(No Model.) 2 Sheets—Sheet 1.

C. G. BUCHANAN.

ELECTRO MAGNETIC ORE SEPARATOR.

No. 264,620. Patented Sept. 19, 1882.

Fig: 1.

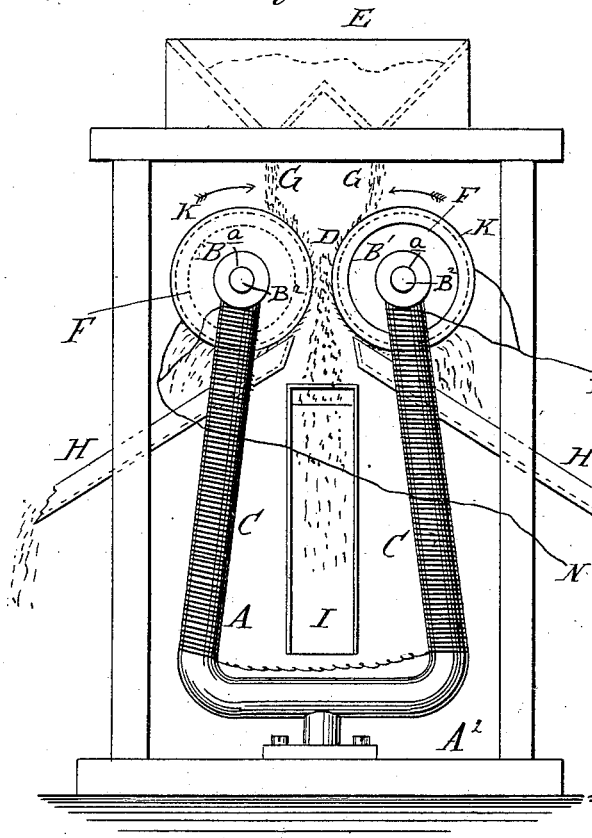


Fig: 2.

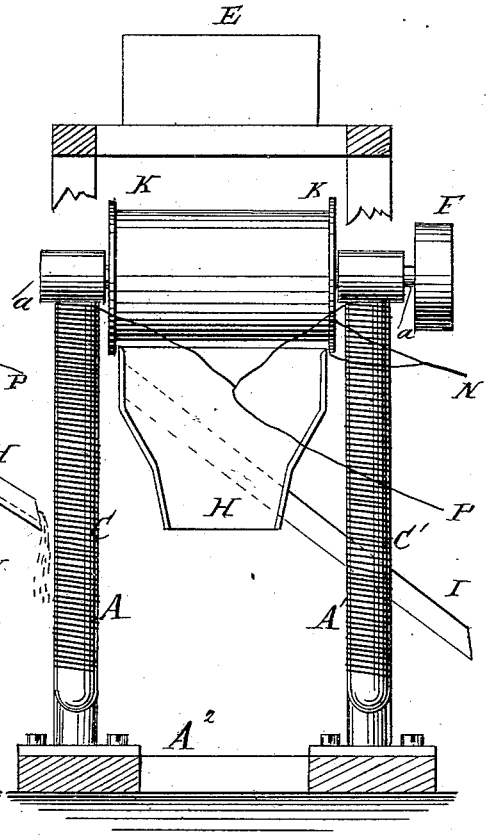


Fig: 3.

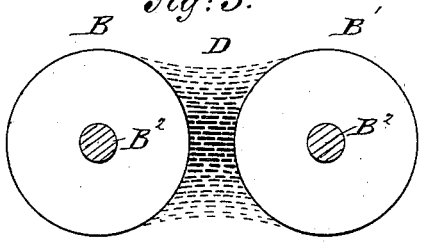


Fig: 4.

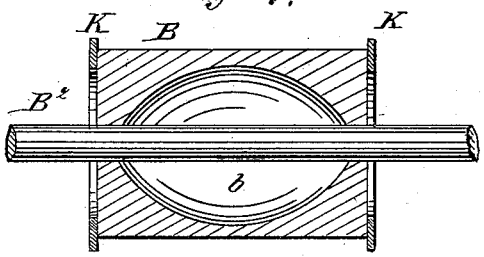
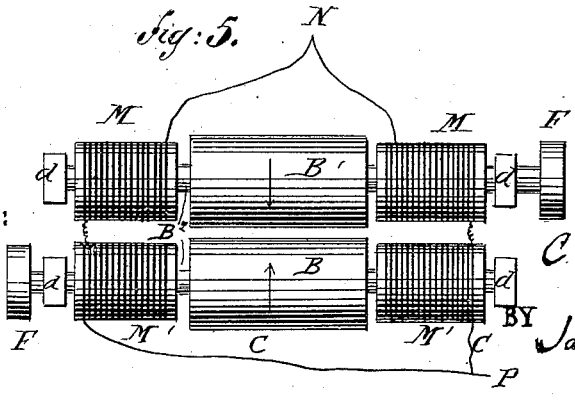


Fig: 5.



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(No Model.) 2 Sheets—Sheet 2.

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Fig: 6.

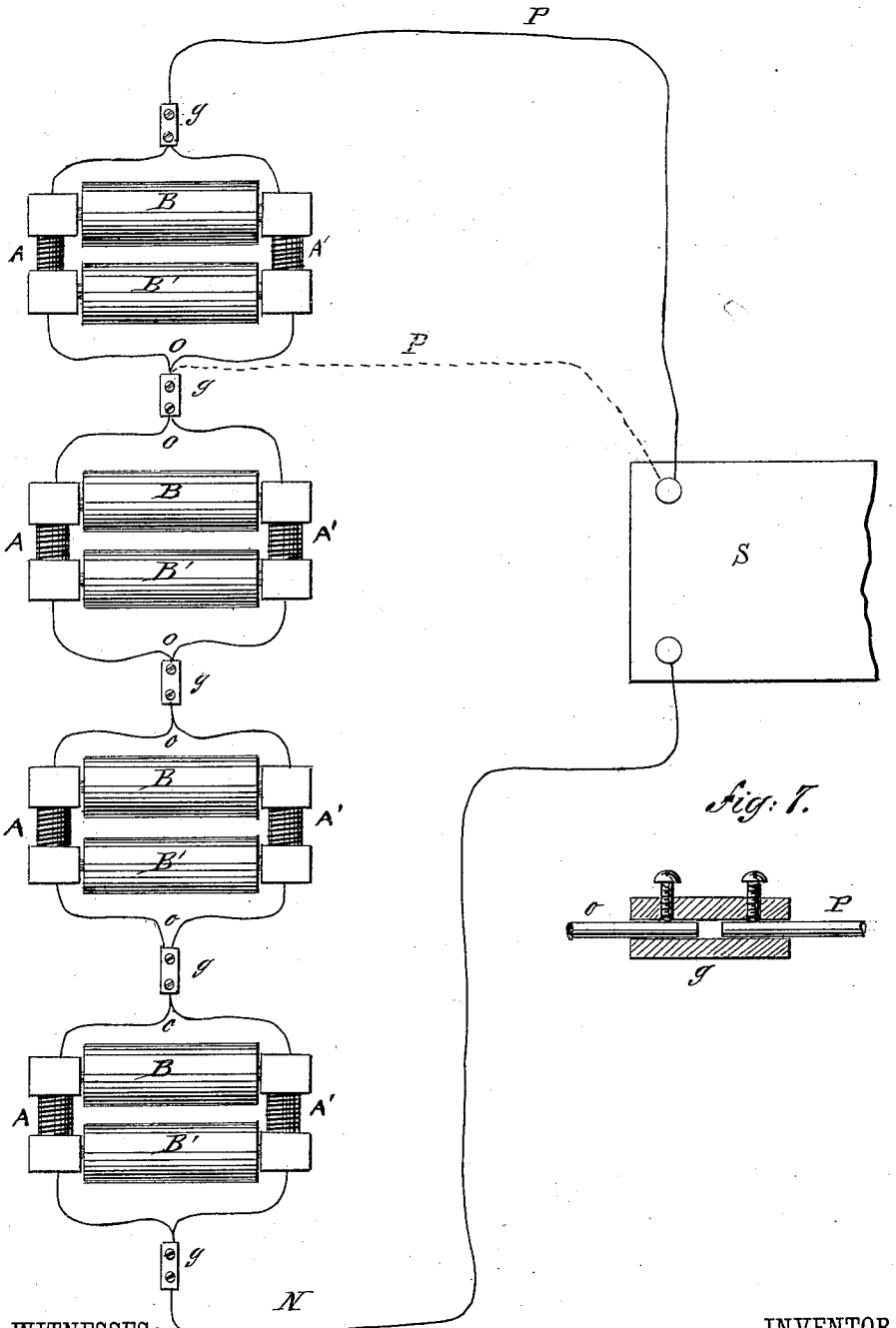

Fig: 7.

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C. GORDON BUCHANAN, OF BROOKLYN, NEW YORK.

ELECTRO-MAGNETIC ORE-SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 264,620, dated September 19, 1882.

Application filed November 14, 1881. (No model.)

To all whom it may concern:

Be it known that I, C. GORDON BUCHANAN, of the city of Brooklyn, in the county of Kings and State of New York, have invented a new and Improved Electro-Magnetic Ore-Separator, of which the following is a full, clear, and exact description.

The object of this invention is to separate the iron in ores or magnetic sands from the gangue or other non-magnetic substances.

The invention consists essentially of two revolving rolls fixed parallel with and at a short distance apart from each other, and charged or magnetized by permanent or electro-magnets in such a manner that a strong magnetic field is formed between them, their outer faces becoming at the same time less magnetic, so that as the ore or sand is fed into the magnetic field of the separator the magnetic particles of said ore or sand are attracted to the rolls and carried by the revolutions of the latter around to opposite points, where the said rolls lose their magnetic force, at which points the said magnetic portions of the ore fall by their own gravity from the rolls, while the gangue or non-magnetic portion of the ores falls directly through the magnetic field between the rolls, whereby the separation of the iron from the gangue is effected. The rolls are also so constructed that when charged the magnetic field formed between them is of equal strength throughout their length.

There are several methods within the scope of my invention by which the rolls may be magnetized or charged with magnetism, and without restricting myself to any particular method I herewith and hereinafter illustrate and describe two by which the desired effects may be produced.

Figure 1 represents a side elevation of my improved separator. Fig. 2 is an end elevation of the same with parts broken away to exhibit other parts. Fig. 3 represents the magnetic field or lines of force formed between the rolls. Fig. 4 is a longitudinal section of a roll. Fig. 5 is a plan view of a modification of the separator illustrating another arrangement of electro-magnets for magnetizing the rolls. Fig. 6 is a plan view illustrating the manner in which a number of my improved machines can be simultaneously charged. Fig. 7 is a longitudinal elevation of a switch used in connecting the wires.

Similar letters of reference indicate corresponding parts.

A A′ represent two electro-magnets, of cast-iron or any other suitable material, of the U or horseshoe magnet form, fixed in a suitable insulating-frame, A^2, and bored out at their upper extremities, as shown at *a*, to serve as journals or supports for the shafts B^2 of the rolls B B′, respectively. The said electro-magnets A A′ are insulated in the usual way, and are closely wound in opposite directions with insulated copper wires C C′ in such a manner that the ends of each wire C C′ can be connected with the two poles of a dynamo-machine (not shown) or any other source of electricity, whereby the one magnet, A, may be charged with positive electricity and the other magnet, A′, with negative electricity, or electricity of opposite polarities, with the effect of converting by induction the roll B into the positive pole of a magnet and the roll B′ into the negative pole or pole of opposite polarity, thus producing or creating a magnetic field, as indicated at D, of great intensity between said rolls B B′.

In order to decrease the resistance to the electric currents toward and at the middle sections of the rolls B B′, and to thereby equalize the effect of the said current throughout the length of the magnet-field, for the purpose of making every portion of the roll-faces in the magnetic field equally effective in attracting the particles of iron in the ore or sand operated upon, the said rolls B B′ are formed with an elliptic or oval core or hollow center, as shown at *b*, Fig. 3, whereby the middle section of each roll is made to contain less metal than the end sections.

It is known that the resistance offered by electric conductors to an electric current of given intensity increases with the cubical contents or amount of metal in the conductor. Consequently the magnetic current would not be uniformly intense through a solid separator-roll, but would be of less intensity at the roll-center than at the ends, and were a roll or shell of equal thickness throughout the ends thereof would not have sufficient conductive capacity to carry the magnetism undiminished

to the center. It will therefore be seen that by constructing the roll as shown in Fig. 3 the metal is so disposed or distributed as to offer a decreasing resistance to the magnetism from the ends to the center proportionate with and compensating for the energy lost by the said magnetism passing from the ends to center. It is found in practice, when these rolls are inductively magnetized by an electric current of given intensity and are moved or separated beyond the influence of each other, that each one possesses an attractive force evenly distributed over its surface corresponding with the intensity of the induced current with which it is charged, and will in virtue thereof attract with equal force on any portion of its surface. It is further found in practice that when these rolls of opposite polarities are brought toward each other, as shown, to constitute an ore-separator—say within one and a half to two inches of each other—that a magnetic field of great intensity is formed between their adjoining faces, which is nearly equal in intensity to the entire energy induced from the electro-magnetic standards, while the faces of the said rolls farthest from the magnetic field are found to be almost entirely devoid of attractive force.

In order to operate the device, two ends of the wires C C′ are connected with a wire, P, which in turn is connected with the positive pole of an electro-dynamo machine or of some other generator of electricity, (not shown,) and the opposite ends of the wires C′ C are connected with a wire, N, that in turn is connected with the negative pole of the electro-dynamic machine or other generator of electricity. (Not shown.) The electricity passing through the wires P N and C C′ of their respective electro-magnets A A′, and thence by induction to the rolls B B′, each roll being then of opposite polarity, one north the other south, a magnetic field is formed between them, as indicated in Fig. 3, wherein the lines of magnetic force are indicated at D.

On the frame A^2 a double hopper, E, is secured above the rolls B B′. Power being applied to the roll-pulleys F, the said rolls B B′ are thereby revolved in opposite directions toward each other, as indicated by the arrows, Fig. 1. Then the ore or sand represented at G, being fed into the hopper E, falls upon the rolls B B′, and thence into the magnetic field between them; and the iron in the ore or sand, being attracted and held to the rolls B B′ within the magnetic field D, adheres to said rolls until it is brought by the revolutions thereof to the points opposite or nearly opposite to and farthest from the said magnetic field D, when said iron particles fall by their own gravity into suitable chutes, H, that conduct them to proper receptacles. At the same time the gangue or non-magnetic substances in the ore fall by their own gravity through the magnetic field D into a chute, I, by which they are conducted to a suitable receptacle, and thus a thorough separation of the iron from the non-magnetic particles of the ore is effected.

In order to prevent any of the ore from falling over the ends of the rolls B B′, collars K, of brass, copper, or other suitable non-magnetic material, of greater diameter than the rolls, are secured on the ends thereof.

It is obvious that instead of the construction and arrangement shown in Figs. 1 and 2, the rolls B B′ could be charged by induction-coils, as shown in Fig. 5, wherein M M′ represent the induction-coils set opposite the ends of the rolls B B′ upon the roll, axles, or shafts B^2, which are lengthened for that purpose, and are supported in suitable journal-boxes, *d*. In this instance the electric current passing through the wire P and wires C connects the coils M′, and by induction converts the roll B into the north magnetic pole, while the current passing through the wire N converts the roll B′ into the south magnetic pole.

It is not absolutely necessary that the rolls should be charged from both poles of a battery or dynamo-electric machine, though by that method, as hereinbefore described, a better effect can be produced; but it is obvious that a number of separators may be charged from one dynamo-electric machine or battery by connecting with only one wire thereof, the effect of north and south polarity being produced by changing the direction of the wrapping of the wires from right to left or left to right, as the case may be, and connecting the other wire with a ground-connection or some suitable conductor to complete the circuit.

In Fig. 6 is an illustration of a system carried out on a considerable scale, wherein the pairs of rolls B B′ are connected by wires O and the negative pole N of the dynamo-electric machine S is applied to the nearest separator, B B′, and the wire O from the nearest or first separator is connected with the next separator, and so on until the last one in the row is reached. Then the positive pole P of the machine S would be connected with the separators on the opposite side, as shown, or vice versa, and the circuit would be complete. There would be a switch or connection, as at *g*, between each separator, and if it were necessary to stop the action of one of said separators, or throw it out of current—say the farthest one—the connection would be broken by disconnecting the wire between it and the next one, and the positive wire P would then be connected with this next one at *g*, as shown in dotted lines, thus cutting out the farthest separator.

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

1. In an ore-separator, the combination of two magnets with two rolls rotating in opposite directions in the field of force of said magnets, substantially as described.

2. In an ore-separator, the combination of two electro-magnets with two rolls rotating in opposite directions and forming the terminal

ends of said electro-magnets, substantially as described.

3. In an ore-separator, the combination of two magnetized parallel rolls of opposite polarity revolving near each other in opposite directions, substantially as described.

4. In an electro-magnetic ore-separator, a magnet or magnetized roll having an elliptic or oval core or hollow center, substantially as herein shown and described.

5. In an ore-separator, the combination of two parallel and contiguous rolls with two magnetized standards of opposite polarities, adapted to magnetize said rolls by induction, as set forth.

6. The combination, in a magnetic ore-separator, of a pair of parallel rolls with suitable standards and devices adapted to convey by induction magnetism of opposite polarities to said rolls, as set forth.

7. A magnetic ore-separator, constructed substantially as herein shown and described, consisting of electro-magnetic standards A A′, insulated wires C C′ P N, hollow rolls B B′, collars, frame A^2, hopper, and chutes, arranged as set forth.

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