(No Model.)

C. Q. PAYNE.

MAGNETIC ORE SEPARATOR.

No. 444,223. Patented Jan. 6, 1891.

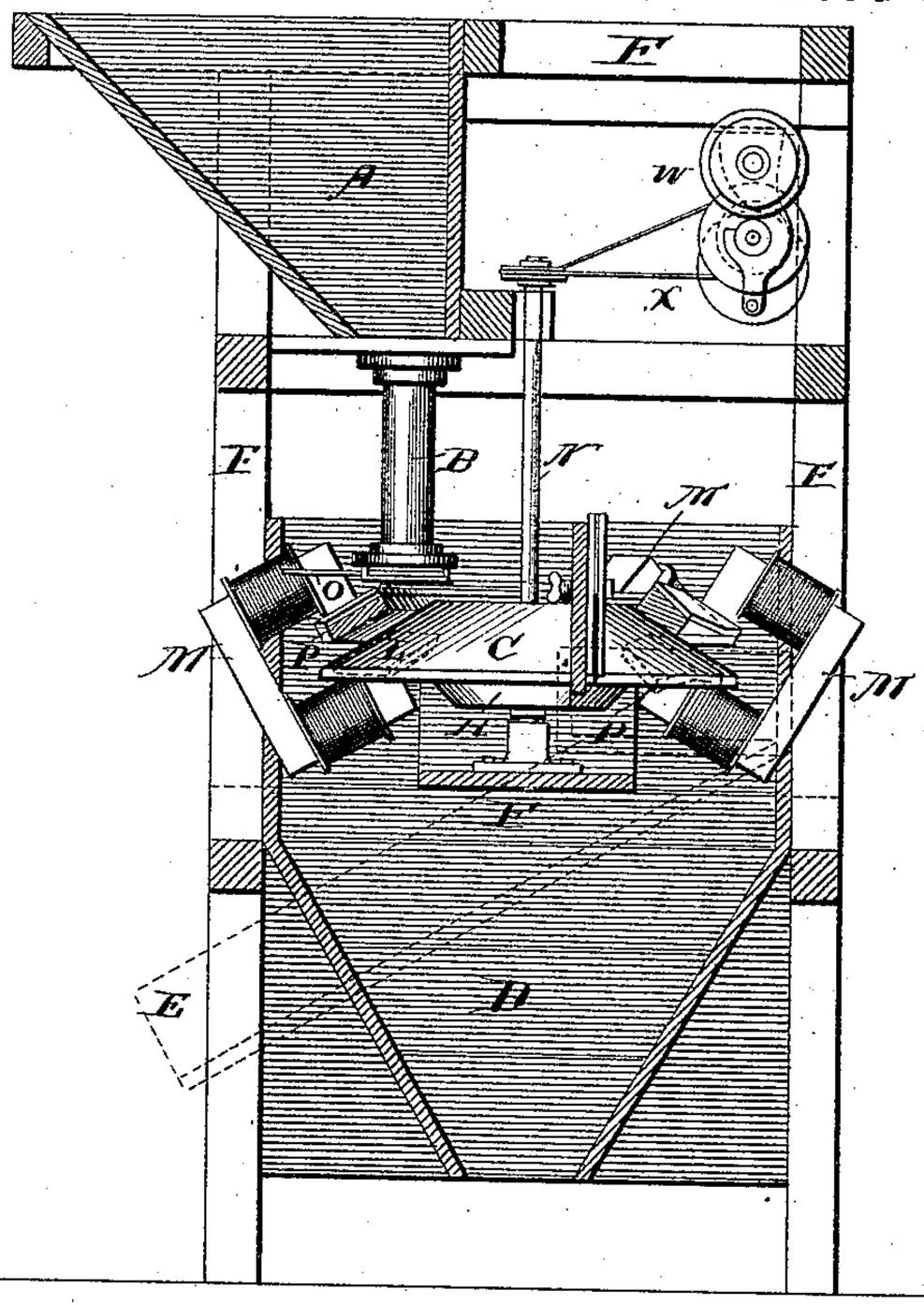

Fig. 1.

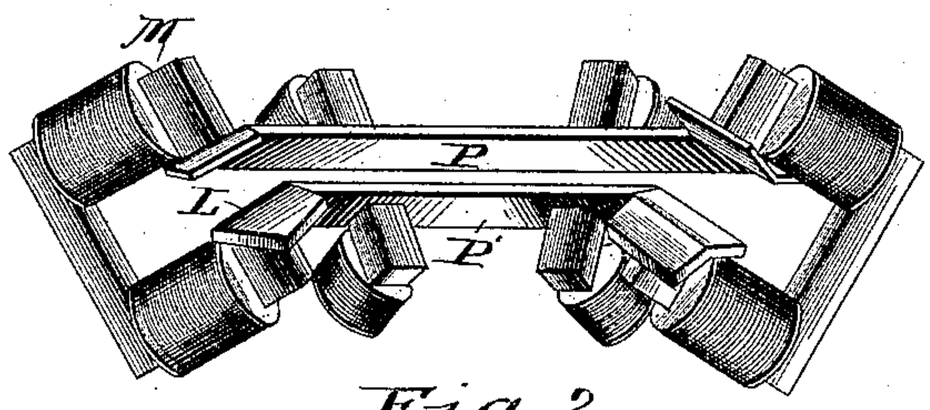

Fig. 2.

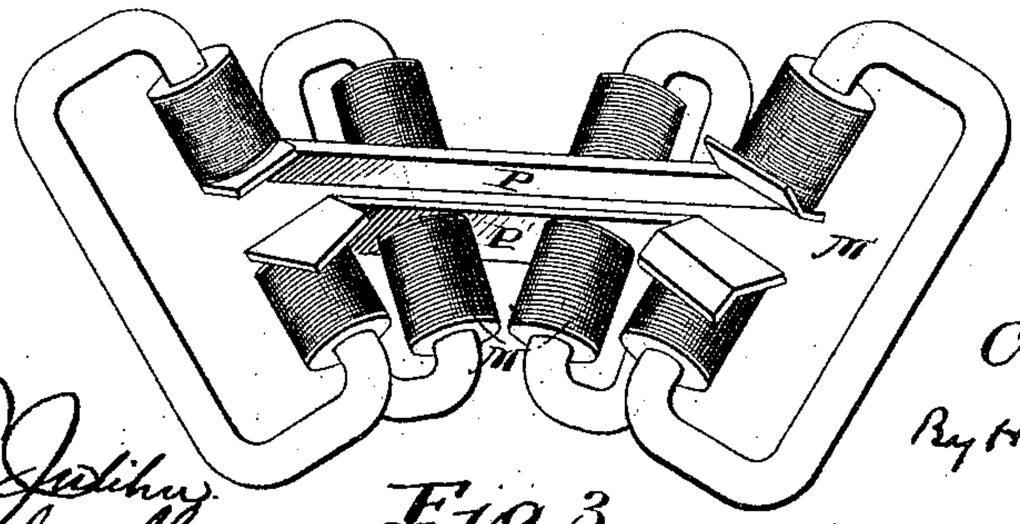

Fig. 3.

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UNITED STATES PATENT OFFICE.

CLARENCE QUINTARD PAYNE, OF STAMFORD, CONNECTICUT.

MAGNETIC-ORE SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 444,223, dated January 6, 1891.

Application filed August 19, 1890. Serial No. 362,461. (No model.)

To all whom it may concern:

Be it known that I, CLARENCE QUINTARD PAYNE, a citizen of the United States, residing at Stamford, in the county of Fairfield and State of Connecticut, have invented an Improved Form of Machine for the Separation or Concentration of Magnetic Iron Ores, as explained hereinafter in the specification and shown in the accompanying drawings.

The object of my invention is to obtain a more perfect concentration of lean or low-grade iron ores. This is accomplished by a construction of the electro-magnets and pole-pieces which secures a better arrangement of the lines of force in the magnetic field in which the separation takes place by using the attracting force of a single pole-piece charged uniformly with either positive or negative polarity. In this way no bunches or clots of magnetic particles are formed upon the attracting-surface, and the non-magnetic particles can therefore be more readily removed by centrifugal force acting on them.

My present invention is therefore a modification of and improvement on my invention which forms the subject of my United States Letters Patent No. 348,771.

In the drawings illustrating my invention, Figure 1 is a view of the complete machine, one side of the frame only being removed in order to show all the parts. Figs. 2 and 3 are perspective views showing different arrangements of the electro-magnets and pole-pieces.

In Fig. 1, F F F is the frame which supports the machine and also the hopper A at the top. The ore to be concentrated is placed in the hopper A, and is then discharged through the feed-pipe B by means of a valve and hand-lever O upon the revolving conical apron or cover C. The conical apron C is of thin brass or any non-magnetic material and conforms to the surface of the pole-pieces of the magnet just below it, so as to revolve with the least possible clearance over the pole-piece. For this purpose it is supported upon the hub H and is mounted on a shaft N, which is concentric with the pole-pieces P and P′. The shaft N may be caused to revolve by means of a belt or gear-wheels directly connected with an outside source of power.

Preferably an intermediate pair of cones is used in order to vary at will the speed of the revolving apron C, and thus to increase or decrease the centrifugal force which removes the non-magnetic particles. Such a pair of cones is shown in end view at W, Fig. 1; but the particular method of driving or varying the speed of the machine is not material to this invention.

The sides of the separator-frame are inclosed to a height above the conical apron C, as shown in Fig. 1. As the non-magnetic particles are discharged from the revolving apron they strike against the inclosed sides of the frame and are collected below by the inclined sides of the chute D. The magnetic particles, on the other hand, are carried around by the apron C and leave the magnetic field after about three-fourths of a revolution. They then strike against the surface of the deflector S and are guided into the chute E (shown in dotted lines) and thus collected. The deflector S consists of two pieces of wood or other material, which hold between them a piece of felt, which rests lightly on the surface of the apron C.

In Fig. 2 are shown four horseshoe electro-magnets M M M M, which are arranged about two segmental ring-shaped pole-pieces P P′. These pole-pieces are of soft iron. Each is preferably of a single piece and of uniform thickness. They are placed coaxially and a short distance apart. The end L of the lower pole-piece P′ projects a few inches beyond the edge of the upper one P, in order that the magnetic particles may be readily held to the cover as they are discharged from the feed-pipe B. The opposite ends of the two pole-pieces are curved up and down, respectively, in the manner shown in the drawings, in order to reduce the strength of the magnetic field at these ends, and thus facilitate the removal of the magnetic particles from the field. The pole-pieces P P′ extend through an arc of about two hundred and seventy degrees and are provided with broad faces, so as to afford ample attracting-surface to the magnetic particles. The faces of the pole-pieces may be either horizontal or may form any convenient angle with a horizontal plane. In order to facilitate the removal of the non-magnetic particles from the apron C, I prefer to give the faces of the pole-pieces a slight angle, so that they form surfaces of frustums of two

concentric cones. I have shown four electro-magnets attached to the pole-pieces. The number does not affect the principle of separation, but depends upon the relative dimensions of the pole-pieces and magnets.

The spools of the electro-magnets are preferably connected together in series—that is, those on the upper pole-piece form one series and those on the lower pole-piece a second—the copper wire of the spools being wound in such a manner that when a current from a galvanic battery or a dynamo-electric machine is passed through it a uniform polarity at each pole-piece is formed. In this way the upper pole-piece forms a single positive pole and the lower pole-piece a single negative pole, or vice versa.

In Fig. 1 I have shown the top pole-piece P covered on the under side with a segmental ring of wood or other non-magnetic material of the same width as that of the top pole-piece itself and conforming to its surface. The thickness of this ring is just sufficient to occupy half the space between the two pole-pieces. Its lower surface therefore coincides with the neutral surface between the two poles, along which the positive and negative polarities of the two poles are exactly balanced. From this construction it is evident that the cover C revolves through what is technically known as a "unipolar" field—that is, one in which the lines of force are all in the same direction and do not reverse at any point. It will also be seen that the top pole P performs an entirely different function from the bottom pole P', for, while the latter holds the magnetic particles to the cover C as it revolves through the magnetic field, the pole P is prevented from holding any of the magnetic particles to its under surface by the wooden ring which extends from the latter to the neutral surface between the two pole-pieces. The object of the top pole-piece is thus to close the magnetic circuit of the lines of force between the two pole-pieces, so that the former shall not only be normal to the adjacent surfaces of the two pole-pieces, but shall maintain a magnetic field of approximately uniform distribution between them, and in which these lines of force are practically parallel throughout. I therefore call the pole-piece P the "circuit-closer" in order to distinguish it from the lower pole-piece P, which holds and separates the magnetic particles.

By this invention I am able to avoid the formation of clots, loops, or bunches of magnetic particles in any part of the magnetic field, which are formed when both the positive and negative poles of one or more magnets are placed on the same side of the apron or plate or cylinder which forms the attracting-surface on which the separating action takes place. These clots or bunches are formed when the magnetic particles are enabled to bridge the space between two opposite poles by inductive action in the direction of the lines of force extending from one pole to the other. These bunches of magnetic particles hold mechanically a certain percentage of non-magnetic particles, which is very difficult to separate.

Fig. 3 shows a different construction of the electro-magnets to accomplish the same result as shown in Fig. 2—viz., by magnetizing the pole-pieces P and P' by positive and negative polarity, respectively. The iron back pieces which connect the cores of each pair of spools may also be omitted without affecting the principle involved in the construction.

The construction and details of the machine being thus explained, the operation of concentrating the iron ore is as follows: The valve at the bottom of the feed-pipe B is opened by means of the hand-lever O, and a regulated stream of ore is allowed to fall upon the revolving conical apron C. The electro-magnets are energized by the current from a dynamo-electric machine, and as soon as the magnetic particles in the ore strike the surface of the apron C they are held to it by the projecting end L of the pole P' and are carried between the pole-pieces about three-fourths of a revolution, and are then discharged on leaving the magnetic field against a deflector S and guided into the inclined chute E, where they are collected. The non-magnetic particles, on the other hand, striking the surface of the apron C, are not held, but slide down and are collected by the chute D. That portion which may be mechanically held or entangled by the magnetic particles is removed by centrifugal force, the position in which the latter are held on the apron C facilitating the release of the non-magnetic particles.

What I claim as my invention, and wish to secure by Letters Patent, is—

1. In a magnetic separator, two segmental ring-shaped pole-pieces magnetized, respectively, by positive and negative polarity and placed concentrically, so as to constrain the lines of force to occupy positions normal to their adjacent surfaces.

2. In a magnetic separator, two segmental ring-shaped pole-pieces placed concentrically, said pole-pieces being magnetized, respectively, by positive and negative polarity by means of one or more electro-magnets, so as to constrain the lines of force to occupy positions approximately parallel throughout the magnetic field.

3. In a magnetic separator, two segmental ring-shaped pole-pieces placed concentrically, said pole-pieces being magnetized, respectively, by positive and negative polarity by means of one or more electro-magnets and having an approximately uniform distribution of magnetism at their surfaces.

4. In a magnetic separator, the combination of two pole-pieces magnetized, respectively, by positive and negative polarity with an apron placed between and close to one of them, whereby the magnetic particles fed upon said apron are held to it by said latter pole-piece.

5. In a magnetic separator, the combination of two segmental ring-shaped pole-pieces placed concentrically and magnetized, respectively, by positive and negative polarity by means of one or more electro-magnets with a revolving apron placed between and close to one of them, whereby the magnetic particles fed on said apron are held to it by said latter pole-piece.

6. In a magnetic separator, two pole-pieces magnetized, respectively, by positive and negative polarity, one of which holds and separates the magnetic particles, while the other closes the magnetic circuit and maintains the lines of force normal to the adjacent surfaces of said pole-pieces.

7. In a magnetic separator, two pole-pieces forming segments of conical surfaces placed coaxially and magnetized, respectively, by positive and negative polarity by means of one or more electro-magnets, the magnetic particles being held to the surface of a revolving apron placed between them and close to one of said pole-pieces, while the other closes the magnetic circuit and maintains the lines of force normal to the adjacent surfaces of said pole-pieces, substantially as described.

8. The method of magnetically separating a mixture composed of magnetic and non-magnetic particles, which consists in passing the mixture through a magnetic field of the so-called "unipolar" type, which acts on the magnetic particles and in which the non-magnetic particles are removed by centrifugal force.

In testimony whereof I have hereunto subscribed my name.

CLARENCE QUINTARD PAYNE.

Witnesses:
THOS. S. WILLIAMS,
C. H. JOÜET.