

No. 774,104.

PATENTED NOV. 1, 1904.

F. B. PETTENGILL.  
CENTRIFUGAL SEPARATOR.

APPLICATION FILED OCT. 7, 1901.

NO MODEL.

3 SHEETS—SHEET 1.

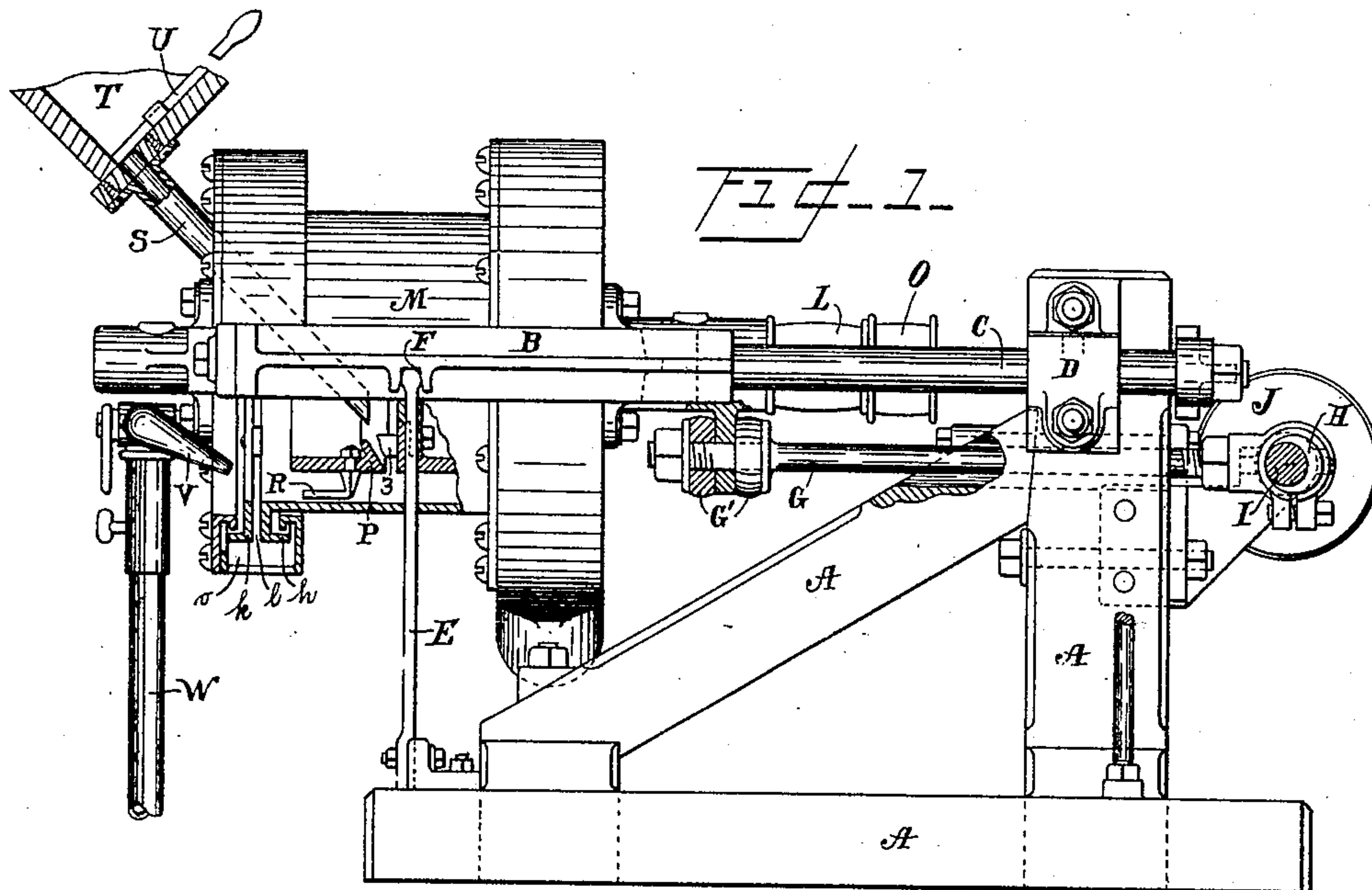
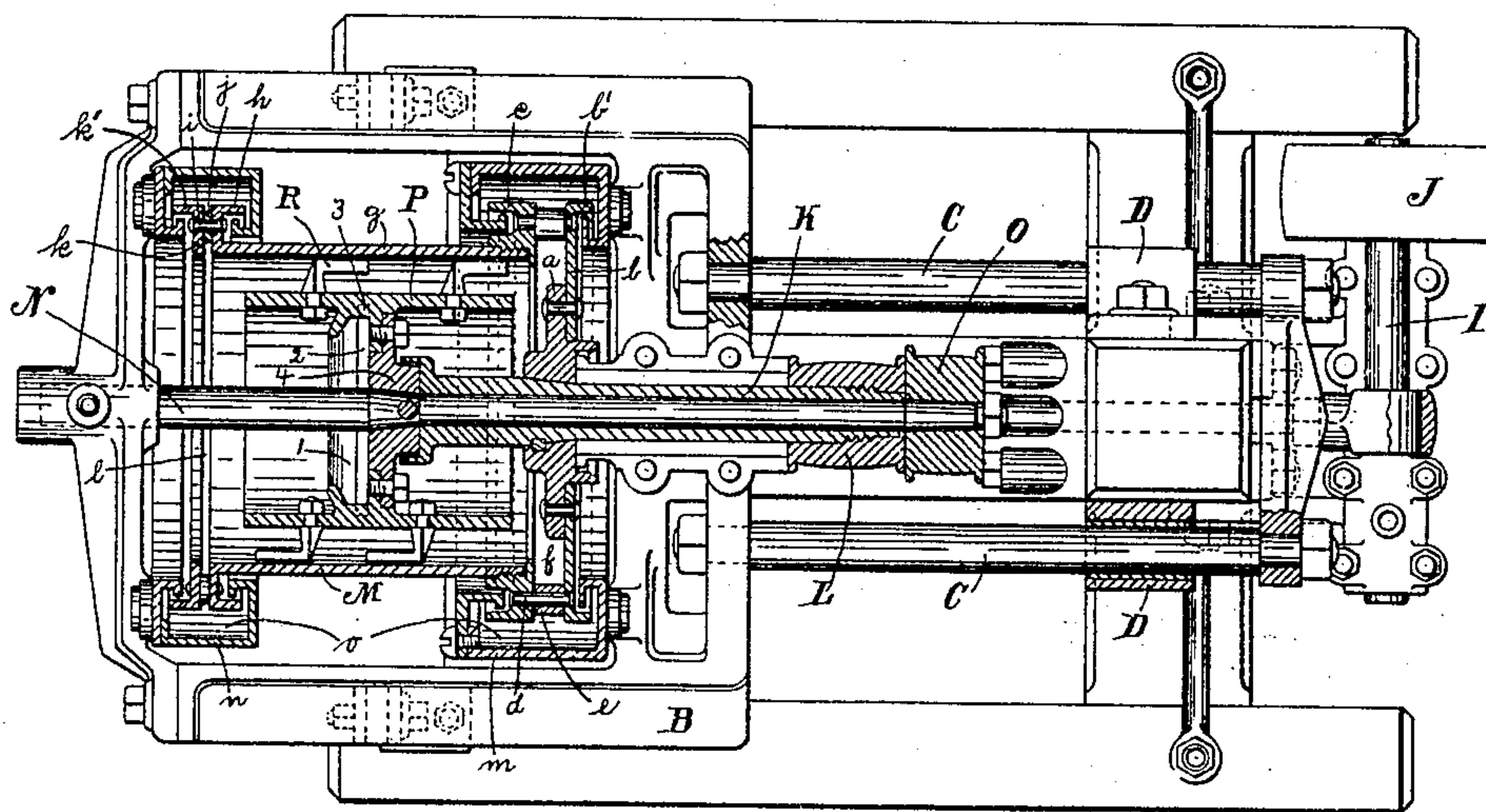


FIG. 2.



WITNESSES

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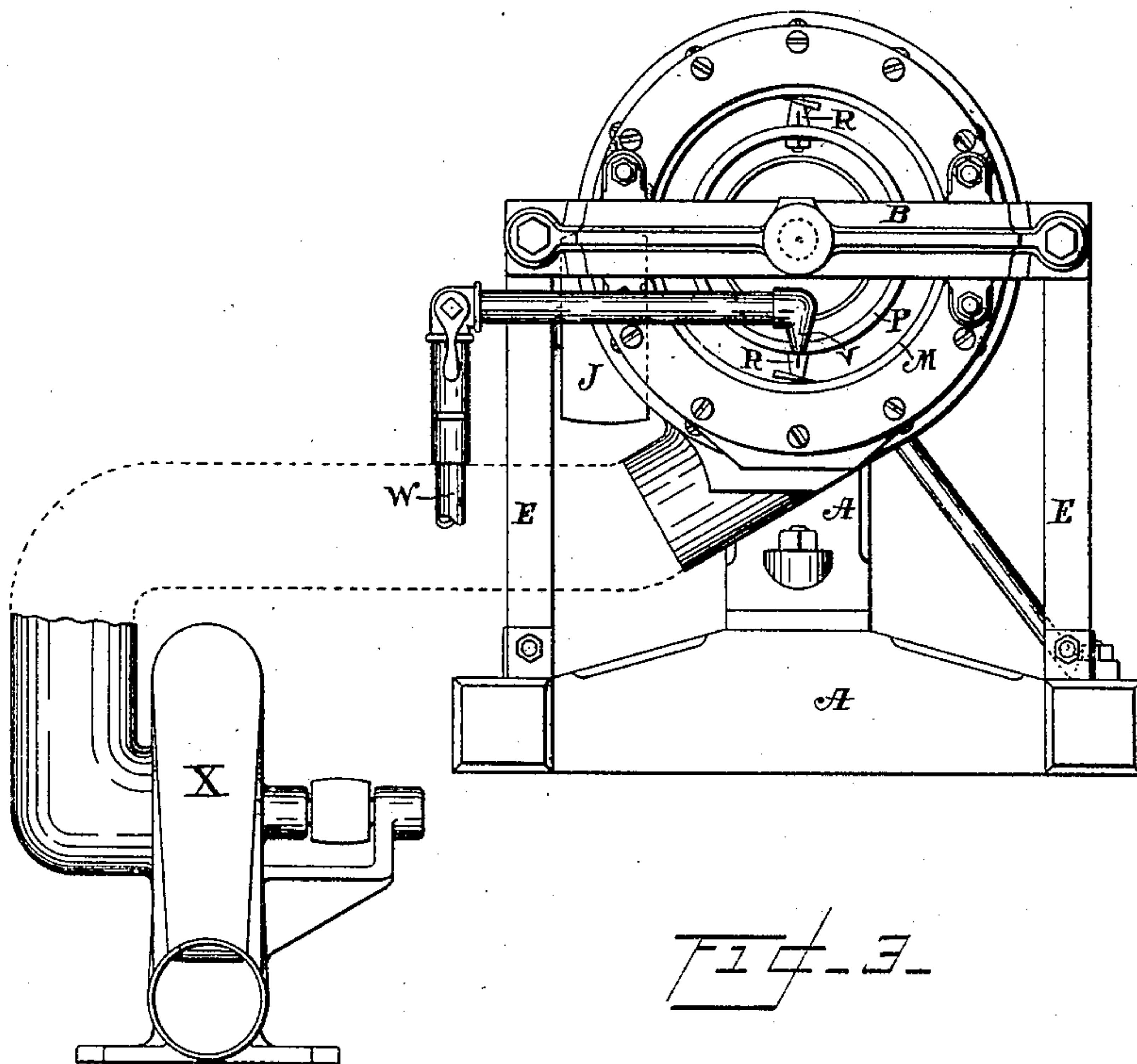
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3 SHEETS—SHEET 2.



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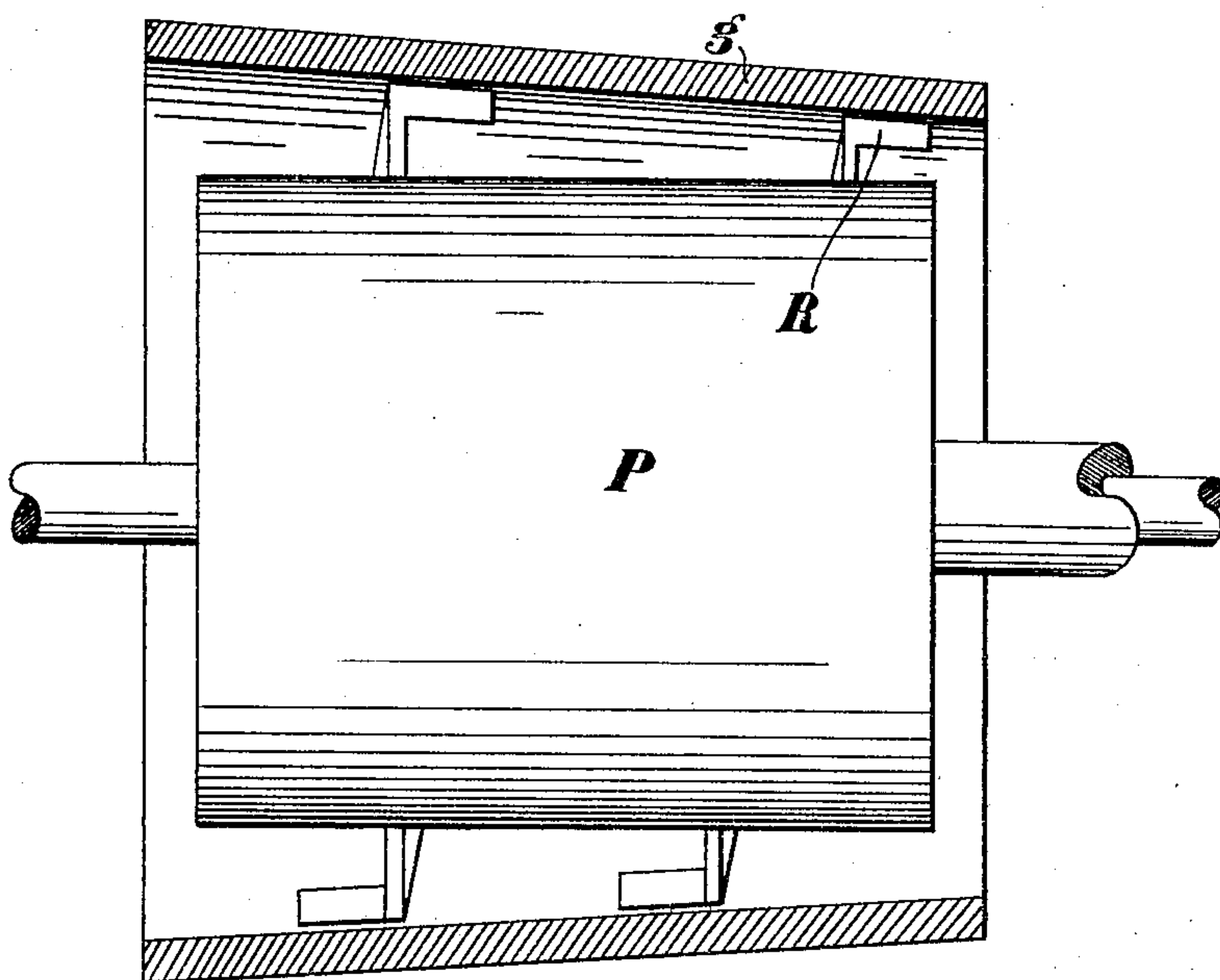
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3 SHEETS—SHEET 3.



**Fig. 4.**

WITNESSES

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# UNITED STATES PATENT OFFICE.

FREDERICK B. PETTENGILL, OF LOS ANGELES, CALIFORNIA, ASSIGNOR  
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## CENTRIFUGAL SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 774,104, dated November 1, 1904.

Application filed October 7, 1901. Serial No. 77,903. (No model.)

*To all whom it may concern:*

Be it known that I, FREDERICK B. PETTENGILL, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles, State of California, have invented new and useful Improvements in Centrifugal Separators, of which the following is a specification.

My invention relates to an improved machine for concentrating discrete metalliferous material for the separation or concentration of the more valuable particles therein, though it is equally applicable for the separation or concentration of other discrete material in which there is a difference of specific gravity in the different elements of the material; and the objects thereof are to effect the separation of the different elements of a discrete mass where there may be only a slight difference in the specific gravity of the different atoms of which it is composed.

My invention consists, essentially, of reducing the material to a finely-powdered state and then introducing it into a rapidly-revolving concentrating-cylinder whose plane of revolution is vertical, within which are a plurality of revolving pulp-lifting blades, preferably revolving in the same direction as the concentrating-cylinder, but at a slightly-reduced speed, which blades will-cause the material in the concentrating-cylinder to be repeatedly lifted off the inner surface thereof and caused to approach the center of the cylinder and then permit it to fall back toward the inner surface of the concentrating-cylinder, and thereby repeatedly subject it to the action of centrifugal force and at the same time to pass through the mass across the lines of centrifugal force a cleansing agent, as water or air.

It also consists of other novel features hereinafter described and claimed.

It is a well-known principle that the swifter the rotary motion of a discrete mass the greater the tendency of the atoms thereof to arrange themselves in layers or strata according to the specific gravity of the respective atoms of which the mass is composed, and it is to take advantage of this well-known principle

as applied to the treatment of discrete metalliferous material that my invention is primarily designed, although it is equally applicable to other discrete material in which there is a difference of specific gravity in the atoms of which the mass is composed.

In the drawings accompanying and forming a part of this application, Figure 1 is a side elevation, partly in section and partly broken away, of my improved concentrator. Fig. 2 is a central horizontal section thereof. Fig. 3 is an end view of the same and showing an exhaust-fan applied thereto to adapt it for use as a dry-process concentrator. Fig. 4 is a side elevation of the concentrating-barrel of the concentrating-cylinder, partly sectional, said view being largely exaggerated to show its taper.

A is the supporting-frame, in which the concentrator-frame B is slidably mounted by rods C, attached to the rear end of the concentrator-frame, which rods slide back and forth in boxes D, affixed to the supporting-frame. The front end of the concentrator-frame is supported by upright resilient bars E, the lower ends of which are rigidly affixed to the supporting-frame, the upper ends being slightly rounded and resting in recesses F of the concentrating-frame, so as to permit of the slight oscillation of said frame, the plane of said oscillation being substantially horizontal. This oscillatory motion is imparted by means of rod G, one end of which is attached to the rear end of the concentrating-frame, rubber washer G' being provided to take off a sudden jar and the other end being attached to the eccentric H, mounted on shaft I, which shaft is mounted in bearings affixed to the supporting-frame and is provided on one end thereof with pulley J, by means of which motion is imparted thereto. Revolvably mounted in the concentrator-frame is hollow shaft K, to which is rigidly attached power-pulley L and concentrating-cylinder M. This concentrating-cylinder is preferably formed of a hub *a*, affixed to shaft K, to which hub is removably attached the annular end piece *b*, having an outwardly-projecting flange *b'*. To the end piece



is attached an annular flanged ring *c* by rivets *d*, which pass through spacing-blocks *e*, which separate the flange from the end piece, thereby providing a channel *f* for the passage there-  
 5 through of the gangue when the machine is in operation, as hereinafter explained. Into this annular ring is screwed the end of the concentrating-barrel *g*, the other end of which is provided with an outwardly-projecting L-  
 10 shaped flange *h*, as shown in Fig. 2. To this flange is riveted by rivets *i*, which pass through spacing-blocks *j*, an annular ring *k*, having an outwardly-projecting flange *k'*, the block separating the two, so as to provide a passage  
 15 *l* for the passage therethrough of the concentrates, as hereinafter explained.

Surrounding the flanges which form the channels at the ends of the concentrating-cylinder are circular rings of casing *m* and *n*,  
 20 having inwardly-projecting ends and flanges, as shown in Fig. 2, which with the parts of the concentrating-cylinder form annular channels *o* for the collection of and passage out through an opening in the bottom of the con-  
 25 centrates and gangue, respectively. These casings are affixed to the concentrating-frame.

Rotatably mounted in the concentrating-frame and passing through the hollow shaft *K* is shaft *N*, on which is rigidly mounted pul-  
 30 ley *O* and the lifting cylinder or hub *P*, which is provided on its periphery with a plurality of L-shaped stirring-blades *R*. The longitudinally-extended portions of these lifting-  
 35 blades present a sharp edge in proximity to the surface of the concentrating-cylinder. This lifting-cylinder is provided with an annular trough *I*, having an open bottom 2, except at the points where the ribs 3 unite the  
 40 two ends of the cylinder, which is preferably of cast metal and is removably attached to the hub 4, affixed to the shaft *N*. The plane of the revolution of the concentrating-cylinder and the lifting-blades is vertical.

In the operation of my machine power is  
 45 applied to impart to the respective parts the desired motion, and pulp is fed into the trough in the lifting-cylinders through chute *S*, which leads it from hopper *T*, the supply being controlled by slide *U*.

50 When my concentrator is used as a wet-process machine, sufficient water is mixed with the pulp to make it flow freely. As soon as the pulp strikes the side of the trough of the lifting-cylinder a centrifugal motion is im-  
 55 parted thereto, and it is forced through the open bottom thereof and falls upon the inner surface of the concentrating-cylinder, which in such machines I prefer to make slightly tapering—say approximately one inch in fifty  
 60 feet—with the larger end at the gangue discharge. As the concentrates possess a greater specific gravity than the gangue, they force themselves through the gangue and contact with the inner surface of the concentrating-  
 65 cylinder, as such separation does not instantly

take place. I have provided lifting-blades which will repeatedly raise the material off the inner surface of the concentrating-cylinder, and as it falls off such blades the concentrates and gangue are operated upon by the  
 70 law of inertia, which also has a tendency to cause their separation. Now by means of the eccentric *H* on shaft *I* an oscillating motion with sudden bumps is imparted to the concentrating-frame and connected parts, which  
 75 causes the concentrates to travel toward the concentrate-outlet, while the gangue travels toward the gangue-outlet at the other end, being caused to flow in that direction by a  
 80 current of water which is fed into the machine through nozzle *V*, affixed to pipe *W*, which cleanses the concentrates in the usual well-known manner. It will be observed that  
 85 by this construction I am able to use centrifugal force upon atoms of different specific gravity, and thereby multiply such difference in proportion to the centrifugal force applied, so that discrete metalliferous material with  
 90 but little difference in the specific gravity of their respective atoms, which could not be separated by means of any concentrator with  
 95 which I am acquainted, may be easily separated therewith.

When my concentrator is used as a dry-process machine, an exhaust-fan *X* is attached  
 100 by suitable means to the gangue-outlet and a current of air is drawn through the machine thereby. The ore is fed into the machine in the same manner as when it is used as a wet-  
 105 process machine, and the same forces act thereon in the same manner, except that instead of water being fed into the machine through nozzle *V* a current of air is forced therethrough by any suitable means. (Not shown.)

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

1. In a centrifugal separator the combination of a rotatable concentrating-cylinder and  
 110 independently and more slowly rotatable lifting-blades within said concentrating-cylinder the plane of whose revolution is vertical, said blades having the outer edge thereof closer  
 115 to the concentrating-cylinder than the inner edge, and having one edge in advance of the other, said lifting-blades having the longitudinally-extended portions thereof presenting  
 120 a sharp edge in proximity to the surface of the concentrating-cylinder.

2. In a centrifugal separator the combination of a reciprocating frame; means to impart  
 125 a horizontally-reciprocating motion to said frame; a revoluble concentrating-cylinder and independently and more slowly revoluble lifting-blades within said concentrating-  
 130 cylinder mounted in said frame, the plane of revolution of said cylinder and blades being vertical; annular flanges affixed to said reciprocating frame surrounding the ends of said



concentrating-cylinder and forming therewith annular channels for the passage out of the concentrates and gangue.

3. In a centrifugal separator the combination of a reciprocating frame; means to impart a horizontally-reciprocating motion to said frame; a revoluble concentrating-cylinder mounted in said frame; annular flanges affixed to said reciprocating frame surrounding the ends of said concentrating-cylinder and forming therewith annular channels for the passage out of the machine of the concentrates and gangue; with independently more slowly revoluble lifting-blades mounted within said concentrating-cylinder, the plane of revolution of said cylinder and blades being vertical and means to impart motion to said moving parts.

4. In a centrifugal separator the combination of a reciprocating frame; means to impart a horizontally-reciprocating motion to said frame; a revoluble concentrating-cylinder mounted in said frame; annular flanges affixed to said reciprocating frame surrounding the ends of said concentrating-cylinder and forming therewith annular channels for the passage out of the machine of the concentrates and gangue; independently more slowly revoluble lifting-blades mounted within said concentrating-cylinder, the plane of revolution of said cylinder and blades being vertical; means for imparting rotary motion to said cylinder and blades; and means to introduce the pulp into said concentrating-cylinder; and means to cause the flow therethrough of a cleansing agent.

5. A machine for concentrating a discrete mineral, comprising a supporting-frame; a concentrator-frame slidably mounted in said supporting-frame; a revoluble concentrating-cylinder mounted in said concentrator-frame, having a gangue-outlet channel near one end, and a concentrate-outlet channel near the other end; and revoluble stirrer-blades mounted within the concentrating-cylinder, the plane of revolution of said cylinder and blades be-

ing vertical; and means to impart motion to the respective moving parts.

6. In a centrifugal separator, the combination of a rotatable concentrating-cylinder and independently more slowly revoluble lifting-blades within said concentrating-cylinder, the plane of revolution of said cylinder and blades being vertical, said lifting-blades having the longitudinally-extended portions thereof presenting a sharp edge in proximity to the surface of the concentrating-cylinder; means for imparting rotary motion to said cylinder and blades; means to introduce the pulp into said concentrating-cylinder; and means to cause the flow therethrough of a cleansing agent.

7. In a centrifugal separator the combination of a reciprocating frame; means to impart a horizontally-reciprocating motion to said frame with sudden stops; a revoluble concentrating-cylinder and independently and more slowly revoluble lifting-blades within said concentrating-cylinder mounted in said frame, the plane of revolution of said cylinder being vertical; means to introduce the pulp into said cylinder; and means to cause the flow therethrough of a cleansing agent.

8. In a centrifugal separator the combination of a reciprocating frame; means to impart a horizontally-reciprocating motion to said frame with sudden stops; a revoluble concentrating-cylinder mounted in same frame; independently more slowly revoluble lifting-blades mounted within said concentrating-cylinder, the plane of revolution of said cylinder and blades being vertical; means for imparting rotary motion to said cylinder and blades; means to introduce the pulp into said concentrating-cylinder; and means to cause the flow therethrough of a cleansing agent.

In witness that I claim the foregoing I have hereunto subscribed my name this 30th day of September, 1901.

FREDERICK B. PETTENGILL.

Witnesses:

G. E. HARPHAM,  
MATTIE MCGINNIS.