pipe is for the purpose of feeding mingled ore and a liquid, preferably water, into the section, from which it passes into a conduit I, extending within the cylinder F for a greater or less part of its length, as desired, and being closed except for orifices I′ through the wall formed by the inner cylinder, through which the material and liquid passes, and the former is deposited upon the separating-surface along and near a longitudinal partition *i* on the inner cylinder, which extends its entire length within the separating-cylinder, as shown by dotted line in Fig. 2. This partition *i*, with a similar partition *i′*, projects radially from the surface of the inner cylinder to a point near the separating-surface and divides the channel or passage therebetween into two longitudinal sections or passages K K′, the former, in which separation is effected, having the greater circumferential width. Upon the top of these partitions nearest the separating-surface are fixed strips *i*² of elastic material, preferably rubber, serving to more completely divide the sections K K′ and as a cushion to prevent injury to the parts if they come in contact during the operation of the machine as a result of the tremor or movement caused by the high speed of rotation of the parts and the yield of the elastic supporting-rings. Into the section K extend hollow projections or tubes *k*, fixed in orifices in the surface of the inner cylinder, these tubes being preferably inclined toward the discharge end, for the purpose hereinafter stated. Over this section on the inner cylinder are also solid agitating-pins *k′* and radial orifices *k*². In the other section, K′, are the similarly-inclined tubes L, of greater inside diameter than tubes *k*, and the pins L′, mounted on the surface of cylinder F. The tubes *k* L and the orifices *k*² have forced through them jets of a liquid, preferably water, introduced into the section H² of the inner cylinder by means of a non-rotatable pipe *l*, passing through the stuffing-box *l′*. The flow of liquid in this pipe *l*, and also that of the mingled material and liquid in pipe *h*, may be controlled as desired by suitable valves. (Not shown.)

The end of the separating-cylinder extends into a hood M, which is divided into two parts or divisions N′ N² by a partition M′, from which the lighter and heavier materials are conducted away by the pipes *n′* *n*², respectively, to separate receptacles. The heavier material is discharged into division N² by means of a spout N, secured to the inner cylinder between the outer sides of the partitions *i* *i′* and extending over the end of the separating-cylinder and embracing, by means of double annular flanges *n* *n*, the inner periphery of the partition M′, thus delivering to the division N² only that material from the section K′ from which the heavier portion is discharged.

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

The operation of the machine is as follows: The treatment vessel being rotated with sufficient rapidity to develop the degree of centrifugal force desired, the material to be separated, in a finely-divided state and mingled with a sufficient amount of liquid to permit its submergence on the separating-surface and the suspension of the lighter portion, is introduced by means of pipe *h* into the section H′ of the inner cylinder F. It then passes into the conduit and thence by the orifices I′ into the section K of the channel or passage between the inner cylinder and the separating-cylinder, being deposited on the separating-surface along and near the longitudinal partition *i*, where by the action of centrifugal force the heavier is precipitated and the lighter allowed to wholly or partially become suspended in the liquid, the separation being assisted by the shocks or vibrations imparted to the inner cylinder by the crank-pin D′ and by the jets of liquid from tubes *k* and orifices *k*², and also by the agitation produced by the direct contact of the moving tubes and the solid pins *k′*. As the lighter is held in suspension, it is moved by the impellent force of the liquid, produced by its resultant flow, aided by the direction of inclination of tubes *k*, along through the channel or passage wholly or partially without frictional contact with the separating-surface and discharged into the division N′ of the hood M, from which it is conducted away by the pipes *n′*. By reason of the differential speed of rotation of the inner and intermediate cylinders the surface of one travels with relation to the other, the resultant motion of the separating-surface being indicated by the arrows in Figs. 3 and 4, and the material on the separating-surface deposited by the orifices I′ along one side of the section K is slowly carried across said section, during which travel the separation and removal of lighter substances is effected, and the heavier material gradually passes under the longitudinal partition *i′* into the space *k′*, where it is subjected to the increased agitation produced by the impact of the jets of liquid from larger tubes L, and at the same

time to the increased impellent force of the greater quantity of liquid flowing with a greater velocity in the more narrow space. These increased aqueous forces will dislodge the heavier and move it along another portion of the separating-surface from that on which the lighter is being separated and discharged in section K, and deliver it to the discharge-spout N, from which it flows into the other division N^2 of the hood and is conveyed by the pipe n^2 to a separate receptacle.

In the form illustrated in Figs. 6 and 7 the surface of the inner cylinder over the section K′ is concentric with the separating-surface and the channel or passage in this section of comparatively small sectional area. Over the other section, K, the inner cylinder is of irregular shape, as shown in Fig. 7, making the channel wider, and this portion also tapers from the feed to the discharge end, thus gradually increasing the area of the channel. The section K is provided with jet-tubes k on the inner cylinder and also with the solid agitating-pins k'. The tubes k, as well as the tubes L over the section K′, are radial and not inclined, as in the form previously described, and the orifices k^2 are omitted. The separating-surface is provided with a removable lining O, preferably of flexible material—rubber, for example—which protects said surface from the abrasion and wear of the material and acts with the elastic strips i^2 to prevent injury to the separating-surface by contact with the partitions. This lining may of course be replaced when worn. The mechanism is otherwise like that illustrated in the other figures in the drawings.

In the operation of this device the radial width of the channel through which the heavier material is discharged being less than that in which the separation and discharge of the lighter is accomplished, there is a greater velocity of flow, and consequently greater impellent aqueous force in the former, resulting in the more certain dislodgment of the heavier at the desired point. As in the form shown in Figs. 2, 3, and 4, this difference in the aqueous forces is further added to by the increased diameter of the liquid-discharge orifices over the section K, the solid pins aiding in the suspension of lighter material by the agitation produced by their contact. The taper of the cylinder F in the portion K maintains a practically constant velocity of flow through the entire length thereof by increasing the area of the channel in approximately the same ratio as the quantity of liquid is increased by the added number of jets. It also permits lighter material to expand or move more freely as it nears the point of discharge, and removes the accumulated heavier farther from the action of the agitating means, thus insuring more perfect separation.

For conciseness the phrases "aqueous forces" and "aqueous suspension" have been used, although it is not intended to limit the liquid employed to water. The term "cylinder," for the same reason, has been applied throughout to the three portions of the treatment vessel, though any other form might be employed by which the desired result would be obtained. It is to be understood that the word is used in this generic sense in both the description and claims.

It will be noticed that while the agitating and other forces opposing centrifugal force permit or allow the precipitation of heavier substances they cause or effect—that is, compel—the suspension of the lighter in the liquid, whereas the centrifugal force acts positively to effect both results. This explanation is made because it is not always possible to bring out the distinction clearly in the claims without undue prolixity when mentioning these forces in connection.

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 departing 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 rotatable separating-surface, and partitions for dividing the separating-surface into two or more portions traveling with respect thereto, and provided with yieldable surfaces nearest to the separating-surface, substantially as described.

2. In a centrifugal separator, the combination of a rotatable, yieldable separating-surface, and partitions traveling with respect thereto for dividing such surface into two or more portions, substantially as described.

3. In a centrifugal separator, a rotatable, yieldable separating-surface, and partitions traveling with respect thereto, provided with yieldable surfaces on the portion nearest the separating-surface, substantially as described.

4. In a centrifugal separator, the combination of a rotatable cylinder provided with a separating-surface, a feed-pipe communicating with the cylinder in a practically watertight manner, a deflector in proximity to the separating-surface, and partitions for dividing said surface and the space in proximity thereto into two or more parts traveling with respect to the same, substantially as described.

5. In a centrifugal separator, the combination of a rotatable cylinder provided with a separating-surface, a feed-pipe communicating with the cylinder in a practically watertight manner, a deflector in proximity to the separating-surface, partitions for dividing such surface and the space in proximity thereto into two or more parts traveling with

respect to the same, and means for subjecting constantly-changing portions of the separating-surface to aqueous forces of greater intensity than upon the remainder of such surface to effect the removal of heavier substances, substantially as described.

6. In a centrifugal separator, the combination of a rotatable cylinder having a closed end and provided with a separating-surface, a feed-pipe communicating with the cylinder in a practically water-tight manner, hollow deflector near the separating-surface provided with perforations for securing aqueous forces of greater intensity on one portion of the separating-surface than another, and partitions traveling with respect to said surface, substantially as described.

7. In a centrifugal separator, the combination of a rotatable separating-surface, means for deflecting or guiding material along near said surface, and partitions for dividing the separating-surface into two or more portions traveling with respect thereto, and provided with yieldable surfaces nearest to the separating-surface, substantially as described.

8. In a centrifugal separator, the combination of a rotatable separating-surface, partitions for dividing the separating-surface into two or more portions traveling with respect thereto, and provided with yieldable surfaces nearest to the separating-surface, and means traveling with such partitions for delivering heavier substances to a separate receptacle as they are discharged from said surface, substantially as described.

9. In a centrifugal separator, the combination of a rotatable cylinder provided with a separating-surface, partitions traveling with respect to said surface for dividing it and the space in proximity thereto into two or more parts, and a feed-pipe communicating with the cylinder in a practically water-tight manner, substantially as described.

10. In a centrifugal separator, the combination of a rotatable separating-surface upon which the material is in a submerged state, relatively-movable agitating projections to effect the suspension of lighter substances, means for causing their removal by securing a flow of liquid, over one portion thereof, and means for removing the heavier by securing an increased velocity of flow over another portion, substantially as described.

11. In a centrifugal separator, the combination of a rotatable cylinder, partitions for dividing the interior thereof into two or more substantially-closed passages extending from the feed to the discharge end thereof, and means for removing lighter and heavier substances separately by different velocities of liquid flow longitudinally through said passages, substantially as described.

12. In a centrifugal separator, the combination of a rotatable cylinder, partitions for dividing the interior thereof into two or more substantially-closed passages extending from the feed to the discharge end thereof and through which there is a longitudinal flow, and means for effecting the suspension of lighter substances by securing agitation in one of said passages, and removing the heavier by increased agitation in another passage, substantially as described.

13. In a centrifugal separator, the combination of a rotatable cylinder, partitions for dividing the interior thereof into two or more substantially-closed passages extending from the feed to the discharge end thereof and through which there is a longitudinal flow, and a feed-conduit communicating with one of said passages, substantially as described.

14. In a centrifugal separator, the combination of a rotatable cylinder, partitions for dividing the interior thereof into two or more substantially-closed passages extending from the feed to the discharge end thereof and through which there is a longitudinal flow, a feed-conduit communicating with one of said passages, and means for removing heavier in another of the passages, substantially as described.

15. In a centrifugal separator, the combination of a rotatable cylinder, and a shaft or cylinder within the same carrying partitions which divide the passage between said cylinders into two or more substantially-closed sections or passages extending from the feed to the discharge end thereof and through which there is a longitudinal flow, substantially as described.

16. In a centrifugal separator, the combination of a rotatable cylinder, a shaft or cylinder within the same carrying partitions which divide the passage between said cylinders into two or more sections or passages extending from the feed to the discharge end thereof, and agitating projections between the partitions, substantially as described.

17. In a centrifugal separator, the combination of a rotatable cylinder, a hollow shaft or cylinder within the same carrying partitions which divide the passage between said cylinders into two or more sections or passages, and hollow projections between the partitions, substantially as described.

18. In a centrifugal separator, the combination of a rotatable cylinder, a hollow shaft or cylinder within the same carrying partitions which divide the passage between said cylinders into two or more sections or passages, and hollow projections of different internal diameters between the partitions, substantially as described.

19. In a centrifugal separator, the combination of a rotatable cylinder, a hollow shaft or cylinder within the same carrying partitions which divide the passage between said cylinders into two or more sections or passages, and hollow projections inclined toward the point of discharge between the partitions, substantially as described.

20. In a centrifugal separator, the combination of a rotatable separating-surface forming one wall of a channel or passage, partitions

traveling with respect thereto for dividing said channel into two portions, one of which portions has a greater radial width than the other, substantially as described.

21. In a centrifugal separator, the combination of a rotatable separating-surface forming one wall of a channel or passage, partitions traveling with respect thereto for dividing said channel into two portions, one of which portions has a greater radial width than the other and gradually varies in width from end to end of the separating-surface, substantially as described.

22. In a centrifugal separator, the combination of a rotatable cylinder, a divided hood into one part of which the open end of the cylinder projects, and a spout extending beyond the end of said cylinder into the other part, substantially as described.

23. In a centrifugal separator, the combination of a rotatable cylinder, a shaft or cylinder within the same carrying partitions which divide the passage between said cylinders into two or more sections or passages, a divided hood into one part of which the outer cylinder projects, and a spout carried between two of said partitions extending into other part, substantially as described.

ORRIN B. PECK.

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

Correction in Letters Patent No. 560,625.

It is hereby certified that Letters Patent No. 560,625, 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.