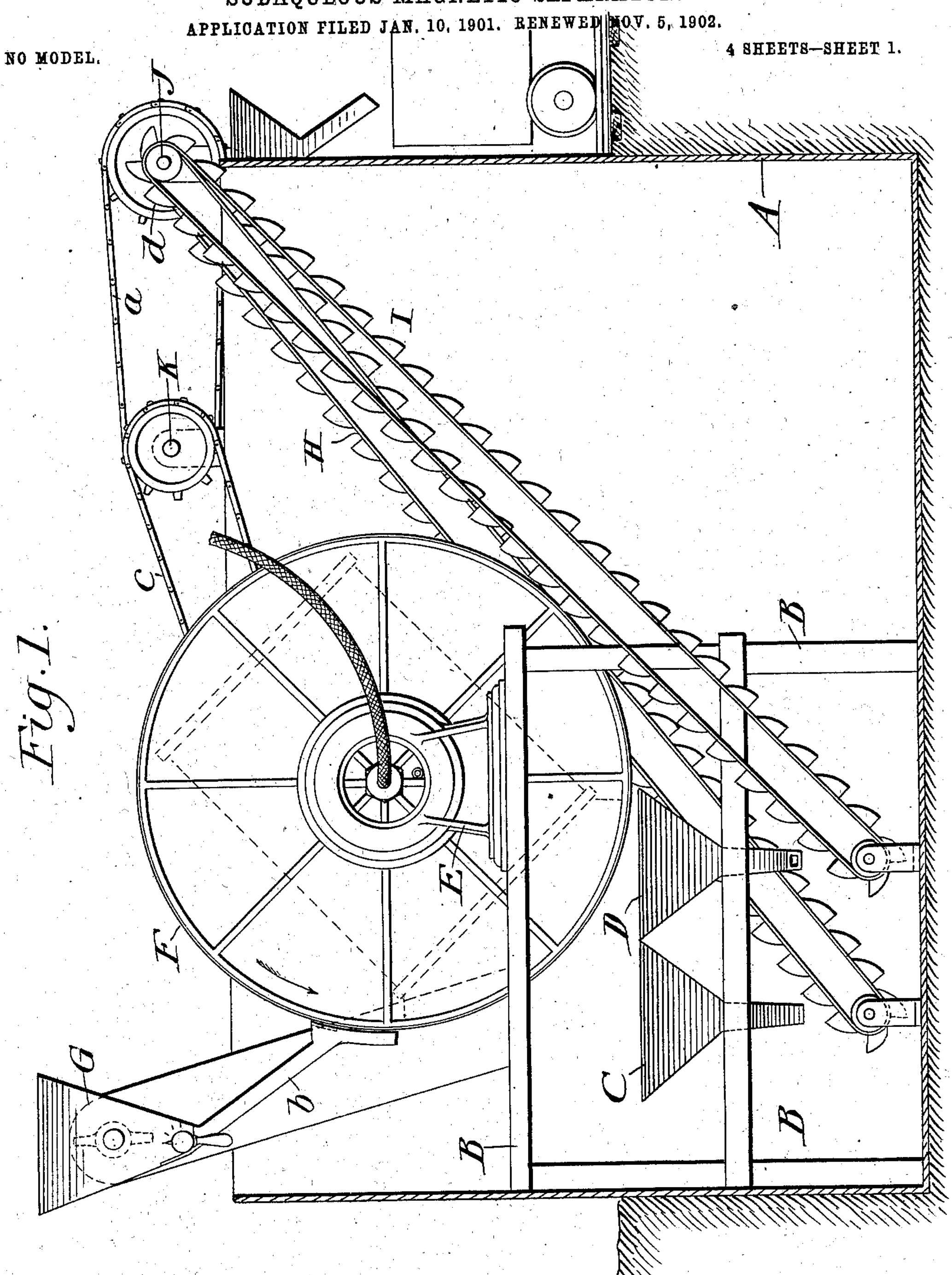
No. 729,753. PATENTED JUNE 2, 1903.

E. GATES.

SUBAQUEOUS MAGNETIC SEPARATOR.

APPLICATION FILED JAN. 10, 1901. RENEWED NOV. 5, 1902.

NO MODEL. 4 SHEETS—SHEET 1.



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NO MODEL. 4 SHEETS—SHEET 2.

Fig. 2.

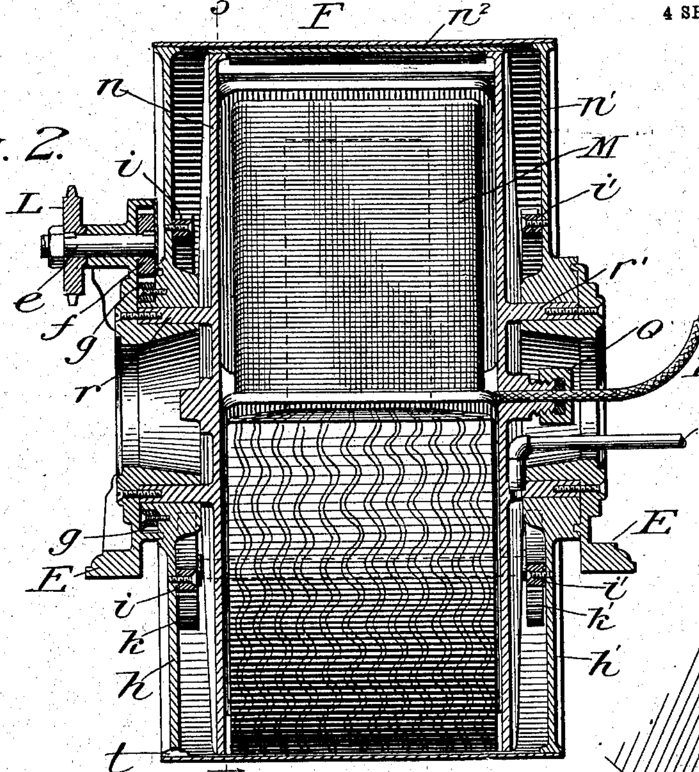


Fig. 2a.

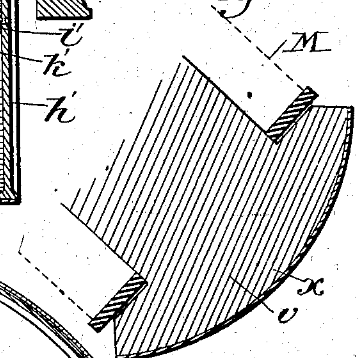
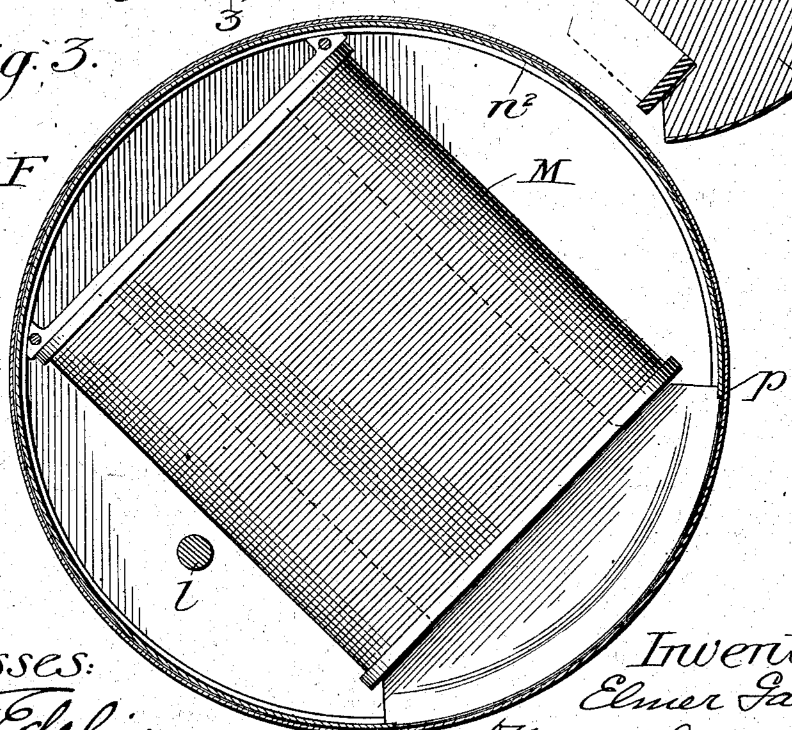


Fig. 3.



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NO MODEL. 4 SHEETS—SHEET 3.

Fig. 4.

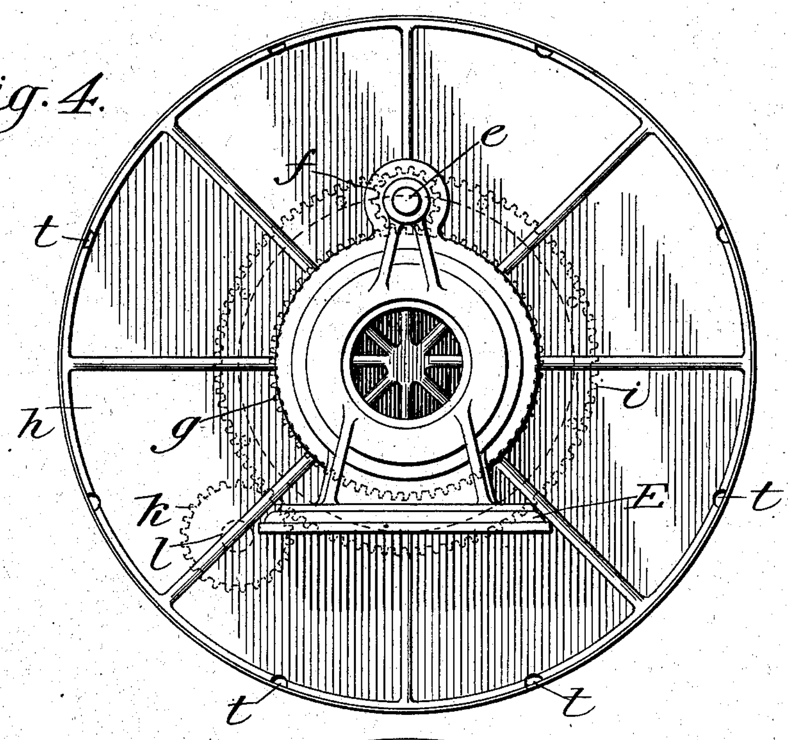
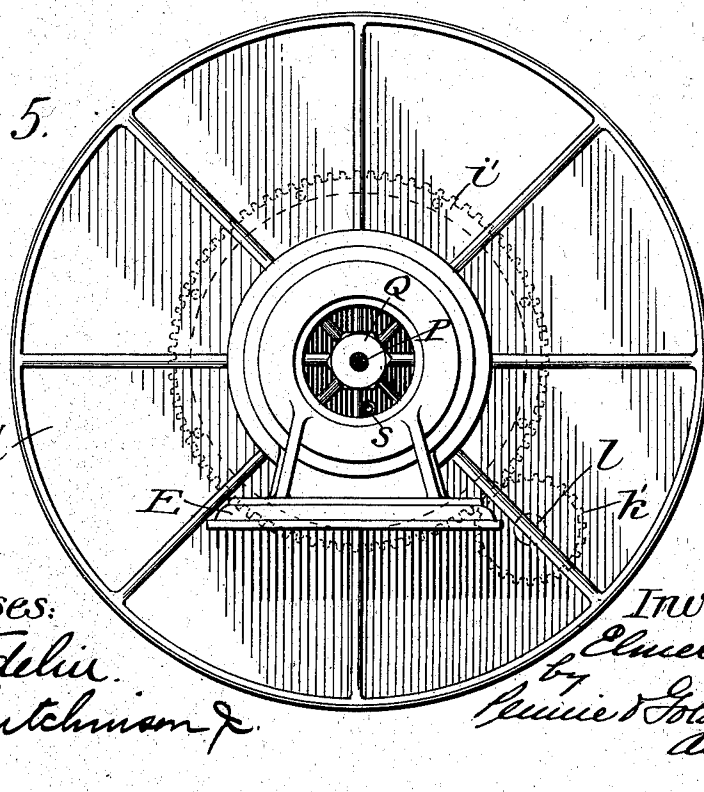


Fig. 5.



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NO MODEL. 4 SHEETS—SHEET 4.

Fig. 6.

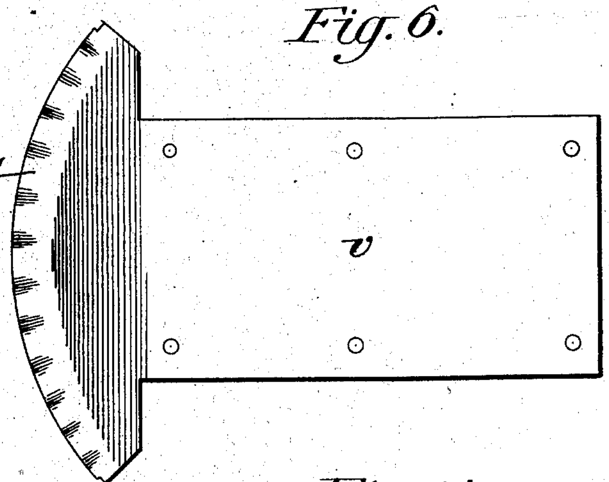


Fig. 7.

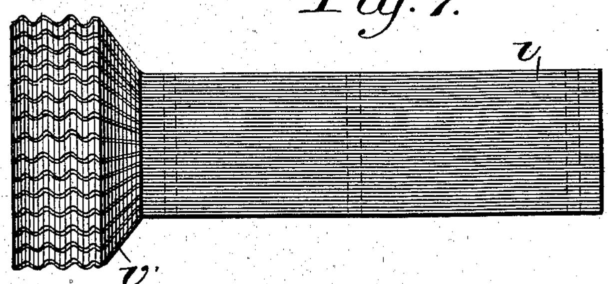
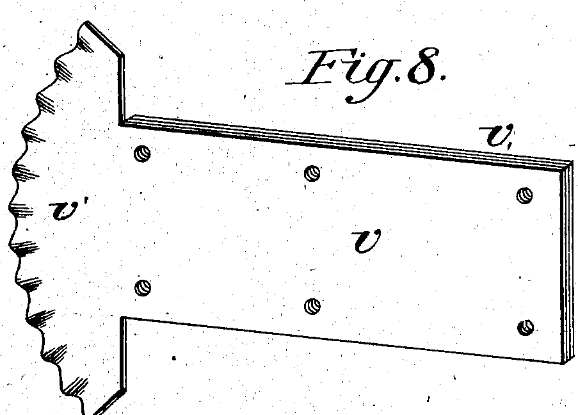


Fig. 8.



Witnesses:
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No. 729,753. Patented June 2, 1903.

UNITED STATES PATENT OFFICE.

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

SUBAQUEOUS MAGNETIC SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 729,753, dated June 2, 1903.

Application filed January 10, 1901. Renewed November 5, 1902. Serial No. 130,153. (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 Subaqueous 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 magnetic separators, and is chiefly designed for separating magnetic sand from silicious sand or other like material with which it is associated, although it will be evident that the apparatus is applicable generally for the separation of paramagnetic from diamagnetic material.

In certain Letters Patent of the United States granted to me November 27, 1900, Nos. 662,409 to 662,414, inclusive, I have described and claimed certain apparatus for separating paramagnetic from diamagnetic material, involving the fundamental idea of feeding the composite material upon a receiving-apron located in a magnetic field of a strength so graduated that the magnetic sand will arrange itself in moss-like or frond-like structures and in zigzag or wavy lines, and thereupon bodily moving said structures on the zigzag or wavy lines of force established, so as to occasion a corresponding zigzag or sinuous travel of said structures and their concurrent progressive reformation. The apparatus herein shown operates upon this general principle and while applicable to the separation of dry material is particularly designed for separating wet material, or rather material to which water has been added, so as to make it flow freely into the magnetic field of the separator, or material dredged by means of a pump or the like and carried by a stream of water into the magnetic field, or preferably material dredged in submerged hoppers and fed into a separator which is itself submerged.

In the accompanying drawings, Figure 1 represents a side elevation of an apparatus embodying my invention in one of its forms or modifications. Fig. 2 represents, partly in section and partly in elevation, the separating-magnet and its associate parts. Fig. 2ᵃ is a fragmentary sectional view of the magnet-core and the protecting-plate affixed to the face thereof. Fig. 3 represents a sectional elevation on the line 3 3 of Fig. 2. Figs. 4 and 5 represent, respectively, elevations of opposite ends of the separator; and Figs. 6, 7, and 8 represent views of the magnet-core.

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

The general arrangement of the working apparatus is illustrated in Fig. 1, wherein A represents a tank adapted to contain water, within which tank is located a framework B, supporting the hoppers C D and the bearings E for the rotatory feed-apron F. G indicates a hopper for supplying material to the feed-apron F through the chute *b*, and H I represent elevating devices operated from a shaft J. Upon the shaft J is mounted a sprocket-wheel *d*, actuating a similar sprocket-wheel upon the shaft K, and upon the shaft K a sprocket-chain *c* actuates a sprocket-wheel L, fixed upon the rotary shaft *e*. Upon the shaft *e* is mounted a pinion *f*, engaging with a gear *g* upon the rotary feed-apron F, whereby the movement of rotation is imparted to said feed-apron in the direction of the arrow shown in Fig. 1. Upon the inner surface of the end plate *h* of the cylinder is mounted a circular rack *i*, engaging with a pinion *k*, fixed to a rotary shaft *l*. The opposite end of the shaft *l* carries a corresponding pinion *k'*, which engages with a rack *i'* on the inner surface of the end plate *h'*. By this expedient the strain is distributed from end to end of the rotary feed-apron. The end plates *h h'* are preferably of cast metal, and the feed-apron itself is preferably of thin sheet metal—as, for instance, sheet brass or copper. The end plates are provided with bosses which rest upon the bearings *r r'* of a water-tight jacket, which jacket hermetically incloses the coil M of the separator-magnet, said jacket consisting of end plates *n n'* and a connecting-sheath n^2. Within this water-tight jacket the electromagnet is mounted in an inclined position, as indicated more clearly in Figs 1 and 3, the pole-piece of the magnet extending through the jacket by making a water-tight joint therewith at the points p p'. The conducting-cable P, carrying the incoming and outgoing wire of the coil M, passes through a stuffing-box Q, as shown in Fig. 2, so as to prevent infiltration of water at that point into the interior of the jacket. In order to sustain the apron F against external pressure of water if submerged too deeply to retain its shape, either air or water may be admitted under pressure through the pipe s, thereby establishing a counter-pressure sufficient to balance the pressure from without. I prefer, however, that in addition to this counter-pressure the volume of fluid (preferably water) admitted through the pipe s shall be sufficient to establish an outflow from the interior of the rotary feed-apron through the apertures t. (See Figs. 2 and 4.) A flow of clean water will under such conditions constantly issue from the rotary feed-apron, thereby preventing any infiltration of sand into the rotary feed-apron from the water contained within the tank. This is of advantage, for the reason that the infiltration of such sand would tend to erode the face of the pole-piece and the interior surface of the feed-apron, thereby causing the separator to rapidly wear out.

The specific construction of the core of the magnet is illustrated in detail in Figs. 6, 7, and 8. As therein shown, it consists of a number of plates or laminæ v, of sheet-iron, arranged side by side and riveted together. Individual members of these laminæ are provided with polar extensions v', which are bent or expanded laterally, as shown, and which have a general circular outer periphery and at their extreme ends are of a wavy configuration, as shown. Between the expanded ends these polar extensions are preferably filled in with non-magnetic material, such as lead or brass, preferably formed into the inner space in a molten condition and then permitted to cool and set. After finishing off the surface of the pole-piece thus formed the pole-piece is preferably electroplated, or in substitution therefor a plate of metal x may be mechanically affixed to the face of the pole-piece, as shown in Fig. 2ª. By this means electrolytic action is avoided between the face of the pole-piece and the inner face of the feed-apron, and a greater wear for the apparatus is consequently secured.

The mode of operation of the invention will be apparent. The material fed from the hopper G and consisting of magnetic sand, with its accompanying burden of diamagnetic sand or the like, diluted with a sufficient quantity of water to make it flow freely, passes through the chute b and upon the face of the feed-apron F. Entering the magnetic field the magnetic sand disposes itself along the wavy lines of force produced by the zigzag configuration of the polar extensions of the core, and as the feed-apron revolves the moss-like or frond-like structures thus produced are shaken laterally, thereby relieving themselves of the diamagnetic sand which they contain, which diamagnetic sand falls into the hopper C and is conveyed off by the conveyer H. The magnetic sand, on the contrary, is carried on until as it emerges from the magnetic field it drops into the hopper D and is carried off by the conveyer I to a suitable point of collection.

Having thus described my invention, what I claim is—

1. A subaqueous magnetic separator, provided with an electromagnet, a water-tight jacket incasing the coil of said electromagnet, and through which passes the magnet-core, said magnet-core having a covering-plate.

2. A subaqueous magnetic separator, provided with an electromagnet, a water-tight jacket incasing the coil of said electromagnet, and through which passes the magnet-core, said magnet having an electrolytically-deposited covering-plate; substantially as described.

3. A subaqueous magnetic separator, provided with an electromagnet, a water-tight casing for the coil of said electromagnet, an outer feed-cylinder passing through the magnetic field, and a fluid-pressure inlet-pipe entering the space between the jacketed coil and the outer feed-cylinder; substantially as described.

4. A subaqueous magnetic separator, provided with an electromagnet, a water-tight casing for the coil of said electromagnet, an outer feed-cylinder passing through the magnetic field, and a fluid-pressure inlet-pipe entering the space between the jacketed coil and the outer feed-cylinder, said cylinder being provided with outlet-openings to establish an outflow from the cylinder, and thus prevent the infiltration of sand; substantially as described.

5. A subaqueous magnetic separator, provided with an electromagnet having a core whose main body portion is made up of laminæ or plates placed side by side, some of said laminæ having polar extensions of wavy configuration and a water-tight jacket inclosing the coil of said electromagnet and through which passes said core; substantially as described.

6. A subaqueous magnetic separator, provided with an electromagnet having a core whose main body portion is made up of laminæ or plates placed side by side, some of said laminæ having polar extensions of wavy configuration, and a strengthening-filling of non-magnetic material between said polar extensions and an inclosing water-tight jacket for the coil of said electromagnet and through which passes said core; substantially as described.

7. In a magnetic separator, an electromagnet having its coil incased in a water-tight jacket, and having its pole-piece projecting through the jacket, and made up of plates or laminæ having a wavy or zigzag configuration

at their outer peripheries, and an outer feed-cylinder passing through the magnetic field; substantially as described.

8. A magnetic separator, comprising a feed-hopper, a rotatory feed-cylinder, a chute or trough leading from the feed-hopper to the cylinder, an electromagnet located inside of the cylinder, and provided with a pole-piece having a wavy or zigzag distribution of its lines of magnetic force, and a water-tight jacket incasing the coil of the electromagnet; substantially as described.

9. In a magnetic separator, an electromagnet having the main body portion of its core made up of plates or laminæ, individual members of said plates or laminæ having polar extensions of wavy or zigzag configuration at their peripheries, said polar projections diverging laterally so as to occupy a larger space; substantially as described.

10. In a magnetic separator, a rotatory feed-cylinder, in combination with an electromagnet located inside of the cylinder, the pole-piece of said electromagnet being faced with a protecting plating of metal; substantially as described.

11. In a magnetic separator, a rotatory feed-cylinder, in combination with an electromagnet located inside of the cylinder, the pole-piece of said electromagnet being faced with a plating of metal, and a water-tight jacket incasing the magnet-coil; substantially as described.

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

ELMER GATES.

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