April 22, 1924. 1,491,600

B. E. FERNOW, JR

ELECTROMAGNETIC SEPARATOR

Filed July 2, 1921

Fig. 1.

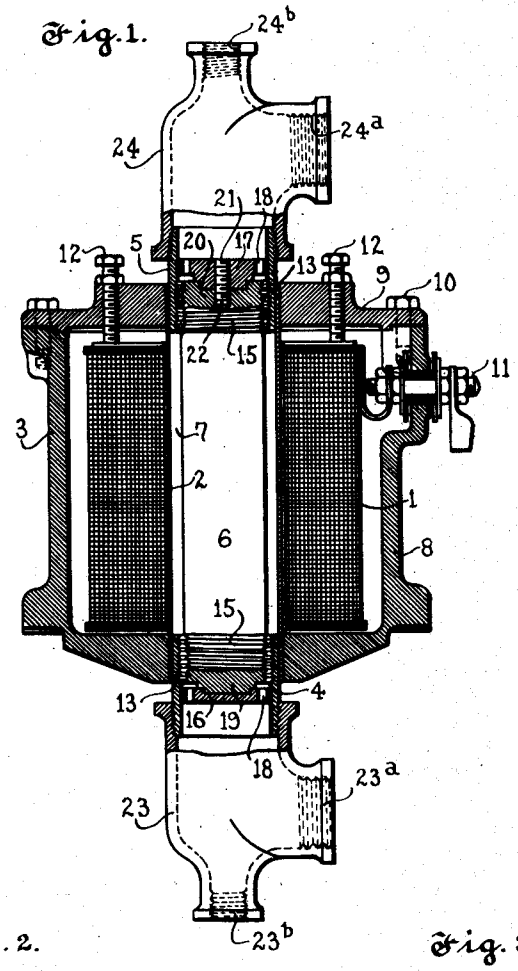


Fig. 2.

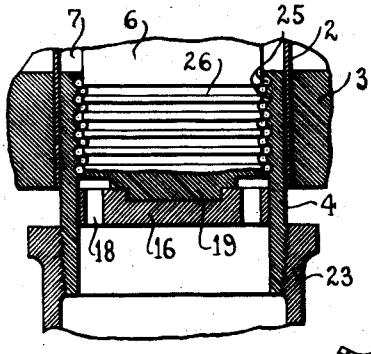


Fig. 3.

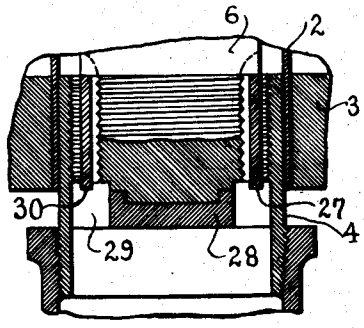
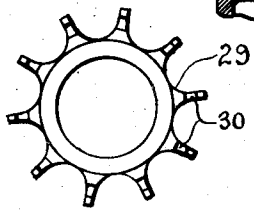


Fig. 4.



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UNITED STATES PATENT OFFICE.

BERNHARD E. FERNOW, JR., OF MILWAUKEE, WISCONSIN, ASSIGNOR TO THE CUTLER-HAMMER MFG. CO., OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

ELECTROMAGNETIC SEPARATOR.

Application filed July 2, 1921. Serial No. 482,069.

To all whom it may concern:

Be it known that I, BERNHARD E. FERNOW, Jr., a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Electromagnetic Separators, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

This invention relates to electro-magnetic separators and more particularly to separators for extracting free magnetic particles from flowing substances.

The invention has among its objects to provide an electro-magnetic separator of increased effectiveness and efficiency and of simple, durable and inexpensive construction.

Another object is to provide an electromagnetic separator having its parts arranged to provide for cooling of the separator winding by the substance undergoing a treatment.

Another object is to provide a separator of the aforesaid character having certain of its parts readily removable to facilitate cleaning thereof.

Various other objects and advantages of the invention will hereinafter appear.

The accompanying drawing illustrates certain embodiments of the invention which will now be described, it being understood that various changes can be made in the embodiments illustrated without departing from the scope of the appended claims.

In the drawing,

Fig. 1 is a vertical sectional view of a preferred form of separator embodying the invention;

Figs. 2 and 3 are fragmentary sectional views illustrating certain modifications which can be made in the separator shown in Fig. 1; and

Fig. 4 is a plan view of one of the parts illustrated in Fig. 3.

The separator comprises in general a magnet winding 1 coiled about a non-magnetic tubular sleeve 2 and provided with a magnetic enclosing casing 3, pole pieces 4 and 5 arranged within said sleeve at opposite ends thereof and a cylindrical magnetic core 6 within said sleeve and having opposite ends projecting into said pole pieces. The diameter of core 6 is less than the inner diameter of tube 2 to form a passage 7 for the material, said passage being restricted at opposite ends of said core by pole pieces 4 and 5. The material undergoing treatment enters at the lower end of passage 7 and emerges at the upper end thereof and as hereinafter set forth, the flux produced by winding 1 is concentrated in the restricted portions of said passage and extends at substantially right angles to the direction of the flowing material.

More specifically, enclosing casing 3 includes a member 8 having a cylindrical opening therein for receiving winding 1 and a cover 9 secured to the upper edge thereof by screws 10. Casing member 8 is provided with openings for receiving terminals 11 for winding 1, one of said terminals being shown in the drawing, and cover 9 is tapped to receive clamping screws 12 for engaging the upper face of winding 1 to hold the latter in place. Cover 9 and the lower wall of casing member 8 are provided with bored openings for receiving sleeve 2, said sleeve having a press fit within said openings. Pole pieces 4 and 5 have a press fit within sleeve 2 and project outwardly therefrom. Said pole pieces have their inner faces screw threaded at 13 and the opposite ends of core 6 are provided with screw threaded portions 15 which project into said surfaces. Core 6 is supported within sleeve 2 between non-magnetic centering plugs 16 and 17 which fit within pole pieces 4 and 5 respectively and are provided with openings 18 adjacent their outer edges which cmmunicate with passage 7. Plug 16 has a drive fit within pole piece 4 and is provided with a recess for receiving a cylindrical projection 19 on the lower face of core 6 while plug 17 is removable from pole piece 5 and has a cylindrical projection 20 fitting within a recess in the upper end of said core. Plug 17 is provided with a tapped opening 21 which communicates with a tapped opening 22 in the upper end of core 6, said openings serving a purpose hereinafter set forth.

With the parts of the separator arranged as above described it is apparent that substantially the entire flux of winding 1 passes across the air gaps between pole pieces 4 and 5 and the opposite ends of core 6, the direction of the flux in said gaps being at substantially right angles to the flow-

ing material. The screw threaded surfaces on opposite ends of core 6 and within pole pieces 4 and 5 coact to accentuate the flux at a plurality of points in said air gaps and therefore upon passage of the material through said air gaps the magnetic particles therein are subjected to relatively strong magnetic pulls towards said surfaces. Further it should be noted that with the parts arranged as above described the magnetic circuit of winding 1 is of relatively small reluctance and also that the material in passing through sleeve 2 has a cooling affect on said winding. In operation the material is passed through the separator until the screw threaded surfaces on opposite sides of the air gaps become loaded with magnetic material and the separator may be then readily cleaned by de-energizing winding 1 and flushing the same by passing water through the upper end thereof. Also, if desired, core 6 can be readily removed from the separator for cleaning by means of a screw bolt inserted into the tapped openings 21 and 22.

In installing the separator the sleeves 4 and 5 are provided with pipe fittings 23 and 24 respectively, said fittings having openings 23^a and 24^a respectively for receiving the inlet and discharge pipes for material and openings 23^b and 24^b for receiving the supply and drain pipes for the wash water.

Referring to Fig. 2 the same illustrates a modification of certain of the parts illustrated in Fig. 1. Instead of providing screw threading in the adjacent surfaces of core 6 and pole pieces 4 and 5, said surfaces are scored, the scoring in pole piece 4 consisting of a plurality of spaced grooves 25 and scoring at the lower end of core 6 consisting of a plurality of spaced grooves 26. The grooves 26 in core 6 are arranged in staggered relation with respect to the grooves 25 in pole piece 4 whereby the material undergoing treatment travels in a tortuous path through the air gap between said parts. It is apparent that pole piece 5 and the upper end of core 6 can be provided with similar grooves or scoring.

Figs. 3 and 4 illustrate a modification wherein a plurality of air gaps are provided between pole piece 4 and core 6. As shown in this figure, said air gaps are provided by reducing the diameter of the lower end of core 6 and arranging an annular magnetic pole piece 27 between the same and pole piece 4. Core 6 and annular pole piece 30 are supported by a non-magnetic centering plug 28, said plug being provided with a series of recesses 29 in the periphery thereof which communicate with the passages on opposite sides of pole piece 30. The upper face of said plug is also provided with a central recess for receiving the projecting end 19 on the lower end of core 6 and a series of recesses 30 for receiving the lower end of annular pole piece 27. It is apparent that the number of air gaps between pole piece 4 and core 6 can be increased by increasing the number of annular pole pieces 27 and also that the parts at the upper end of the separator can also be modified as shown in Fig. 3.

What I claim as new and desire to secure by Letters Patent is:

1. In an electromagnetic separator, in combination, a winding having an axial passage therein for the material undergoing treatment and means associated with said winding for concentrating its flux at opposite ends thereof and for directing the flux at substantially right angles to the direction of the material undergoing treatment.

2. In an electro-magnetic separator, in combination, a winding having an axial opening therein, a core within said opening and traversed by substantially the entire flux of said winding, the cross sectional area of said core being less than the area of said opening to provide a passage between the same and said winding for the material undergoing treatment.

3. In an electro-magnetic separator, in combination, a winding having a central opening therein, a cylindrical core member extending through said opening and traversed by substantially the entire flux of said winding, the cross sectional area of said core member being less than the area of said opening to provide an annular passage between the same and said coil for the material undergoing treatment.

4. In an electro-magnetic separator, in combination, a winding having a circular opening extending axially therethrough, a cylindrical core member extending through said winding and arranged centrally with respect thereto, the cross sectional area of said core member being less than the area of said opening to provide a passage for the material undergoing treatment and means associated with said winding for providing concentrated flux zones at opposite ends of said core.

5. In an electro-magnetic separator, in combination, a winding having a circular opening therein, a non-magnetic sleeve within said opening, a core member within said sleeve arranged centrally with respect thereto, the diameter of said core member being less than the inner diameter of said sleeve to provide an annular passage for the material undergoing treatment and annular pole pieces within said sleeve and arranged adjacent opposite ends of said core.

6. In an electro-magnetic separator, in combination, a winding having a circular opening therein, a magnetic enclosing cas-

ing therefor, a non-magnetic tubular sleeve extending through said winding and supported at opposite ends by said casing and a core member within said sleeve arranged centrally with respect thereto, the diameter of said core member being less than the inner diameter of said sleeve to provide an annular passage for the material undergoing treatment.

7. In an electro-magnetic separator in combination, a winding having a central opening therein, a magnetic enclosing casing for said winding, a non-magnetic tubular sleeve extending through said winding and supported at opposite ends by said casing, magnetic pole pieces arranged at opposite ends of said sleeve and a core member within said sleeve and having its opposite ends projecting into said pole pieces, said core member being of smaller diameter than the inner diameter of said sleeve to provide a passage for the material undergoing treatment.

8. In an electro-magnetic separator, in combination, a winding having a central opening therein, a magnetic enclosing casing for said winding, a non-magnetic tubular sleeve extending through said winding and supported at opposite ends by said casing, annular magnetic pole pieces fitting within opposite ends of said sleeve and a core member within said sleeve and having its opposite ends projecting into said pole pieces, the adjacent surfaces of said core member and said pole pieces being scored to provide for further concentration of the flux between said surfaces.

9. In an electro-magnetic separator, in combination, a winding having a central passage therein, a magnetic enclosing casing for said winding, a non-magnetic tubular sleeve extending through said winding and supported at opposite ends by said casing, annular magnetic pole pieces within said sleeve and arranged on opposite ends thereof, a core arranged within said sleeve and having its opposite ends projecting into said pole pieces and supporting means for said core carried by said sleeve.

10. In an electro-magnetic separator, in combination, a winding having a circular opening therein, a magnetic enclosing casing for said winding, a sleeve extending through said winding and supported at opposite ends by said casing, annular pole pieces fitting within opposite ends of said sleeve, a cylindrical core arranged within said sleeve and having opposite ends projecting into said pole pieces, said core being of such diameter as to provide a passage between the same and said pole pieces and also between the same and said sleeve and supporting members for opposite ends of said core fitting within said pole pieces, one of said supporting members being fixed to its respective pole piece and the other being removable therefrom.

11. In an electro-magnetic separator, in combination, a winding having a circular opening therein and a core extending through said opening, the cross-sectional area of said core being less than the area of said opening to provide a passage for the material to be treated and pole pieces arranged at opposite ends of said core to restrict said passage and to provide concentrated flux zones, the flux in said zones extending at substantially right angles to the axis of said winding.

In witness whereof, I have hereunto subscribed my name.

BERNHARD E. FERNOW, Jr.