(No Model.) 2 Sheets—Sheet 1.

G. M. GOUYARD.

ELECTRO MAGNETIC SEPARATOR.

No. 460,962. Patented Oct. 13, 1891.

Fig. 1

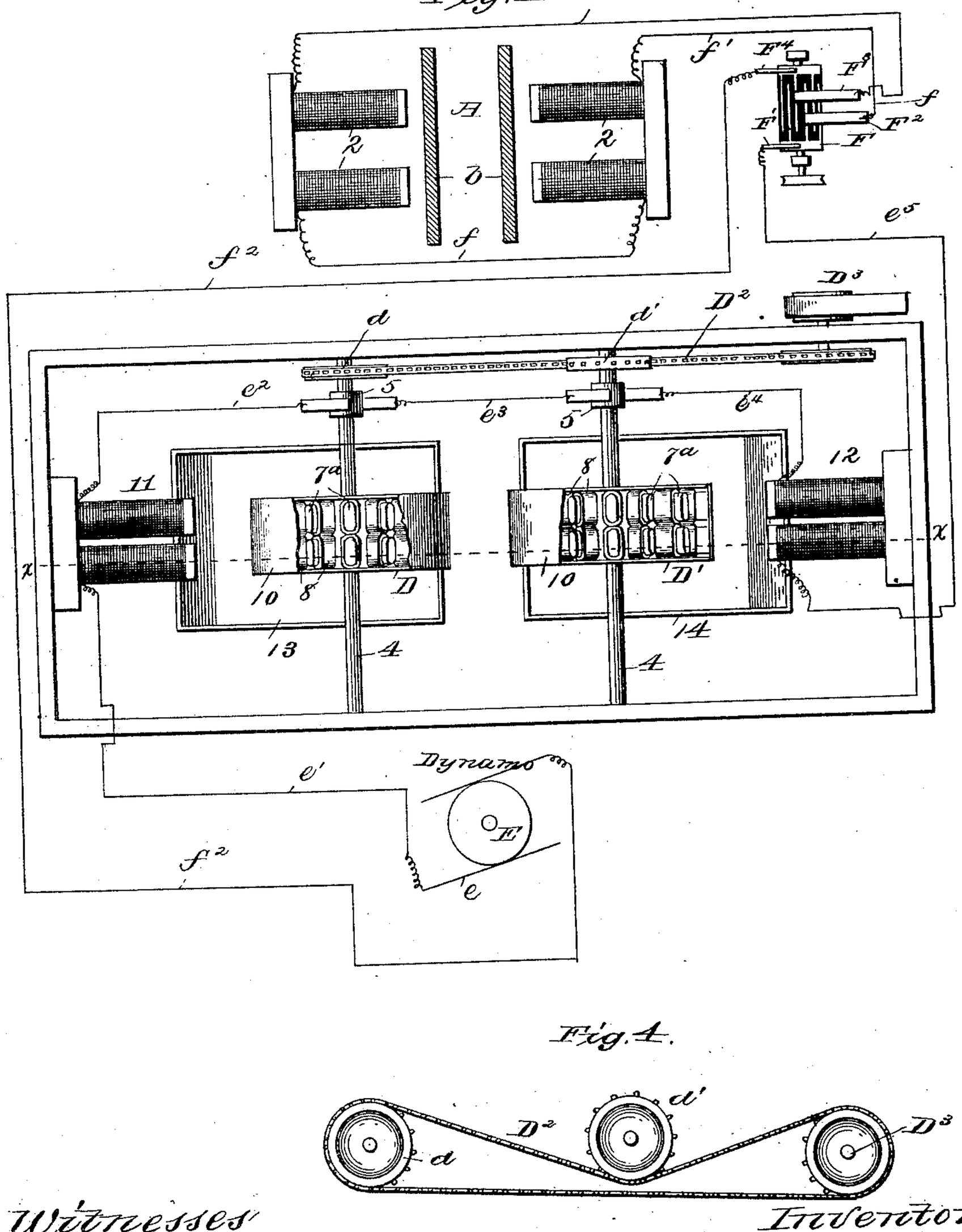

Fig. 4.

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(No Model.) 2 Sheets—Sheet 2.

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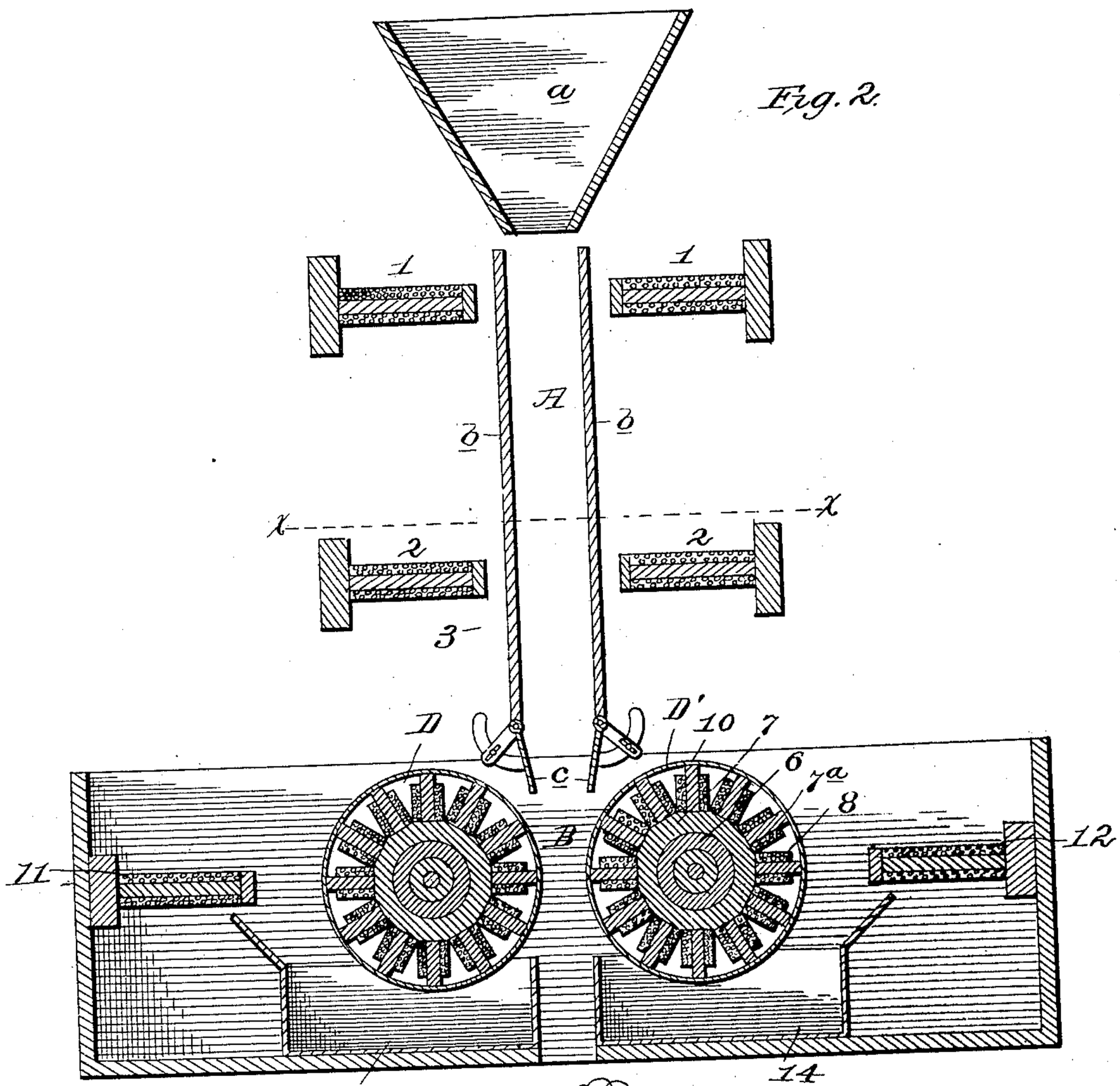

Fig. 2.

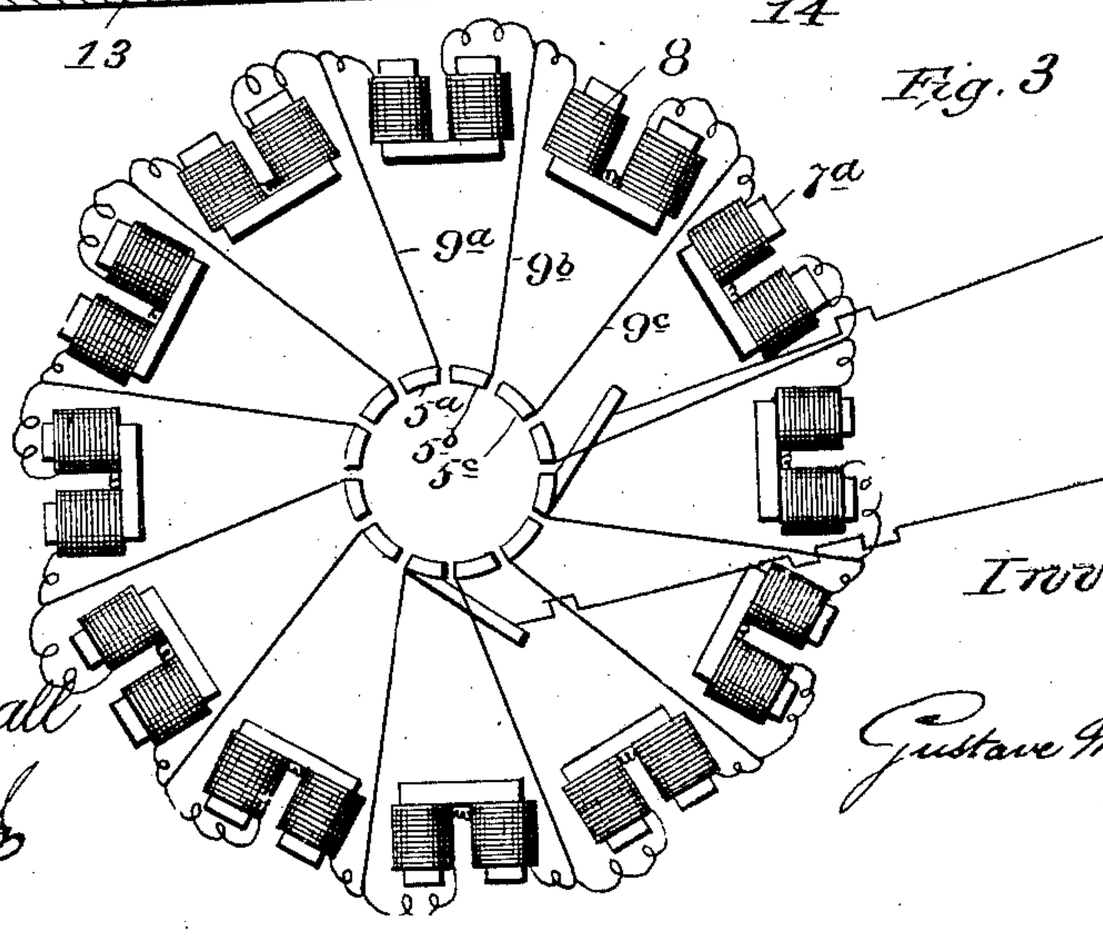

Fig. 3

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UNITED STATES PATENT OFFICE.

GUSTAVE M. GOUYARD, OF LEADVILLE, COLORADO.

ELECTRO-MAGNETIC SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 460,962, dated October 13, 1891.

Application filed January 6, 1891. Serial No. 376,924. (No model.)

To all whom it may concern:

Be it known that I, GUSTAVE M. GOUYARD, a citizen of the United States, residing at Leadville, in the county of Lake and State of Colorado, have invented certain new and useful Improvements in Electro-Magnetic Separators; and I hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, in which—

Figure 1 is a plan view of apparatus embodying my invention, the electro-magnetic chute or preparatory portion thereto displaced to show the revolving electro-magnets to better advantage, the electric circuit from a dynamo or other source of electricity through the apparatus and through a pole-changer being also shown, and the preparatory chute being shown in transverse section. Fig. 2 is a vertical section of the apparatus on the line *x x*, Fig. 1, showing the preparatory chute thereof. Fig. 3 is a diagram illustrating the relative arrangement and electrical connection of the revolving electro-magnets with each other and with the commutator; and Fig. 4 illustrates one form of positive gearing by means of which the two sets of revolving magnets or drums which contain them may be caused to move in unison, the same consisting of sprocket-wheels on the shafts of the drums and a sprocket-chain from the power-shaft.

Like symbols refer to like parts wherever they occur.

My invention relates to the construction of electro-magnetic separators for eliminating magnetic particles from pulverized ore of any character or from any other material which contains the metal in a divided condition, and has for its object to dispense with clearing-brushes, belts, aprons, and like adjuncts, whereby the apparatus is simplified and rendered more efficient and certain in its operation.

To this end the main feature of my invention embraces the combination of a plurality of revolving electro-magnets arranged in series, a divided commutator, and a plurality of connections between the divided commutator and the series of electro-magnets, whereby the polarity is reversed in successive portions of the series of electro-magnets.

A secondary feature of my invention embraces the combination of two or more sets of revolving electro-magnets, the electro-magnets of each set arranged in series, a divided commutator for each set, and a plurality of connections between each series and its commutator, said sets arranged in juxtaposition to increase the working field of the apparatus.

There are other minor features of invention, all as will hereinafter more fully appear.

I will now proceed to describe my invention more fully, so that others skilled in the art to which it appertains may apply the same.

The apparatus shown in the drawings includes a preparatory apparatus, (indicated by A) and the separator proper, (indicated by B.)

In the preparatory apparatus, *a* indicates a suitable hopper for the reception and delivery of the material containing the magnetic metal; *b b*, two thin vertical walls of non-magnetic material, which form a chute, the lower ends of said walls *b b* being provided with hinged deflectors *c c*, which can be adjusted to any desired inclination to direct to the desired point the material passing through the chute. Exterior thereof and in close proximity to the said walls *b b* are placed electro-magnets 1 1 2 2—any desired number—to produce an electric field within the chute, and through which the magnetic particles must pass.

Immediately below the preparatory apparatus A is located the separator proper B, and said separator is composed of one or more sets of moving electro-magnets, each set connected in series, each set having a plurality of connections with a divided commutator. The preferred construction of each set is that shown in the drawings—that is to say, on a suitable shaft 4 is arranged a divided commutator 5, the number of sections or divisions of the commutator corresponding with the number of electro-magnets in the series or with the number of distinct portions into which it is desired to divide the series in the operation of the machine.

6 indicates the non-magnetic metal or insulation surrounding the shaft 4, and 7 the soft-iron exterior thereto and forming the cores 7^a of the several electro-magnets 8. The electro-magnets 8, which, as shown, are radially ar-

ranged with relation to the shaft with which they revolve, may be any desired number, either arranged in multiples transversely or in pairs, as shown in the drawings, (see Fig. 1,) and all the electro-magnets of the set are wound continuously or in series (see diagram Fig. 3) and connected with the separate divisions of the commutator 5 by a plurality of connections 9^a 9^b 9^c, &c., either between the separate magnets or between groups of magnets, according to the number and accordingly as force or length of field is required. For instance, where there are twelve electro-magnets 8 there may, if desired, be twelve commutator divisions or plates 5^a 5^b, &c., and twelve connections 9^a 9^b, &c., so that each electro-magnet has a direct connection with the commutator, or there may be only six, four, or three commutator-plates, so that separate groups of the series have but a joint connection with the commutator.

The radially-arranged electro-magnets 8 8 8 are inclosed by a thin non-magnetic casing 10, preferably of paper or leatheroid, which constitutes the periphery of the revolving drum and upon which the material to be separated falls from the preparatory apparatus A or is drawn by the magnets, and the ends of the drum thus formed may be closed by disks of brass or other non-magnetic metal, so that the sets of magnets are thus entirely incased and protected from dust or dirt. Though a single set of such magnets is operative in itself and is the type of my machine, yet I prefer to use two of such drums (or sets of revolving magnets) D D′, arranged in juxtaposition, and connect the same by positive gearing of any character which will insure their revolving in unison, so as to present negative and positive poles to each other, and thus increase the force of the field through which the material from preparatory apparatus A has to pass. For this purpose the drums D D′ may be provided with suitable shafts having sprocket-wheels *d d′*, which gear with a sprocket-chain D^2, driven from a suitable power-shaft D^3, as illustrated in Fig. 4.

11 12 indicate electro-magnets placed opposite the respective sets D D′ of electro-magnets, preferably diametrically opposite to the field, so as to present a neutralizing force to the non-gathering portion of each drum, and thus insure the discharge of all iron particles.

Owing to the arrangement of the electro-magnets 8 8 8 in series and their connection either separately or in groups with the divided commutator by a plurality of connections, as hereinbefore described, it follows that while the working magnets or those next the falling current of material to be separated are charged to the full capacity the remainder are also more or less charged in proportion inverse to their resistance, and though weaker than the working magnets are still sufficiently strong to carry some magnetic particles. To clear these particles from the drums, I provide the electro-magnets 11 and 12, so arranged that the poles thereof are opposite the similar poles of the magnets on the drums, and thus neutralize the power of the drum-magnets. These magnets so arranged I term "repulsive magnets."

Below the drums D D′ are pans or receptacles 13 14 for the reception of the magnetic particles, and between the said pans and directly below the passage between the drums D D′ is a chute for conducting off the material from which the magnetic material has been eliminated.

In connection with apparatus of the general character hereinbefore described some form of pole-changer and some source of electricity are employed; but the particular construction thereof is not material. The pole-changer may, if desired, have the general construction of the one shown at the right-hand upper corner of Fig. 1—that is to say, on a suitably-journaled driven shaft is mounted a cylinder of insulating material having at its ends brass contact-rings, from each of which extends a series of contact-strips less in length than the length of the cylinder, but of sufficient length to accommodate the brushes F^2 F^3, said contact-strips interlapping or arranged alternately, as shown. With the brass contact-rings of the pole-changer F the wire e^5 from and the wire f^2 to the dynamo are connected by suitable brushes F′ and F^4, respectively. The brushes F^2 and F^3, which rest on the contact-strips arranged longitudinally on the periphery of the cylinder, should be set one in advance of the other equal to the distance between strips.

In the drawings, E indicates a dynamo, which is the preferred source of electricity. One distributing-brush *e* of the dynamo is connected with the neutralizing or repulsion magnet 11 by wire *e′*, and the current is conducted thence by wire e^2 to the first of revolving electro-magnets D, thence by wire e^3 to the second set of revolving electro-magnets, thence to the second neutralizing or repulsion magnet 12 by wire e^4, by wire e^5 to the pole-changer F, and from the brush F′ of pole-changer F the current passes by brush F^2 and wire *f* to and through the several magnets 2 1 1 2, and by wire *f′* returns to the pole-changer F, whence it passes through wire f^2 to the dynamo E.

When the current enters the set of revolving magnets 8 8, which are wound in circuit and have independent connections 9^a 9^b, &c., with the respective commutator-plates, (see Fig. 3,) it will divide, the larger portion passing through the singles or the small group of magnets, as the case may be, lying between the brushes, while, owing to the resistance in the remaining magnets or larger group, but a small portion of the current passes therethrough. As each single or each group passes beyond the brush or beyond the field it follows that it enters the larger group, and its polarity is immediately reversed and acts repulsively on the iron particles, causing them to fall or be deposited in the receptacles 13

14. Should the particles not be immediately deposited on the reversal of the polarity in the magnets 8, escaping from the field, they will be carried into the fields of the neutralizing or repulsion magnets 11 and 12, which will neutralize the force of drum-magnets 8 as they come opposite thereto and insure the deposit of any residuum in the receptacles, and thus clear the peripheries of the revolving drums D D'.

In operating the separator the pulverized ore or equivalent material containing the magnetic particles is fed into hopper *a* and allowed to fall in a divided current through the chute formed by the walls *b b* and between the electro-magnets 1 1 and 2 2. This attracts the magnetic particles to the outside of the current of falling matter, and by regulating the inclination of the hinged deflectors *c c* the delivery of the current of fine material and the partially-separated (or concentrated) magnetic particles to the field of the revolving magnets can be perfectly regulated. The magnets in the preparatory chute will, however, if constant, cause an accumulation of more or less of the magnetic particles on the walls of said chute opposite said magnets, which accumulation will, if permitted to remain, impair the efficiency of the apparatus. This, however, is corrected by the use of the pole-changer, which changes the polarity of the magnets, and thus prevents the accumulation on the sides of the chute. As the material passes through the field of the revolving magnets the magnetic particles will be eliminated and deposited in the receptacles 13 and 14, in manner hereinbefore specified when deseribing the operation of the revolving magnets.

Having thus described my invention, what I claim and desire to secure by Letters Patent, is—

1. In a magnetic separator, the combination, with a plurality of magnets connected in series and each set of magnets connected to a separate plate or division of the commutator, of a commutator having a separate plate or division for each set of magnets and a pair of brushes therefor, whereby the working magnets are all of one polarity, which polarity is changed when the magnets pass the brushes, substantially as and for the purposes specified.

2. In a magnetic separator, the combination of two sets of electro-magnets, each set arranged in series and having a plurality of commutator-plates and connections, said sets geared to move in unison, and suitable brushes, substantially as and for the purposes specified.

3. In a magnetic separator, the combination, with a revolving set of electro-magnets arranged in series, of a commutator having a plurality of plates, each connected with the series of electro-magnets, and a neutralizing or repulsion magnet arranged opposite the revolving magnets, substantially as and for the purposes specified.

4. In a magnetic separator, a preparatory chute having electro-magnets at its opposite sides and a pole-changer for alternating the currents in said magnets, substantially as and for the purposes specified.

5. In a magnetic separator, the combination, with a revolving set of electro-magnets, of a preparatory chute having electro-magnets arranged on opposite sides thereof, substantially as and for the purposes specified.

6. In a magnetic separator, the combination, with a series of revolving electro-magnets, of a preparatory chute having pivoted deflectors at its lower end and electro-magnets arranged on opposite sides of the chute, substantially as and for the purposes specified.

7. In a magnetic separator, the combination, with electro-magnets arranged in series, of a divided commutator having a plurality of connections with the series of electro-magnets, a neutralizing or repulsion magnet arranged opposite the revolving magnets, and a preparatory chute arranged over the field of the series of magnets, said chute having electro-magnets upon its opposite sides, substantially as and for the purposes specified.

In testimony whereof I affix my signature, in presence of two witnesses, this 5th day of January, 1891.

GUSTAVE M. GOUYARD.

Witnesses:
F. W. RITTER, Jr.,
F. R. CORNWALL.