

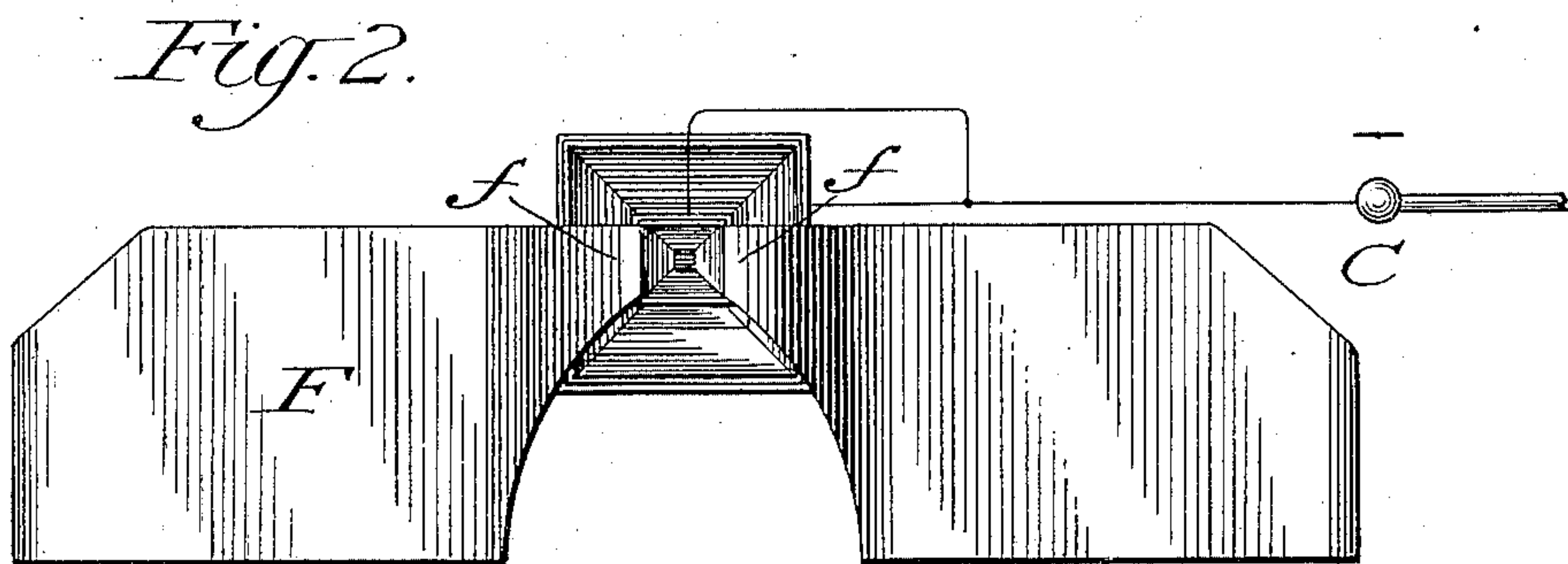
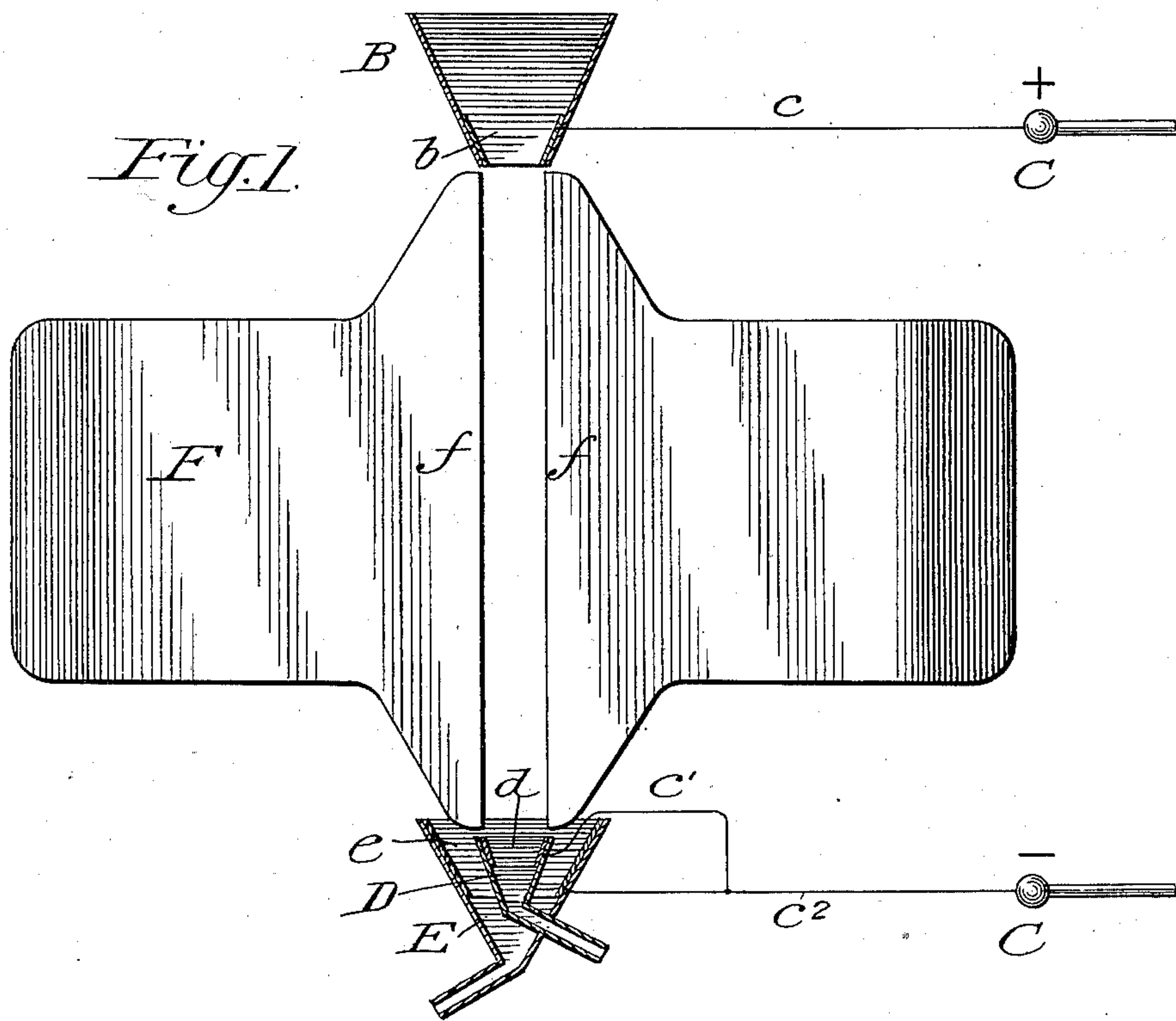
No. 653,344.

Patented July 10, 1900.

E. GATES.  
DIAMAGNETIC SEPARATION.

(Application filed Dec. 2, 1899.)

(No Model.)



Witnesses:  
O. W. Edelin.  
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Inventor:  
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By his attorney  
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# UNITED STATES PATENT OFFICE.

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

## DIAMAGNETIC SEPARATION.

SPECIFICATION forming part of Letters Patent No. 653,344, dated July 10, 1900.

Application filed December 2, 1899. Serial No. 739,007. (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 Diamagnetic 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.

In an application for Letters Patent of the United States filed by me under date of September 26, 1899, Serial No. 731,762, I have described and claimed a method for separating diamagnetic substances from the remaining constituents of mixtures containing them, or from mixtures in which they are present, together with other diamagnetic substances of less diamagnetic susceptibility by availing myself of their tendency to move from an intense part of a magnetic field into a relatively-weak part of said field to an extent dependent upon their individual susceptibility and the duration of the time during which the mixture is passing through the field and is subjected to its action. My present invention is based upon the discovery that the tendency of diamagnetic substances to seek the weaker portion of the magnetic field is considerably increased if the particles of the mixture to be separated are statically charged during their transit through the field, this tendency to move being exercised in the same direction as the tendency due to the unaided action of the field itself.

In the accompanying drawings, Figure 1 represents, in front elevation, the main or principal portions of one form of apparatus adapted for the practice of my invention. Fig. 2 represents a top plan view thereof with the upper or supply hopper removed.

Similar letters of reference indicate similar parts in both views.

Referring to the drawings, F indicates the pole-pieces of an electromagnet shown in my application hereinbefore referred to. The pole-pieces F terminate in tapering ends *f*, separated by an intervening space or gap, between which a field of high concentration of the magnetic lines of force is obtained.

At the upper portion of the magnetic field thus established is situated a supply-hopper B, which may conveniently be provided at its lower end with a metallic lining *b*, adapted to be put in connection with one of the electrodes C of a static machine or other source of high-tension electricity by means of a connecting-wire or like conductor *c*. At the lower end of the magnetic field are located two receivers, one of them, D, being intended for the reception of the tailings and the other, E, being intended for the reception of the heads, as will hereinafter more fully appear. The hopper D is provided with a metallic lining *d* at its upper portion, and the hopper E is provided with a similar metallic lining *e*. The metallic linings *d e* are adapted to be connected with the opposite terminal of the static machine or equivalent source of high-tension electricity by means of the wires or like conductors *c'* and *c''*.

The static machine which I have employed for separation in accordance with the method herein described has been a Wimshurst eighteen-inch ten-plate machine adapted to give a discharge equivalent to a three-foot spark across the gap between the two terminals or poles formed by the metallic linings of the upper and lower hoppers, it being of course understood that the electromagnet is insulated from any conductive ground connection during the operation of the apparatus. The electromagnet being energized and the static machine being operated, the separation may begin by permitting a regulated quantity of the material to fall from the upper hopper through the intense portion of the magnetic field immediately between the narrow faces of the tapering pole-pieces. The falling stream is electrified by the convective discharge of high-tension electricity between the upper and lower hoppers, which has the effect of charging the constituent elements differently. Thus I have found that with a mixture of gold and sand—as, for instance, placer sand, containing minute quantities of free gold distributed through its mass—the particles of gold will be so charged as to tend to separate out from the particles of sand in the falling mixture. This movement corresponds to and reinforces the tendency of the



gold particles to move outwardly from the particles of sand in the falling stream under the influence of the magnetic field. Consequently for the production of the same result the magnetic field may be made materially shorter or may be of less intensity, or, otherwise stated, with the same length and intensity of the magnetic field the separation will be more complete and satisfactory when the falling stream is electrified as described. The particles of sand (which are practically unaffected by diamagnetic action) even when reinforced by the passage of the static discharge fall into the hopper D as tailings and the particles of gold move outwardly and drop into the hopper E as heads of greater or less degree of concentration, thereby effecting the separation desired.

While I have usually connected the lining of the upper hopper to the positive electrode of the static machine and the linings of the lower hopper to the negative electrode, the result is the same with the connections re-

versed, it being immaterial whether the falling stream be charged positively or negatively.

Having thus described my invention, what I claim is—

The method of separating diamagnetic particles from a mixture containing them, which consists in feeding the mixture into a relatively-intense part of a magnetic field, simultaneously charging the mixture electrostatically, and subjecting the electrostatically-charged mixture to the action of the magnetic field until the diamagnetic particles to be separated have gradually moved out from the mixture into a relatively-weak part of the field, and then collecting said particles as heads, substantially as described.

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

ELMER GATES.

Witnesses:

THEODORE J. MAYER,  
HUGH M. STERLING.