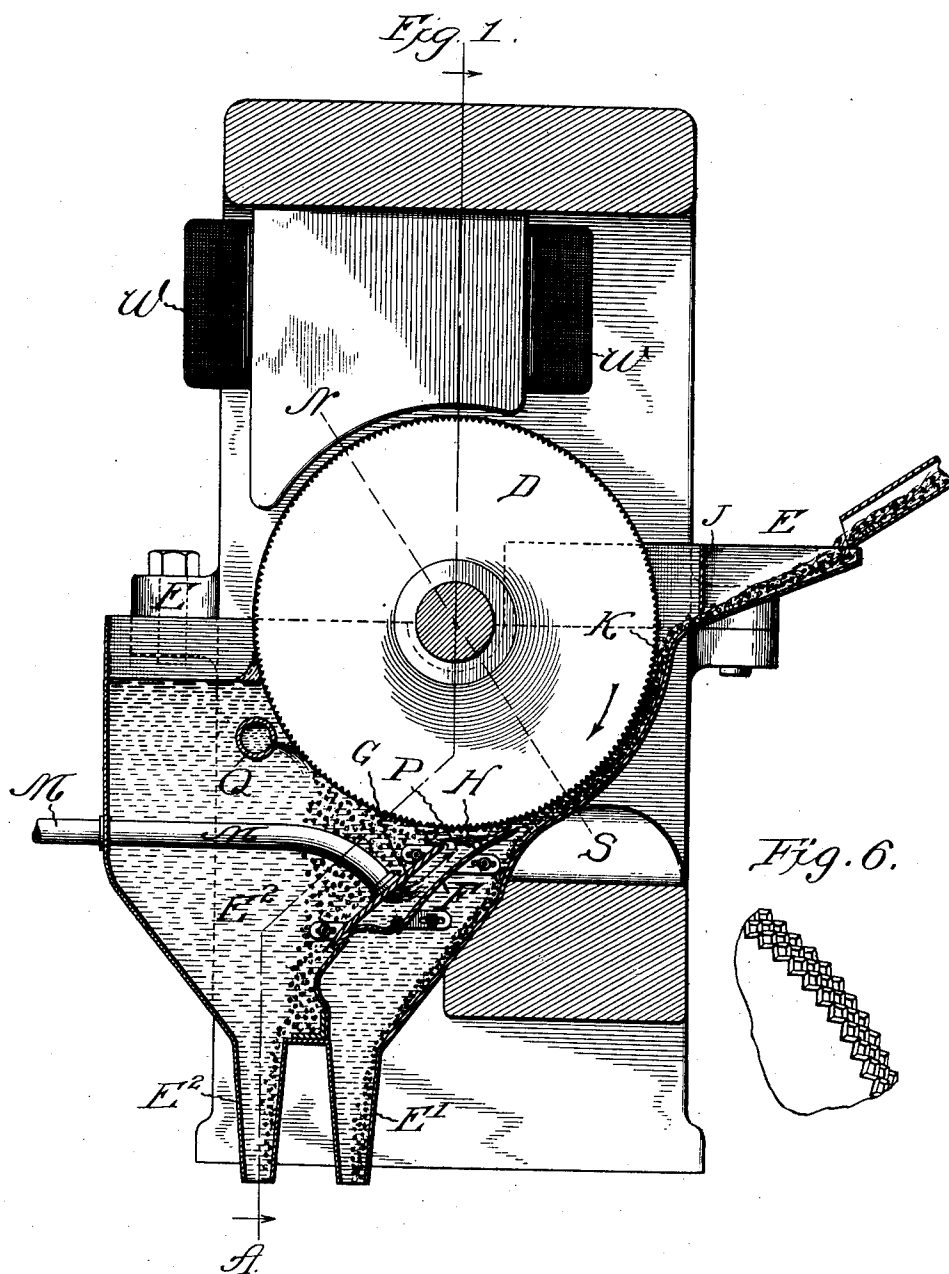


No. 832,823.

PATENTED OCT. 9, 1906.

H. H. WAIT.
MAGNETIC ORE SEPARATOR.
APPLICATION FILED MAR. 20, 1906.

3 SHEETS—SHEET 1.



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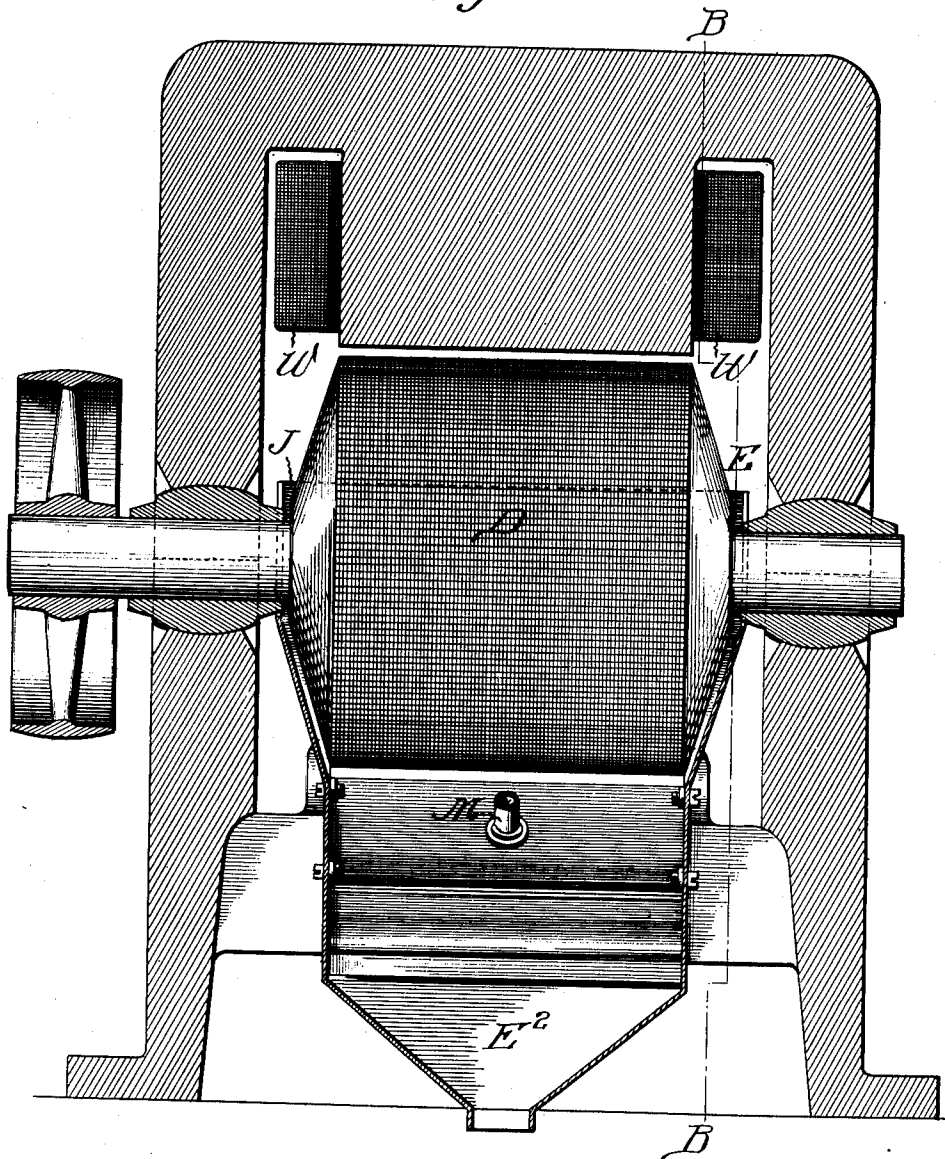
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3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

Fig. 3.

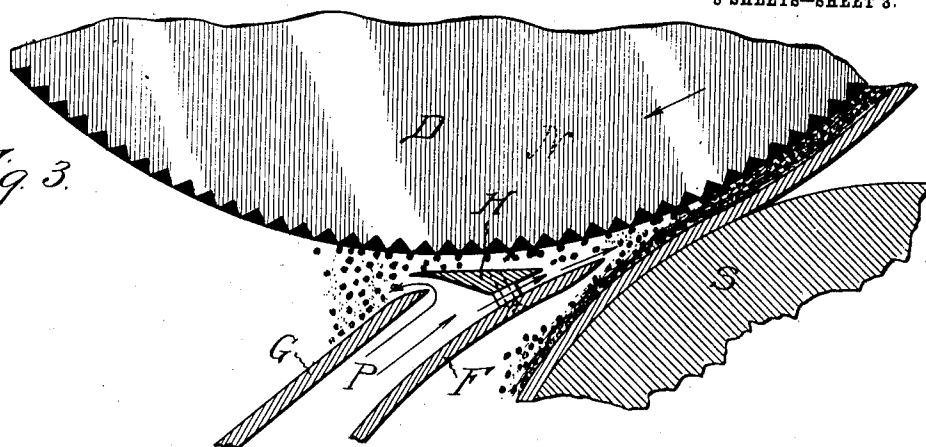


Fig. 4.

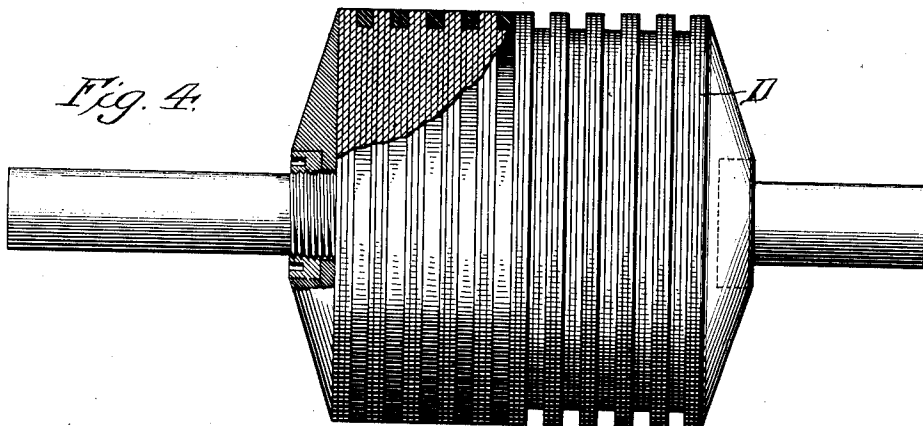
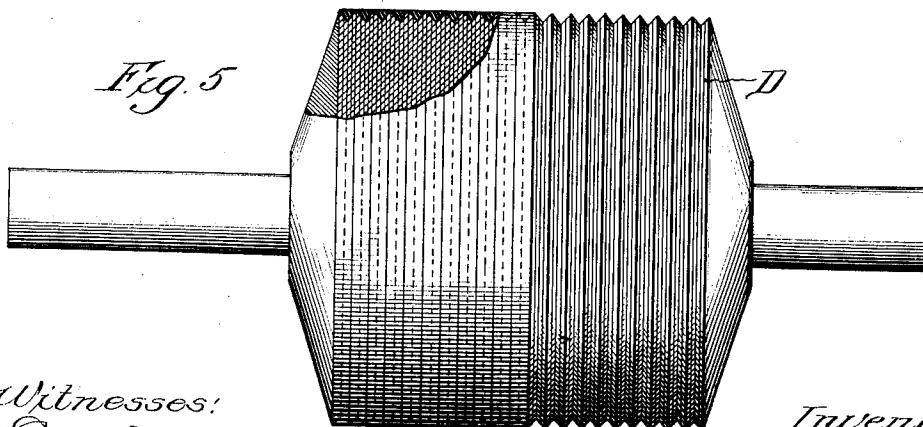


Fig. 5.



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UNITED STATES PATENT OFFICE.

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MAGNETIC ORE-SEPARATOR.

No. 832,823.

Specification of Letters Patent.

Patented Oct. 9, 1906.

Application filed March 20, 1905. Serial No. 251,067.

To all whom it may concern:

Be it known that I, HENRY H. WAIT, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Magnetic Ore-Separators, of which the following is a full, clear, concise, and exact description.

My invention relates to a magnetic separator; and its object is to provide improved apparatus for the separation of magnetic materials from a mixture in the presence of water or other fluid. In such apparatus the material to be separated is carried by a stream of fluid through a magnetic field, where it is acted upon by the flux, and a feature of this invention lies in the means for preventing the unattracted or non-magnetic particles from being carried along by the main stream past the divider-plate, and so reaching the space reserved for the attracted particles.

In the preferred form of machine for practicing my invention an armature-cylinder having teeth or permeable projections upon its periphery is arranged to rotate between magnet-poles placed above and below the same, and a stream of water carrying the mixture to be separated is passed between the lower pole-piece and the armature, passing under the latter as in an undershot water-wheel. The magnetic particles are attracted toward the armature and carried along by it beyond the edge of a divider-plate which is located at a suitable point near the periphery of the armature-cylinder, such that the magnetic material will fall on one side of said divider and the unattracted material will continue its passage on the other side thereof. To prevent a portion of the unattracted material from being carried along past the divider-plate by the stream of water in which it is fed through the machine, means are provided for creating a current of fluid in opposition to the main stream and of a force sufficient to wash the unattracted material back and away from the armature, though insufficient to dislodge the attracted material therefrom. Preferably this counter current is created by additional water, which is led in through a pipe or jet and directed against the surface of the armature-cylinder near the region where separation takes place.

While the surface of the magnetic cylinder

should be provided with permeable projections to create convergences of the lines of force, and so to provide for the attraction of the magnetic particles toward its surface, I preferably build up the cylinder with a smooth surface physically by filling in the spaces between the permeable projections with non-magnetic material. The cylinder having such a smooth surface will thus avoid unnecessarily agitating the fluid in which it rotates.

Preferably the chute or trough for the passage of the stream carrying the material to be separated is inclined at such an angle that the velocity of the fluid and the material is approximately the same as the peripheral speed of the revolving cylinder, the surface of which thus moves along with the stream, the object being to allow the comparatively weak forces of magnetism to act upon the permeable particles with the least hindrance from the fluid.

Further features of my invention will be described by reference to the accompanying drawings, in which—

Figure 1 is a vertical sectional elevation on line B B of Fig. 2 of a wet undershot separator constructed and equipped in accordance with the invention. Fig. 2 is a transverse sectional elevation on line A A of Fig. 1 with the cylinder in elevation. Fig. 3 is a detail view, on a larger scale, of a portion of the armature-cylinder and the parts associated therewith near the region where separation takes place. Fig. 4 is a detail view showing a modified form of armature, and Fig. 5 is a similar detail illustrating still another modification. Fig. 6 is a detail view showing the arrangement of the teeth of the armature.

The same letters of reference indicate the same parts wherever they are shown.

The machine illustrated is of the type in which a cylindrical iron armature D is arranged to rotate between two magnet-poles N S of opposite polarity, the magnetic material being passed between the armature and one of said poles S, the armature being provided with means for securing concentration of the magnetic flux at points or lines upon the surface, so that the magnetic material, following converging lines of force, will be attracted to the armature and carried around in the rotation thereof. At a point on the

surface of the armature where the magnetic flux reverses—that is to say, at the “neutral point”—the attracted material will be released.

5 In the machine illustrated a casing, trough, or feed-chute E is arranged to receive a stream of water carrying the material to be separated and to guide this stream around and under the armature between said armature and the pole-piece S of the field-magnet, the water and the separated materials being discharged through spouts E' E². The velocity and volume of the entering stream may be controlled by the gate J and by the area of the working passage K.

15 The speed of the particles and the water as influenced by gravity at the working part of the machine is regulated by the angle of inclination of the working passage—that is to say, at the place just before the divider-plate F. This plate, which is preferably adjustably mounted, as shown, is arranged with its edge close to the surface of the armature-cylinder in such a position that the magnetic particles attracted by the armature will be carried past said plate and discharged from spout E², while the unattracted material will continue its course at the other side of said plate and be discharged through the spout E'.

30 The armature-cylinder should have teeth adapted to produce points or lines of concentration of the magnetic flux upon its periphery; but the physical surface of the armature should be smooth in order to avoid unnecessarily agitating the water. The armature, furthermore, should be laminated, so that it may turn easily in the intense magnetic field. A good construction of the armature is to build it up of disks or laminations having teeth upon their edges, the disks being assembled in relative positions to present the teeth in staggered rows upon the surface of the armature. The interstices between the teeth should then be filled with wax or some other suitable non-magnetic material to build up a smooth surface.

45 In Figs. 4 and 5 I have shown armatures of modified forms in which circumferential grooves are provided in the iron, forming magnetic ridges around the cylinder. These grooves may be filled with non-magnetic material, as before stated. In these modifications some of the laminations will be of larger diameter than the others, so that their edges will project beyond the edges of adjacent laminations to form the magnetic ridges referred to. The armature may thus be built in a great variety of forms, the principal requirement being that it should have a surface of such character that the lines of force will be converged upon points or narrow areas in order that the magnetic material, which tends to follow the converging lines of force, will be attracted to the armature rather than to the stationary pole of the

magnet, and a further requirement being that the armature should not unnecessarily agitate the fluid in which it rotates.

The forces exerted by currents in the water upon the particles of the mixture requiring separation are quite strong in comparison with the effects of gravity and of the magnetic pull of the permeable particles tending to produce separation. It becomes, therefore, a matter of some difficulty to construct a machine of this type which will be effective for the separation of materials of low magnetic permeability and in general to avoid the disturbing effect of currents in the fluid in which separation takes place. The peripheral speed of the revolving armature D and the velocity of the water in the passage K should in general be relatively adjusted so that there will be no great difference between the velocity of the magnetic particles which are attracted to the drum and that of the water which accompanies them. In some cases, however, it may be found desirable to have a certain slight difference in these velocities in order to wash away entrained non-magnetic particles or to increase the output of the machine.

As the material passes the divider-plate F the current of water following along with the armature in its rotation has a tendency to carry non-magnetic material along with it past the divider-plate into the space for the magnetic particles. In order to counteract this tendency, I provide means for creating a current of water in opposition to the main stream and of a force sufficient to wash the unattracted material back and away from the armature while insufficient to dislodge the attracted material therefrom. A pipe M is shown through which water is introduced into the chamber P, formed between the divider-plate F and an auxiliary divider-plate G, located on the said plate F. In other words, the mouth of this chamber P forms a jet of the width of the machine, directed against the under surface of the armature-cylinder in opposition to the stream of water tending to follow the armature in its rotation. If the auxiliary divider-plate G is not arranged with considerable inclination, there will be a tendency of the magnetic particles falling from the armature to settle and accumulate on this plate, and I therefore provide means, such as a baffle-plate H, at the mouth of the chamber P for directing a portion of the current of water over the edge of said plate G and down the other side thereof to prevent such clogging of material.

In order to clean off particles which stick to the armature-cylinder on account of residual magnetism or adhesion, a jet of water is arranged to be directed against the surface of the cylinder from the pipe Q, located substantially in front of the neutral region of the cylinder. This also assists in washing away

the accumulated magnetic product from the plate G. It will be understood, however, that other means for removing the magnetic material from the surface of the cylinder may be provided.

The operation of the machine will be easily understood. The magnet being energized by an electric current applied to the field-winding W, a stream of water carrying the ore to be separated is fed into the receiving-hopper E to the armature D, which is rotated in the direction of the arrow shown in Fig. 1. Water is also supplied through the pipes M and Q. As the mixture is passing the magnet-pole S the magnetically-permeable particles will be attracted toward the surface of the armature and will be carried around in the rotation thereof until finally released at the neutral point or by the action of the jet from the water-pipe Q. The magnetic material is then finally discharged through the spout E'. The unattracted material continues its course on the right-hand side of the divider-plate F and is finally discharged through the spout E'. The current of water directed from the mouth of the chamber P toward the surface of the armature-cylinder in opposition to the main stream of water acts, as before stated, to prevent the non-magnetic particles from being carried along with the stream past the edge of the divider-plate. The force of this counter force of water will of course be comparatively slight, as, in fact, will be the force exerted by the main stream. In some cases the current of water supplied through the chamber P may be strong enough to overcome the force of the feeding-stream, so as to flow around the edge of the divider F and down with the non-magnetic material. The forces of the opposing water-currents may be adjusted as conditions may require. The water should flow in all cases as easily as possible and without any violent agitation in order to get the best results.

It will be apparent that my invention is capable of modification, and I do not desire to be understood as limiting myself to the precise construction shown in the drawings.

I claim—

1. The combination with a revolving magnetic separating-cylinder, of means for di-

recting a stream of fluid containing material to be separated into passing contact with the periphery of said cylinder on the under side thereof, a divider-plate in position to separate the unattracted material from that which is attracted, a fluid jet directed over the edge of the divider-plate and exerting a force in opposition to the main stream, an auxiliary divider-plate, and means for directing a fluid jet over the edge of said auxiliary plate to exert a force in the direction of the rotation of said cylinder.

2. The combination with a separating-cylinder having permeable projections upon its periphery, and opposing pole-pieces of opposite polarity applied close to the upper and lower surfaces of said cylinder, a chute adapted to carry a stream of water around and under said cylinder in contact therewith, between the cylinder and said lower pole-piece, a main divider-plate and an auxiliary divider-plate forming a chamber with its mouth or jet upward toward the cylinder, means for supplying water under pressure to said chamber and means for directing a jet of said water in opposition to the main stream of material and another jet backward to wash off accumulated material.

3. In a magnetic separator, the combination with a revolving cylinder, of means for directing a stream of fluid-containing material to be separated along the under side of said cylinder, of a divider-plate in position to separate the attracted and unattracted material, a fluid-delivering means having two openings, one opening adapted to direct the fluid in opposition to the main stream and the other opening adapted to direct the fluid backward and means for directing an additional jet of water against said cylinder in opposition to its direction of rotation, said latter jet being adapted to clean off the cylinder and to coöperate with said second stream to wash off accumulated material.

In witness whereof I hereunto subscribe my name this 17th day of January, A. D. 1905.

HENRY H. WAIT.

Witnesses:

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D. C. TANNER.