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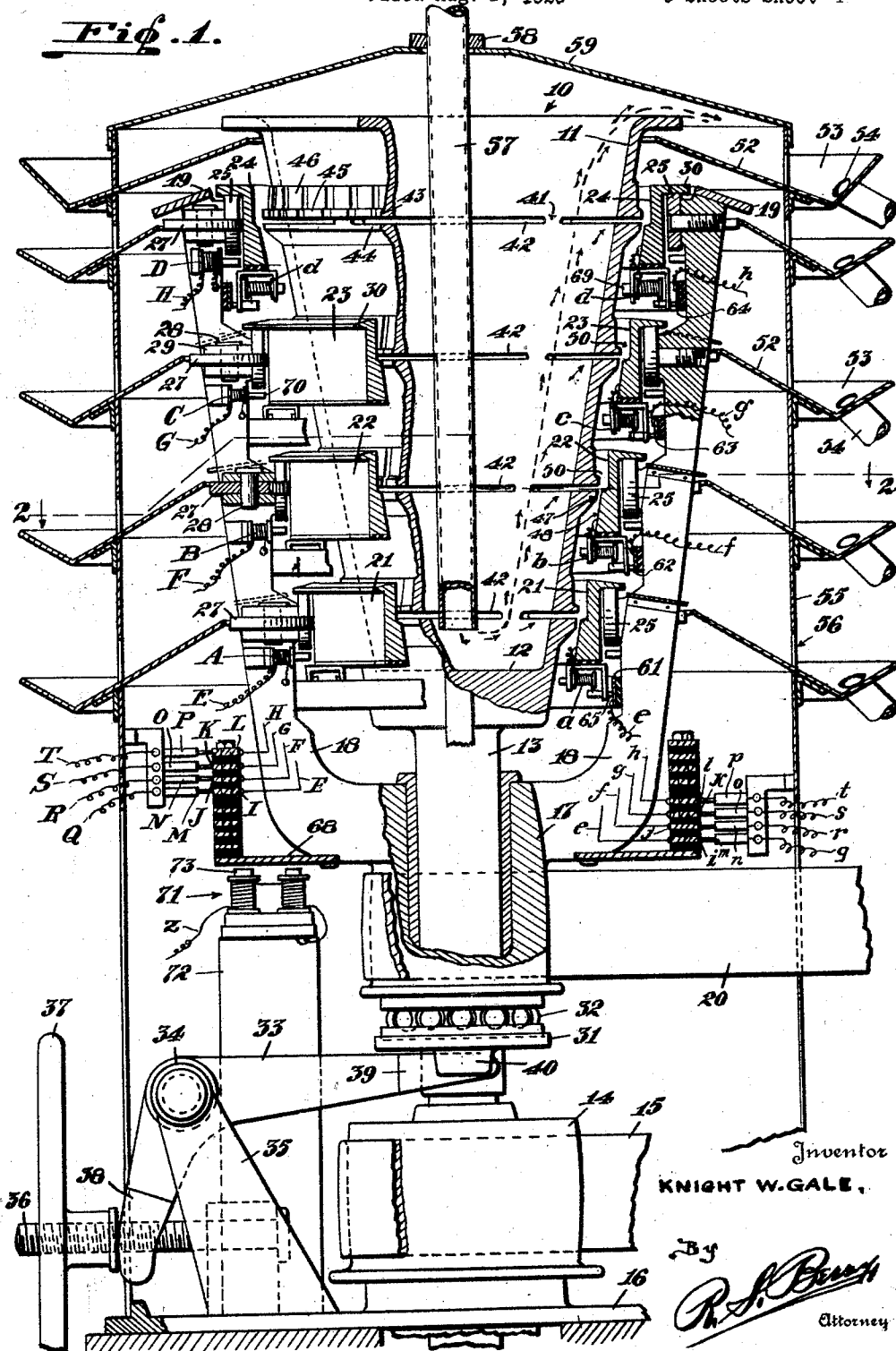
K. W. GALE

SEPARATOR

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Fig. 1.



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Fig. 2.

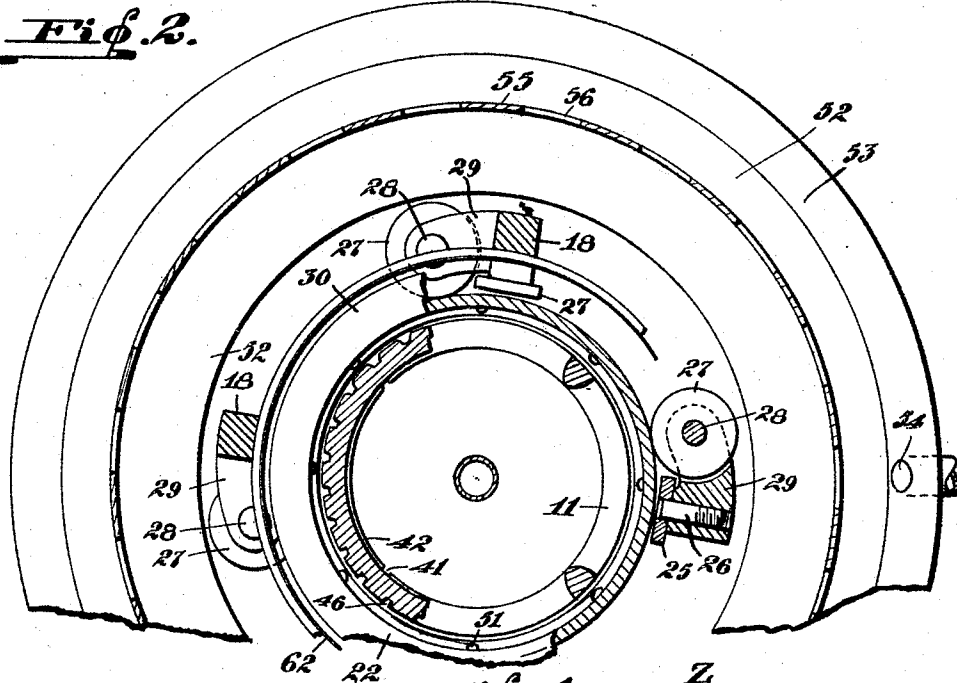


Fig. 4.

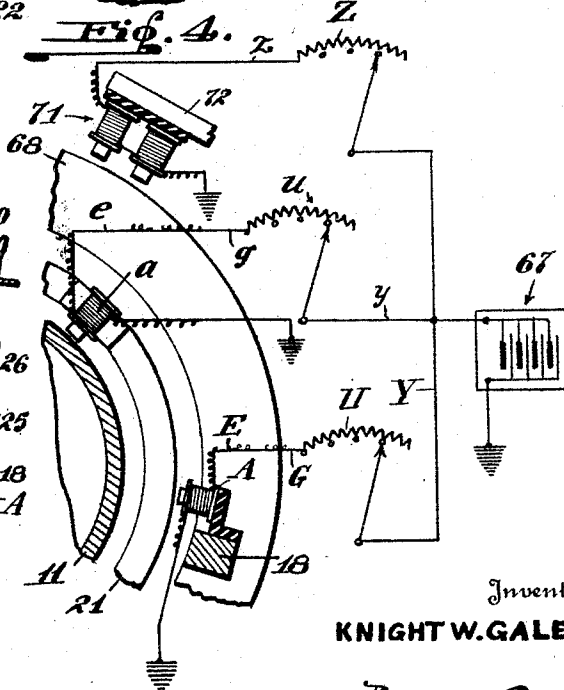
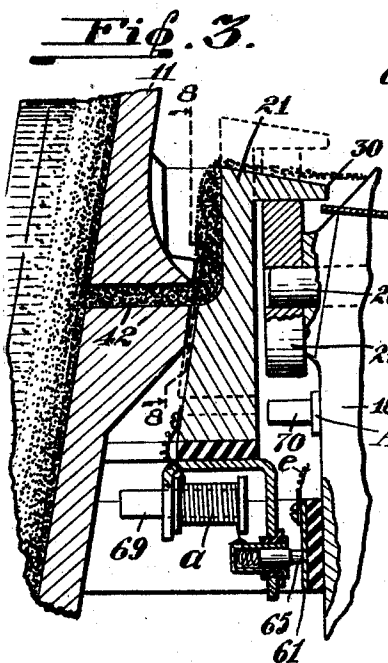


Fig. 3.



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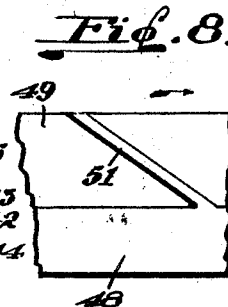
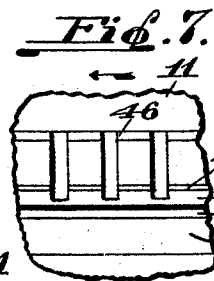
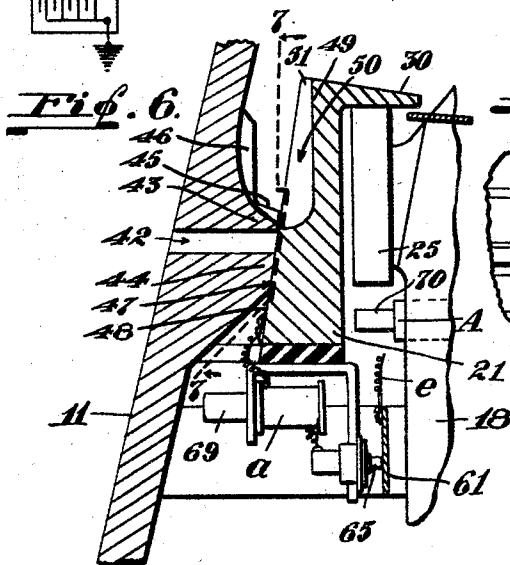
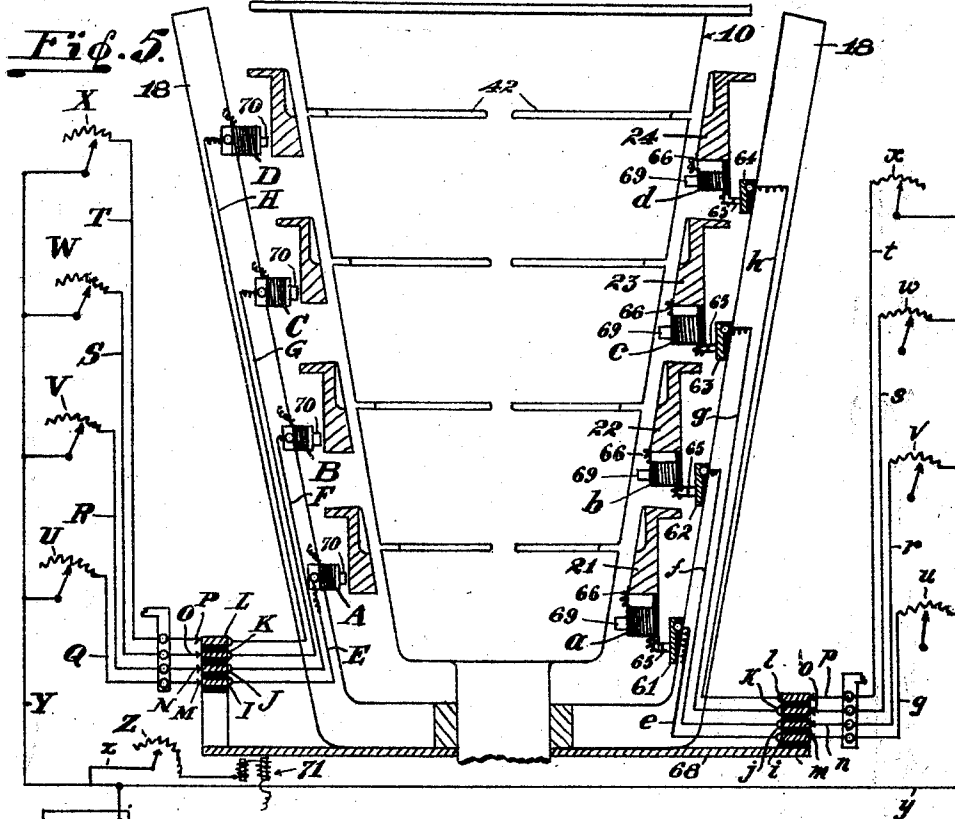
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

KNIGHT W. GALE, OF LOS ANGELES, CALIFORNIA.

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Application filed August 1, 1923. Serial No. 655,037.

To all whom it may concern:

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

My invention relates to apparatus for separating solids from liquids, especially adapted for treating crushed ore slimes or pulps and for separating metal particles from the gangue; and particularly pertains to a centrifugal separator for working value-bearing ores such as those containing gold, silver, and other metals.

An object of my invention is to provide means for concentrating and separating fine metal particles by stratifying the same according to their specific gravities and causing the metal particles of different gravities or values to continuously pass off and be separately collected.

Another object is to provide means for separating the gangue from the valuable metals and remove the tailings while the metals are separating.

Another object is to provide a separating mechanism whereby various separating actions may be accomplished with a single apparatus according to the character of the material being worked and the results sought.

Another object is to provide a means in an apparatus of the above character for readily affording a fine adjustment of the separator to accommodate it to the treatment of various materials, and whereby a thorough separating action may be economically effected.

With the foregoing objects in view, together with such other objects and advantages as may subsequently appear, my invention resides in the parts and the construction, arrangement and combination of parts, or the equivalents thereof, hereinafter described and claimed and illustrated in the accompanying drawings, in which:—

Figure 1 is a view in vertical section, partly in elevation, of the separator.

Figure 2 is a fragmentary horizontal sectional view as seen on the line 2—2 of Figure 1.

Figure 3 is an enlarged vertical cross-

sectional view taken on the same plane as Figure 1 of a portion of the separator, showing the manner of effecting the separating action.

Figure 4 is a diagram of the electric control elements arranged to clearly show their relation to the parts controlled.

Figure 5 is a diagram of the electro-mechanical control mechanism.

Figure 6 is a detail in vertical section similar to that shown in Figure 3 illustrating the parts in the starting position.

Figure 7 is a detail in elevation as seen on the line 7—7 of Figure 6, on a reduced scale.

Figure 8 is a detail in elevation showing a portion of the interior of a riffle ring as seen on the line 8—8 of Figure 3 in the direction indicated by the arrows.

Referring to the drawings more specifically, 10 indicates a stratifier embodying a revoluble receptacle having annular flaring side walls 11 and a bottom wall 12, which receptacle is designed to be rotated on a vertical axis and for which purpose is here shown as carried on the upper end of a shaft 13 to which is secured a pulley 14 driven by a bolt 15. The shaft 13 is supported in conventional manner on a suitable base 16. Journaled on the shaft 13 is a sleeve 17 carrying a plurality of upwardly extending posts 18 secured at their upper ends to a ring 19, the top face of which ring is outwardly and downwardly inclined. The sleeve 17 forms a pulley that may be driven by a belt 20 whereby the frame formed by the posts 18 may be rotated independently of the stratifier. The posts 18 are outwardly inclined to extend substantially parallel to the walls 11 of the stratifier and carry a plurality of superposed loose rings 21, 22, 23, and 24 constituting annular riffles which rings are revolubly supported on wheels 25 mounted on stub shafts 26 fastened on the posts. A series of horizontally mounted wheels 27 are rotatably carried on shafts 28 supported in lugs 29 provided on the sides of the posts 18, and which wheels 27 bear on the outer walls of the loose riffle rings and constitute side thrust bearings to centralize the rings.

Each riffle ring is formed at its upper edge with an outwardly extending flange 30, the under face of which bears on the wheels 25

whereby the riffle rings are adapted to turn circumferentially. By the construction just described the stratifier and frame may be rotated independently of each other, with the riffle rings floating therebetween; the rings however being adapted to revolve relatively to either the stratifier or the frame or in unison therewith on rotation of the stratifier or frame as will be later described.

The rotary frame is mounted for vertical movement relatively to the stratifier and for which purpose the sleeve 17 is revolvably supported on a base plate 31 mounted for vertical movement on the shaft 13, there being antifriction bearings 32 interposed between the sleeve 17 and the base plate 31. The base plate 31 rests on a bell crank 33 pivotally mounted on a pivot 34 on standards 35 projecting from the base 16. A screw 36 extends from the standard 35 on which is threaded a hand wheel 37 that is designed to bear at all times on a yoke 38 formed on the lower end of the bell crank. The upper end of the bell crank is formed with a yoke 39 which extends between lugs 40 on the base plate 31 and holds the plate against rotation.

The wall 11 of the stratifier 10 is preferably built up in sections from the bottom 12 by a set of superposed flaring rings having walls inclined outwardly at an angle to a vertical plane, the rings being welded together at their adjacent edges at several points around the circumference thereof as indicated at 41 and spaced apart between the joined portions to form the stratifier with a series of circumferentially extending slots 42 at different levels in the stratifier, there being a slot or plurality of slots opposite the inner periphery of each riffle ring. The slots 42 serve as discharge outlets for concentrates from the stratifier when in operation, as will later appear.

Formed on the outer face of the wall 11 and extending along the upper and lower edges of the slots 42 are flanges 43 and 44 (see Figure 6), the upper flange 43 being provided with teeth 45 which are continued into teeth 46 extending upwardly on the exterior of wall 11, the purpose of which will appear hereinafter. The lower flange 44 is formed with a smooth inclined outer face 47 which aligns with the lower edge of the upper flange 43. The inside wall of each riffle ring has an inclined face 48 extending from the bottom edge of the ring to substantially half its height, which face is parallel to the inclined outer face of the flange 44 and is adapted to be brought into contact therewith, as will be later described. The upper inner portion of the ring is formed with a recessed vertical wall 49, which extends opposite to the slots 42 and projects upwardly thereabove and opposite the teeth 45—46 to form with the wall 11

an annular pocket or trough 50 adapted to receive the materials discharged through the slots of the stratifier.

Formed on the wall 49 is a series of inclined ribs 51 which serve as plows to agitate materials in the trough 50 on rotation of the rings and stratifier relative to each other.

Encircling the rotary frame and extending around and adjacent each riffle ring and adjacent the top of the stratifier, is a plurality of superposed circular inclined aprons 52 having collecting troughs 53 fixed thereto provided with drain conduits 54 leading therefrom. The aprons 52 are supported by a cylindrical casing 55 in which are openings 56 through which the concentrates delivered to the aprons may fall to the collection troughs exteriorly of the casing.

Extending downwardly into the stratifier is a feed pipe 57 the lower end of which opens adjacent to the bottom wall 12 of the stratifier. The feed pipe is carried by any suitable support being here shown as fitted with a collar 58 seating on a cover 59 carried on the casing 55.

Means are provided whereby the riffle rings may be caused to revolve on rotation of either the stratifier or the frame; that is, to be driven in some instances from the stratifier and in other instances from the frame, and by which the rings may be driven either at a speed corresponding to or differing from that of the stratifier or frame and whereby the rings may be caused to revolve at different speeds relatively to each other, or whereby either one or more of the rings may be held stationary relatively to the stratifier, or to the frame. This means is here shown as comprising two groups of magnets arranged relatively to each ring, there being a series of magnets, *a*, *b*, *c*, *d* carried on the rings 21, 22, 23, and 24, respectively and adapted when energized to magnetically connect the rings to the stratifier; and there being a series of magnets *A*, *B*, *C* and *D* carried by the posts 18 and adapted when energized to magnetically connect the rings 21, 22, 23, and 24, respectively to the rotary frame. A series of conductor bands 61, 62, 63 and 64 are carried by the posts 18 and are arranged to be contacted by brush contacts 65 connected to one terminal of the magnets *a*, *b*, *c*, and *d*, the other terminals of which magnets are grounded to the riffle rings as indicated at 66. The several conductor bands are electrically connected to one terminal of a battery 67, the other terminal of which battery leads to ground in such manner that a circuit may be completed through the magnets *a*, *b*, *c*, and *d*. The electrical connections between the conductor bands 61, 62, 63, and 64 and the battery consist of conductors *e*, *f*, *g*, and *h* leading from the several bands

to contact rings *i*, *j*, *k*, and *l*, and which rings are insulated from each other and are supported on a horizontal annular plate 68 carried by the posts 18. Brush wipers *m*, *n*, *o*, *p* bear on the contact rings *i*, *j*, *k*, *l* and connect with conductors *q*, *r*, *s*, and *t* leading through rheostats *u*, *v*, *w* and *x*, connecting with a conductor *y* leading to battery 67. The cores of the magnets *a*, *b*, *c* and *d* extend adjacent the outer surface of the wall 11 of the stratifier.

The magnets A, B, C and D carried by the posts 18 are arranged with their cores 70 extending adjacent the outer surfaces of the riffle rings and are spaced therefrom. One terminal of these magnets is grounded to the posts 18 in electrical connection with the ground of battery 67. The electrical connections between the magnets A, B, C and D and the battery 67 consist of conductors E, F, G, and H leading from the magnets to contact rings I, J, K and L, which rings are insulated from each other and are supported on the annular plate 68 carried by the posts 18. Brush wipers M, N, O and P bear on the contact rings E, F, G and H and connect with conductors Q, R, S and T leading through rheostats U, V, W and X and through conductor Y to battery 67.

A third set of electromagnets 71 is supported on a bracket 72, the cores 73 of which magnets face the plate 68 on the posts 18 and are spaced therefrom. One terminal of magnets 71 is grounded on the bracket 72; the other terminal connecting with battery 67 through a conductor *z* leading to conductor Y through a rheostat Z. The magnets 71 are energized to retard or inhibit rotation of the frame.

In the operation of the invention the sleeve 17 with the parts carried thereby is raised by means of the hand wheel 37 so as to cause the riffle rings 21, 22, 23 and 24 to be positioned with their inclined walls 48 extending over and closing the discharge slots 42 as shown in Figure 6.

The materials to be treated, in the form of pulp, are delivered to the receptacle or stratifier 10 through the feed pipe 57 which discharges below the lowermost row of slots 42 as shown in Figure 1. The magnets *a*, *b*, *c* and *d*, and magnets A, B, C and D are then fully energized so as to effect a magnetic connection between the stratifier and the rotary frame through the riffle rings; the magnets *a*, *b*, *c* and *d* acting to hold the rings against turning relatively to the stratifier and the magnets A, B, C and D holding the rings in engagement with the rotary frame. Initial operation is then effected by rotating the stratifier by means of the belt 15 and pulley 14 acting on shaft 13, and if desired the belt 20 may be also driven to assist rotation of the frame which then

travels in unison with the stratifier, but in some instances driving of belt 20 at this time may not be necessary. In some cases only the magnets *a*, *b*, *c* and *d* need be energized to effect engagement between the stratifier and rings in which event rotation of the stratifier will cause the rings to turn therewith and travel on the wheels 25 with the frame stationary or nearly so.

On rotation of the stratifier a centrifugal action will be set up which will cause the pulp therein to travel outward to the wall 11 and thence upward over the inclined inner face of the wall as indicated by the arrows in Figure 1. The solids in the pulp will accumulate against the wall 11 and will creep upward thereon and will form in layers or strata according to their specific gravities with the heavier particles against the wall and the lighter particles forming in strata progressively toward the vertical center of the stratifier, according to the speed of rotation of the stratifier and the volume of the pulp fed thereto. The liquid will flow to the top of the stratifier and will be discharged therefrom into the uppermost trough 53 and be delivered to any suitable point of discharge. Some solids may be discharged with the liquid which can be regulated by varying the speed of rotation of the stratifier.

When a sufficient quantity of solids has accumulated on the wall of the stratifier, the frame carrying the rings is lowered after deenergizing the magnets *a*, *b*, *c* and *d* and effecting rotation of the frame at a speed substantially corresponding to that of the stratifier with the magnets A, B, C and D energized so that the rings will travel with the frame. This lowering of the frame and rings opens the discharge slots 42 as shown in Figures 1 and 3, whereupon the heavier solids lying immediately against the wall 11 and in the slots 42 will be discharged into the trough 50 between the riffle rings and the stratifier.

The troughs may be filled in this manner and when filled to the top the continued pressure of the solids passing through the slots will force the solids upwardly and outwardly on the upper edge of the rings and into the collecting troughs 53 from whence they are gathered or delivered to a suitable point of discharge.

By adjusting the frame vertically the discharge areas of the slots 42 may be varied from a fully closed to a fully opened condition so as to regulate the discharge of the materials through the slots.

The heavier particles in the stratifier will be delivered to the lowermost riffle ring 21 and the lighter particles will be delivered progressively to the riffle rings 22, 23, and 24, thus effecting the separation of several grades of the solids.

Various actions may be effected according to the character of the materials being worked and according to the speed at which the stratifier is rotated. For example, when it is desired to collect but one kind of material in the several rifle rings, the stratifier is rotated at high speed and the pulp or slimes are fed to the stratifier in such volume that the heavier particles will be thrown to the sides of the stratifier and be discharged through the several superposed slots.

Variations in the separating actions of the apparatus is accomplished by varying the relative movement of the stratifier and the rifle rings. For example, should it be desired to retard the discharge from any one of the rifle rings and accordingly retard the passage of material through the row of slots feeding to the ring, the ring is caused to turn at a slower speed than that of the stratifier which is effected by decreasing the energization of the magnets on the ring so that a slip will occur between the stratifier and the ring; the ring lagging when the magnets thereon are not sufficiently energized to hold the ring fixed in relation to the stratifier. By thus retarding the ring, the centrifugal action thereof, tending to eject materials therefrom, is reduced, and furthermore, the stratifier then having a greater peripheral speed, the materials carried in the trough 50 will be moved in the direction of the downward inclination of the ribs 51 and thereby be further obstructed. By holding the rotary frame stationary, as by energizing the magnets 71, and then energizing the magnets A B C or D opposite the ring to be retarded, this ring may be held stationary in relation to the stratifier.

If it is desired to accelerate the discharge of the material from a rifle ring and thereby effect a more rapid flow of the materials from the stratifier through the row of slots opposite the ring, the ring is caused to rotate in the direction of rotation of the stratifier at a speed exceeding that of the stratifier. This is effected by rotating the frame at a speed greater than that of the stratifier and then deenergizing the magnets *a*, *b*, *c*, or *d* on the selected ring and energizing the magnet A B C or D on the frame which will magnetically connect the ring to the frame so that the ring will turn with the latter. The increased speed of the ring will augment its centrifugal action on the materials therein and thereby hasten their discharge. Furthermore, the materials will then be caused to move relatively to the ring in the direction of the upward inclination of the ribs, which ribs will then act to plow the materials and direct them upwardly to discharge.

When the stratifier is turned relatively to a ring the teeth 45—46 will act to agitate the

materials so as to prevent caking or packing in the rifle ring troughs.

By operating the rheostats the several magnets may be energized or deenergized to a varied extent, so as to cause one set of magnets to be energized more than either of the remaining sets of magnets.

It will now be seen that I have provided a separator which is capable of extremely fine adjustment, as the discharge from any of the outlets of the centrifugal stratifier may be regulated to control the discharge of materials therefrom to any desired extent, from a minimum or completely inhibited discharge to a maximum, thereby enabling a fine separation of the materials being treated.

In carrying out my invention the wall 11 of the receptacle or stratifier 10 may be of any suitable height and may be formed with any suitable number of rows of peripheral discharge slots 42. In some instances only a single row of the slots may be necessary, but any desired plurality of rows of such slots may be provided, as occasion may require.

Other changes in the arrangement and form of the parts may be made without departing from the spirit of my invention, such for example as the number of magnets provided for each ring, it being obvious that while I have shown a single magnet carried by the ring, any suitable number of such magnets may be arranged in series, the same being true as to the magnets carried by the rotary frame. I therefore do not limit myself to the exact arrangement and construction shown, but may employ such changes in the construction and arrangement of the parts as come within the scope of the appended claims.

I claim:

1. In a separator a rotary receptacle having an outlet through which materials may be discharged from said receptacle by centrifugal force upon rotation of the said receptacle, an annulus encircling said receptacle adapted to receive the materials discharged from said outlet, means for rotating said annulus to effect discharge of materials therefrom by centrifugal force, means for shifting said annulus independent of rotation thereof, and means operable by such shifting of the annulus for regulating the discharge of materials from said receptacle.

2. In a separator, a rotary receptacle having a discharge outlet through which materials in the receptacle may be discharged by centrifugal force on rotation of the receptacle, an annulus encircling said receptacle adapted to receive the materials discharged from said outlet, means for supporting said annulus independent of said receptacle, means adapted to regulate discharge of

materials from said outlet operable by shifting said annulus, means for shifting said annulus, and means for rotating said annulus to effect the discharge of materials therefrom.

3. In a separator, a rotary receptacle having a discharge outlet through which materials in the receptacle may be discharged by centrifugal force on rotation of the receptacle, an annulus encircling said receptacle adapted to receive the materials discharged from said outlet, means for supporting said annulus independent of said receptacle, means adapted to regulate discharge of materials from said outlet operable by shifting said annulus, means for shifting said annulus, and means for rotating said annulus to effect the discharge of materials therefrom, adapted to be operated to maintain the annulus stationary or cause it to rotate at various speeds to vary the rate of the discharge of materials therefrom.

4. In a separator, a rotary receptacle having a discharge outlet through which the materials in the receptacle may be ejected on rotation of the receptacle, an annulus encircling the receptacle adapted to receive the materials discharged therefrom, means for rotating said annulus relative to said receptacle, and means operable by a relative movement of the receptacle and annulus for agitating materials carried on the latter and to facilitate discharge of the materials from said annulus.

5. In a separator, a rotary receptacle having an outlet through which materials may be discharged from the receptacle, a rotary annulus encircling said receptacle adapted to receive the materials discharged from the latter, and means for operatively connecting the annulus and receptacle whereby the annulus may be rotated in unison with or at variable speeds relative to said receptacle.

6. In a separator, a rotary receptacle having an outlet through which materials may be discharged from the receptacle, a rotary annulus encircling said receptacle adapted to receive the materials discharged from the latter, means for operatively connecting the annulus and receptacle whereby the annulus may be rotated in unison with or at variable speeds relative to said receptacle, and means whereby said annulus may be rotated independently of said receptacle either in unison therewith or at various speeds greater or less than the peripheral speed of the receptacle.

7. In a separator, a rotary receptacle having a discharge outlet through which materials in said receptacle may be ejected, a rotary annulus encircling said receptacle adapted to receive the materials discharged from the receptacle, means for vertically ad-

justing said annulus relatively to the discharge outlet, means operable by elevating said annulus to choke the passage of materials from said outlet, and means for discharging the materials from said annulus operable to vary the rate of discharge therefrom.

8. In a separator, a rotary receptacle having a discharge outlet, a rotary annulus encircling said receptacle adapted to receive materials discharged through said outlet, and electro-magnetic means for operatively connecting said annulus to said receptacle.

9. In a separator, a rotary receptacle having a discharge outlet, a rotary annulus encircling said receptacle adapted to receive materials discharged through said outlet, electro-magnetic means for operatively connecting said annulus to said receptacle, a rotary support for said annulus movable independently thereof, and electro-magnetic means for operatively connecting said annulus to said support whereby said annulus may be rotated independently of said receptacle.

10. In a separator, a rotary receptacle having a discharge outlet, a rotary annulus adapted to receive materials discharged through said annulus, an electro-magnet adapted when energized to operatively connect the annulus and receptacle whereby rotation of the receptacle will effect rotation of the annulus, and means for varying the attractive force of said electro-magnet.

11. In a separator, a rotary receptacle having a discharge outlet, a rotary annulus adapted to receive materials discharged through said annulus, an electro-magnet adapted when energized to operatively connect the annulus and receptacle whereby rotation of the receptacle will effect rotation of the annulus, means for varying the attractive force of said electro-magnet, a rotary support for said annulus movable independently of the latter, and an electro-magnet for operatively connecting the annulus to said support whereby the annulus may be rotated independently of the receptacle.

12. In a separator, a rotary receptacle having a discharge outlet, a rotary annulus adapted to receive materials discharged through said annulus, an electro-magnet adapted when energized to operatively connect the annulus and receptacle whereby rotation of the receptacle will effect rotation of the annulus, means for varying the attractive force of said electro-magnet, a rotary support for said annulus movable independently of the latter, an electro-magnet for operatively connecting the annulus to said support whereby the annulus may be rotated independently of the receptacle, and means for varying the attractive force of said last named electro-magnet.

13. In a separator, a rotary receptacle having a discharge outlet, an annulus encircling said receptacle, adapted to receive materials discharged from said outlet, a rotary support for said annulus movable independently of the latter, and an electromagnet for operatively connecting said annulus to said support.
14. In a separator, a rotary receptacle having an outlet, a rotary annulus adapted to receive materials discharged from said outlet, a rotary support for said annulus revoluble independently of the latter, electromagnetic means for operatively connecting said annulus to said receptacle, electromagnetic means for connecting said annulus to said support, and means for shifting said annulus independently of the rotation thereof relative to the discharge outlet for regulating the passage of materials through said outlet.
15. In a separator, a rotary receptacle mounted to turn on a vertical axis, having a series of spaced superposed outlets, rifle rings encircling said receptacle opposite each of said outlets and adapted to receive materials discharged through said outlet, and means for rotating said rings at corresponding or variable speeds relative to each other and relative to said receptacle.
16. In a separator, a rotary receptacle mounted to turn on a vertical axis, having a series of spaced superposed outlets, rifle rings encircling said receptacle opposite each of said outlets and adapted to receive materials discharged through said outlet, means for rotating said rings at corresponding or variable speeds relative to each other and relative to said receptacle, means whereby said rings may be raised or lowered relative to the receptacle, and means whereby said rings will operate to regulate the flow of materials from said receptacle.
17. In a separator, a rotary receptacle mounted to turn on a vertical axis and having a series of superposed discharge outlets through which materials in the receptacle may be ejected by centrifugal force on rotation of the receptacle, and means for collecting the materials ejected from each of said outlets operative to regulate the flow of materials through said outlets.
18. In a separator, a rotary receptacle mounted to turn on a vertical axis, having a series of superposed discharge outlets, a rotary rifle ring encircling said receptacle arranged opposite each outlet and adapted to receive the materials discharged from the outlet, a rotary frame encompassing said receptacle and turnable independently thereof, means for supporting said rings on said frame, whereby the rings may be rotated independently of the latter, means whereby said rings may close or vary the extent of opening of the outlets on vertical adjustment of the rings relative to the receptacle, means for raising and lowering said frame to effect vertical adjustment of said rings, and means whereby the rings may be operatively connected to either or both the receptacle or frame.
19. In a separator, a rotary receptacle mounted to turn on a vertical axis, having a series of superposed discharge outlets, a rotary rifle ring encircling said receptacle arranged opposite each outlet and adapted to receive the materials discharged from the outlet, a rotary frame encompassing said receptacle and turnable independently thereof, means for supporting said rings on said frame, whereby the rings may be rotated independently of the latter, means whereby said rings may close or vary the extent of opening of the outlets on vertical adjustment of the rings relative to the receptacle, means for raising and lowering said frame to effect vertical adjustment of said rings, and means whereby the rings may be operatively connected to either or both the receptacle or frame adapted to permit variable rotary movement of the rings relative to the receptacle or frame.
20. In a separator, a rotary receptacle mounted to turn on a vertical axis, having a series of superposed discharge outlets, a rotary rifle ring encircling said receptacle arranged opposite each outlet and adapted to receive the materials discharged from the outlet, a rotary frame encompassing said receptacle and turnable independently thereof, means for supporting said rings on said frame, whereby the rings may be rotated independently of the latter, means whereby said rings may close or vary the extent of opening of the outlets on vertical adjustment of the rings relative to the receptacle, means for raising and lowering said frame to effect vertical adjustment of said rings, means whereby the rings may be operatively connected to either or both the receptacle or frame adapted to permit variable rotary movement of the rings relative to the receptacle or frame, and means whereby the rings may have variable rotary movement relative to each other.
21. A separator comprising a rotary receptacle mounted to turn on a vertical axis and having a series of superposed discharge outlets, means for rotating said receptacle, a frame encompassing said receptacle mounted for vertical movement relative thereto, means for adjusting said frame vertically, a series of rings carried by said frame and rotatable independently thereof there being a ring arranged opposite each discharge outlet, said rings adapted to regulate the discharge of materials from said outlets on vertical adjustment of the frame, and said rings adapted to receive the materials ejected from said receptacle.

22. A separator comprising a rotary receptacle mounted to turn on a vertical axis and having a series of superposed discharge outlets, means for rotating said receptacle, a frame encompassing said receptacle mounted for vertical movement relative thereto, means for adjusting said frame vertically, a series of rings carried by said frame and rotatable independently thereof there being a ring arranged opposite each discharge outlet, said rings adapted to regulate the discharge of materials from said outlets on vertical adjustment of the frame, and said rings adapted to receive the materials ejected from said receptacle, and means whereby the rings may have variable rotary movement relative to each other.

23. A separator comprising a rotary receptacle mounted to turn on a vertical axis and having a series of superposed discharge outlets, means for rotating said receptacle, a frame encompassing said receptacle mounted for vertical movement relative thereto, means for adjusting said frame vertically, a series of rings carried by said frame and rotatable independently thereof there being a ring arranged opposite each discharge outlet, said rings adapted to regulate the discharge of materials from said outlets on vertical adjustment of the frame, and said rings adapted to receive the materials ejected from said receptacle, and means whereby the rings may have variable rotary movement relative to each other said last named means being operative to permit the rings being rotated in unison with the receptacle or at variable speeds relative thereto.

24. A separator comprising a rotary receptacle mounted to turn on a vertical axis and having a series of superposed discharge

outlets, means for rotating said receptacle, a frame encompassing said receptacle mounted for vertical movement relative thereto, means for adjusting said frame vertically, a series of rings carried by said frame and rotatable independently thereof there being a ring arranged opposite each discharge outlet, said rings adapted to regulate the discharge of materials from said outlets on vertical adjustment of the frame, and said rings adapted to receive materials ejected from said receptacle, means whereby the rings may have variable rotary movement relative to each other, said last named means being operative to permit the rings being rotated in unison with the receptacle or at variable speeds relative thereto, and means whereby said rings may be operatively connected to said frame whereby rotation of the rings may be effected independently of the receptacle at a speed of travel exceeding that of the receptacle.

25. In a separator, a rotary receptacle having a horizontal discharge outlet through which materials in said receptacle may be ejected, a rotary annulus encircling said receptacle adapted to receive the materials discharged from the receptacle having a wall extending close to the external wall of the receptacle opposite the discharge outlet forming a space between the receptacle and annulus in which materials discharged from the receptacle may accumulate and oppose the passage of materials from said outlet, and means whereby said annulus and discharge outlet may be relatively adjusted vertically to regulate the flow of materials from said outlet.

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