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A. F. JOBKE

MAGNETIC SEPARATOR

Original Filed April 24, 1918

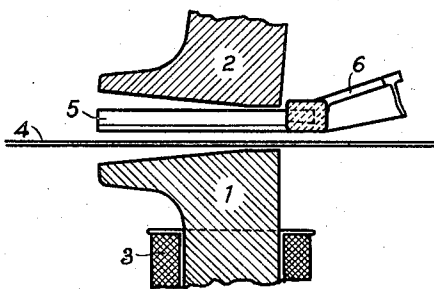


Fig. 1

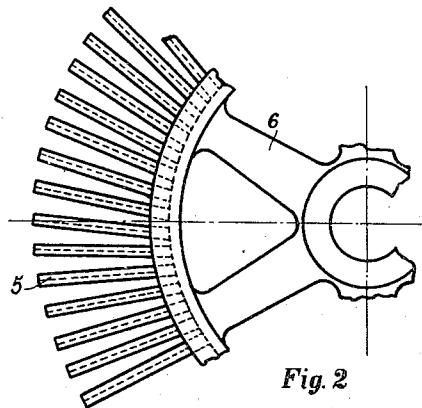


Fig. 2

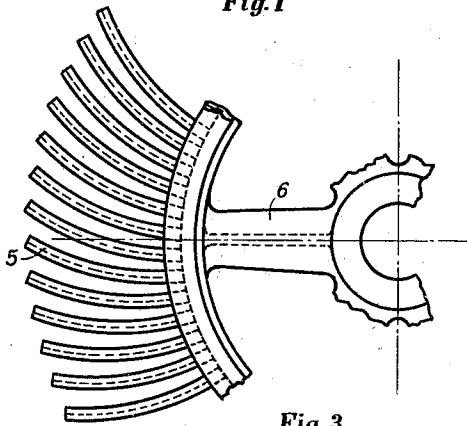


Fig. 3



Fig. 4



Fig. 5

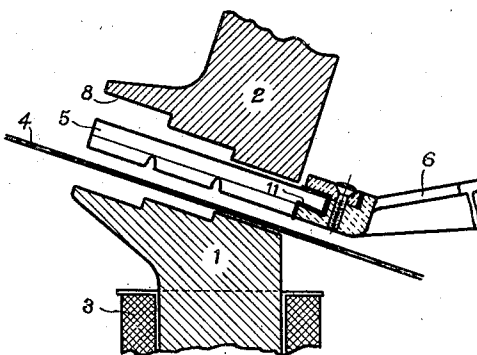


Fig. 6

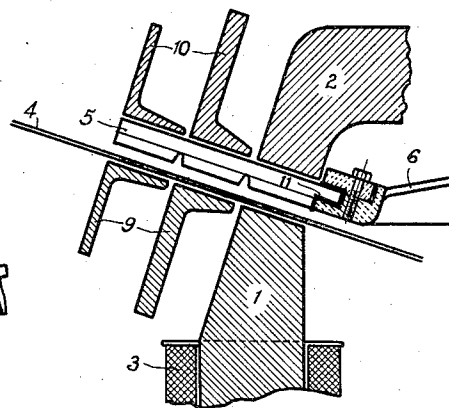


Fig. 7

INVENTOR:

August F. Jobke

UNITED STATES PATENT OFFICE.

AUGUST F. JOBKE, OF PITTSBURGH, PENNSYLVANIA.

MAGNETIC SEPARATOR.

Division after grant of application Serial No. 230,604, filed April 24, 1918. This application filed May 29, 1922. Serial No. 564,576.

To all whom it may concern:

Be it known that I, AUGUST F. JOBKE, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented an Improvement in Magnetic Separators, of which the following is a specification.

My invention relates to improvements in magnetic separators, particularly to the means forming the magnetic separating fields and the separating members, and its object is an increase of the working capacity of a magnetic separator and a separating member of low reluctance and freedom from induction currents due to its movement in a strong magnetic field.

In U. S. Patent 1,346,544 there is a separating member described and specified, which is arranged on a radius to the axis of its movement, and the advantage of its form and position in the magnetic field shown. The present invention makes use of a similar member and field arrangement, but deviates from the cited arrangement in that the separating member is placed at an angle to the radius, thereby providing certain advantages, which will be brought out in the following description, where reference is had to the accompanying drawing, in which:

Figure 1 is a sectional view showing a magnet-field formed by an upper and lower magnet-pole with an air-gap of varying lengths and traversed by a separating member rotating about a vertical axis and normally to the direction of the flux. Figure 2 shows a fractional plane view of a spider carrying a determined number of separating members at its rim. Figure 3 shows a similar view, having the separating members at an angle varying with the length of the radius, i. e., curved. Figures 4 and 5 are two sectional views of the separating members adapted to vary the forms of the separating-field to suit varying requirements. Figure 6 is a sectional view of the field formed by upper and lower magnet poles and a separating member, the arrangement providing for a distinct separation of the magnetic field into three zones of different strengths, and Figure 7 is a sectional view similar to Figure 6, but attaining the formation of distinct zones in a different way.

In order to secure perfectly working fields, arranged in a circle around the centerline of motion, their number is made an

even one, and the lines of force of each field are directed oppositely to those of the neighboring ones, thus providing for a reversal of the magnetization of the separating members in passing from one field to the next one. Each field is formed by a lower pole 1 and an upper pole 2, Figure 1. A magnetizing coil 3 is arranged on a core carrying the pole 1, and the pole 2 is advantageously connected magnetically with the upper poles of the neighboring magnet-fields, the return-circuit being made through their lower poles.

The separating member 5 is of such length that it extends across the magnetic field or its several zones. The other two dimensions may be as shown in Figures 4 and 5, preferably the former, where the vertical dimension, as the second-largest, is in the direction of the field-flux. The horizontal dimension should be sufficiently small, to suppress the eddy currents due to the motion in a magnetic field, which would be set up in planes at right angles to the flux. A temporary magnet of such form and magnetized as here stated has a very high factor of demagnetization, which is of great importance in the performance of the magnetic separator, in that it permits the ready release of the ore particles upon leaving the magnet-field. Dynamic currents, the path of which will be in a radial direction, will be successfully suppressed, if the members are mounted with an air space between them and their ends isolated from one another.

The separating members 5 are arranged over an ore conveyor 4 with the necessary clearance to permit the ore to travel freely, while the conveyor may be arranged closely over the lower pole. The upper pole 2 is placed so closely to the separating members as to provide the necessary working clearance only.

While in Figure 1 a tapering field is shown, which provides for a gradual increase in flux-density, a field of uniform length, or zones of different strengths in the same field may be provided, according to the requirements of the ore to be treated.

The separating members 5 are mounted with their lower edge parallel to the conveyor 4 and at an angle to a radius from the axis, around which they revolve, as shown in Figure 2. They are preferably made of the softest iron of a high permeability, in order to become

highly magnetized in the magnet-fields. Their support, the spider 6, arranged to be revolved with a uniform speed about a vertical axis, is to be made of non-magnetic material, and various means may be employed to fasten the separating members to the same, for example casting them in or clamping them at their dove-tailed ends.

In passing through a magnet-field, members 5 become highly magnetized, and the flux density in them is higher than that on the pole-faces, due to the air spaces between them, which are voided of flux on account of the higher permeability of the iron members. Their lower side, having a wedge-shaped edge, concentrates the magnetic flux to a maximum, and magnetic particles will therefore be readily attracted to the same. Their vertical dimension being relatively short, the members will, upon leaving the field, immediately lose their magnetism, i. e., demagnetize themselves, and drop the concentrate in the space between adjacent fields.

Upon approaching the next field the direction of the flux through the members 5 is gradually reversed due to the existing stray field, and any ore particles clinging to the edges through their permanent magnetism, will now be repelled. The separating members are then ready to repeat their performance in the next field.

Owing to the position at an angle to a radius of the separating members 5, there is a difference in performance at different velocities of the same and more so at different directions of velocities. Suppose the separating members are revolved in a clockwise direction, viewing Figure 2, the ore feed being assumed to be radially inward. Depending on the speed of the ore, the collecting edge of the separating member can be made to follow an ore particle more or less during its travel through the field, or the particle, upon entering the field, may be under the influence of one separating member and upon leaving under the edge of the following member, in both cases having a maximum time in its exposure to the magnetic action of at least one member, and therefore the best opportunity to disengage itself from entangling non-magnetic matter.

If the conveyor 4 is of the vibratory type, it may be assumed, that every particle at any time is free to follow the magnetic attraction, and in this case it is of advantage, to rotate the separating members 5 in a counter clockwise direction. In its travel through the magnetic field every part of the ore charge would then be subjected to the influence of several separating edges in succession, but, if picked up immediately, more actual length of bare separating edge is presented. Therefore a quicker separation takes place, and the ore-feed can be increased.

In Figure 3 the separating members 5 are

shown curved. If the curve is made a spiral, a uniform air-space between the members can be attained, resulting in a most compact arrangement for a determined length of separating member.

The field forms shown in Figures 6 and 7 are to provide several zones of uniform but distinctly different strengths. In Figure 6 I attain this object by providing air gaps of different lengths on both the upper and lower pole in stepping off the pole shoes 7 and 8. The flux density through the members 5 then varies according to the reluctance of the circuit through the different air-gaps. In Figure 7 the same object is attained with gaps of equal lengths by providing separate magnetic pole pieces 9 and 10, which are energized through the straying flux between poles 1 and 2. Since they are magnetically separated from the main poles 1 and 2, the air gaps between them are the factors determining the strengths of flux through the separating members 5.

The separating members are shown as being clamped to the spider with the interposition of insulation 11, which insulates the members from the spider 6 as well as from one another. Through this arrangement galvanic currents will be prevented, which would arise between the alloy of the spider and the iron of the separating member, if wet separation were undertaken.

Having thus described my invention, what I claim is:

1. In a magnetic separator a separating member movable between upper and lower magnet poles, having its largest dimension and a lower collecting edge at an angle to the direction of the flow of ore and to a radius from the axis of its movement, and its smallest dimension in a direction at right angle thereto and to the flux and in the direction of its movement.

2. In a magnetic separator a separating member movable between upper and lower magnet poles, having its largest dimension and a lower collecting edge at an angle to the direction of the flow of ore and to a radius from the axis of its movement, the angle varying with the length of this radius, and its smallest dimension in a direction at right angle thereto and to the flux and in the direction of its movement.

3. In a magnetic separator a separating member movable between upper and lower magnet-poles, having its largest dimension and a lower collecting edge at an angle to the direction of the flow of ore and to a radius from the axis of its movement, and its smallest dimension in a direction at right angle thereto and to the flux and in the direction of its movement, its one end being isolated from an adjacent separating member.

4. In a magnetic separator a separating

member movable between upper and lower magnet-poles, having its largest dimension and a lower collecting edge at an angle to the direction of the flow of the ore and to a radius from the axis of its movement, the angle varying with the length of this radius, and its smallest dimension in a direction at right angle thereto and to the flux and in the direction of its movement, its one end being isolated from an adjacent separating member.

5. In a magnetic separator a separating member movable between upper and lower magnet-poles having its largest dimension and a lower collecting edge at an angle to the flow of ore and to a radius from the axis of its movement and its smallest dimension at right angle thereto and to the flux and in the direction of its movement, and a conveyor between the separating member and a lower magnet-pole.

6. In a magnetic separator a separating member movable between upper and lower magnet-poles having its largest dimension and a lower collecting edge at an angle to the flow of ore and to a radius from the axis of its movement, the angle varying with the length of this radius, and its smallest dimension at right angle thereto and to the flux and in the direction of its movement, and a conveyor between the separating member and a lower magnet-pole.

7. In a magnetic separator substantially vertical magnet-poles of alternately opposite directions formed by upper and lower

poles located on a circle, having zonal air-gaps of uniform but increasing strength, due to decreased reluctance in the circuits through the several zones in the direction of the ore flow, electrically insulated separating members, extending with their largest dimension and a lower collecting edge in a direction at an angle to a radius of a spider supporting one end of the said members, the movement of the separating members being at right angle to the flow of ore and to the flow of flux, and a conveyor between the lower poles and the separating members, parallel with the latter.

8. In a magnetic separator, substantially vertical magnet-poles of alternately opposite directions formed by upper and lower poles located on a circle, having zonal air-gaps of uniform but increasing strength, due to decreased reluctance in the circuits through the several zones in the direction of the ore flow, electrically insulated separating members, extending with their largest dimension and a lower collecting edge in a direction at an angle to a radius of a spider supporting one end of the said members, the angle varying with the length of the said radius and the movement of the separating members being at right angle to the flow of ore and to the flow of flux, and a conveyor between the lower poles and the separating members, parallel with the latter.

In testimony whereof I affix my signature.

AUGUST F. JOBKE.