No. 796,110. PATENTED AUG. 1, 1905.

I. A. CAMMETT.

ORE CONCENTRATOR.

APPLICATION FILED MAY 13, 1903.

5 SHEETS—SHEET 1.

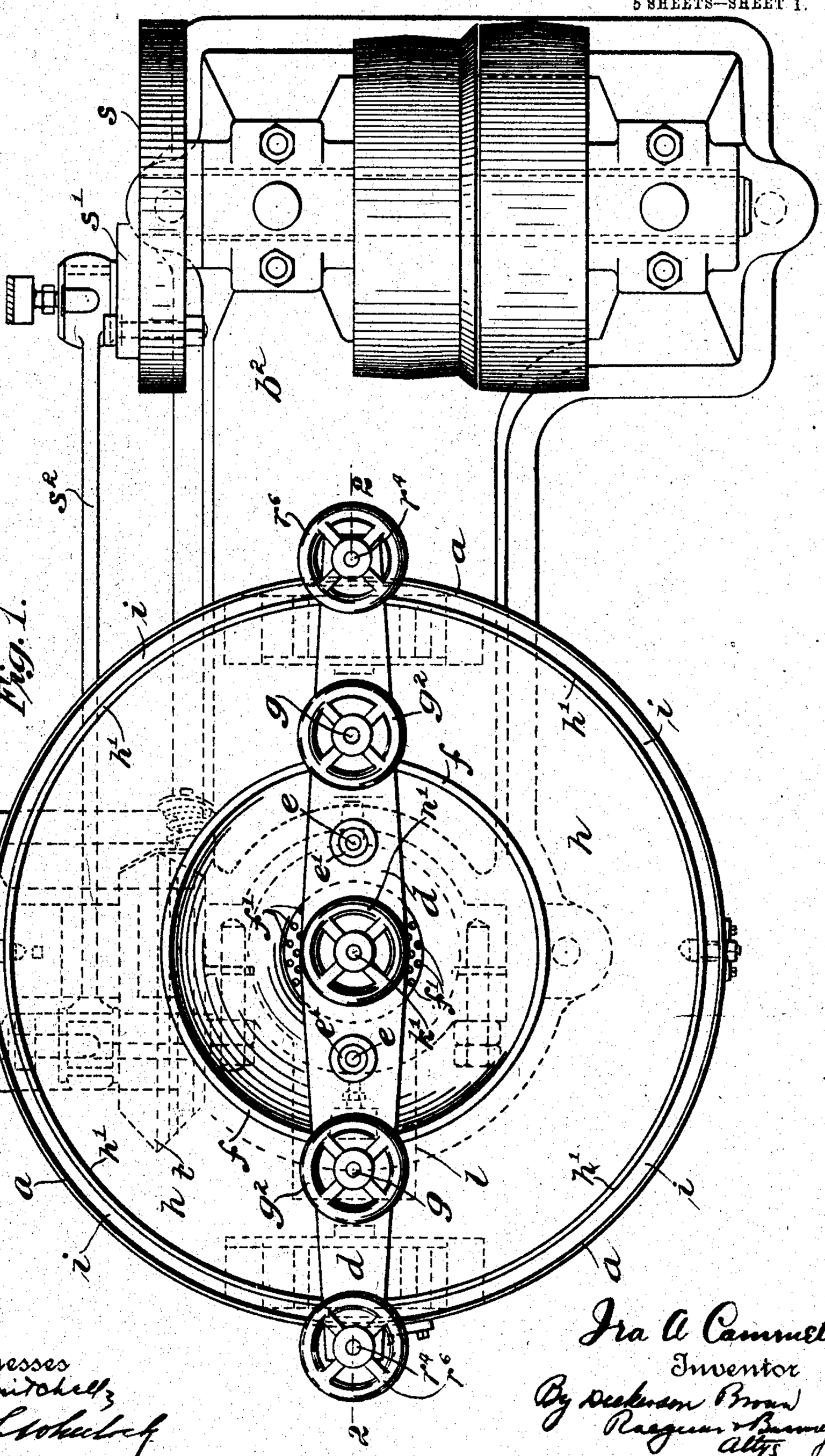

Fig. 1.

Witnesses
Comstock & Wheeler
Geo. L. Whitlock

Ira A Cammett
Inventor
By Dickerson Brown
Raymond & Barney
Attys

ANDREW. B. GRAHAM CO., PHOTO-LITHOGRAPHERS. WASHINGTON, D. C.

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5 SHEETS—SHEET 2.

Fig. 6.

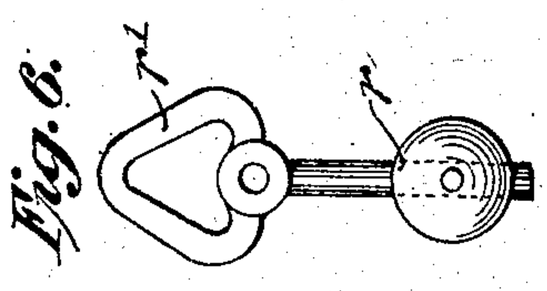

Fig. 5.

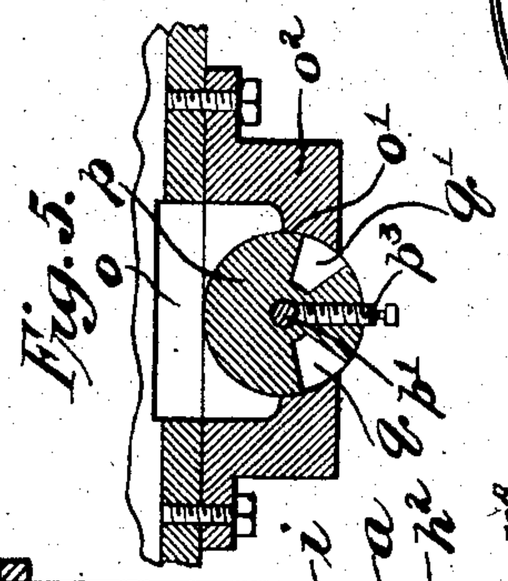

Fig. 2.

Witnesses
C. Mitchell,
Geo. L. Wheelock.

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Attys

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5 SHEETS—SHEET 3.

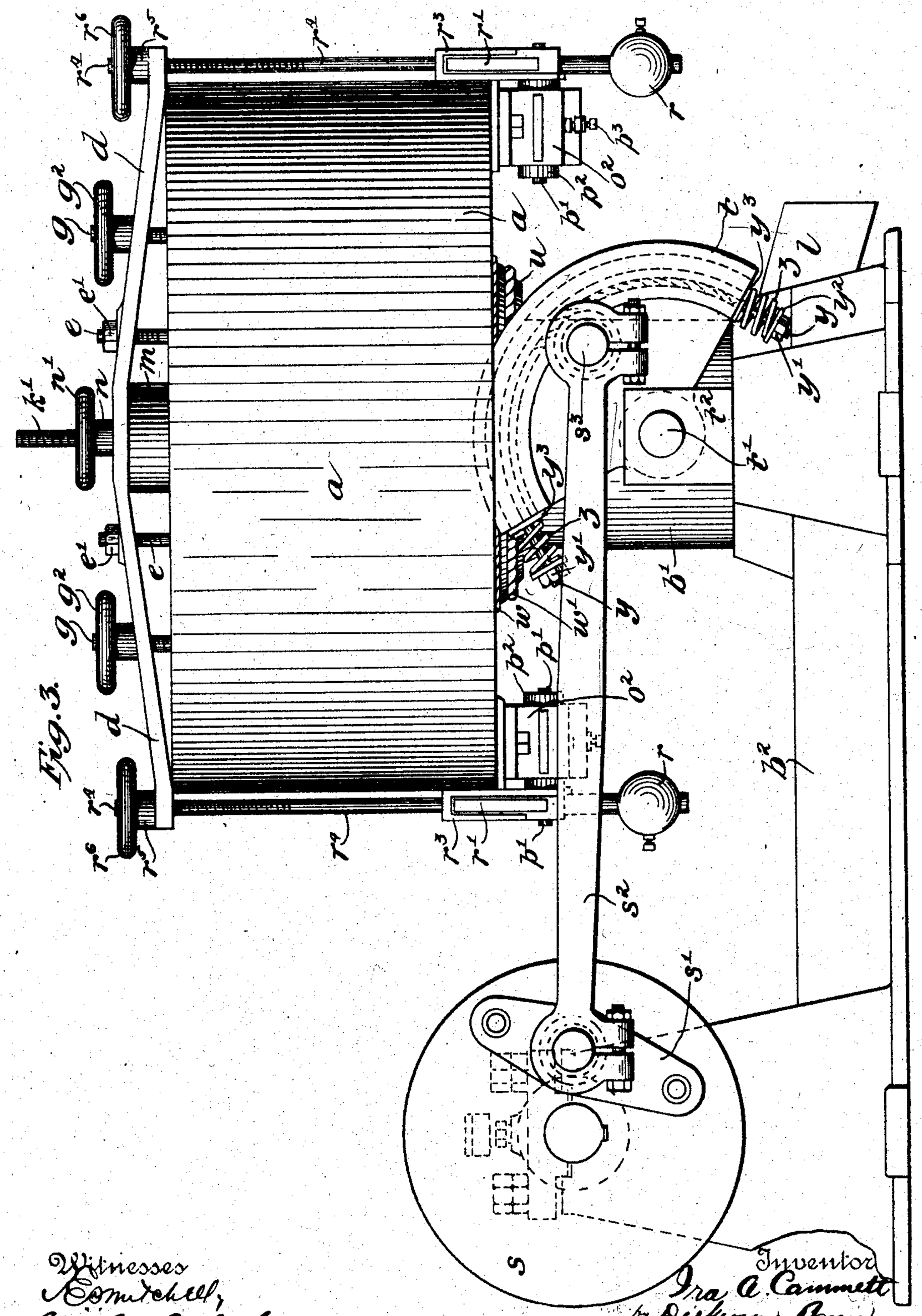

Fig. 3.

Witnesses
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No. 796,110. PATENTED AUG. 1, 1905.

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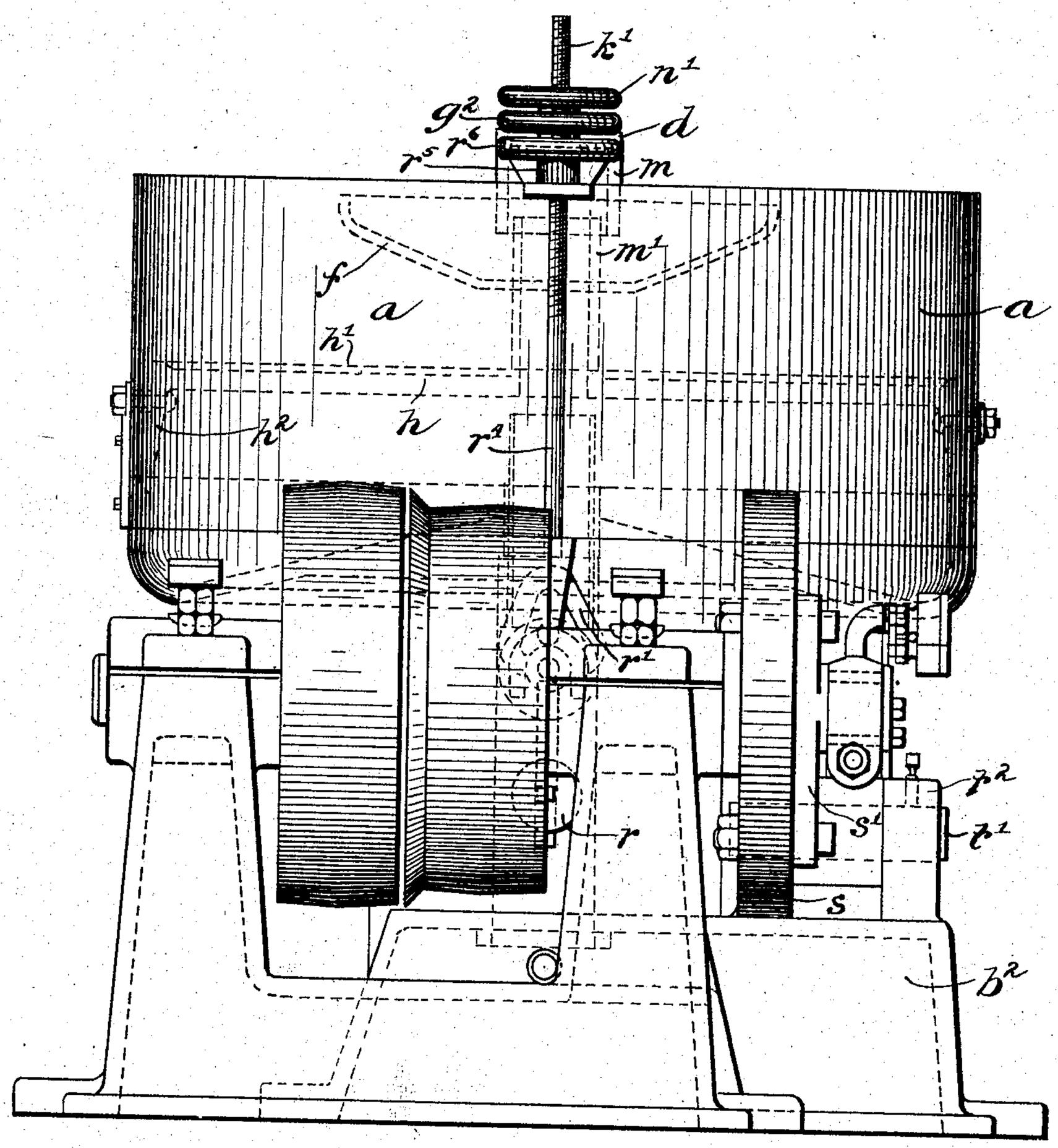
ORE CONCENTRATOR.

APPLICATION FILED MAY 13, 1903.

5 SHEETS—SHEET 4.

Fig. 4.



Witnesses
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I. A. CAMMETT.

ORE CONCENTRATOR.

APPLICATION FILED MAY 13, 1903.

5 SHEETS—SHEET 5.

Fig. 7.

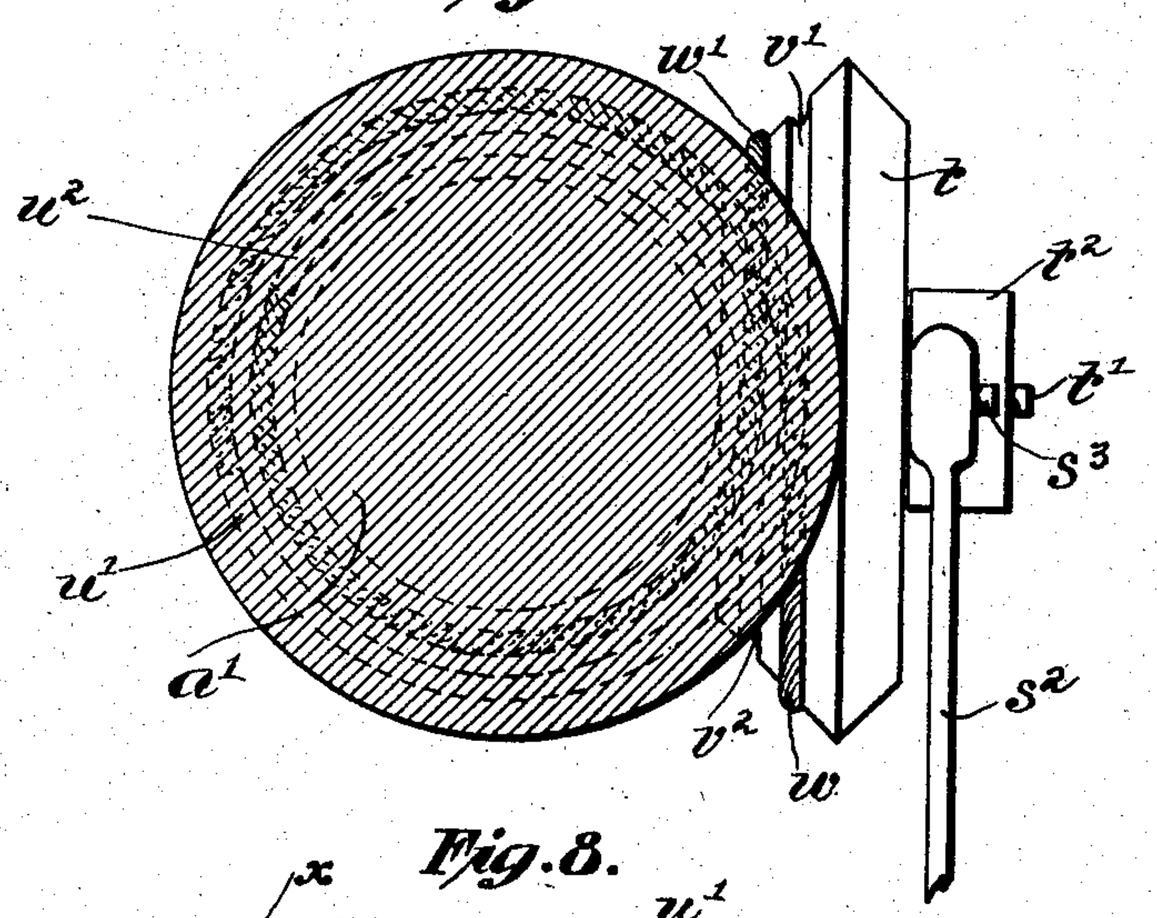


Fig. 8.

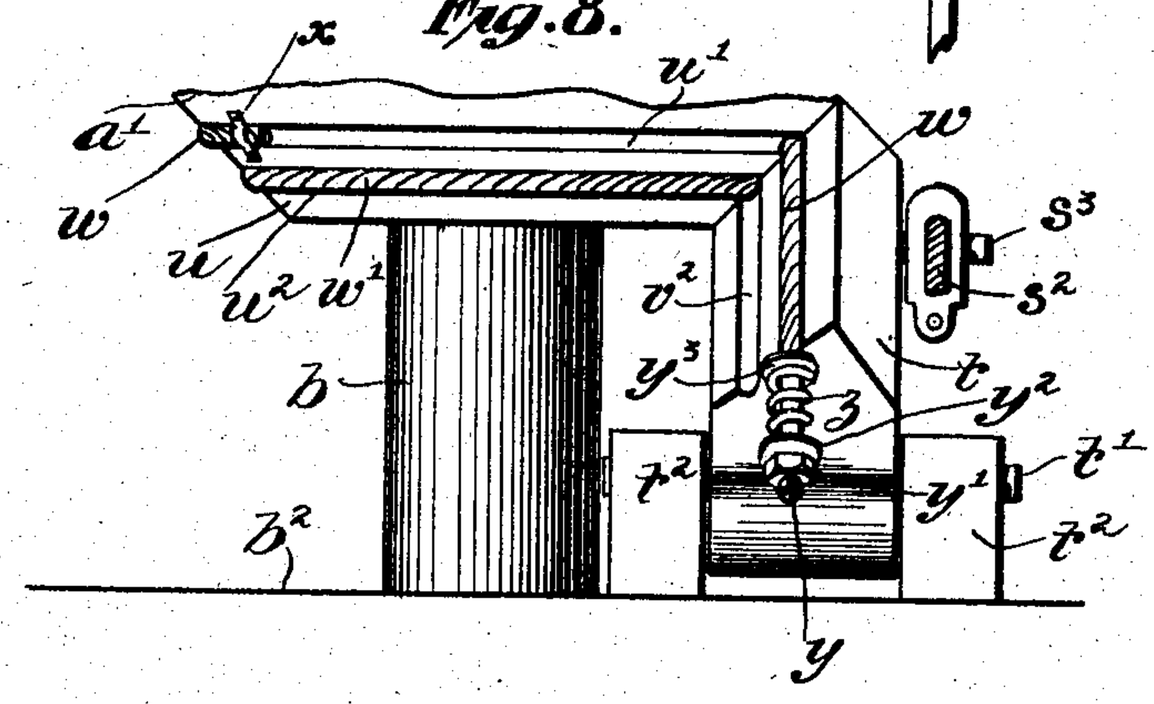
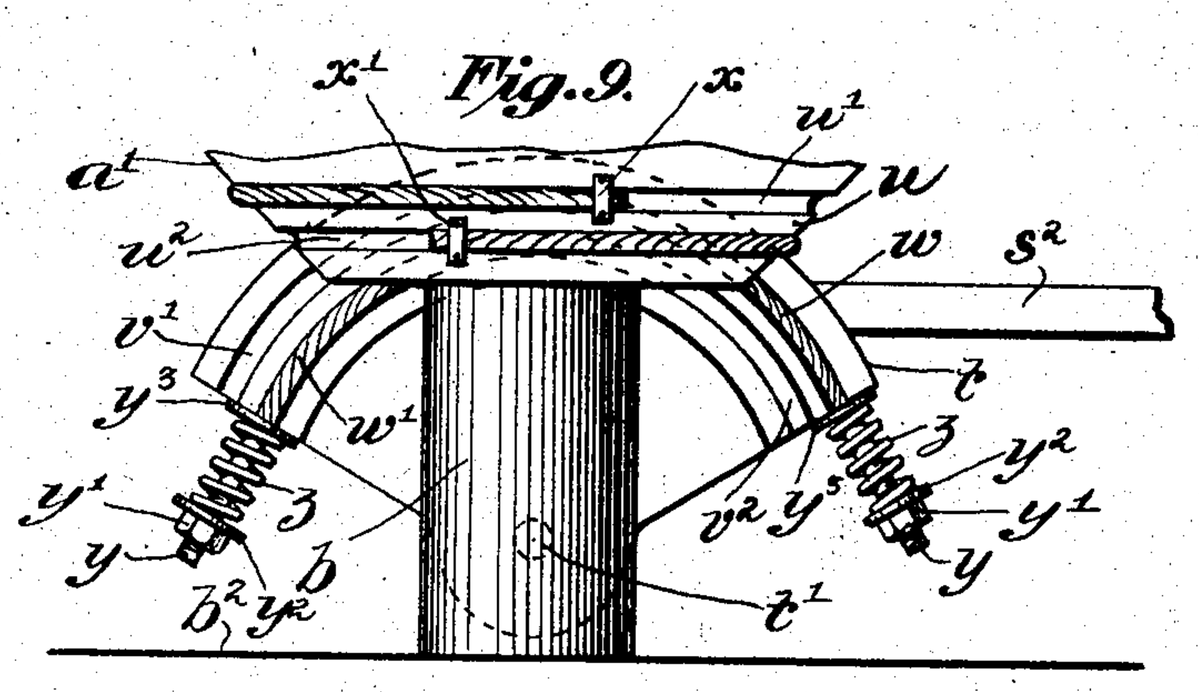


Fig. 9.



Witnesses
E. Mitchell
Geo. Sutherland

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By Dickerson Brown
Raegener & Bayley
Attys

UNITED STATES PATENT OFFICE.

IRA A. CAMMETT, OF DENVER, COLORADO.

ORE-CONCENTRATOR.

No. 796,110. Specification of Letters Patent. Patented Aug. 1, 1905.

Application filed May 13, 1903. Serial No. 156,906.

To all whom it may concern:

Be it known that I, IRA A. CAMMETT, a citizen of the United States, residing at Denver, in the county of Arapahoe, State of Colorado, have invented certain new and useful Improvements in Ore-Concentrators, of which the following is a specification.

This invention relates to ore-concentrators which separate the pulp into concentrates and waste.

Prior to my invention it has been proposed to feed the pulp to a distributer-disk which is separated from the bowl a slight distance sufficient to permit the pulp to flow over the edge and drop onto the bottom of the bowl, which oscillates, so that by the centrifugal force created the heavier metallic particles are caused to move outwardly, the lighter particles, which form the waste, accumulating toward the center of the bowl. In these devices the waste passes out through a suitable center passage and the concentrates through valved outlets in the peripheral portion of the bowl. It has also been proposed to close the outlets for the concentrates by valves which open and close automatically under the centrifugal action. It has furthermore been proposed to provide an adjustable discharge-pipe for the waste material.

My invention relates to improvements in the described class of ore-concentrators; and one of its objects is to provide a construction by which water can be used in the bowl in such manner as to compel the pulp to pass under water before being stratified, so that by submerging the finer particles of mineral or slimes, thereby excluding them from the air, they are rendered much more susceptible to treatment, and a much larger percentage of values can be saved.

Another object of the invention is to provide an improved form of automatic valve for the outlet of the concentrates and to provide simplified means in connection therewith for an adjustment of the valve.

A further object of the invention is to provide improved power-transmitting means for oscillating the bowl, which means are extremely simple and reliable for converting rotary motion into oscillatory motion.

These being some of the main objects of my invention, the same consists of certain features of construction and combinations of parts to be hereinafter described and then pointed out in the claims.

In the accompanying five sheets of drawings, which illustrate a simple form of my invention, Figure 1 is a plan view. Fig. 2 is a vertical longitudinal section on the line 2 2 of Fig. 1. Fig. 3 is a side view. Fig. 4 is an end elevation. Figs. 5 and 6 are respectively a section and an elevation of details of the valve for discharging the concentrates; and Figs. 7, 8, and 9 are respectively a plan, partly in section, a side elevation, and a second side elevation viewed from the left of Fig. 8.

Referring to the drawings, the bowl a is suitably supported, so that it may be oscillated and produce the requisite centrifugal action. The bottom a' of the bowl is preferably supported by the vertical hollow shaft b, which turns in a journal-bearing furnished by an upwardly-projecting socket b', located on a supporting-base b^2 of the concentrator. The antifriction-bushing c is preferably interposed between the vertical shaft b and the bearing b', while washers c' are located on the upper end of the socket b' under the bottom a' of the bowl. The bowl a is provided at the top with a cross-piece d, which leaves the entire top of the bowl practically open. The cross-piece d supports, by means of bolts e, secured thereto by means of nuts e', a feed-pan f, onto which the pulp is deposited. This feed-pan is provided with bottom perforations f', which preferably extend in annular series around it. Supporting-bolts g are supported by the cross-piece d at the side of the feed-pan, and these supporting-bolts are screw-threaded at their upper ends to receive adjusting-nuts g', provided with hand-wheels g^2 for turning them. The lower ends of the supporting-bolts g support within the bowl a a distributer h of disk shape, which is of somewhat less diameter than the interior diameter of the bowl, to form an annular space i between the bowl and the distributer. Said supporting-bolts g, by means of the adjusting-nuts g', may be adjusted to raise or lower the distributer-disk, as desired. The distributer-disk h is provided with a slightly-raised limb h', so that the upper surface of the disk practically forms a shallow pan or tray for the purpose of containing a small quantity of water. A peripheral flange h^2 depends from the distributer-disk a sufficient distance, so that its lower edge will extend below the normal water-level of the body of water which is carried in the bottom of the bowl, and thereby form a water seal. The pulp which is fed onto the feed-pan f is discharged through the

perforations f' onto the dished or tray-like upper surface of the distributer-disk for treatment, while by the centrifugal action caused by the oscillation of the bowl in the manner hereinafter described the pulp and water are caused to run over the outer edge of the disk and drop into the body of water in the bowl. The adjustment of the distributer-disk by the supporting-bolts g is for the purpose of regulating the height of the lower edge of the flange h^2 with respect to the amount of water in the bowl, so that even with a small quantity of water in the bowl the lower edge of the flange may be adjusted downwardly to permit the water seal to be made. By the provision of a water seal the slimes are thoroughly wet before separation, which takes place in the body of water in the bowl, the heavier parts or values settling toward the peripheral portion of the bowl and the waste tending to accumulate toward the center. To facilitate the separation, the bottom of the bowl is made of conical shape, so that its surface inclines downwardly from the center. This permits the gravity of the heavier particles or values to assist the separation thereof from the waste.

A passage j extends through the oscillatory shaft b from the bottom of the bowl, the upper end of which passage receives a sleeve j', in which is guided friction-tight the discharge-pipe k, which may be adjusted in the sleeve, so as to raise or lower its upper edge relatively to the body of water in the bowl. The upper edge of the discharge-pipe k normally projects above the lower edge of the flange h^2 on the distributer, or, in other words, it is normally located above the water-level. This discharge-pipe is adjusted from the top of the bowl preferably by means of an adjusting-rod k', which is connected suitably with the lower end of the discharge-pipe k, as by means of a cross-piece or spider k^2, which is sufficiently open to permit a free discharge of the waste through the discharge-pipe k into the passage j, and from thence into the launder l, from whence the waste is discharged for further treatment, if desired, as the waste may show that some values worth saving are still present in the same. The adjusting-rod k' passes up through telescoping tubular sections m m', located, respectively, on the cross-piece d and on the distributer h and also through the cross-piece d, where it receives an adjusting-nut n, which may be turned by means of a hand-wheel n'. The feed-pan, the distributer-disk, and the discharge-pipe will thus be seen to be supported positively and directly by the cross-piece d and to be adjusted therefrom.

The concentrates which are thrown by centrifugal force toward the peripheral portion of the bottom of the bowl and tend to settle toward that portion through the assistance of the conicity of the bottom are discharged through discharge-openings o in the peripheral portion of the bottom. These openings are controlled by means of suitable valves, as p. (Shown clearly in Figs. 2 and 5.) Preferably these valves act in both directions of oscillatory movement of the bowl and are of cylindrical shape, being turned to snugly and truly fit openings o' in the bottom of valve-boxes o^2, which are bolted or otherwise suitably secured to the bottom of the bowl below the openings o thereof. The valves p are provided with spindles p', which turn in suitable bearings p^2 in the sides of the valve-boxes, the valves being secured thereto against relative rotation by means of set-screws p^3, which screw through the valves and bind at their inner ends against the spindles. The said spindles are arranged radially with respect to the vertical axis of the bowl. It being preferable to provide, as above indicated, for discharge of the concentrates in both directions of oscillation of the bowl, the valves for this purpose are each formed with two discharge-pockets q q', which in the normal position of the valves are located below the inner surface of the valve-boxes. When the valve is rocked on its spindle toward one side, one of the pockets q communicates with the chamber in the valve-box and receives a charge of concentrates, while when the valve rocks in the opposite direction for a sufficient distance the valve-pocket q' receives a charge of concentrates, these charges being discharge when the pockets are presented away from the valve-box. In the instance shown both pockets are located to one side of a diameter of the valve. To effectuate the automatic rocking of the valve by the oscillatory motion of the bowl, each valve carries on its spindle p' a pendulum r, (shown also in detail in Fig. 6,) the upper end of the pendulum above the spindle being provided with a yoke r', the side pieces of which yoke alternately abut against the buffer r^2, which is supported by an open stop-piece r^3, that is located at the side of the bottom of the bowl and is supported by means of a screw-threaded rod r^4. There are two of these stop-pieces r^3 shown, and hence two adjusting-rods r^4, and these rods extend at their upper ends through the projecting outer ends of the cross-piece d. The screw-threaded upper ends of the rods r^4 receive nuts r^5, which may be turned by means of hand-wheels r^6 for the purpose of raising and lowering the adjusting-rods. By adjusting the stop-pieces r^3 the swing of the pendulum r is controlled, and hence the extent of the rocking movement of the valve. The buffer r^2, which is of some suitable soft material, as rubber, provides for a yielding abutment and reduces shock and obviates noise. The pendulums r, as they hang downwardly, normally close the automatic valves p.

Before going into a description of the power-transmitting mechanism for impart-

ing an oscillatory motion to the bowl the operations of the part so far described will now be given.

The pulp with water is fed in suitable quantities into the feed-pan *f*, from whence it discharges through the openings *f'* in the bottom thereof onto the upper surface of the distributer-disk, which is always supplied with a small quantity of water. The oscillatory motion of the bowl thoroughly distributes the pulp over the upper surface of the distributer *h* and is discharged with the water fed in small quantities to the disk over the rim *i*. The pulp then flows through the annular space *i* into the body of water on the bottom of the bowl, passing through the water seal formed as above described. By the provision of the seal all the pulp is forced to pass under water before being stratified, so that by submerging the finer particles of mineral or the slimes they are excluded from the air, rendered much more susceptible to treatment, and a much larger percentage of values can be saved. The downward inclination of the bottom of the bowl and the centrifugal motion imparted by the oscillation thereof cause the heavier particles, values, or concentrates to be thrown and directed toward the peripheral portion of the bowl, while waste accumulates toward the center of the bowl and runs over the upper edge of the discharge-pipe *k*. From thence the waste passes through the pipe *k*, the passage *j*, and to the launder *l*. When the valves *p* rock in one direction, some of the concentrates are taken up thereby and discharged as the valves rock in the other direction. It will hence be seen that when the bowl oscillates in one direction the pendulums act on the valves in such a manner that while the concentrates are being received in one of the pockets of each valve the other pocket of each valve is discharging the charge already received, and this takes place with each oscillatory movement.

The power-transmitting mechanism comprises a wheel *s*, which may be driven either from a steam-engine or electric motor and with which is suitably connected, as by a bolted plate or head *s'*, a pitman s^2. This pitman s^2 is connected by a pin s^3 to a segment or prime mover *t*, the curved edge of which is concentric with the pivot *t'* of the segment, whereby the latter is pivoted to suitable lugs t^2 on the base b^2 of the concentrator. The arcuate surface of the segment *t* is beveled and matches with the correspondingly-beveled periphery of the wheel or pulley *u*, that may be either cast integral with the bottom *a'* of the bowl, or it may be formed as a separate part bolted or riveted thereto. The said wheel *u* is provided on its beveled surface with two annular grooves *u' u²*, and the beveled surface of the segment *t* is provided with grooves *v' v²*, the groove *v'* matching with the groove *u'* and the groove v^2 matching with the groove u^2. The beveled surfaces of the segments *t* and the beveled wheel *u* are in frictional contact, so that at the points of contact the grooves form passages between the beveled surfaces. Through the said passages ropes or cords *w w'* are led and guided or trained in the grooves. One end of the rope *w* is secured in the groove *u'* of the beveled wheel *u* by any suitable fastening device, be it a staple or plug, as at *x*, the opposite end of the said rope *w* being secured to one end of the segment *t* and in any suitable manner. The other rope *w'* is secured to be guided in the groove u^2 by means of a staple or plug, such as *x'*, securing one end of said rope, the other end of the rope being secured in suitable manner to that side or end of the segment *t* opposite the side to which the other rope *w* is secured. In effect it will be seen that the ropes cross each other, so that by the oscillation of the segment *t* in one direction the rope *w* will oscillate the beveled wheel *u* in a corresponding direction, and a rocking of the segment *t* in the other direction will oscillate the beveled wheel *u* in the corresponding direction. The attachment of the ropes *w w'* to the ends of the segment *t* is effected by means of stems *y*, which are suitably secured to the ends of the ropes and receive the nuts *y'* between washers y^2, of which nuts and washers y^3, seated against the ends of the segments *t*, helical springs *z* are confined. These springs take up slack in the ropes *w w'* and also relieve the power-transmitting device of shock during the oscillation of the bowl. One rope serves as a pull to oscillate the bowl in one direction, and the other rope serves as a pull to oscillate it in the opposite direction, both of the ropes, together with the bevel-gear, which consists of the segment *t* and wheel *u* or equivalent, forming a desirable and efficient adjustable bevel-rope transmission and dispensing with the nicety of fit and expense incurred by the use of tooth-gears. The contact of the beveled surfaces assists the ropes in oscillating the bowl.

Obviously some features of my invention may be used without others, and my invention may be embodied in widely-varying forms.

Therefore, without limiting myself to the construction shown and described nor enumerating equivalents, I claim, and desire to obtain by Letters Patent, the following:

1. In an ore-concentrator, the combination of an oscillatory bowl having discharges respectively for concentrates and waste and constructed to contain water in its lower part, an automatic mechanical valve substantially as described for the concentrates-discharge, and a distributer supported in the bowl and provided with means below its periphery to form a water seal, whereby all the

material is caused to be submerged, for substantially the purposes set forth.

2. In an ore-concentrator, the combination of an oscillatory bowl having discharges respectively for concentrates and waste, and constructed to contain water in its lower part and an adjustable distributer supported in the bowl, and a water seal below the distributer variable through adjustment of the distributer, for substantially the purposes set forth.

3. In an ore-concentrator, the combination of an oscillatory bowl having discharges respectively for concentrates and waste, and constructed to contain water in its lower part, and a distributer adjustable to various heights and suitably supported away from the bowl and provided with a depending flange for location below the water-level, for substantially the purposes set forth.

4. In an ore-concentrator, the combination of an oscillatory bowl, having discharges respectively for concentrates and waste, and constructed to contain water in its lower part, a support firmly fixed to the top of the bowl, vertically-adjustable bolts or rods screwed through and depending from said support, and a distributer supported in the bowl by said bolts or rods, for substantially the purposes set forth.

5. In an ore-concentrator, the combination of a bowl, means for producing a centrifugal movement within the same, a discharge-opening for waste material, and oscillating rotary valves in the bottom of the bowl provided with pendulums, for substantially the purposes set forth.

6. In an ore-concentrator, the combination of a bowl, means for producing a centrifugal movement within the same, a discharge-opening for waste material from said bowl, a discharge-opening for concentrates in the outer portion of the bottom of the bowl, an oscillatory rotary valve for controlling the concentrates-discharge opening, and adjustable means for limiting the rotary movement of the valve, for substantially the purposes set forth.

7. In an ore-concentrator, the combination of a bowl provided with a discharge-opening for concentrates, a valve-box supported by the bowl below the said opening, an oscillatory rotary valve in the valve-box provided with a spindle journaled in the walls of said box, and a pendulum located on said spindle, for substantially the purposes set forth.

8. In an ore-concentrator, the combination of an oscillatory rotary bowl provided with a discharge-opening, an oscillatory valve controlling said opening and provided with a pocket, and means for normally closing the valve-pocket, for substantially the purposes set forth.

9. In an ore-concentrator, the combination of an oscillatory rotary bowl provided with a discharge-opening, an oscillatory valve controlling the discharge through said opening, said valve being supported by a spindle radial to the axis of the bowl, and a pendulum supported on said spindle, for substantially the purposes set forth.

10. In an ore-concentrator, the combination of a bowl provided with a discharge-opening, an oscillatory cylindrical valve supported to control said opening, means for limiting the oscillation of the valve in either direction, and means for adjusting the said limiting means, for substantially the purposes set forth.

11. In an ore-concentrator, the combination of a bowl provided with a discharge-opening for the concentrates, an oscillatory valve for controlling said opening, a buffer, a part carried by the valve for striking said buffer in both directions of oscillation, and means for adjusting the position of the buffer, for substantially the purposes set forth.

12. In an ore-concentrator, the combination of an oscillatory bowl having separate discharges for concentrates and waste, and constructed to contain water, distributing means, means below the latter for compelling all the material to pass under water before separation, both of said means being supported by and oscillating with the bowl and an automatic mechanical valve for the concentrates-discharge, for substantially the purposes set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

IRA A. CAMMETT.

Witnesses:

LEONARD DATES,

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