June 6, 1961 J. J. FERRIS ET AL 2,987,184

IMPROVED SELF CLEANING MAGNETIC SEPARATOR

Filed July 31, 1959 2 Sheets-Sheet 1

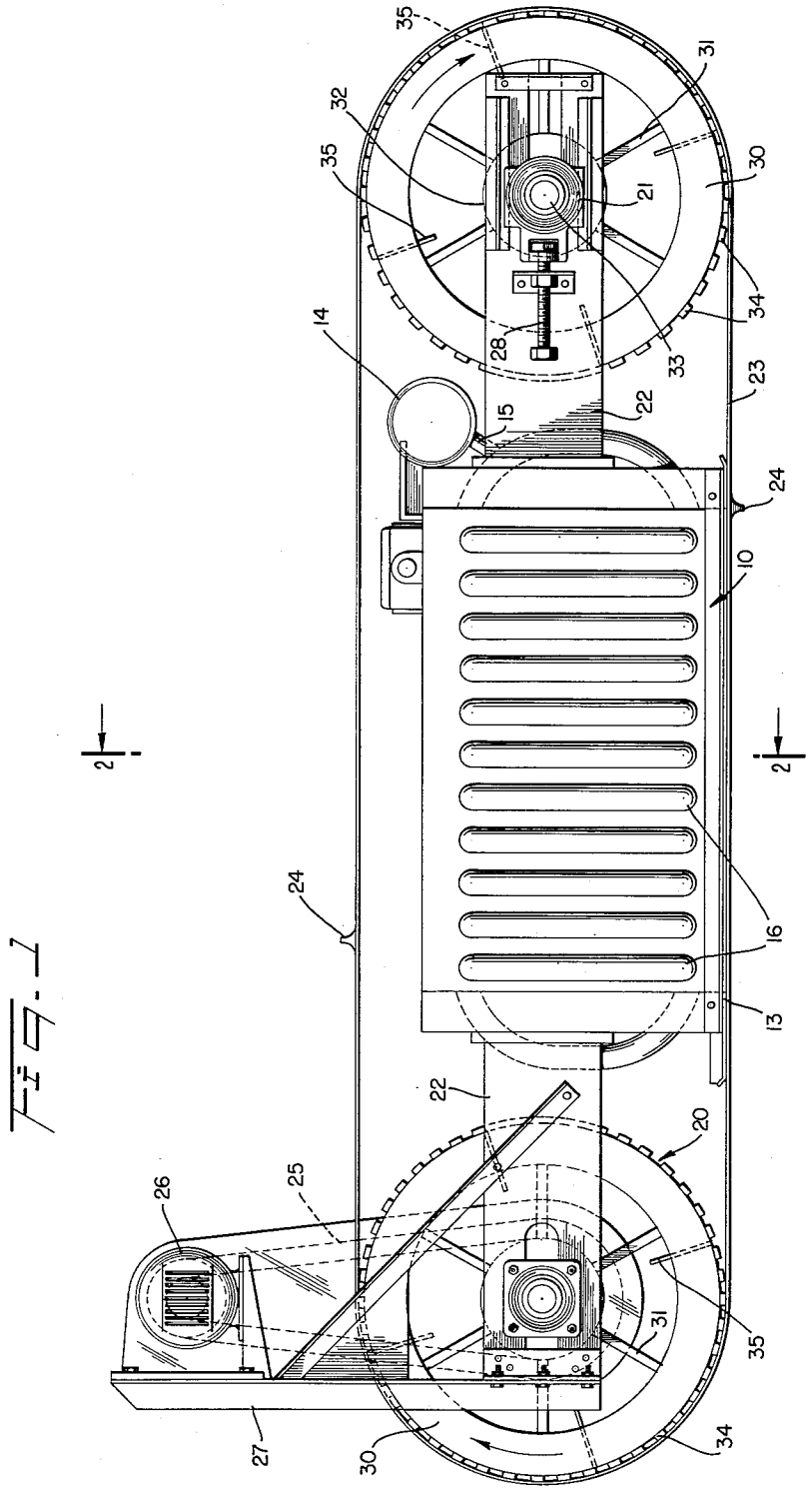


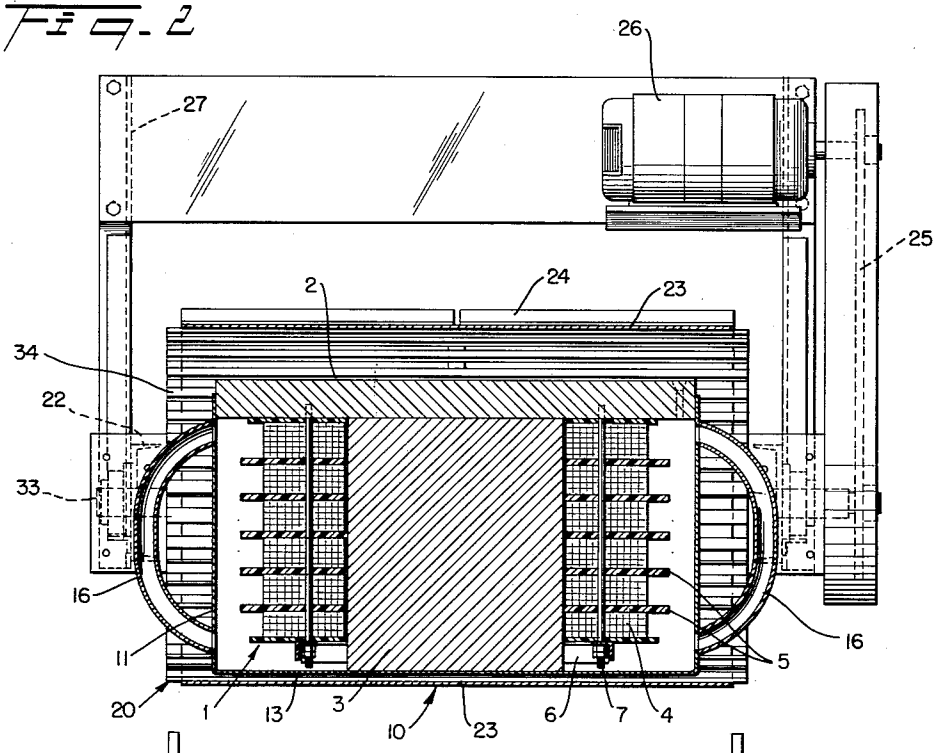
FIG. 1

June 6, 1961 J. J. FERRIS ET AL 2,987,184

IMPROVED SELF CLEANING MAGNETIC SEPARATOR

Filed July 31, 1959 2 Sheets-Sheet 2

Fig. 2



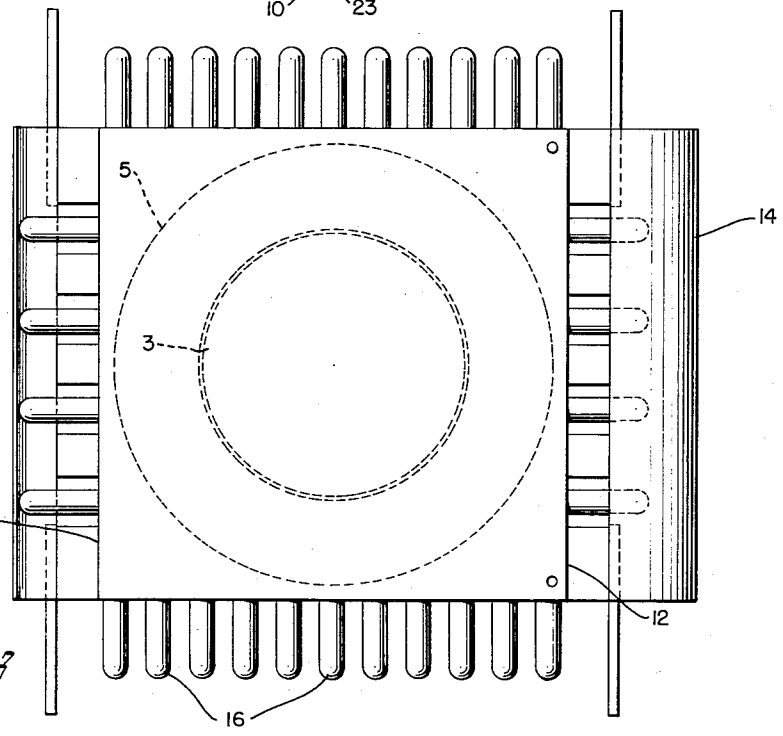


Fig. 3

United States Patent Office 2,987,184
Patented June 6, 1961

2,987,184
IMPROVED SELF CLEANING MAGNETIC SEPARATOR

James J. Ferris, Upper Montclair, and James L. Hope, Montclair, N.J., assignors to Magnetic Engineering & Manufacturing Company, Clifton, N.J., a company of New Jersey

Filed July 31, 1959, Ser. No. 830,864
3 Claims. (Cl. 209—223)

The present invention relates generally to self cleaning magnetic separator.

Magnetic separators are used for many purposes, for example for removing tramp iron from coal, rock, food products and other nonmagnetic material. The magnetic separator comprises an endless belt conveyor having an upper and lower run and an electromagnet mounted therebetween. The magnetic material attracted by the magnet is carried off by the belt and discharged.

In order to reduce the size and weight of the magnet, it is desirable to operate it at high power rating and high efficiency. As the power consumed by the magnet results in the generation of heat, it is necessary to dissipate the heat produced in order to avoid damaging the magnet winding.

It is an object of the invention to provide an improved self cleaning magnetic separator having means for effectively and efficiently cooling the magnet to permit it to operate with relatively high power input while maintaining a safe operating temperature.

The nature, objects and advantages of the invention will be more fully understood from the following description and claims in conjunction with the accompanying drawings which show by way of example a preferred embodiment of the invention. In the drawings:

FIG. 1 is a side view of an improved self cleaning magnetic separator in accordance with the invention.

FIG. 2 is a cross section taken approximately on the line 2—2 in FIG. 1 and

FIG. 3 is a partial plan view of the magnetic separator.

The preferred embodiment of the invention shown by way of example in the drawings comprises an electromagnet 1 having a top plate 2 and an iron core 3 surrounded by an annular winding or coil 4 comprising a plurality of sections separated by insulating spacers 5. The coil is supported from the top plate 2 by angles 6 and rods 7. The magnet is contained in an enclosure 10 comprising the top plate 2, side plates 11, end plates 12 and a bottom plate 13. The enclosure 10 is filled with a suitable liquid such as transformer oil which assists in insulating and cooling the magnet winding. An expansion tank 14 connected to the enclosure 10 by a pipe 15 maintains the enclosure completely filled while compensating for expansion and contraction. The sides and ends of the enclosure are provided with heat dissipating means to assist in cooling the fluid in the enclosure. As illustrated in the drawings the cooling means comprises a series of tubes 16 which are of approximately semi-circular configuration and are connected at their opposite ends with the interior of the enclosure near the top and bottom plates respectively. With the construction shown, fluid circulates through the tube loops 16 by convection. Warmer fluid entering the upper ends of the tubes is cooled as it flows downwardly through the tubes and is discharged back into the enclosure at the lower ends of the tubes.

At opposite ends of the magnet enclosure 10 there are provided drum-shaped belt pulleys 20 rotatably supported by bearings 21 carried by frame members 22 which extend from the ends of the enclosure. An endless conveyor belt 23 runs over the pulleys 20 and passes over and under the magnet enclosure 10 so that the magnet is

disposed between the opposite runs of the belt. Molded rubber cleats 24 extend transversely the full width of the belt at equally spaced intervals. The pulleys 20 have a length somewhat greater than the width of the magnet enclosure 10 and a diameter greater than the height of the magnet enclosure together with the expansion tank 14. The pulleys are positioned so that the lower run of the belt is directly beneath and in contact with the bottom plate 13 of the magnet enclosure. The upper run of the belt is located above and spaced from the top of the enclosure. One of the pulleys is driven through a chain 25 by a motor 26 mounted on a support 27 which extends upwardly from the frame members 22. The bearings of the other pulley are movable longitudinally of the frame members 22 by take-up screws 28 to maintain the belt under proper tension.

Each of the pulley drums 20 is of open construction comprising end rings 30 supported by spokes 31 radiating from a hub 32 on a shaft 33. Spaced bars or slats 34 extend between the end rings 30 and constitute the peripheral surface of the drum on which the belt 23 runs. A plurality of circumferentially spaced vanes 35 extend longitudinally of the drum between the end rings 30 and are disposed approximately radially of the pulley. While the vanes 35 are shown as being flat, they may if desired be curved and may be inclined with respect to the radii of the pulley. The vanes do not extend all the way to the pulley shaft but terminate at a distance from the shaft, the inner edges of the vanes being for example about midway between the shaft and the periphery of the pulley.

It will thus be seen that the pulley drums are of open construction, the ends of the pulleys being naturally open and elongated openings or slots being provided in the periphery between the spaced bars 34. As the pulleys rotate, the vanes 35 act as impeller blades of a blower, causing air to be drawn in through the open ends of the pulley drums and discharged radially outwardly between the end rings and through the openings between the bars 34. The conveyor belt running over the pulleys closes the peripheral openings of the pulley drum except on the side facing the magnet enclosure 10. Hence the discharge of air from the drum is directed toward the magnet. Moreover, the upper and lower runs of the conveyor belt direct the air flow so that it is not dissipated but is confined and guided toward the magnet enclosure. The airstream flowing over the magnet enclosure and particularly over the cooling tubes 16 of the enclosure greatly increases the dissipation of heat from the magnet and keeps the magnet temperature within safe limits even when the magnet is operating at a high power rating.

In operation, the magnet is suspended or otherwise supported over a chute, conveyor belt or other transporting equipment carrying material which is to be treated. For example the magnet may be disposed over the end pulley of a conveyor belt or alternatively may be disposed transversely of a conveyor belt carrying the material. As the material passes under the magnet, any pieces or particles of iron or other magnetic material are attracted by the magnet 1 and drawn up against the conveyor belt 23. They are thereupon carried by the belt to a point where the belt passes beyond the end of the magnet, whereupon the magnetic pieces or particles are automatically discharged from the belt since they are no longer attracted by the magnet. The pulleys 30 serve the dual purpose of supporting and driving the conveyor belt 23 and also acting as blowers to direct a flow of air toward the magnet enclosure to dissipate heat generated by the flow of current through the magnet winding. Moreover, the conveyor belt 23 cooperates with the pulleys in directing the air flow not only by closing the peripheral openings in the pulley drum on the side away from the magnet enclosure, but also in confining the airstream and directing it toward

the magnet. The invention thus provides effective cooling permitting the magnet to operate at high power rating without overheating.

While a preferred embodiment of the invention has been shown by way of example in the drawing, it will be understood that the invention is in no way limited to this embodiment and that many modifications may be made in details of construction without departing from the scope and spirit of the invention.

What we claim and desire to secure by Letters Patent is:

1. In a self-cleaning magnetic separator having an electromagnet mounted between two pulleys and the upper and lower runs of a belt passing around said pulleys, an improved means for cooling said electromagnet comprising a pair of combination pulley and blower each having a hub, spokes attached to and radiating from said hub, end rings supported by said spokes said end rings partially enclosing the ends of said pulley, spaced bars extending between said end rings forming the peripheral surface of said pulley and defining transverse peripheral slots, a plurality of circumferentially spaced vanes between said end rings and extending inwardly from said rings and adapted to create an outward radial flow of air between said end rings and said spaced bars when said pulley is rotated, said air flow being directed toward said electromagnet by said belt passing around said pulley blower and leaving open the peripheral openings directed toward said magnet.

2. An improved self-cleaning magnetic separator for separating magnetic material from a mixture of magnetic and non-magnetic materials comprising; a pair of drum-shaped pulleys, having ends and spaced radially apart, mounted for rotation about parallel axes, each said pulley comprising a periphery defining a plurality of transverse slots extending from end to end of the pulley and substantially parallel to its axis of rotation, and end rings supported at said pulley ends normal to said slots, for partially closing said ends adjacent said periphery, said end rings extending radially toward said axis of rotation; a plurality of vanes circumferentially spaced around the periphery of each said pulley between said respective end rings and radially extending from the associated peripheries to points intermediate the respective axes of rotation, said vanes operating as impeller blades when the pulleys are rotated for drawing in air axially through the pulleys' ends between the end rings and the axes of rotation and expelling said air in air blasts radially outwardly between said respective pulleys' end rings and through said transverse peripheral slots; an endless conveyor belt mounted on said pulleys for being driven in an upper run and a lower run around said pulleys when at least one said pulley is rotated for conveying magnetic material, said belt closing those peripheral slots of the respective pulleys that are oppositely disposed to each other to direct opposed air blasts out of the opposed slots of the respective pulleys; an electrically energized electromagnet mounted intermediate said pulleys and between said belt runs in said opposed air blasts for magnetically attracting magnetic material to said endless conveyor belt from said mixture passed near said belt, said electromagnet being cooled by opposed air blasts directed thereon, whereby said electromagnet is operable to provide greater magnetic attraction than an uncooled electromagnet of the same size and electrical characteristics.

3. An improved self cleaning magnetic separator as described in claim 2 further comprising a fluid-tight enclosure for enclosing said electromagnet, said enclosure having a top, a bottom, and connecting sides, and externally connecting said enclosure's interior adjacent said top and bottom, cooling fluid means for filling said enclosure and cooling tubes, whereby said liquid, heated by said electromagnet, circulates by convection through said enclosure and pipes and is cooled in said cooling pipes by said opposed air blasts.

References Cited in the file of this patent

UNITED STATES PATENTS

1,400,671	Fischer	Dec. 20, 1921
1,873,971	Hill	Aug. 30, 1932
2,654,583	Treanor	Oct. 6, 1953
2,702,123	Injeski	Feb. 15, 1955