

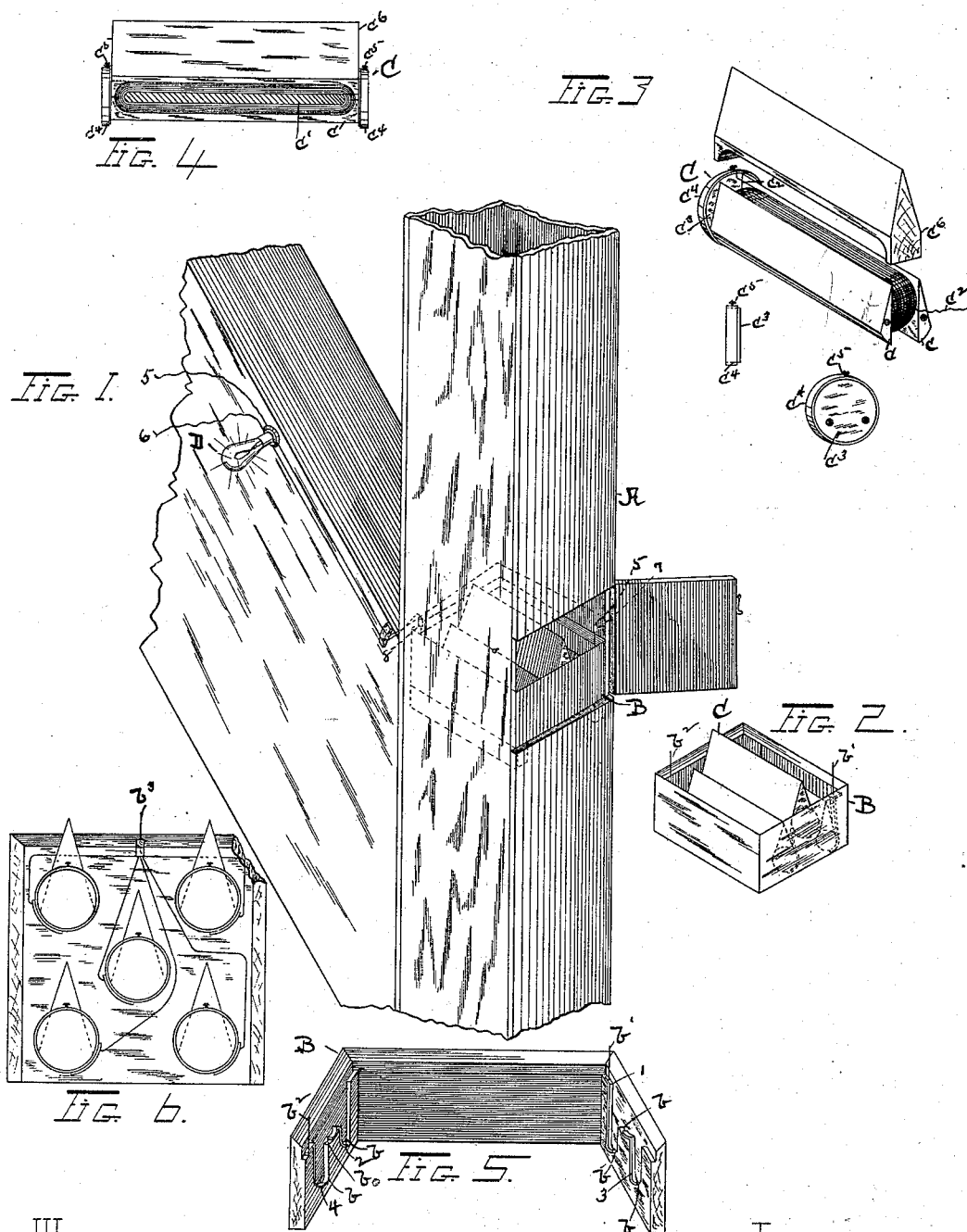
(No Model.)

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## ELECTRO MAGNETIC SEPARATOR.

No. 384,035.

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# UNITED STATES PATENT OFFICE.

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## ELECTRO-MAGNETIC SEPARATOR.

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*To all whom it may concern:*

Be it known that I, JOSEPH B. HAMILTON, of Springfield, in the county of Hampden and Commonwealth of Massachusetts, have invented a new and useful Improvement in Electro-Magnetic Separators, of which the following is a specification, reference being had to the accompanying drawings, forming part thereof.

My invention relates to means for separating particles of iron from a mass of comminuted material with which said particles are mingled by subjecting said material to the action of electro-magnets; and it has for its object to provide an apparatus for this purpose in which an extended area of magnetized surface will be presented in such manner that the entire mass of comminuted material can be rapidly passed thereover, however fine its particles may be.

A further object of the invention is to provide novel means for supporting a series of electro-magnets in such manner that the entire series can be quickly inserted within and withdrawn from a chute or conductor for comminuted material, and which will permit each magnet to be readily removed from its support for the purpose of cleaning the same.

To these ends my invention consists in the apparatus constructed and operating as herein after fully described, and particularly pointed out in the claims.

Referring to the drawings, in which like letters designate like parts in the several figures, Figure 1 is a view in perspective of a portion of a chute or conductor for comminuted material having applied thereto the separating apparatus devised by me. Fig. 2 is a similar view of the electro-magnets and their supporting-frame removed from the chute. Fig. 3 is a perspective view of one of the magnets removed from the frame, having its cap slightly elevated therefrom, said figure also showing an edge and face view, respectively, of one of the disks removed from the end of said magnet. Fig. 4 is a side view, partly in section, of said magnet. Fig. 5 is a view of the magnet-supporting frame with one of the sides removed to show the interior thereof. Fig. 6 is a view of a frame provided with five magnets instead of three, one of the end pieces of said frame being removed.

While the apparatus about to be described

is adapted to be used in connection with all kinds of comminuted material in which particles of iron may exist, and also in connection with wheat and other grain, I have devised it with especial reference to the separation of iron particles from natural sulphate of lime, as used to form a filler in the manufacture of writing and other paper. It is found that after this material has passed through the reducing and calcining processes it contains a greater or less proportion of minute particles of iron, each of which particles, if not removed, causes a blemish in the finished paper and greatly diminishes the value of the latter. As the said particles of iron are distributed through the entire mass of the material, and as the latter has substantially the consistency of finely-ground flour, it has heretofore been found to be impracticable to attempt to eliminate the iron. I have found that by arranging a series of magnets of the form presently to be described within a chute in such manner that the natural sulphate of lime in descending through said chute is caused to pass between and in contact with said magnets an entire separation of the particles of iron from said material can be effected.

In the drawings, the letter A designates a portion of a vertically-disposed chute or conductor, which may be of any desired size, and which will be adapted at its top and bottom, respectively, to receive and discharge the material to be operated upon. I have shown in connection with said chute a housing, A', for an endless-belt elevator by which the comminuted material, after passing the magnets, can be conveyed upwardly to an upper floor should it be desired to do so; but said housing forms no part of my invention, and the material can be run from the bottom of the chute directly into any suitable receptacle, if preferred. At some point between its ends the chute R is provided with an opening in one of its sides and with a door for closing the same, as shown, and is furthermore provided with ways upon its inner surface in the plane of the lower side of said opening to support the magnet-holding frame B. When the apparatus is to be used in connection with finely-comminuted material—such as the natural sulphate of lime, above mentioned, or flour—the opening in the chute just described will preferably be located

at such distance from the top of the chute or the point where said material enters the same that in its descent to the magnets the material will be diffused throughout the area of the chute and caused to pass the magnets in cloud-like form, and this result can be rendered still more positive by locating cross-pieces at various points within the chute and in different horizontal planes.

The magnet-supporting frame B is rectangular in shape, and is of the proper dimensions to closely fit within the chute when placed within the latter through its opening, as shown in Fig. 1. Said frame is open at top and bottom, and is preferably beveled inwardly at the top, as shown. Two of the opposite sides of the frame B are provided with a ledge upon their inner surface, within which ledges are formed depressions *b* to receive the ends of the magnets and form seats for the latter. The frame shown in Figs. 1, 2, and 5 is provided with three of such seats, the middle one of which is located in a plane above that occupied by the other two.

In order to enable the connections between each magnet and the dynamo-electric machine or other generator to be quickly made and broken, I provide the magnets at each end with contact-strips, as will be presently described, and provide the seats for said magnets in frame B with corresponding contact-strips of brass or other suitable material. The contact-strips in said frame are arranged in such manner as to establish a direct circuit through the frame and through each magnet from end to end, as follows: Strip 1, having connected therewith binding-post *b'*, makes connection with the seat of one of the outer magnets at one end of the frame. Strip 2 connects the seat of said magnet at the opposite end of the frame with the seat of the middle magnet. Strip 3 connects the seat of the middle magnet at the end of the frame first mentioned with the seat of the third magnet, and strip 4 connects the seat of the latter magnet at the opposite end of the frame with binding-post *b''*. The binding-posts *b'* *b''* are thus located at opposite corners of the frame and can be quickly connected with the wires leading from the generator when the frame is placed within the chute, and as quickly disconnected therefrom when it is desired to remove the frame for the purpose of cleaning the magnets, as hereinafter described.

The magnets C are constructed as follows: An iron core is formed by casting or otherwise, said core consisting of two parallel bars, *c c*, united by an intermediate rib, *c'*. The bars *c* are of such shape in cross-section that their inner sides are vertical and parallel, while their outer sides extend from the upper nearly to the lower edges of said bars at a slight angle to the vertical inner sides, and then preferably curve slightly to the lower edges, as shown in Fig. 3. The wire *c''* is wound upon rib *c'* between bars *c* and lengthwise of the lat-

ter, in the usual manner, so that when completed the projecting end of the wire at one end of the magnet will lead to the center of the coil, while the opposite end of the wire at the surface of the coil projects from the opposite end of the magnet. As thus constructed, an electrical current passed through the coil will cause bars *c c* to be magnetized throughout their entire area, one of said bars being the positive and the other the negative pole, as the wire *c''* is wound in one or the other direction.

After winding the magnet, as just described, a disk, *c''*, preferably of wood, is secured to each end thereof by screws or otherwise, each of said disks having upon its periphery a brass or other metallic contact-strip, *c'*, and the projecting ends of the wire *c''* are each connected to one of said strips *c'* by means of the binding-screws *c''*. Such construction enables me to create a circuit through the magnet by making connection between the strips *c'* and an electric generator. A cap, *c''*, preferably made of wood, is constructed of the proper length and width to closely fit the space between the upper edges of side pieces, *c*, and rests upon the wire coil, as shown in Fig. 4. The upper surface of said cap is wedge-shaped, and its sides form a continuation of the inclined sides of bars *c c* when the cap is placed in position upon the magnet. The function of the cap *c''* is to guide the particles of the material being operated upon to the inclined faces of the magnet and to prevent said particles from lodging upon the magnet.

Wires 5 6, (see Fig. 1,) leading from a dynamo-electric machine (not shown) or from any other suitable electrical generator, communicate with the interior of chute A at opposite corners of the latter, wire 5 terminating within the chute in a contact-cap, 7, and wire 6 terminating in a similar contact-cap, 8, whereby connection between said wires and the binding-posts on frame B can be quickly made and broken, or any other devices for securing such result can be used in lieu of said caps.

The letter D designates a lamp, which may be located at any convenient point upon the chute or adjacent thereto, said lamp being connected with wires 5 6 in the usual manner, whereby it is adapted to serve as an indicator to notify the operator of any accidental stoppage of the current from the generator, and enable him to shut off the supply of material to the chute.

The operation of the apparatus thus constructed is as follows: The magnets are placed within frame B, the disks *c''* resting in depressions *b*, thus making connection between strips *c'* and strips 1 3 at one end of the frame and strips 2 4 at the opposite end thereof. These connections, it will be observed, are made and broken by simply placing the magnets in and removing them from the depressions *b* of the frame. By the arrangement of said depressions as previously described the intermediate magnet is elevated slightly above the other

two, and the magnets will be of such size relatively to the frame that when seated in said depressions any material passing through the frame will necessarily be brought in contact with one of the former. In placing the magnets in the frame, moreover, the intermediate magnet is so arranged that its positive bar *c* will face the negative bar of one of the other two magnets, while its negative bar will face the positive bar of the third magnet, which is done by simply reversing the ends of the intermediate magnet relatively to the ends of the other two. The frame B, with the magnets thus disposed therein, is then inserted through the opening in the chute and placed upon the ways upon the inner surface of the latter, contact-cap 7 of wire 5 being placed upon binding-post *b'* and cap 8 of wire 6 being placed upon post *b''*, and the door of the chute is closed. The dynamo-electric machine is then set in operation and the current generated thereby passes through the circuit established by wire 5, post *b'*, strip 1, the first magnet, strip 2, the second magnet, strip 3, the third magnet, strip 4, post *b''*, and wire 6, thereby magnetizing the bars *c* of each magnet. The material to be operated upon is then caused to descend through the chute, and as it passes through the frame its particles are deflected by the inclined sides of the caps *c'* in such manner as to cause them to pass over the inclined faces of the bars *c* of the magnets, and any particles of iron mingled therewith will be retained upon the surface of said bars. The particles of iron retained upon the magnets are gradually moved downwardly upon the bars *c* by the descending material until said particles are deposited upon the curved lower surface of said bars, where they remain, thus leaving the inclined surface of the bars comparatively clean and insuring the retention thereon of all the particles of iron passed thereover. The continuous inclined surface formed by the caps and sides of the magnets effectually prevents any accumulation of the material within the frame, which result is still further facilitated by the inwardly-beveled surface at the top of the frame.

The lamp D, which burns as long as the circuit is established and is extinguished by the breaking of the circuit, indicates to the operator the condition of the circuit at all times, and enables him to immediately shut off the supply of material to the chute in case of accidental breaking of any of the connections between the apparatus and the generator, or of any irregularity in the operation of the latter.

Whenever it becomes necessary to clean the magnets, the supply of material to the chute is stopped, wires 5 & 6 disconnected from posts *b'* & *b''*, and frame B withdrawn from the chute, whereupon each of the magnets can be separately removed from the frame and the particles of iron adhering thereto can be removed with a brush in the usual manner.

The magnets retain their power of attraction

a sufficient length of time after the current from the generator is cut off to enable the frame to be withdrawn, as just described, before the iron particles begin to escape from the magnets, so that none of said particles are mingled with the purified material at the bottom of the chute.

As above described, the posts *b'* & *b''* and contact-strips of frame B are so arranged that the current is reversed in passing through the intermediate magnet; but an equally strong if not a stronger magnetic action can be secured by causing the current to pass through the entire series of magnets at the same time and in the same direction, which can be done by connecting wire 5 to each of the magnets at one end of the frame and wire 6 with the opposite ends of the magnets.

In Fig. 6 I have shown a series of five magnets seated in a frame, one end of the latter being removed to show the interior thereof, and have shown binding-post *b''* connected to contact-strips located in each of the five depressions forming the seats of the magnets. The opposite end of the frame will contain a similar post similarly connected with each of the seats at that end of the frame, and when thus connected it will be obvious that by connecting wire 5 with one of said posts and wire 6 with the opposite post the current will pass through all of the five magnets simultaneously and in the same direction. Aside from this difference in the movement of the current the operation of this form of the apparatus is the same as that previously described.

It will be observed that the apparatus herein described is simple and inexpensive in construction and peculiarly applicable to the purpose for which it is designed.

The means for directing the material to be operated upon to and from the magnets can be varied at will; but I prefer to utilize a chute for such purpose, as shown.

I do not wish to limit myself to the exact construction of either the magnets or their supporting-frame shown and described, as various modifications therein can be made without departing from the spirit of my invention.

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

1. The apparatus for separating particles of iron from a mass of comminuted or other material, herein described, consisting of a frame open at top and bottom, one or more electromagnets supported within said frame, each of said magnets being composed of two parallel bars united by an intermediate rib and having wound upon said rib lengthwise of said bars a wire coil, and suitable connections between each of said coils and an electrical generator for inducing an electric current through the former, substantially as described.

2. An apparatus for separating particles of iron from a mass of comminuted or other material, consisting of a series of magnets each

comprising two parallel bars, an intermediate connecting-rib, and a wire coil wound upon said rib lengthwise of said bars, suitable connections between the coils of said magnets and an electrical generator for inducing an electric current through the former, and a chute or similar device for conducting the material to be operated upon to and through said series of magnets, substantially as set forth.

3. The apparatus herein described for separating particles of iron from a mass of comminuted or other material, consisting of a frame open at top and bottom, one or more electro-magnets supported at each end by opposite sides of said frame, each of said magnets being composed of two parallel bars, an intermediate connecting-rib, and a wire coil wound upon said rib lengthwise of said bars, said bars having their outer faces inclined outwardly from their upper toward their lower edges, and suitable connections between each of said coils and an electrical generator for inducing an electric current through the former, arranged and operating substantially as set forth.

4. In an apparatus for separating particles of iron from a mass of comminuted or other material, a frame open at top and bottom and having at opposite sides thereof seats for supporting the ends of a series of magnets, a series of magnets each consisting of two parallel bars, an intermediate connecting rib, and a wire coil wound upon said rib lengthwise of said bars, and having at each end a contact-strip connected to one of the ends of the wire composing said coil, contact-strips upon said frame located in such manner as to make connection with the strips upon said magnets when the latter are seated in said frame, and suitable connections between the contact-strips on the frame and an electrical generator for inducing an electric current through the former, whereby said current will also be induced through the coils of each of the magnets seated in the frame, substantially as set forth.

5. The combination, with chute A, having in one side thereof an opening and a door for closing the same, of frame B, supported within said chute adjacent to said opening, said frame being open at top and bottom and having horizontally disposed therein a series of electro-magnets, and suitable connections between each of said magnets and an electrical generator for inducing an electric current through the former, substantially as and for the purpose described.

6. The combination, with chute A, of frame B, detachably supported within said chute, said frame being open at top and bottom and having detachably supported therein a series of electro-magnets, C, positive and negative binding-posts upon said frame electrically connected with the positive and negative poles of each of said magnets, contact devices upon said chute to engage said posts on the frame, and suitable connections between said contact devices on the chute and an electrical generator for inducing an electric current through the former, arranged and operating substantially as and for the purpose set forth.

7. The combination, with chute A, frame B, located within said chute, and electro-magnets C, supported within said frame, of suitable connections between said magnets and an electrical generator for creating an electric circuit through said magnets, and lamp D, located in said circuit outside of said chute, whereby said lamp is adapted to serve as an indicator, substantially as and for the purpose described.

8. The electro-magnetic separator herein described, composed of a series of magnets, C, each consisting of parallel bars *c c*, connecting-rib *c'*, having a wire coil wound thereon, disks *c''*, and contact-strips *c'* upon said disks, connected to opposite ends of the wire composing said coil, frame B, having seats *b* for said magnets, and contact-strips 1 2 3 4, arranged upon said seats, substantially as described, suitable connections between two or more of said strips on the frame and an electrical generator for inducing an electric current through the former, and a chute or similar device for conducting a mass of comminuted or other material to and through said frame, arranged and operating substantially as and for the purpose set forth.

9. In an electro-magnetic separator of the kind herein described, the combination, with the series of magnets C, each composed of bars *c c*, having their outer sides inclined, as shown, connecting-rib *c'*, and wire coil *c''* upon said rib, of a series of caps, *c''*, closely fitting the space between said bars and above said coils, said caps having their upper surface wedge-shaped, substantially as and for the purpose described.

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