

E. GATES.
MAGNETIC SEPARATOR.

(Application filed Apr. 14, 1900.)

(No Model.)

2 Sheets—Sheet 1.

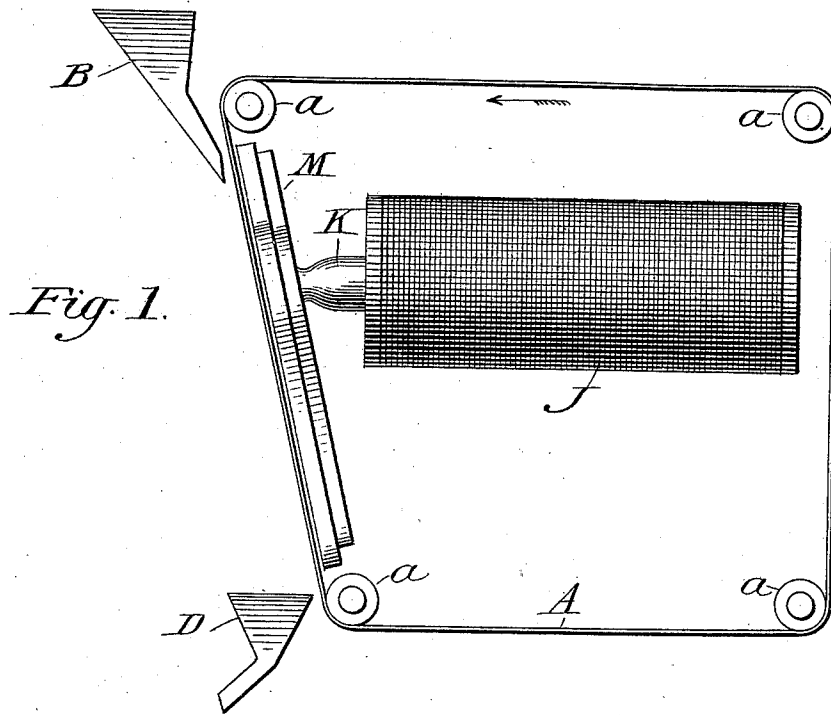


Fig. 1.

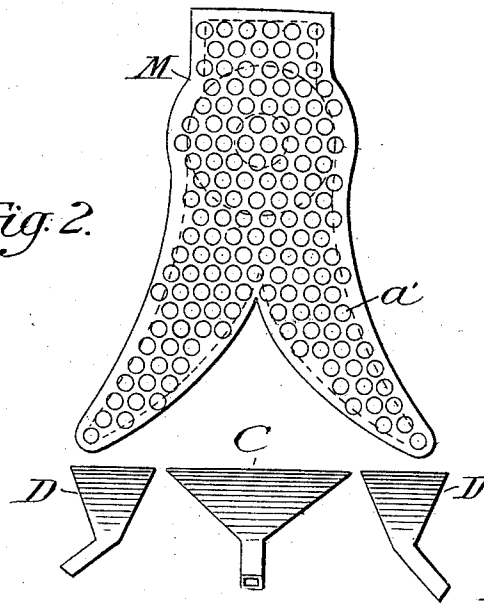


Fig. 2.

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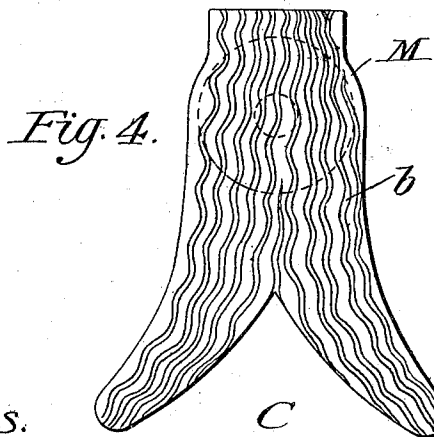
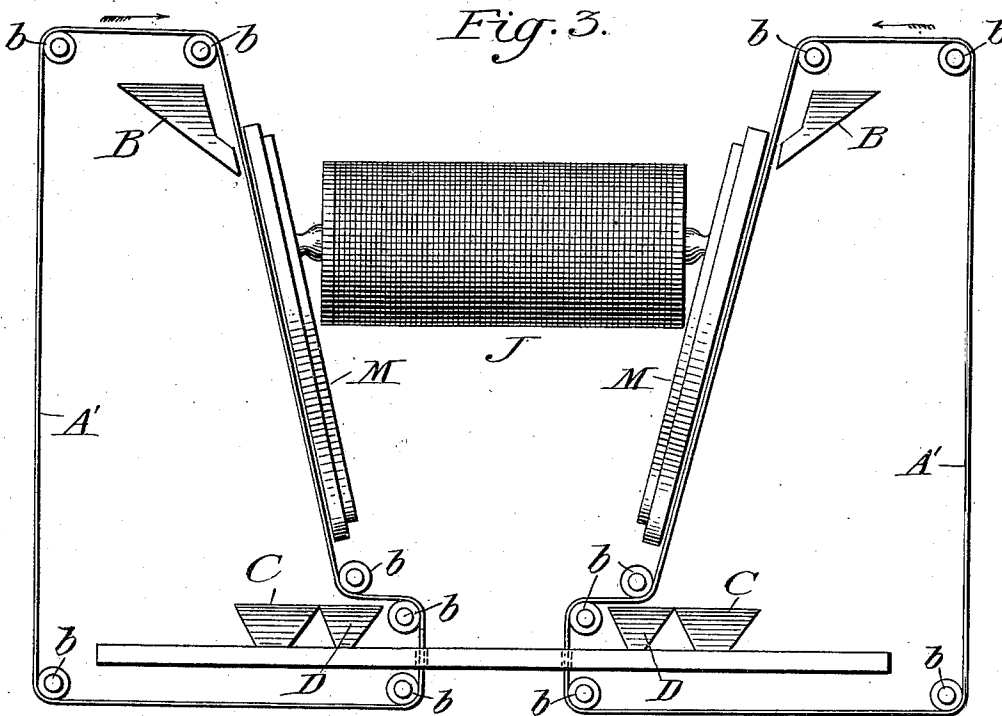
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MAGNETIC SEPARATOR.

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2 Sheets—Sheet 2.



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UNITED STATES PATENT OFFICE.

ELMER GATES, OF CHEVY CHASE, MARYLAND, ASSIGNOR TO THEODORE J. MAYER, OF WASHINGTON, DISTRICT OF COLUMBIA.

MAGNETIC SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 662,413, dated November 27, 1900.

Application filed April 14, 1900. Serial No. 12,906. (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.

My invention relates to certain new and useful improvements in the separation of paramagnetic and diamagnetic material—as, for instance, the separation of magnetic iron ore from associated gangue or the separation of diamagnetic metallic particles, such as free gold, from copper or the like from magnetic sands. To this end the material to be separated is fed into the field of an electromagnet energized to a degree sufficient to cause the paramagnetic particles to arrange themselves in the form of moss-like or frond-like built-up structures, thereby partly releasing the diamagnetic material entangled or enmeshed therewith. These structures are thereupon caused to shift their formation or arrangement and to continuously travel across wavy, zigzag, or tortuous magnetic fields of force. During this period the diamagnetic material is constantly separating out from the paramagnetic material and may conveniently be collected in a hopper provided for its reception, while the paramagnetic material goes on to a separate collecting hopper or hoppers. The present invention relates to apparatus embodying these general characteristics.

In the accompanying drawings, Figure 1 represents a side elevation of one form or modification of apparatus embodying my present invention. Fig. 2 represents a front elevation of the magnet-pole and illustrates its relation to the receiving-hoppers. Fig. 3 represents a side elevation of a duplex form of separator wherein both poles of the magnet are utilized. Fig. 4 represents a modified form of pole-piece.

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

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

core K, which terminates in a pole-piece M, which is preferably inclined and bifurcated at its lower portion, as illustrated. The pole-piece M is provided (in the form shown in Fig. 2) with a series of recesses *a'*, preferably filled with lead or other non-magnetic material or (in the form shown in Fig. 4) with a series of continuous wavy grooves *b*, similarly filled with non-magnetic material and extending from the top portion along the bifurcated portions to the edges of the magnet-pole. The purpose of the recesses, indentations, or grooves referred to is to establish along the face of the magnet-pole a series of wavy, zigzag, or tortuous fields of magnetic force, so that when the electromagnet is energized to a degree sufficient to cause the building up of the moss-like or frond-like structures hereinbefore referred to these structures will form in a corresponding wavy, zigzag, or tortuous distribution upon the screen or apron employed for their reception immediately in front of the magnet-pole.

In the construction shown in the drawings the screen or apron employed is an endless band of non-magnetic material A, such as fabric or the like, although it will be understood that in many instances other forms of traveling or moving screens or aprons may be employed for a like purpose. In Fig. 1 the traveling belt A passes over the rollers *a*, any one of which may be operated from a power-shaft to actuate the belt in the direction indicated by the arrow. In the form shown in Fig. 3 like belts A' pass over similar guide-rollers *b*, any one of which may serve as a driving-roller to actuate them in like manner, as indicated by the arrows in said figure. B indicates a supply-hopper for the material to be separated. C indicates the receiving-hopper for the diamagnetic material, and D indicates the receiving-hoppers for the paramagnetic material.

The mode of operation of the invention is as follows: The material to be separated is directed by the hopper B against the face of the traveling belt or apron A as the latter passes the magnet-pole. The paramagnetic material thereupon at once adheres to the traveling belt or apron A in the form of moss-like or frond-like built-up structures, and as

the belt continues its travel these structures in their endeavor to travel onward with the belt and also to arrange themselves along the wavy, zigzag, or tortuous fields of magnetic force follow the course of said fields of force and move onward with the belt into paths which diverge along the bifurcated ends of the magnet-pole until they reach the extreme lower edges thereof, whereupon by successive accretions they drop off into the hoppers D. During this movement the moss-like structures continuously shift their arrangement and formation into other structures of a like character, and in this rearrangement of their particles the diamagnetic material is released from its entanglement and drops freely down into the collecting-hopper C.

By means of this apparatus I am enabled to separate magnetic sands from their accompanying gangue, so as to obtain a product of extraordinary concentration adapted for metallurgical uses without further separation. The apparatus is also effective for the separation of particles of free copper, free gold, or like diamagnetic metal from magnetic sands with which they are frequently associated in natural deposits.

Having thus described my invention, what I claim is—

1. Apparatus for separating magnetic from diamagnetic material comprising a magnet pole-piece having a wavy, zigzag, or tortuous distribution of the effective lines of force, in combination with a traveling screen or apron passing in front of said pole-piece; substantially as set forth.

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 line of force, in combination with a traveling screen or apron passing in front of said 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, the magnetic fields of force thus established finally diverging from each other, in combination with a traveling screen or apron moving in front of the pole-piece; substantially as described.

4. 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, the magnetic fields of force thus established diverging from each other and leaving an intermediate space, in combination with a traveling screen or apron moving in front of the pole-piece, a feed-hopper, a collecting-hopper at the ends of the diverging fields of force, and a collecting-hopper for the intermediate space; substantially as described.

5. Apparatus for separating magnetic from diamagnetic materials, comprising a magnet pole-piece having the general configuration of bifurcations at the discharge end of the separator, said magnet-pole being grooved or recessed to produce wavy, zigzag, or tortuous fields of force, in combination with a traveling screen or apron, moving in front of the pole-piece from top to bottom thereof; substantially as described.

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

ELMER GATES.

Witnesses:

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