No. 751,100. PATENTED FEB. 2, 1904.

E. M. OVIATT & A. DEAN.

ELECTROMAGNETIC ORE SEPARATOR.

APPLICATION FILED MAY 3, 1901.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. I.

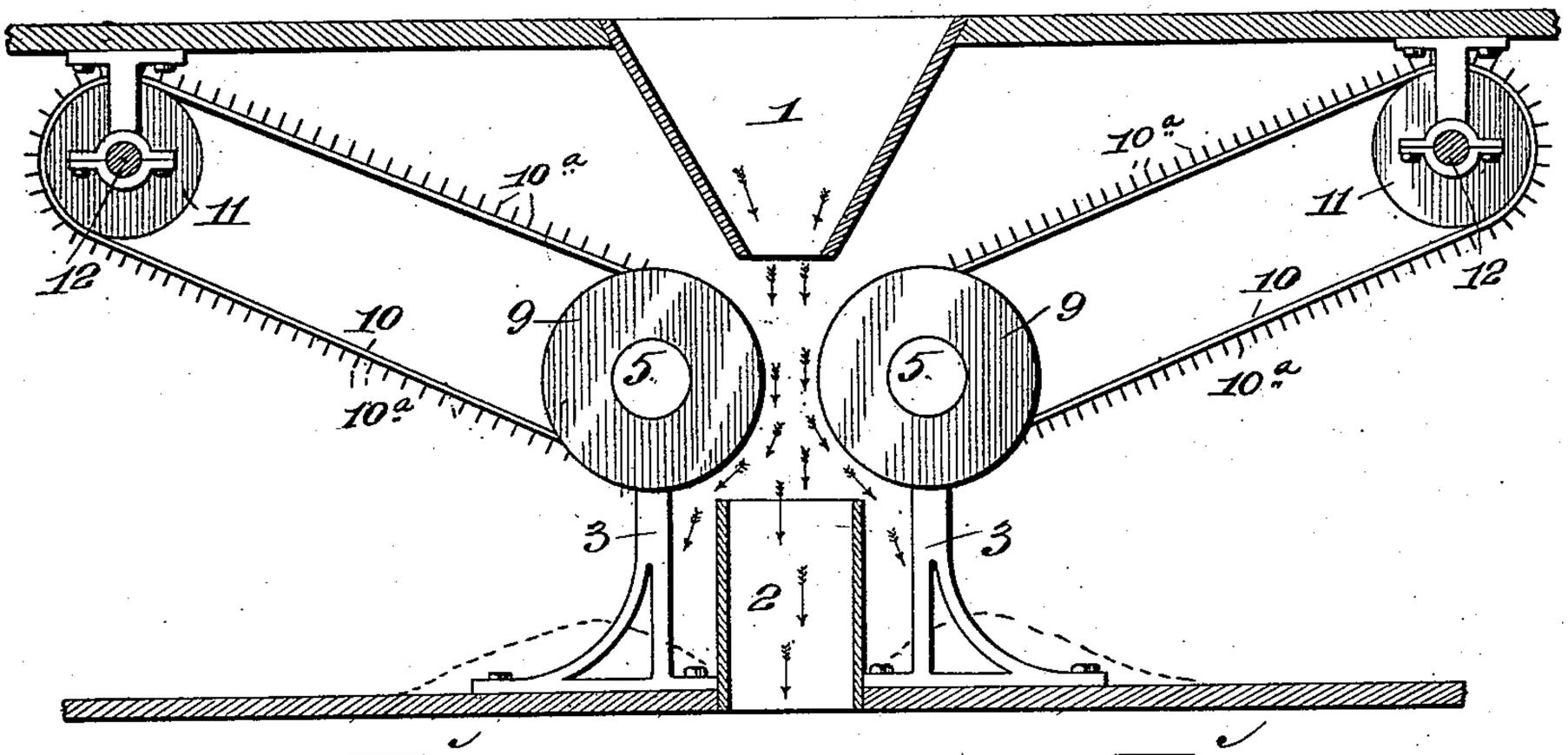


Fig. II.

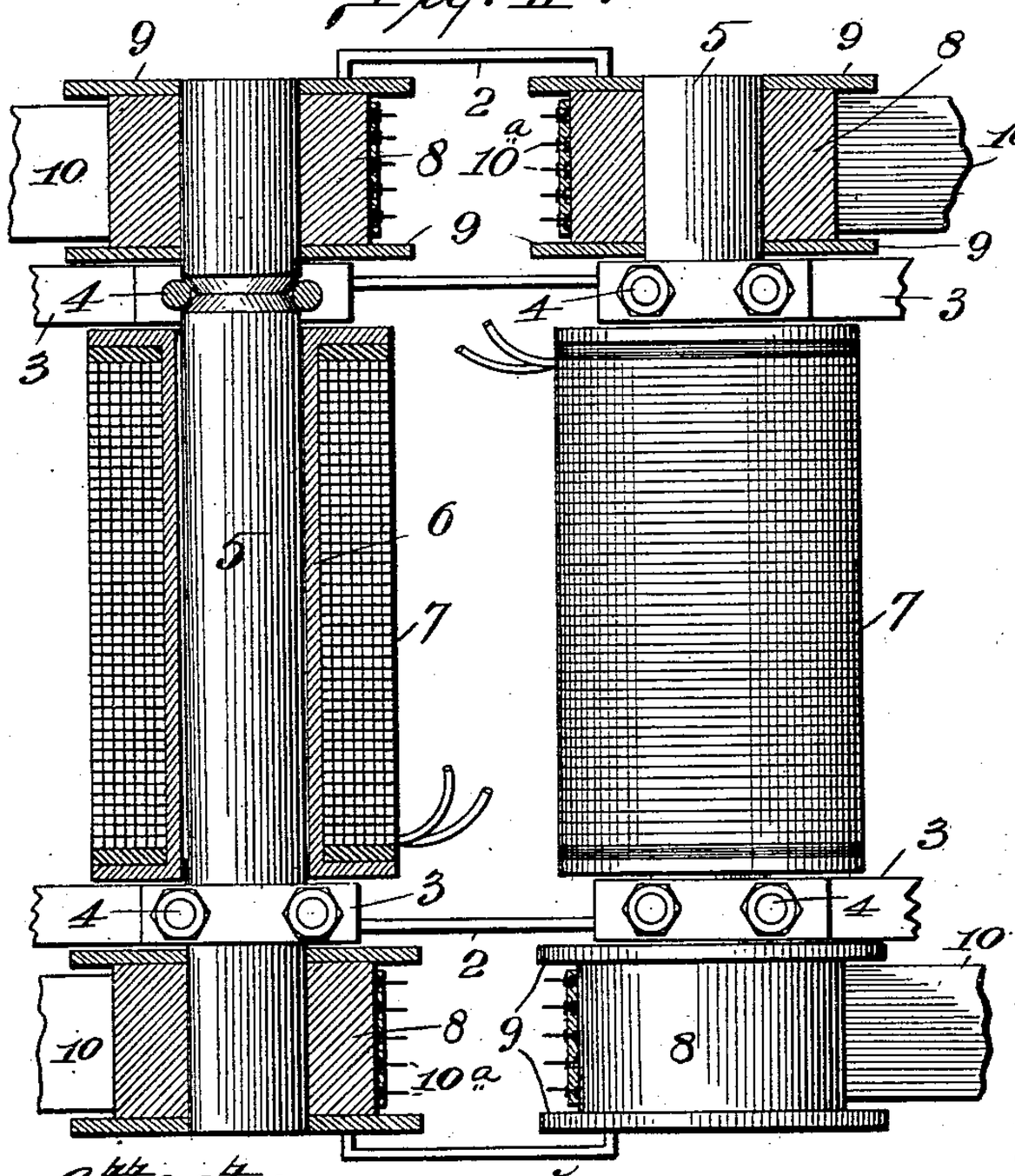


Fig. III.

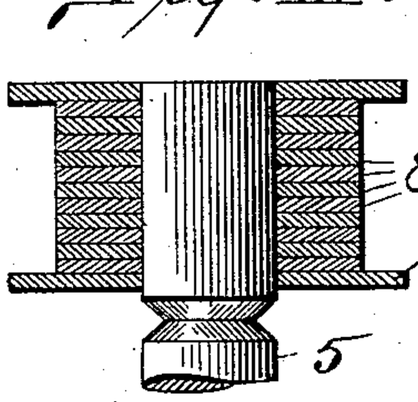


Fig. IV.

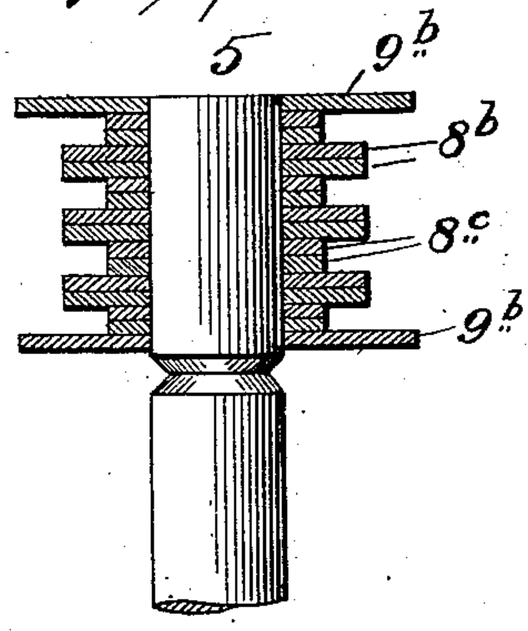
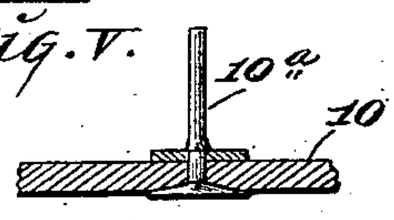


Fig. V.



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NO MODEL. 2 SHEETS—SHEET 2.

Fig. VI.

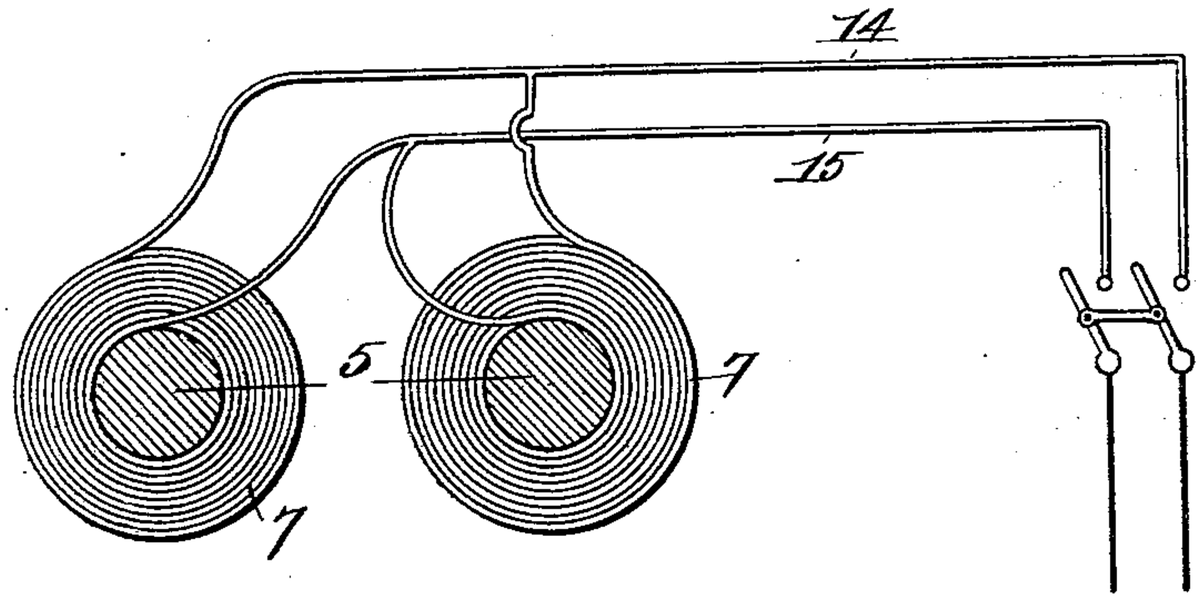

Fig. VII.

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No. 751,100. Patented February 2, 1904.

UNITED STATES PATENT OFFICE.

ELLEN M. OVIATT AND ALEXANDER DEAN, OF DENVER, COLORADO.

ELECTROMAGNETIC ORE-SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 751,100, dated February 2, 1904.

Application filed May 3, 1901. Serial No. 58,607. (No model.)

To all whom it may concern:

Be it known that we, ELLEN M. OVIATT and ALEXANDER DEAN, citizens of the United States, and residents of Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Electromagnetic Ore-Separators, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

Our invention relates to that class of separators utilized in the extraction from crushed ores or sand of metallic particles such as are subject to magnetic influence.

The invention consists in features of novelty hereinafter fully described, and pointed out in the claims.

Figure I is a view, partly in end elevation, of our separator and partly in vertical section. Fig. II is an enlarged view, partly in plan and partly in horizontal section. Fig. III is a detail cross-sectional view showing one of the pole members of the separator of laminated structure. Fig. IV is a similar view to Fig. III, showing a modification in which the sections of the pole members are of varying diameters. Fig. V is a detail view showing one of the prongs carried by the separator-belts. Figs. VI and VII are diagrammatical views illustrating varying manners of connection between the coils of the electromagnets and the conducting-wires leading thereto.

1 designates one of the hoppers through which the crushed ore or sand is delivered to the separator, and 2 designates one of the chutes located beneath the electromagnet pole members and through which the residue of substance not influenced by the magnetic action passes. The metallic substances influenced by magnetic action pass over the upper edges of the chutes 2 and fall to the ground or floor outside of said chutes.

3 designates standards, four in number, that are provided at their upper ends with journal-boxes that may contain bearing-balls 4, as seen in Fig. II.

5 designates soft-metal electromagnet-cores that are journaled in the boxes of the standards 3.

6 designates the spools of electromagnets loosely mounted on the cores 5 between the standards 3. These spools 6 are of material non-magnetic, such as brass. The spools are surrounded by coils 7.

The cores 5 are preferably of iron or soft steel, and fixed to their ends outside of the standards 3 are pole members 8, of iron, soft steel, or analogous metal. At each end of each pole member is a flange-rim 9, of material non-magnetic, such as brass, and of greater diameter than the pole members. The pole members 8 may be of solid form, as shown in Fig. II, or they may be of laminated structure, as shown in Figs. III and IV. In the form shown in Fig. III the pole member is composed of a series of layers 8^a of uniform diameter inclosed within the flange-rims 9^a. In the form shown in Fig. IV the pole member is composed of two series of layers 8^b and 8^c, positioned between the flange-rims 9^b. The layers 8^b are of greater diameter than the layers 8^c abutting against them, the object of this construction being to provide for greater concentration and intensity of the lines of force in the magnetic action induced in the pole members.

The coils 7 of the electromagnets are provided with connection to a suitable source of electrical supply, whereby electrical current is conveyed to the coils for the purpose of magnetizing the cores 5, and consequently the pole members 8, carried by said cores. The pole members are designed to rotate with the cores 5, which turn in the bearings of the standards 3, and their rotation is effected by suitable means, such as endless belts 10, that pass around the peripheries of the members and also around pulleys 11, carried by shafts 12, to which power to drive the belts is applied in any suitable manner.

In the practical use of the separator the crushed ore or sand is fed into the hoppers 1 and descends therethrough between the pole members 8 at each end of the separator, the pole members being rotated at the same time by power transmitted thereto through the medium of the belts 10. As the material passes between the pole members the metallic portion attracted and influenced by the mag-

netism imparted to the pole members from the electromagnets attracts the particles toward the pole members, with the result that such particles are thrown over the upper edges of the chutes 2 and fall to the ground or floor beneath said pole members, as illustrated by the arrows in Fig. I. The substances, such as silica, that are not influenced by magnetic attraction, descend through the chutes 2, as shown by the arrows extending therethrough. During the rotation of the pole members 8 the flange-rims 9 being non-conductive of magnetic waves serve as guards to prevent metallic particles influenced and drawn to the poles from adhering to the ends thereof, in which event the magnetic action of the pole members would be deteriorated. The flange-rims also serve as guards to retain the belts on the pole members, and the belts are thereby permitted to throw the metallic particles away from the pole members as rapidly as they are attracted thereto.

The coils 7 of the electromagnets may be wound in any suitable manner, and the conducting-wires leading thereto may be coupled to said coils in any manner that may be deemed most advisable according to circumstances or conditions.

By the construction of our separator the electrical current may be manipulated to suit the purpose desired in any instance, and there is no necessity of the employment of a rheostat to regulate the force of the current, as is usual in other separators belonging to the same class. The apparatus contains what is virtually its own rheostat, which can be regulated by simply closing the proper switches.

In Figs. V and VI we have illustrated varying forms of electrical connection to the coils of the electromagnet by means of which the desired end, as stated, may be obtained.

Referring to Fig. VI, by connecting the wire 14 to both coils 7 and to the positive pole or wire leading from the generating dynamo or source of electrical supply and the conducting-wire 15 to the negative pole or wire we provide for a minimum resistance in the coils 7.

Referring to Fig. VII, by connecting the conducting-wire 14 to the positive pole or wire of the source of electrical supply and to one of the coils 7 only, and the other conducting-wire 15 leading from the negative pole or wire to the other coil 7 and providing a cross connection through the wire 16 we provide for a maximum resistance in the coils. It will be understood that in both instances the wires leading to the coils are provided with individual or independent switches.

In a separator constructed according to our invention it is essential that the pole members 8 be rotatively mounted in order to accomplish the practical operation in magnetically attracting the metals influenced and attracted thereby; but it is not essential that the entire cores 5 rotate, the said cores being of service only in connection with the coils 7 to produce the electromagnets and serving as conductors to convey the magnetism to the pole members at the end thereof. For this reason we do not wish to be limited to a construction wherein the cores are rotatively mounted, as it is obvious that the cores might be stationary and the pole members mounted thereon and carried by ferrules or sleeves loosely mounted on the cores, whereby the same results would be obtainable as in the instance of the cores revolving.

By referring to the drawings it will be seen that the coils are reversely wound, thus producing a pair of magnets with poles of opposite polarity adjacent to one another—that is, the north pole of one magnet will be opposite the south pole of the other and the south pole of the former will be opposite the north pole of the latter. By this arrangement an induced current is obtained which, for instance, beginning with the north pole of either magnet will pass to the adjacent south pole of the other, then to its north pole, to the south pole of the first magnet to the original north pole. This induced current, it is obvious, materially strengthens the field.

In the separator each magnet acts on the other, and thus the lines of force are confined and concentrated, and by the use of the circular pole members practically all presence of magnetic brake is obviated, and thereby we are enabled to save in power to propel the machine. Owing to the fact that the highest point of concentration is directly between the poles from center to center and the poles circular in shape, there is a uniform attraction. The opposing pole-member surfaces being always at an equal distance from each other, the construction provides for the magnetic attraction upon the metals at the peripheries of the poles and not at the ends, and there is therefore constantly a fresh surface of each pole brought to the path of descent of the material being influenced.

For the purpose of increasing the capacity of the separator we insert in the endless belts 10 a plurality of prongs 10^a, suitably held to the belts. These prongs are of iron or soft steel and the points of the prongs project over one face of the belt and receive the material treated, while the heads of the prongs or pegs project from the other side of the belt and form contacts adapted to contact with the pole members and complete the circuit through the pegs, whereby the magnetism is applied to the material treated. By this construction each prong has an independent positive contact with the pole member, whereby it is an individual or independent collector of the ore, thereby giving a much cleaner concenter, or, in other words, much purer metal. The flattened head of the pin or peg adheres to the pole-piece as soon as it comes in contact with

it, and is for all practical purposes a part of the pole-piece. Now in the course of the travel with the belt when the peg gets on the end side of the pole-piece the flattened end or head has a tendency to stick to the pole-piece and draw the belt along to the back of the pole-piece with it. This of course it cannot do, and the prong is in consequence pulled off with a jerk, and a vibration is set up in the prong due to the elasticity of the belt.

We claim as our invention—

1. A magnetic ore-separator comprising a pair of electromagnets each having a north and a south pole and a fixed coil, each pole of each magnet being arranged adjacent to the pole of opposite polarity of the other magnet, producing an induced current through both magnets, a plurality of revoluble pole members within the magnetic circuit of said magnets, and means rotating said members.

2. A magnetic separator comprising a pair of reversely-wound stationary solenoids, a core revoluble within each solenoid, providing pole members at the respective ends of each solenoid, and producing an induced current through both cores.

3. A magnetic separator comprising a pair of reversely-wound stationary solenoids, a core mounted within each solenoid and projecting from each end thereof, and revoluble pole members mounted on said projecting ends of the cores.

4. In a magnetic separator, the combination with a magnet having a revoluble pole, of a non-magnetic belt pliable in all directions and movable over the revoluble pole of the magnet and vibrating prongs projecting through said belt, and having flattened heads which contact with the pole of the magnet.

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In presence of—
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