No. 856,612. PATENTED JUNE 11, 1907.

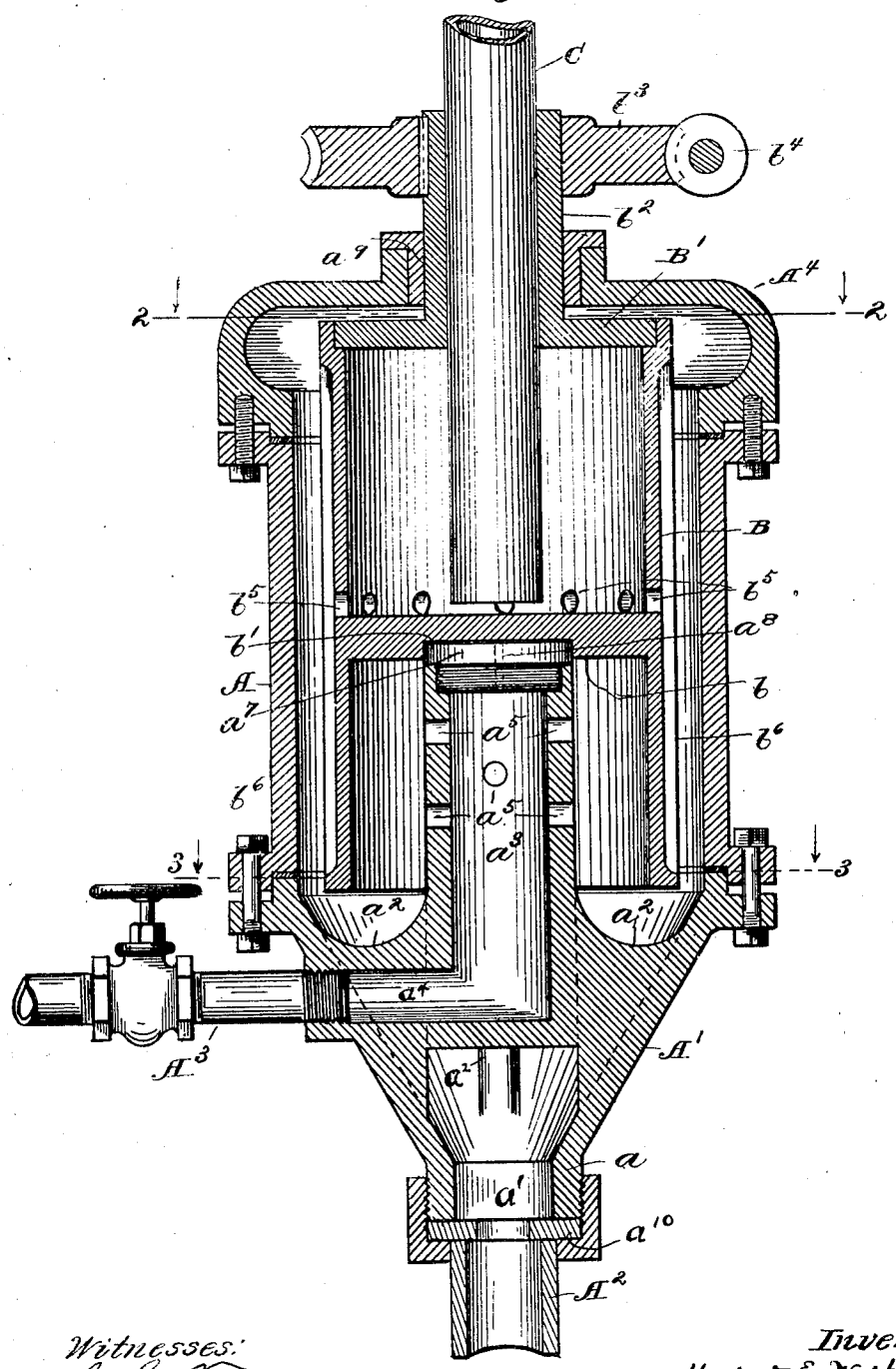
H. E. WETHERBEE.

MEANS FOR SEPARATING OR CLASSIFYING ORES.

APPLICATION FILED MAR. 25, 1907.

2 SHEETS—SHEET 1.

Fig. 1



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2 SHEETS—SHEET 2.

Fig. 2

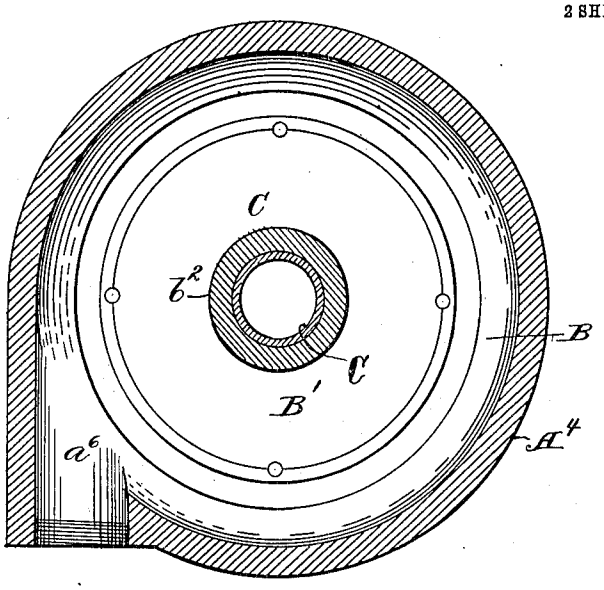
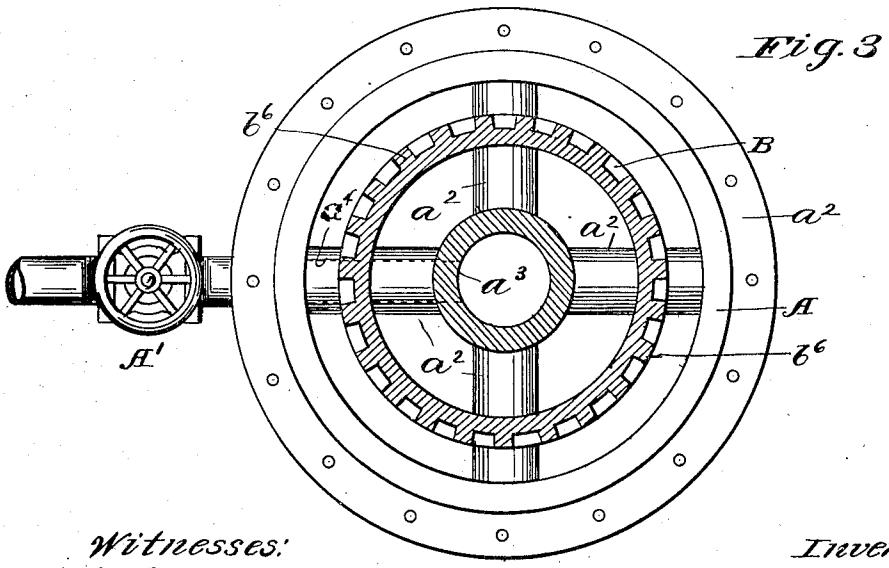


Fig. 3



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UNITED STATES PATENT OFFICE.

HERBERT E. WETHERBEE, OF CLEVELAND, OHIO, ASSIGNOR OF SIX-TWENTIETHS TO WILLIAM RATTLE, ONE-EIGHTH TO JAMES F. LEITCH, AND SEVEN-FORTIETHS TO CYRUS W. MERRELL, ALL OF CLEVELAND, OHIO.

MEANS FOR SEPARATING OR CLASSIFYING ORES.

No. 856,612. Specification of Letters Patent. Patented June 11, 1907.

Continuation of application Serial No. 252,132, filed March 27, 1905. This application filed March 25, 1907. Serial No. 364,283.

To all whom it may concern:

Be it known that I, HERBERT E. WETHERBEE, a citizen of the United States, and a resident of Cleveland, county of Cuyahoga, State of Ohio, have invented a new and useful Improvement in Means for Separating or Classifying Ores, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

My invention relates to means for separating or classifying ores and particularly to that class of such means which is adapted to separate or classify a mixture of ores of different specific gravities into constituent ores.

Said invention consists of means hereinafter fully described and particularly set forth in the claims.

The annexed drawings and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawings: Figure 1 represents a central vertical section of one form of ore separator embodying my several improved features of construction and operation; Fig. 2 is a horizontal cross-section of the same taken on the line 2—2, Fig. 1; and Fig. 3 is a horizontal cross-section thereof taken on the line 3—3, Fig. 1.

The body of my improved separating or classifying device consists primarily of an outer stationary casing A preferably of the cylindrical form shown. Secured to the lower end of such casing is conical bottom member A′ that terminates in a boss a provided with an opening a'. A suitable discharge pipe A^2 is connected with boss a and such opening a' therein. The rate of discharge through pipe A^2 is controlled by any suitable means as, for example by the insertion in the same of a diaphragm a^{10} of any desired size. Formed integral with bottom member A′ is a spider comprising four arms a^2, Fig. 3, that supports centrally within the lower portion of the receptacle inclosed by casing A a terminally closed, vertical, conduit a^3. The latter communicates below with a bore or passage a^4 in one of the arms a^2, to which is connected a valve controlled water supply pipe A^3. The upper portion of the conduit is provided with a plurality of lateral discharge apertures a^5, preferably arranged in series bearing a staggered relation toward each other. Thus, Fig. 1, there are shown three such series of apertures consisting of two apertures each. The number and arrangement of these apertures, however, is more or less immaterial although it is desirable that the aggregate cross-section thereof should be slightly greater than that of water supply pipe A^3; this in order that the liquid may flow from the conduit a^3 perfectly freely and not in pronounced jets.

The upper end of casing A is closed by a cap A^4 suitably secured thereto and formed with a tangentially disposed discharge orifice a^6, Fig. 2. A pipe, not shown, serves to conduct that portion of the receptacle's contents which escapes by this orifice to such point as may be desired.

Revolubly mounted within casing A is a hollow member or drum B, formed intermediately of its ends with a heavy transversely disposed partition b that divides said drum into two chambers, one extending upwardly, the other downwardly from such partition. Said member rests with partition b centrally disposed upon the upper closed end of conduit a^3, a cap a' of brass being utilized to effect such closure with the object of affording a good bearing upon which to support the member. The under face of the partition is formed with a corresponding recess b' to receive such cap. If desired, an aperture a^8 is formed in this cap and the bearing between the suface of the latter and partition b thus lubricated by the water which is thereby admitted into the same. The upper end of the drum, and hence of the upwardly opening chamber therein, is closed by means of a disk or plate B′ rigidly secured thereto and provided with an integral upwardly projecting sleeve b^2 that is journaled in a suitable bearing a^9 therefor provided in cap A^4 of casing A. Rotation of the drum B is effected by means

of a worm gear b^3 splined upon this sleeve and a worm b^4 meshing therewith. The material to be separated is designed to be introduced into the chamber formed by the upper portion of the cylindrical walls of drum B and plate B'. To this end a feed pipe C connected with a suitable source of supply is introduced through the bore of sleeve b^2 so that its lower or discharge end is positioned only a short distance above the surface of partition b. For the escape of the material from the drum chamber, a plurality of apertures b^5 are provided in the cylindrical walls of the drum substantially on a line with such upper surface of partition b. The length of the drum is such as to cause it to extend from substantially the line of juncture between casing A and conical bottom A' to nearly the top of cap A^4. It will hence be seen that the upper perforated portion of conduit a^3 is laterally surrounded by the lower portion of the cylindrical walls of drum B, as by a flange depending from partition b. The diameter of the drum is such as to leave a vertical elongated annular space between its outer surface and the inner surface of casing A. This outer surface of the drum is longitudinally furrowed or grooved from a point near its top to a point near its bottom. The number and depth of the grooves are such as to form a plurality of longitudinal ribs or imperforate blades b^6 on the face of the drum, Figs. 1 and 3.

The method of operating my improved ore separating device should be fairly obvious from the preceding description of its structure. In such operation the rotatable member or drum B is driven at the proper speed, which depends upon the character of the material being treated as will hereinafter appear, by means of worm b^4 and worm gear b^3. While the drum is thus more or less rapidly rotating the ores to be separated are fed into the upper chamber in said drum and simultaneously therewith a stream of water is admitted into conduit a^3. The latter, escaping through apertures a^5, is first deflected downwardly by the lower portion of the drum's wall but thereupon immediately rises and flows upwardly filling the aforesaid annular space described as being left intermediately of the drum and casing B. To this ascending annular column of water the ribs b^6 of the rotating drum impart a rotary movement so that the water does not flow in a direct but in a helical upward course. Rising to the top of casing A, the stream is discharged through orifice a^6, the latter being disposed to correspond with the direction of rotation of the water. The rotation of the drum, in addition to imparting the above described rotary motion to the stream of water, also serves at the same time to centrifugally discharge the material from within the drum outwardly through apertures b^5 in the drum's walls. Such material as it thus emerges from within the drum is caught up by the revolving blades or ribs b^6 and by them projected horizontally into the ascending stream of water that fills the annular space lying intermediately of the drum and casing.

The heavier ore particles, upon which the force of gravity acts more strongly than the power of the rotating current to keep the same in suspension, gradually settle through the water to the bottom of the casing where they are removed through discharge pipe A^2. The rate of discharge through the outlet thus provided is of course regulated by the insertion of a diaphragm a^{10} of the proper size or by such other means as might suggest themselves as being suitable for this purpose. The water that is prevented from escaping through said outlet necessarily must travel the upward helical course around member B. Now the water that is admitted through inlet pipe A^3 is admitted at just such a pressure as is sufficient to enable that part thereof which flows through the annular space between said member B and the casing to wash out the lighter ore particles that are kept in suspension by the rotation imparted to the upwardly ascending stream. Such lighter particles being swept by the water through discharge orifice a^6, it will be seen are thus separated from the heavier particles. It will be noted that the rate of rotation of the member B, the rates of flow of water through inlet A^3 and outlet A^2, and the consequent rate of upward flow around the member B, can all be kept under constant control and regulated as is desired; so that, if upon examination of the resultant products being discharged through pipe A^2 and orifice a^6, the separation is found to be unsatisfactory, the error can be continuously corrected until the ore of desired weight or kind is obtained. In this manner a continuous flow of part of the water is allowed in an upward direction and simultaneously a continuous flow of another part in a second direction. By combining the effects of these two currents with the effect of the rotary member, a rapidly rotating annular column of water having a general upward flow is produced throughout substantially the whole length of casing A, while below such column is a relatively quiescent body of water in what may be termed the settling chamber. In view of the action of the annular column of water, the corresponding portion of the device may be termed a sorting column. Obviously the plane of demarcation between the settling chamber and sorting column will approximately coincide with that of the lower edge of rotating member B.

It need scarcely be remarked that the words separation and separator, as employed herein, are used in their ordinary or general significance. Technically speaking my invention may be used either as a "separator"

or as a "classifier." In using, for example, that form of my invention just illustrated and described as a separator the material fed into the machine would have been previously sized by screens. The result of the operation in this case is the segregation of particles having different specific gravities as will be evident. In using the machine as a classifier, the material is fed thereto without being screened and the two segregated products will respectively comprise particles having equal settling capacities under free settling conditions. It is of course understood that if in the handling of any particular material such substitution should be found desirable, other liquids than water may be used in the machine.

The general process or method of separating or classifying materials exemplified in the operation of the above described apparatus is separately set up and claimed in an application Serial No. 281,882, filed by me October 9, 1905.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any one of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. In means for separating ores, the combination of a stationary receptacle provided with openings for the ingress and egress of liquid; a positively-driven rotary member in said receptacle which is separated from the receptacle's walls by an annular space forming a sorting column, said rotary member being adapted to impart a rotary motion to the receptacle's contents and to receive and project the ores to be separated into said sorting column intermediate of the top and bottom of the latter; and a source of liquid supply adapted to furnish a stream of liquid flowing upwardly through said sorting column from such ingress opening.

2. In means for separating ores, the combination of a stationary receptacle provided with openings for the ingress and egress of liquid; a positively-driven rotary member in said receptacle which is separated from the receptacle's walls by a vertical elongated annular space forming a sorting column in which the heavier material is free to descend by gravity, said rotary member being adapted to impart a rotary motion to the receptacle's contents and to receive and horizontally project the ores to be separated into said sorting column; and a source of liquid supply adapted to furnish a stream of liquid flowing upwardly through said sorting column from such ingress opening.

3. In means for separating ores, the combination of a stationary receptacle provided with openings for the ingress and egress of liquid; a positively-driven rotary member in said receptacle which is separated from the receptacle's walls by a vertical elongated annular space forming a sorting column in which the heavier material is free to descend by gravity, said rotary member being adapted to impart a rotary motion to the receptacle's contents and to receive and horizontally project the ores to be separated into said sorting column intermediately of the ends of the latter; and a source of liquid supply adapted to furnish a stream of liquid flowing upwardly through said sorting column from such ingress opening.

4. In means for separating ores, the combination with a stationary receptacle provided with openings for the ingress and egress of liquid and normally open; of a positively-driven rotary member in said receptacle adapted to impart a rotary motion to the receptacle's contents, said latter member and the receptacle's walls being separated by an elongated annular space forming a sorting column in which the separation is effected, said rotary member adapted to receive the ores to be separated and deliver them into said sorting column.

5. In means for separating ores, the combination with a stationary receptacle provided with an upper and a lower egress opening for liquid and an opening for the ingress of liquid; of means in said receptacle forming an annular space comprising an upper perpendicular elongated portion forming a sorting column in which the separation is effected, and a lower portion forming a settling chamber; said means including a positively-driven rotary member adapted to impart a rotary motion to the receptacle's contents, said rotary member being located horizontally adjacent to said sorting column and terminating substantially in the horizontal plane which marks the lower termination of said sorting column; said openings being normally open.

6. In means for separating ores, the combination with a receptacle provided with an upper and a lower egress opening for liquid and an opening for the ingress of such liquid; of means in said receptacle forming an annular space comprising an upper perpendicular elongated portion forming a sorting column in which the separation is effected, and a lower portion forming a settling chamber; said means including a positively-driven rotary member adapted to impart a rotary motion to the receptacle's contents and located horizontally adjacent to said sorting column, together with means for deflecting currents of liquid laterally of such rotary member and prior to the entrance of such currents into the said annular space.

7. In means for separating ores, the combination with a receptacle provided with an upper and lower egress opening for liquid and an opening for the ingress of such liquid; of means in said receptacle forming an annular space comprising an upper portion forming a sorting column in which the separation is effected, and a lower portion forming a settling chamber, said means including a positively-driven rotary member adapted to impart a rotary motion to the receptacle's contents and located horizontally adjacent to said sorting column, such rotary member being adapted to deflect currents from below laterally of said member.

8. In means for separating ores, the combination with a receptacle provided with an upper and lower egress opening for liquid and an opening for the ingress of such liquid; of means in said receptacle forming an annular space comprising an upper portion forming a sorting column in which the separation is effected, and a lower portion forming a settling chamber, said means including a positively-driven rotary member adapted to impart a rotary motion to the receptacle's contents and located horizontally adjacent to said sorting column; such rotary member being provided with a web or flange adapted to deflect currents from below, laterally of such rotary member.

9. In means for separating ores, the combination with a receptacle provided with an upper and a lower opening for the egress of liquid and an opening for the ingress of liquid; of means located in said receptacle forming an upright annular space comprising an upper portion in communication with said upper opening and a lower portion in communication with said lower opening, said means including a positively-driven rotary member horizontally adjacent to said upper portion of the annular space, adapted to impart a rotary motion to the receptacle's contents and adapted to receive and horizontally project the ores to be separated into said annular space, said openings for the ingress and egress of liquid being normally open, and said rotary member being concentric with the upper portion of the receptacle.

10. In means for separating ores, the combination of a receptacle comprising an upper cylindrical portion and a lower portion having its interior in direct communication therewith, said receptacle provided with openings for the egress of liquid and respectively in communication with said upper and lower portions, together with an opening for the ingress of liquid located below said upper portion; of a positively-driven rotary member having a vertical axis and located in said upper portion, said member provided with projecting blades having their longitudinal outer edges parallel with the walls of such upper portion and horizontally adjacent thereto throughout substantially their entire length, said blades being removed from said wall a substantial distance forming a free annular space wherein the heavier particles of ore may descend by gravity unobstructed; and means intermediate of the upper and lower portions of said receptacle and adapted to deflect upward currents of liquid laterally of said rotary member.

11. In means for separating ores, the combination of a stationary receptacle provided with openings for the ingress and egress of liquid, a positively-driven rotary member in said receptacle adapted to impart a rotary motion to the receptacle's contents, said latter member and the receptacle's walls being separated by an upright annular space forming a sorting column in which the material is separated and in which the heavier material is free to descend by gravity, said rotary member being provided with an interior passage and with lateral openings communicating with said passage and with said sorting column intermediate of the top and bottom of the latter, said rotary member being adapted to receive in said interior passage the ores to be separated and to project the same therefrom through said lateral openings into said sorting column; and a source of liquid supply adapted to furnish a stream of liquid flowing upwardly through said sorting column from such ingress opening.

12. In means for separating ores, the combination of a stationary receptacle provided with openings for the ingress and egress of liquid; a revoluble member in said receptacle having a vertical axis and provided with an interior passage together with a plurality of projecting blades running in the direction of such axis, said revoluble member and the receptacle's walls being separated by an upright annular space forming a sorting column in which the material is separated and in which the heavier material is free to descend by gravity, said interior passage communicating with said sorting column intermediately of said blades and at points intermediate of the top and bottom of said revoluble member; and a source of liquid supply adapted to furnish a stream of liquid flowing upwardly through said sorting column from such ingress opening.

13. In means for separating ores, the combination with a receptacle comprising an upper cylindrical portion and a lower portion having its interior in direct communication therewith, said receptacle provided with openings for the egress of liquid and respectively in communication with said upper and lower portions, together with an opening for the ingress of liquid located below said upper portion; of a positively-driven rotary member having a vertical axis and located in said

upper portion, said member provided with projecting blades having their longitudinal outer edges parallel with the walls of such upper portion and horizontally adjacent thereto throughout substantially their entire length, said blades being removed from said walls a substantial distance forming throughout their length a free annular perpendicular space wherein the heavier particles of ore may descend by gravity unobstructed.

Signed by me, this 21st day of March, 1907.

HERBERT E. WETHERBEE.

Attested by—
D. T. DAVIES,
JNO. F. OBERLIN.