(No Model.)

2 Sheets—Sheet 1.

C. J. REED.

ORE SEPARATOR.

No. 466,515. Patented Jan. 5, 1892.

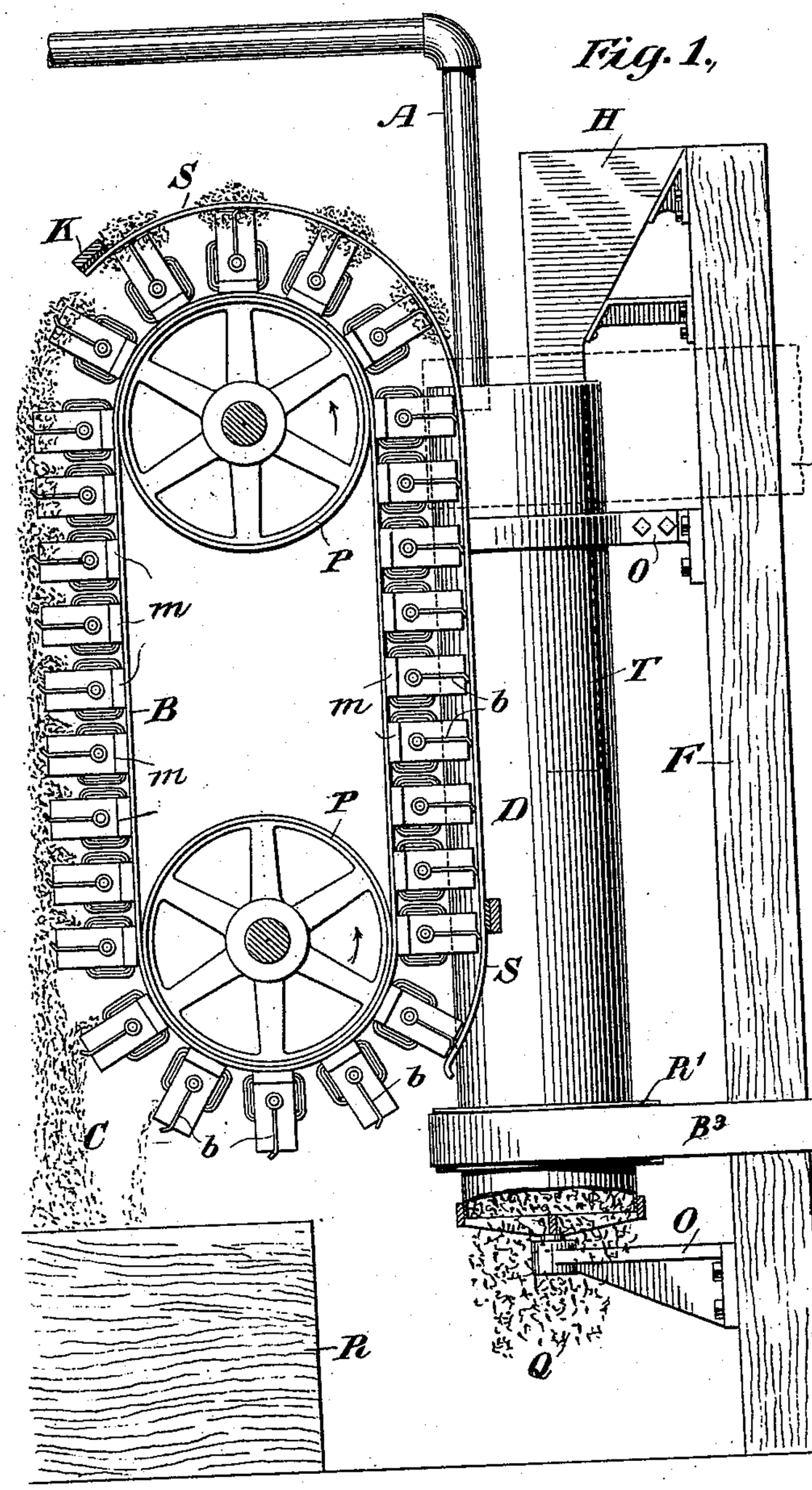

Fig. 1.

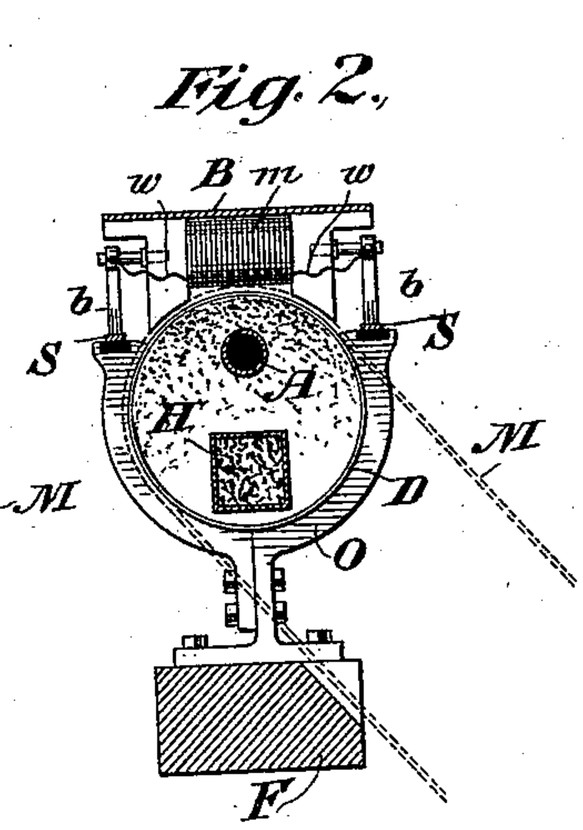

Fig. 2.

Fig. 3.

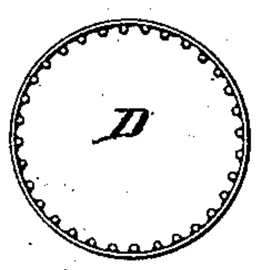

Fig. 4.

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(No Model.) 2 Sheets—Sheet 2.

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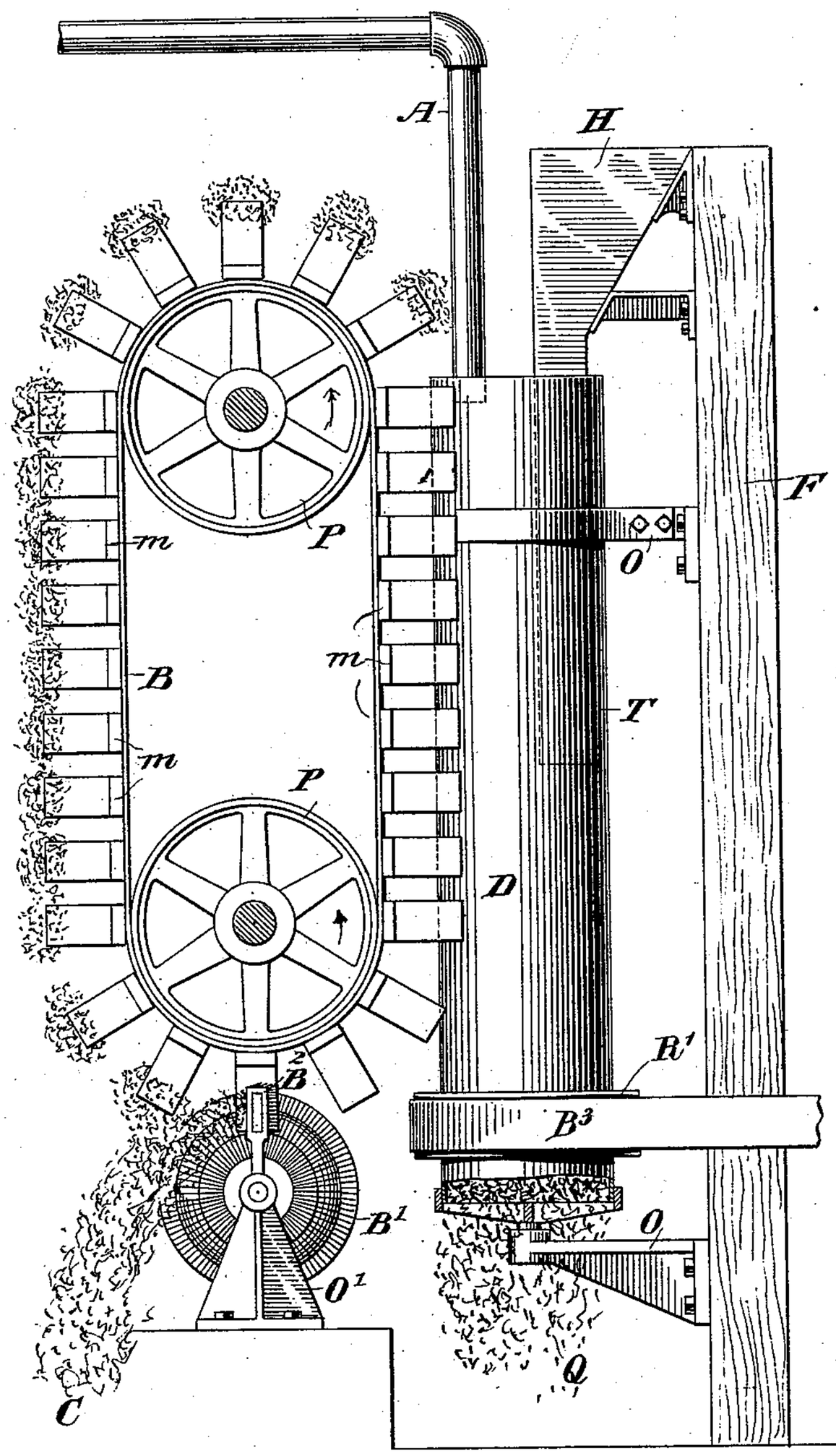
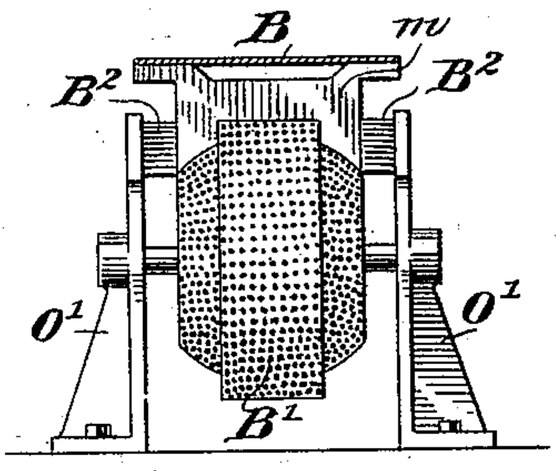


Fig. 5.

Fig. 6.



Witnesses
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H. W. Lloyd.

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UNITED STATES PATENT OFFICE.

CHARLES JOHN REED, OF ORANGE, NEW JERSEY.

ORE-SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 466,515, dated January 5, 1892.

Application filed April 6, 1891. Serial No. 387,863. (No model.)

To all whom it may concern:

Be it known that I, CHARLES JOHN REED, a citizen of the United States, residing at Orange, in the county of Essex and State of New Jersey, have made a new and useful invention in the Art of Ore-Separating, of which the following is a specification.

My invention relates to improvements in ore-separating machines in which a hollow revolving drum acts in conjunction with moving external magnets, gravity, and a current of air or water; and it has for its object the provision of a novel apparatus for separating mixtures of powdered minerals, particularly magnetic particles from non-magnetic particles. I attain this object by the utilization of the mechanism illustrated in the accompanying drawings, and described in the specification which follows.

Referring now to the drawings, Figure 1 is a side elevational view of the entire mechanism. Fig. 2 is a sectional view taken through the body of the machine, showing one of the operating-magnets in elevation. Figs. 3 and 4 are end views of modified forms of the drum, showing in the one instance projections and in the other grooves on the inner surface. Fig. 5 is a side elevational view of a modified form in which permanent magnets supplant the electro-magnets shown in Figs. 1 and 2 and in which a brush is illustrated for removing the magnetic particles from the poles of the magnets. Fig. 6 is a detail elevational view of the rotary brush shown in Fig. 5, one of the magnets being shown in elevation.

Like letters of reference represent like parts wherever they occur throughout the specification and in the drawings.

D is a hollow revolving drum, preferably cylindrical in form, revolving in supports O and receiving its motion from a pulley R′ and belt B^3, connected to a source of power. (Not shown.)

H is a hopper or feed-box into which the powdered mixture is fed.

F is a frame work or support to which the apparatus is bolted or secured, and is adapted to hold said apparatus in any preferred position.

A represents a tube or pipe through which a current of air or water passes into the interior of the drum D from the top thereof toward the bottom.

C represents the magnetic particles or concentrates, and Q the non-magnetic particles or tailings.

m m represent electro-magnets in Figs. 1 and 2 and permanent magnets in Figs. 5 and 6, said magnets being in both instances attached to a belt B, which passes over pulleys P P, revolving in the direction indicated by the arrows, so that the magnets adjacent to the drum move upward as the pulleys P carry the belt B continuously forward. These magnets *m* have curvilinear pole-pieces, as shown in Figs. 2 and 6, adapted to lie in close proximity to the outer surface of the revolving drum D, but not in actual contact therewith.

In Figs. 1 and 2 I have shown electro-magnets in which the coils are connected through side supports by conductors *w* and brushes *b* with a pair of side conductors S S, insulated from each other and held in position on either side of the drum by the support O and end supports K. One of these side conductors S is connected to one pole of a dynamo-electric machine or electric battery and the other to the remaining pole thereof, said source of electrical energy not being shown, and the arrangement of these electro-magnets, as shown in Figs. 1 and 2, is such that as the pulleys P rotate in the direction indicated by the arrows the electro-magnets will be thrown into multiple-arc circuit with the conductors S and the generator to which said conductors are connected during the time that their poles are passing from the bottom of the drum D to the upper support K. (See Figs. 1 and 2.)

T, Figs. 1 and 5, represents a tube connected directly to the hopper H and extending into the drum D, its function being to convey the powdered mixture into the interior of said drum. The interior surface of the drum D is preferably of a roughened nature, grooves or projections being provided, as shown in Figs. 3 and 4. This particular feature, however, of a rotary drum with a roughened interior surface constitutes the subject-matter of a separate application filed by me in the United States Patent Office on the 1st day of December, 1890, and serially numbered 374,246. The drum D is thus roughened on the interior for

the purpose of facilitating the agitation of the powdered mixture.

In the modified form shown in Figs. 5 and 6 permanent magnets *m* are used in place of electro-magnets *m* in Figs. 1 and 2, and the magnetic particles or concentrates are removed by a rotary brush B′, journaled at the lower end of the machine and rotated by the same source of power which rotates the pulleys P and drum D.

B^2 B^2 are side brushes fixed permanently to the supports O′ O′, adapted to remove the magnetic particles from the side faces of the magnets *m*.

M, Fig. 1, represents another means for removing the magnetic particles or concentrates when used either with electro-magnets or permanent magnets. It consists of a broad belt of leather or other analogous material, and is supported at one end by the drum D and at the other by a pulley. (Not shown.) A considerable portion of this belt projects past the end of the drum, so that as the magnetic particles are carried forward by the magnets and out of the end of the drum they are directed toward the belt, which is moving in such a direction as to carry them to one side, so that as they pass the end of the cylinder and finally out of the influence of the magnets they drop off under the influence of gravity, or may be swept off by a broom or in any other manner which will readily suggest itself to those skilled in the art.

The operation of the apparatus is as follows: Referring first to Figs. 1 and 2, the drum D is caused to rotate in either direction about its axis through the agency of the belt B^3 and pulley R′. A blast of air or current of water is passed through the drum from the top to the bottom, entering from tube A. At the same time the finely-powdered mixture of magnetic and non-magnetic particles is passed from the hopper H by its own weight through the tube T into the interior of the revolving drum D. The rotary motion of the drum keeps the mixture thoroughly agitated, while the magnets *m*, which are being rotated in the direction of the arrows by the pulleys P, are being magnetized as the brushes *b* ride forward in contact with the two side conductors S S, connected to the dynamo, and hence continuously attract the magnetic particles in an upward direction, so that while the drum is rotated continuously the tailings Q are passing downward and at the same time the magnetic particles or concentrates are being successively advanced in an upward direction, until they finally pass out at the top and are attached by their magnetic influence directly to the poles of the magnets. This action continues to carry them forward until the brushes *b* pass off the side conductors S, when the magnets are demagnetized and the concentrates fall by their own weight into the box R. It will thus be observed that in the practice of my improved method the separation of magnetic from less magnetic or non-magnetic particles is accomplished by the magnetic action thereof through the agency of moving magnets which move in one direction, while the non-magnetic particles are continuously advanced in the other direction through the agency of an air-blast or stream of water, the magnetic particles always passing out of one end of the drum, while the non-magnetic particles pass out at the other end thereof. The rotary motion of the drum serves to agitate the mass and facilitate the separating action due to the aforesaid opposing forces. The quality of the separation, therefore, depends upon the relative strengths of these two forces, and they may be adjusted by varying the strength of the magnetic field, the force of the current of air or water, and the position of the apparatus. By inverting the apparatus, for instance, or what amounts to the same, by reversing the motion of the magnets and the direction of the interior current, we have gravity and the magnetic fields acting together and against the current.

I do not limit myself to any particular position of the apparatus, as it may be operated in an inclined position at any angle from the horizontal to vertical. Nor am I limited to the particular form of magnets shown in my drawings, nor to any particular method of attaching or carrying the magnets or magnetic fields, nor to any particular direction of motion of said magnets or magnetic fields, nor do I limit myself to the kind or quality of interior current used, as I may use a current of nitrogen or other inert gas, or a solution of salt would serve equally as well as air or water. In other words, I desire it to be distinctly understood that my claims hereinafter made are directed, broadly, to any apparatus which will effect the separation of magnetic from non-magnetic particles by giving to the combined mass of magnetic and non-magnetic particles an advance and a rotary motion, and simultaneously subjecting the same to the influence of a moving magnetic field, which moves in a reverse direction to that of the moving mass of particles in the manner described.

What I claim, and desire to secure by Letters Patent, is—

1. An ore-separator having a hollow revolving drum, through which the ore passes longitudinally, in combination with one or more magnets carried in close proximity to the exterior surface of the drum, but detached therefrom and having a motion different from and independent of the motion of said drum, substantially as described.

2. In an ore-separator, a hollow revolving drum, through which the ore passes longitudinally, in combination with one or more electro-magnets attached to a belt or carrier and moving longitudinally in close proximity to the exterior surface of the drum, substantially as described.

3. In an ore-separator, a hollow revolving drum, through which the ore passes longi-

tudinally, in combination with a series of moving magnets carried in close proximity to the exterior surface of the drum and having a motion different from and independent of the motion of said drum, substantially as described.

4. In an ore-separator, a hollow revolving drum, through which the ore passes longitudinally, in combination with one or more external magnets moving in close proximity to the exterior surface of the drum, said magnet or magnets having a motion different from and independent of the motion of the drum, and means for injecting a blast of air through the drum, substantially as described.

5. In an ore-separator, a hollow revolving drum, through which the ore passes longitudinally, in combination with moving external magnets having a motion substantially in the direction of the length of the drum and a hopper or feed-box, substantially as described.

6. In an ore-separator, a hollow revolving drum, through which the ore passes longitudinally, in combination with one or more moving external magnets having a motion substantially in the direction of the length of the drum and means for discharging the concentrates, substantially as described.

7. An ore-separator having a hollow revolving drum provided with a roughened interior surface, in combination with a series of magnets exterior to the drum and attached to a carrier or belt, substantially as described.

8. In an ore-separator, a hollow revolving drum provided with an interior roughened surface, in combination with one or more moving magnets arranged exterior to the drum, substantially as described.

CHARLES JOHN REED.

Witnesses:
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HUGH MCCOY.