

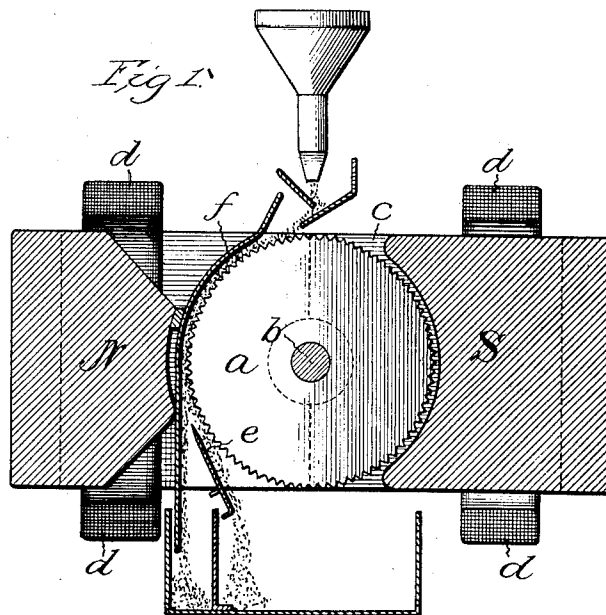
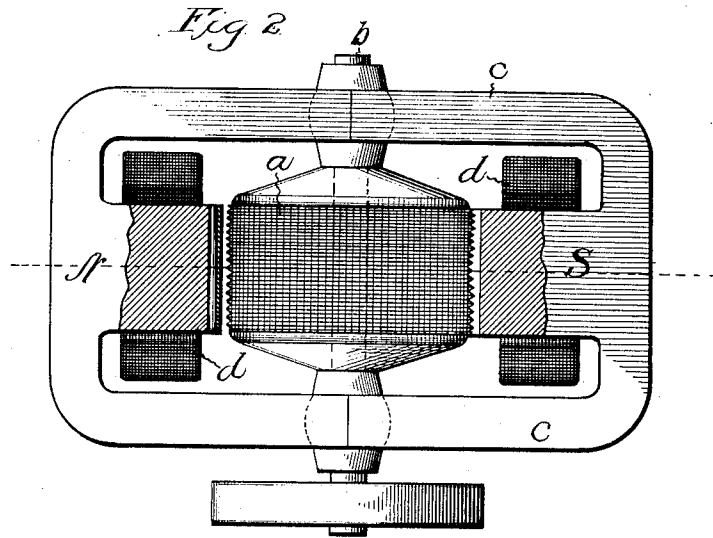
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MAGNETIC ORE SEPARATOR.

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MAGNETIC ORE-SEPARATOR.

No. 832,822.

Specification of Letters Patent.

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To all whom it may concern:

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

Our invention relates to a magnetic separator; and its object is to improve the detailed construction of the separator in such a manner as to provide for a greatly-increased power of separation in a machine of given weight and size.

Our invention concerns more particularly the general type of machine in which the material to be separated is fed upon a horizontal rotating cylinder or separating-carrier which in its rotation carries said material through the vertical air-gap between said carrier and a magnet pole-piece facing the side thereof.

Our invention is concerned especially with the shape of the pole-piece, which in combination with the armature forms the working gap, the object being to form this pole-piece so as to secure the best and most economical distribution of the magnetic flux.

We will describe our invention particularly by reference to the accompanying drawings, and the parts, improvements, or combinations which we regard as novel will be pointed out in the appended claims.

Figure 1 is a vertical sectional elevation of a magnetic ore-separator constructed in accordance with our invention, and Fig. 2 is a plan view thereof.

The same letters of reference indicate the same parts in both figures.

The ore-separator illustrated in the drawings is of the general type in which a cylinder or separating-carrier is arranged to rotate adjacent to the pole of a powerful magnet placed at the side thereof, the material to be separated being fed onto the top of the cylinder, so as to be carried around in the rotation thereof through the working air-gap formed between said cylinder and said magnet-pole. In the machine illustrated the cylinder or armature *a* is of laminated construction, formed of circular disks assembled upon a shaft *b*, and said armature is arranged to rotate between two opposed magnet-poles N S of opposite polarity placed on diametrically oppo-

site sides thereof. Said pole-pieces are shown as projecting inwardly from the sides of the magnet-frame *c*, of hollow box form, open top and bottom, and the armature-shaft is journaled in bearings in the neutral sides of said frame. The pole-pieces are provided with suitable magnetizing-windings *dd*. The space between the magnet-pole N and the armature *a* is utilized as a working air-gap, the other magnet-pole S being for the purpose of balancing, so far as practicable, the magnetic pull upon the armature. The armature is laminated, as above described, in order to suppress eddy-currents to permit the rotation of said armature in the intense magnetic field with the least expenditure of energy. The armature should be provided with means for producing dispersions of the magnetic flux at its periphery in order that the magnetic particles passing between the armature and the magnet-pole may be attracted to the armature instead of to the magnet. A convenient construction is to provide teeth or serrations upon the circumferential edges of the disks or laminations of which the armature is built up. The magnetic lines of force leaving the pole-piece N will converge upon the points of the teeth and will also tend to converge upon the edges of the individual laminations or disks.

A divider-plate *e* is provided on the under side of the armature in close proximity thereto. The edge of this divider-plate may be located just inside a vertical plane tangent to the armature, so that non-magnetic material falling straight down will pass on one side of said divider-plate, while the magnetic material adhering to the surface of the armature will be carried past the edge of the divider and fall upon the other side thereof. A neutral point is formed upon the surface of the armature *a* by the cooperating action of the two magnet-poles N and S of opposite polarity. The magnetic material attracted to the armature will therefore fall off as it is carried beyond the region of the intense field and toward said neutral point.

Heretofore in machines of this type it has been customary to make the face of the magnet-pole vertical, so that it most closely approaches the armature *a* at the horizontal plane through the axis of said armature. The greater part of the magnetic flux in such case therefore passes from the pole-piece to

the armature in the vicinity of this horizontal plane or point of nearest approach. As a matter of fact, however, the magnetic particles at this point are falling freely past the surface of the armature, and the least amount of magnetism is required at this point to attract them to the armature and keep them in contact therewith. It is necessary that these attracted particles should be caused to adhere to the armature at least until they pass the edge of the divider-plate *e* in order that the separation of the magnetic material from the rest may be properly effected. As the armature carries an attracted particle around there is from the moment it leaves the vertical plane tangent to the armature an increasing component, due to gravity, which must be overcome by the attractive power of the armature in order to hold the magnetic particle to its surface. We therefore construct the pole-piece *N* with reference to the armature *a*, so that the magnetic flux instead of being concentrated at the horizontal plane through the axis of the armature shall be concentrated just above the edge of the divider-plate. To secure the greatest concentration of the flux at this point, it is desirable that the pole-piece *N* should here approach the armature *a* more closely than elsewhere; but it is desirable for the purposes of rapid working that the permeable particles in the mixture being treated should be magnetized while they are still supported upon the armature—that is to say, before they approach a position at which they would otherwise slide off. It is therefore desirable that a certain amount of magnetic flux should occur between the armature and the pole-piece *N* from the entire face of the pole-piece. For these reasons we prefer to construct the pole-piece *N*, as shown, with its face curved approximately concentric with the surface of the armature, so that the magnetic flux will be at least as strong at a point just above the edge of the divider-plate as it is anywhere else. The strongest flux being required at this point, which we term the "point of separation," it is evident that any more intense flux at another point, as in machines heretofore constructed, is wasteful. The place of separation must be at a point considerably lower than a horizontal plane through the axis of the armature, because the non-magnetic material will fall straight down, and the edge of the divider-plate must therefore be well inside of a vertical plane tangent to the armature, which necessarily means that the magnetic particles can be held onto the surface of the armature for a considerable arc in the rotation thereof in order to get them past the edge of the divider-plate, and this must be against an increasing component of gravity. By providing a flux of maximum density just above the edge of the divider-plate—that is, at a point considerably below the

horizontal plane through the axis of the armature—the most efficient and economical separation is obtained. If the magnet-pole were constructed, as heretofore, with a vertical pole-face approaching the armature-surface most closely at a horizontal plane through the axis of the armature, it will be evident that in order to obtain a flux of requisite strength at the place of separation just above the divider-plate the total flux would have to be much greater than would be required in our construction, in which the principal part of the pole-face is cut back. We prefer to provide a non-magnetic shield over the face of the pole-piece *N* which will not necessarily follow the contour of the magnet-pole face, but will be curved around the armature-surface, so as to hold the material close to the armature through the arc above the horizontal plane through the armature-axis. The shield *f* should be at least vertical downwardly from said horizontal plane in order to permit the free fall of the non-attracted material. In other words, neither the magnet-pole *N* nor the non-magnetic shield *f* therefor should approach the armature below the horizontal axis thereof more closely than a vertical plane tangent to the surface of the armature or slightly outside of it.

There may be an open space back of the shield *f* between the shield and the pole-piece *N*, or this space may be filled with non-magnetic material. The distance between the armature and the inner curved surface of the pole-piece is determined by the sum of the spaces on each side of the divider-plate *e* which will be required by the streams of magnetic and non-magnetic material, these spaces being determined by the size of the particles which are to pass through.

By forming the magnet-pole as above described, so as to provide a flux of maximum density at the place of separation just above the edge of the divider-plate and in this way reducing the total flux required to produce the necessary density at this point, it will be seen that not only is there economy of the energy required for producing the flux, but the magnet-frame may be made much smaller than would otherwise be required.

Having thus described our invention, we claim—

1. In a magnetic separator, the combination with a magnetizable cylinder, of a divider located under said cylinder with its edge closely adjacent thereto behind a vertical plane tangent to said cylinder, a magnet-pole facing the side of said cylinder above said divider, said pole being wholly outside a vertical tangent to said armature, but formed to provide a magnetic flux of maximum density near the edge of said divider and below a plane passing horizontally through the axis of said cylinder, and means

for passing material to be separated through the working gap between said pole and said armature.

2. In a magnetic separator, the combination with a cylindrical armature, of a magnet-pole facing the side of said armature, the face of said pole being formed substantially concentric with the armature, but having the portion thereof which is below the plane passing horizontally through the axis of the armature, said pole approaching closest to said armature below a plane passing horizontally through the axis of said armature lying outside a vertical tangent to said armature, means for feeding material to be separated onto the top surface of the cylinder, and means for rotating the cylinder to carry said material past said magnet-pole.

3. In a magnetic separator, the combination with a cylindrical armature, of a magnet-pole facing the side of said armature, the face of said pole being formed to approach the armature-surface the minimum distance at a point below a plane passing horizontally through the axis of the armature, said pole-face being formed to recede upwardly from such point, a non-magnetic shield over the face of said magnet-pole passing upward from said point of closest approach of said pole-face, and being curved toward said ar-

mature and around the upper surface thereof leaving a space between said shield and said pole-face, means for passing material to be separated between said shield and said armature, and means for rotating said armature to carry said material past said pole.

4. In a magnetic separator, the combination with a cylindrical armature built up of transverse laminæ, of a magnet-pole facing the side of said armature, said pole having a concave face of substantially the same curvature as that of the armature, the portion of said pole below the plane passing horizontally through the axis of the armature approaching closer to said armature than the portion above said plane, said pole lying wholly outside a vertical tangent to said armature; means for causing dispersions of the magnetic flux at the periphery of said armature, means for feeding material to be separated to said armature, and means for rotating said armature.

In witness whereof we hereunto subscribe our names this 10th day of October, A. D. 1904.

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FREDERICK T. SNYDER.

Witnesses:

ALFRED H. MOORE,

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