No. 653,346. Patented July 10, 1900.

E. GATES.

MAGNETIC SEPARATION.

(Application filed Dec. 2, 1899.)

(No Model.) 2 Sheets—Sheet 1.

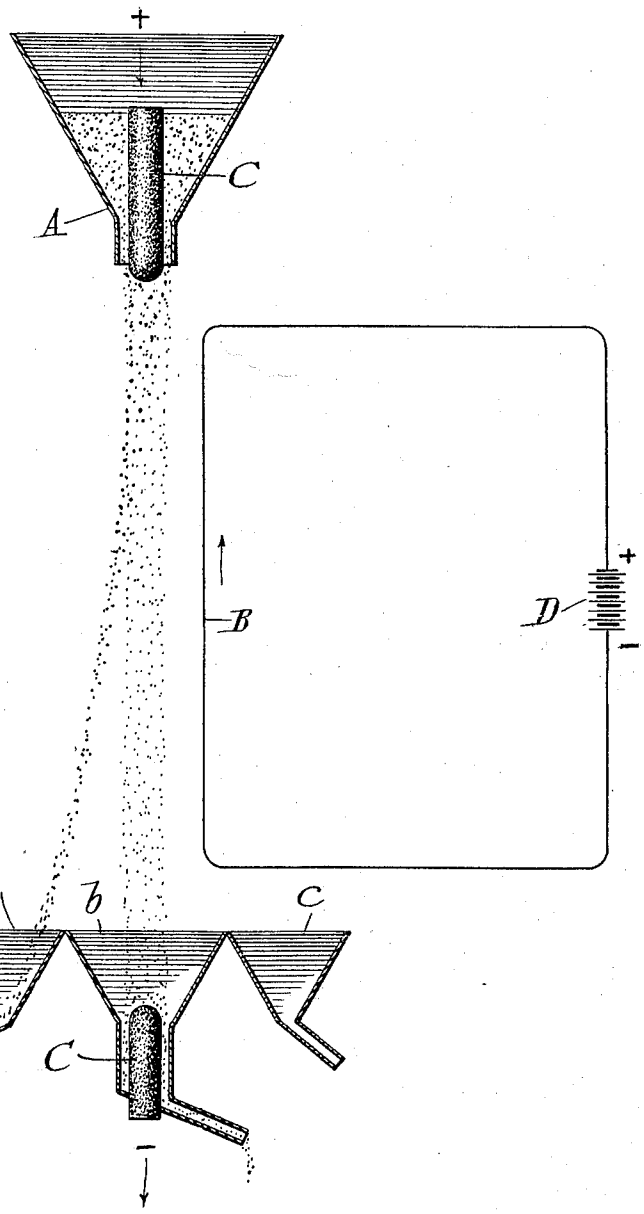

Fig. 1.

Witnesses:
D. W. Edelin.
J. E. Hutchinson Jr.

Inventor:
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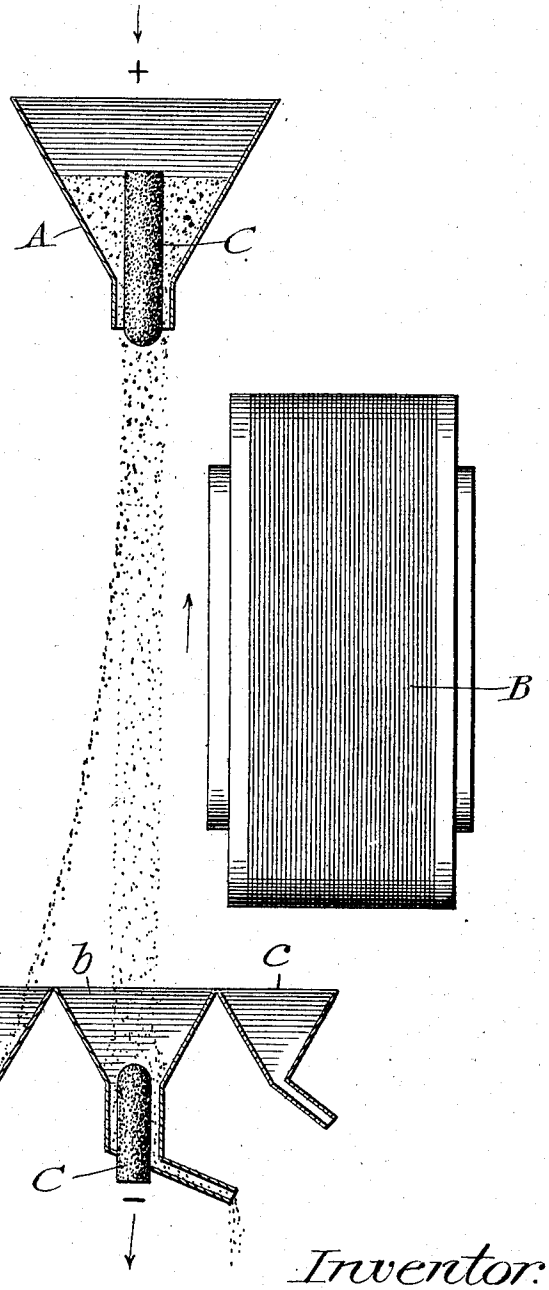

Fig. 2.

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UNITED STATES PATENT OFFICE.

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MAGNETIC SEPARATION.

SPECIFICATION forming part of Letters Patent No. 653,346, dated July 10, 1900.

Application filed December 2, 1899. Serial No. 739,009. (No specimens.)

To all whom it may concern:

Be it known that I, ELMER GATES, a citizen of the United States, residing at Chevy Chase, in the county of Montgomery, State of Maryland, have invented certain new and useful Improvements in Magnetic Separation; 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.

The invention relates to the separation of metallic substances from granular mixtures containing them, and is more particularly concerned with the separation of gold, silver, copper, or such other metals as have normally so feeble a magnetic susceptibility as not to be ordinarily considered magnetic at all; and it consists in passing a current of electricity through a flying or falling body of granular materials containing such substances in a freely-movable condition, and thereby making the mixture itself a conductor for the current, and while so conducting the current to introduce the mixture into or pass it through another field of magnetic intensity, the result of which is that the particles of better conductivity are attracted or repelled by the influence of the auxiliary field of magnetism and caused to move out of the path or trajectory of the non-metallic constituents of the mixture, so as to be capable of being separately received and collected.

I have discovered that it is feasible to make a continuous stream of flying or falling granular materials the conductor of an electric current when the voltage of the current is substantially sufficient to arc the sum of the distances between the conducting particles included in the stream. This distance is to some extent variable in proportion to the degree of conductivity of the constituents of the mixture, and it may be increased beyond the normal by moistening or wetting the mixture. In the accompanying drawings I have represented diagrammatically two forms of apparatus for making this discovery available in the separation of magnetic substances on a commercial scale.

Figure 1 is a diagram of an apparatus where the auxiliary field of magnetic force is derived from an auxiliary current of electricity passing in proximity to the falling mixture, and Fig. 2 is a similar view where an electromagnet is substituted for the auxiliary current of the first figure and furnishes the field of magnetic intensity.

Referring to the first figure, A is an elevated feed-hopper of any usual or preferred construction, and *b* is a receptacle located below it and in the same vertical plane. C C denote ordinary carbons, such as are employed in arc-lamps. These carbons are located the one in the feed-hopper and the other in the receptacle *b*. A current of electricity is passed between the carbons, and the distance apart of the hopper A and receptacle *b* is so proportioned to the voltage of the current, substantially as above explained. The stream of falling material thus becomes a conductor for the current passing between the carbons, and the natural tendency of the whole mixture is to fall into the receptacle *b*, below the feed-hopper A. B denotes a conductor arranged in proximity to and substantially parallel with the path of the falling material, and another current is generated in this conductor from a suitable source D and preferably passed therethrough in the opposite direction to the falling material and in opposition to the current passing between the carbons C C. There is thus established an auxiliary field of magnetic intensity, and the two currents (the one passing between the carbons and the one in the conductor B) act upon each other according to certain well-known laws of magnetic attraction and repulsion, and the metallic particles in the primary field of force of those included in the stream of falling materials forming the conductor for the current passing between the carbons partake of the repellent action of the auxiliary field of force derived from the second current passing through the conductor B. These metallic particles are therefore deflected out of the trajectory of the falling stream and separately received and conducted away as heads by a receptacle *a*, located immediately adjacent to and on the side of the receptacle *b*, away from the conductor B. The non-metallic particles in the stream of the falling mixture are, however, not affected by the auxiliary field of force and fall straight down-

ward as tailings into the central receptacle *b*. On the opposite side of the receptacle *b* from the receptacle *a* or on the side of the path of the falling material nearest the conductor B there may be arranged another receptacle *c*, similar in all respects to the receptacle *a*. As illustrated in the drawings herein, the two currents pass in opposite directions and therefore repel each other, and the freely-movable metallic particles in the stream of falling materials partake of this repellent action; but the current in the conductor may be reversed in direction, in which case it will pass in the same direction as the course of the current in falling materials. In this case the two currents attract each other and the metallic particles are attracted by the current in B out of the path of trajectory of the falling mixture toward the conductor B and fall as heads into the receptacle *c*.

In Fig. 2 I have illustrated the substitution of an electromagnet for the conductor B of the first figure. The action of this magnet upon the metallic constituents of the stream falling from the elevated hopper A is the same as that of the conductor B, and the direction of the current passing through the windings of the magnet determines whether the process of separation is carried on by magnetic attraction or repulsion.

Having thus described my invention, what I claim is—

The method of separating from a mixture, particles of conductive material which consists in passing an electric current through a moving body of the mixture, and diverting the conducting particles by causing the moving mixture to pass through an auxiliary field of force, substantially as described.

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

ELMER GATES.

Witnesses:
J. A. GOLDSBOROUGH,
EDWIN S. CLARKSON.