No. 662,411.

Patented Nov. 27, 1900.

E. GATES.

MAGNETIC SEPARATOR.

(Application filed Apr. 14, 1900.)

(No Model.)

2 Sheets—Sheet 1.

Fig. 2.

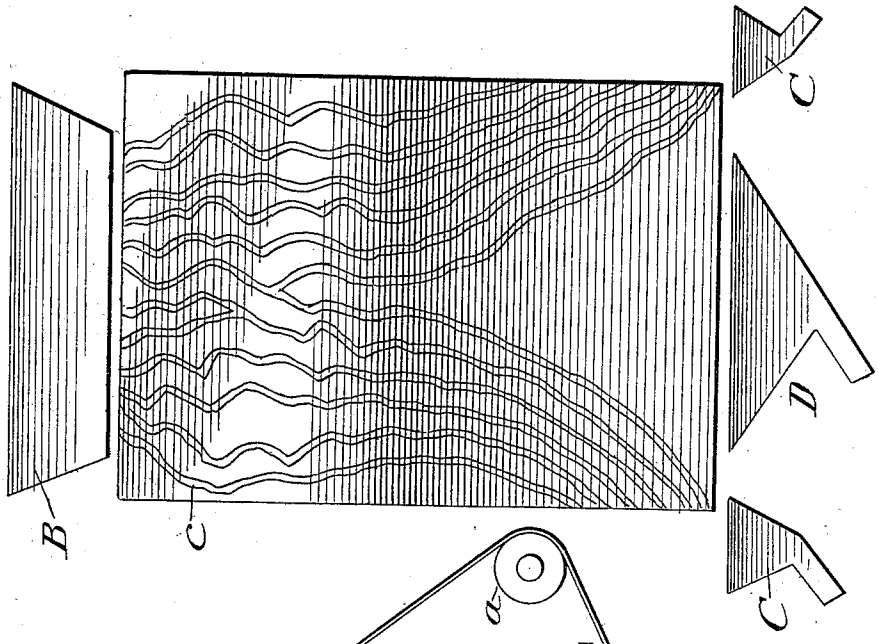

Fig. 1.

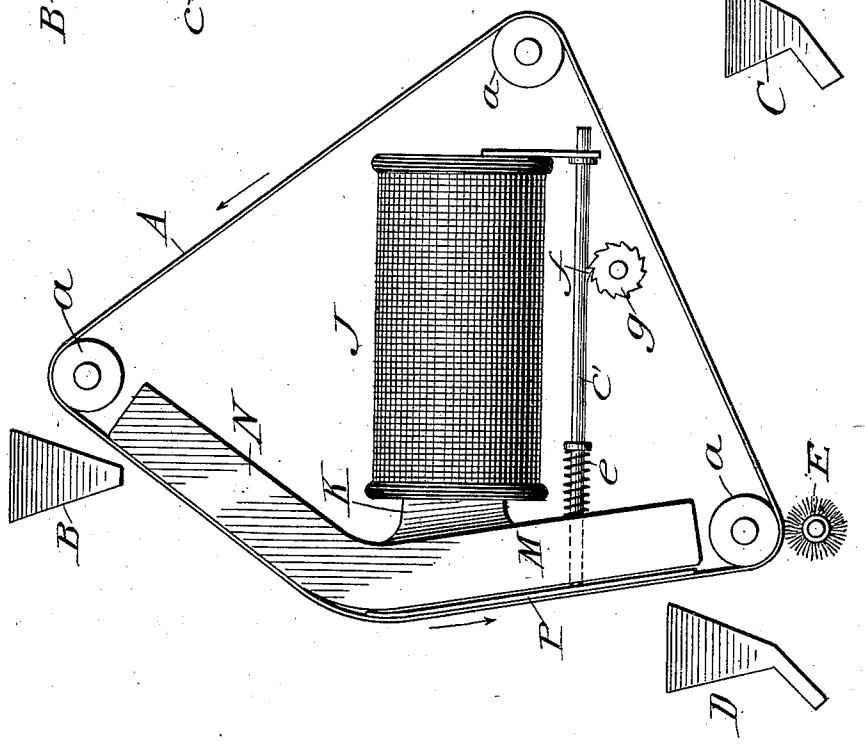

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Fig. 4.

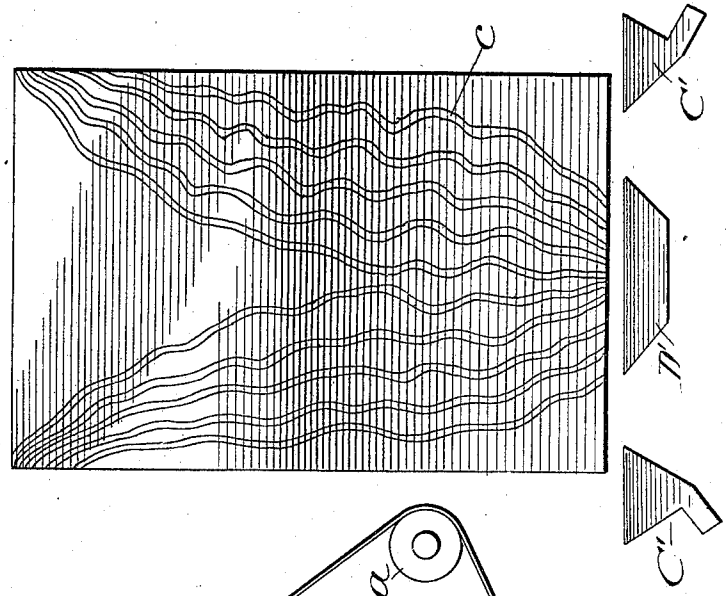
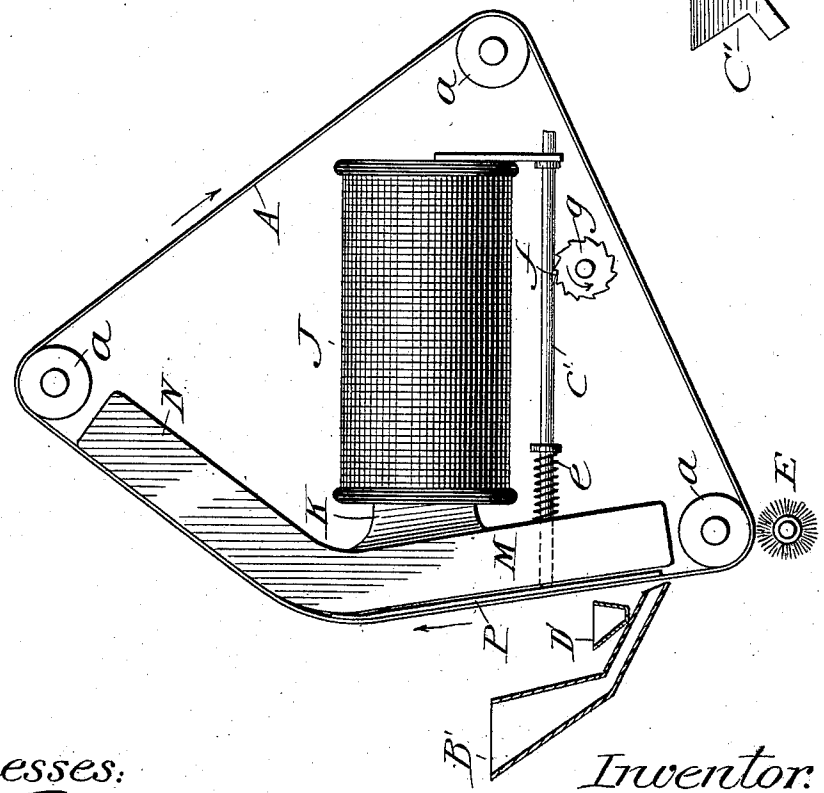


Fig. 3.



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UNITED STATES PATENT OFFICE.

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MAGNETIC SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 662,411, dated November 27, 1900.

Application filed April 14, 1900. Serial No. 12,904. (No model.)

To all whom it may concern:

Be it known that I, ELMER GATES, a citizen of the United States, residing at Chevy Chase, county of Montgomery, State of Maryland, have invented certain new and useful Improvements in Magnetic Separators; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

In a companion application for Letters Patent of the United States filed by me of even date herewith, Serial No. 12,906, I have illustrated and described a form of magnetic separator wherein the material to be separated is directed by a feed-hopper or the like against a traveling belt or apron moving in front of the face of a magnetic pole energized to a degree sufficient to cause the paramagnetic particles of the material treated to arrange themselves in moss-like or frond-like structures and having a series of tortuous, wavy, or zigzag magnetic fields of force along which the paramagnetic particles move, while the diamagnetic particles as they become disentangled from the paramagnetic particles fall by gravity into a receiving-hopper intended for their collection.

The present invention relates to a specific embodiment of the generic features of construction illustrated in the application referred to.

In the accompanying drawings, Figure 1 represents a side elevation of a magnetic separator embodying my present improvement. Fig. 2 represents a front elevation of the face of the magnet-pole. Fig. 3 represents a side elevation of another form or modification thereof, and Fig. 4 represents a front view of the face of the magnet-pole of the modification shown in Fig. 3.

Similar letters of reference indicate similar parts throughout the several views.

Referring to the drawings, J indicates the energizing-coil of an electromagnet.

K indicates the core of the electromagnet, which terminates in a pole-piece having branches M N at an angle to each other, as shown. In front of the branch M is located a plate P of non-magnetic material, such as brass or the like, and an endless belt or apron A passes over said plate and over the outer face of the upper portion N of the magnet-face, said endless belt being supported by rollers *a*, any one of which may be suitably driven from a power-shaft, so as to impart motion to the belt.

In the modification shown in Figs. 1 and 2 the motion imparted to the belt is in the direction indicated by the arrows in Fig. 1—*i. e.*, in a direction downward over the face of the magnet-pole. In this modification the magnet is provided on its outer surface with a series of grooves *c*, preferably filled with non-magnetic metal, said grooves being of a wavy, zigzag, or tortuous configuration and extending downwardly in a general longitudinal direction to the transverse bend of the magnet-face, whereupon they diverge in opposite series and finally reach the outer edge of the magnet-pole near the lower end thereof. B indicates a feed-hopper for the material, the discharge end of said feed-hopper being of a width substantially equal to that of the magnet-face, so as to utilize the full capacity of the magnet-face for separation. C indicates collecting-hoppers for the paramagnetic material, and D a collecting-hopper for the diamagnetic material. E indicates a cleaning-brush.

The mode of operation of the apparatus shown in Figs. 1 and 2 is as follows: The material to be separated is fed from the hopper B upon the surface of the traveling belt or apron A as the latter passes over the upper portion N of the magnet-face. The paramagnetic material—as, for instance, magnetic sands—arranges itself immediately in the form of moss-like or frond-like structures, and as the belt travels downward these structures travel with it and in their endeavor to follow the wavy, zigzag, or tortuous fields of magnetic force the diamagnetic material, already partly released by the original formation of said structures, becomes more and more disentangled as the structures shift and alter their formation. This initial separation becomes still further accentuated after the material passes the bend of the magnet-pole and enters the region of the portion M. Here the magnetic fields of force are diverted toward the right and left, as shown, leaving a

free intermediate space. The paramagnetic material follows the diverging fields of force, and finally by gradual accretions drops from the edges of the belt or apron A into the receiving-hoppers C. The diamagnetic material—as, for instance, silicious sand or gangue, or in some instances diamagnetic metal, such as free particles of gold or copper—falls into the receiving-hopper D. In the modification shown in Figs. 3 and 4 the endless band A moves in an opposite direction to that contemplated in Figs. 1 and 2. Consequently the general direction of the grooves *c* is altered, so that beginning at the bottom of the magnet-face they mount in a substantially longitudinal direction toward the bend of the magnet and then diverge to the right and left, respectively. In this modificaton the feed-hopper B′ discharges near the bottom of the magnet-pole. The receiving-hopper D′ for the diamagnetic material is located immediately above the discharge-chute of the feeding-hopper B′. The receiving-hoppers C′ for the paramagnetic material are located on either side of the receiving-hopper D. The material to be separated being fed against the apron A at a point near the lower end of the magnet-face is immediately carried upward by the traveling belt, assisted by the attraction and directing influence of the tortuous magnetic fields of force. The paramagnetic material therefore finally reaches the extreme upper ends of the diverging magnetic fields of force and by gradual accretions drops off and falls by gravity into the receiving-hoppers C′, the disentangled diamagnetic particles in the meantime falling into the hopper D′.

The function of the roller E is to clean the belt or apron, if necessary, from any fine particles that would otherwise adhere to the fabric. It will also be noted that the plate P is provided with means for causing it to continuously jostle the traveling band or apron. To this end the plate is adapted to be struck a series of intermittent blows by a rod *c′*, normally restrained by the spring *e*, and having a tooth or projection *f* in the path of the coöperating teeth of a ratchet-wheel *g*, so that the rotation of the ratchet-wheel in the direction indicated by the arrow will, in connection with the spring *e*, cause the rod *c′* to rapidly reciprocate and correspondingly jar or jostle the plate P, and consequently the traveling belt or apron. The jarring effect of this jostling or motion is to assist in the rearrangement or re-formation of the traveling moss-like or frond-like structures, and thereby furthers the disentanglement of the diamagnetic particles therefrom.

Having thus described my invention, what I claim is—

1. Apparatus for separating magnetic from diamagnetic material, comprising a magnet pole-piece grooved or recessed to produce a wavy, zigzag, or tortuous distribution of the effective lines of force, in combination with a traveling screen or apron moving in front of the pole-piece, and means for jostling the apron; substantially as described.

2. Apparatus for separating magnetic from diamagnetic material, comprising a magnet pole-piece grooved or recessed to produce a wavy, zigzag, or tortuous distribution of the effective lines of force, said pole-piece having a transverse bend substantially midway of its length, so as to form corresponding inclines, in combination with a traveling screen or apron moving in front of the pole-piece; substantially as described.

3. Apparatus for separating magnetic from diamagnetic material, comprising a magnet pole-piece grooved or recessed to produce a wavy, zigzag, or tortuous distribution of the effective lines of force, said pole-piece having a transverse bend substantially midway of its length, so as to form corresponding inclines, in combination with a traveling screen or apron moving in front of the pole-piece, and means for causing the traveling band or apron to move over the pole-piece from below upwardly.

In testimony whereof I affix my signature in presence of two witnesses.

ELMER GATES.

Witnesses:
J. E. HUTCHINSON, Jr.,
A. E. GRANT.