United States Patent

Parnell

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[54] MAGNET ASSEMBLY FOR MAGNETIC SEPARATOR

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[52] **U.S. Cl.** .....**209/223 R,** 209/231
[51] **Int. Cl.** **B03c 1/22**
[58] **Field of Search**.....209/214, 215, 228, 223, 224, 209/232, 212, 213, 216, 231, 223 A; 210/222, 223; 335/285, 306

[56] **References Cited**

UNITED STATES PATENTS

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[57] **ABSTRACT**

A pair of ceramic permanent magnets are inclined at a predetermined angle relative to one another and to an arcuate path along which cotton is conveyed so as to concentrate the magnetic field on the path and increase the ability of the magnets to attract magnetic particles from the cotton.

3 Claims, 2 Drawing Figures

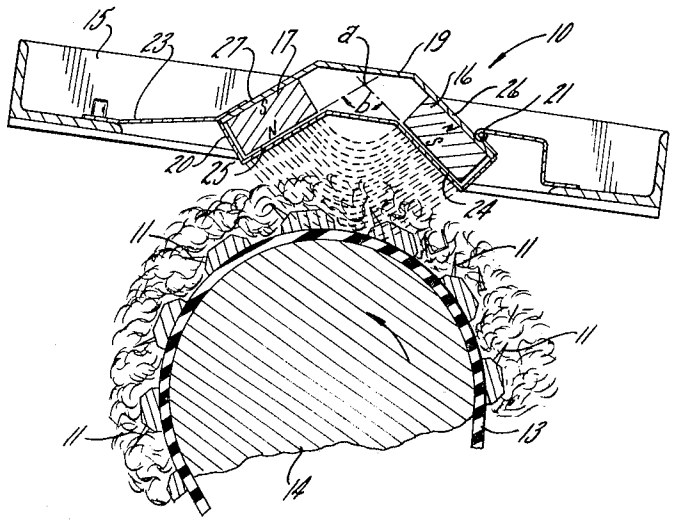
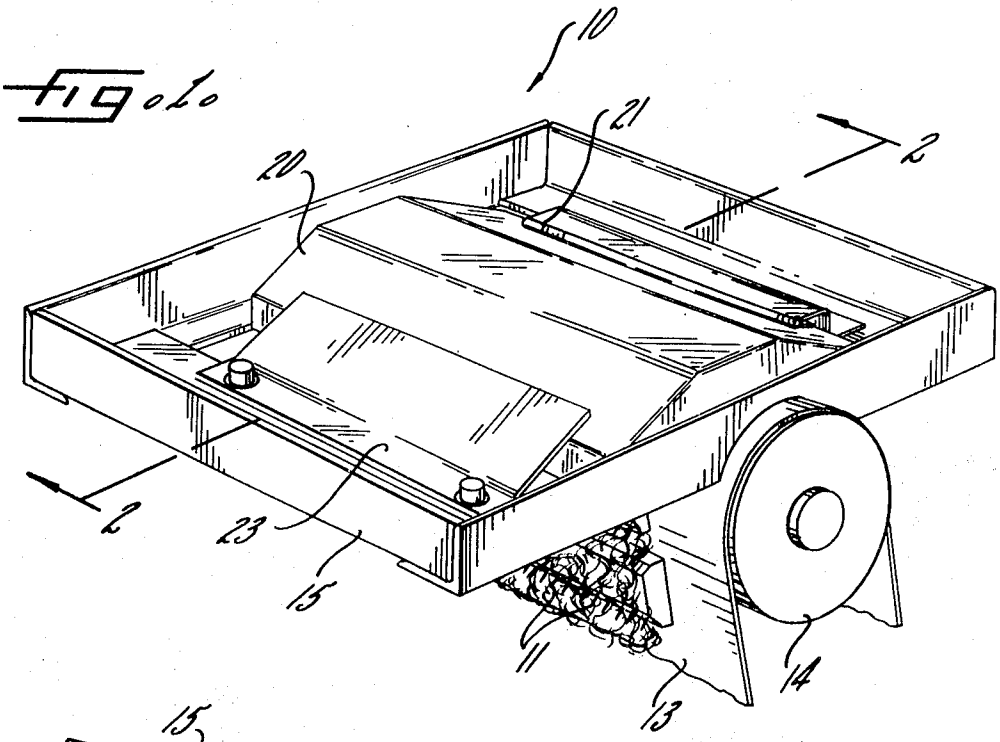


FIG. 1a



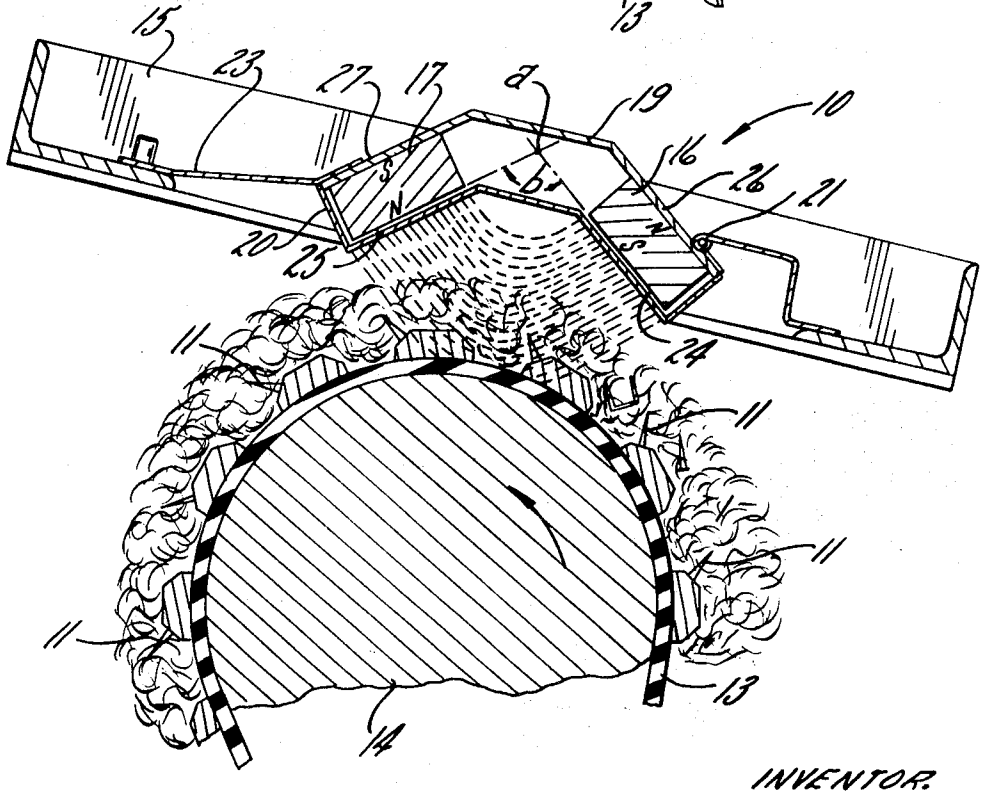


FIG. 2a

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MAGNET ASSEMBLY FOR MAGNETIC SEPARATOR

BACKGROUND OF THE INVENTION

This invention relates to a magnet assembly having permanent magnets which attract and separate magnetic material from non-magnetic material as the material is conveyed along an arcuate or angular path. A magnet assembly used for this purpose is disclosed in Molins U.S. Pat. No. 2,646,883.

SUMMARY OF THE INVENTION

The primary aim of the present invention is to provide a new and improved magnet assembly of the above character in which the magnets are arranged relative to each other and to the path in a novel manner to increase the ability of magnets of a given size and positioned a given distance from the path to attract more and smaller particles of magnetic material than has been possible heretofore.

A more detailed object is to achieve the foregoing by inclining the magnets at a predetermined angle relative to one another and the path to concentrate and intensify the magnetic force on the path and thereby effectively use more of the potentially available magnetic force for attracting the magnetic material away from the non-magnetic material.

The invention also resides in the comparatively simple construction of the assembly to make the assembly economically competitive with prior assemblies having less efficient separation capabilities.

These and other objects and advantages of the invention will become more apparent from the following detailed description when taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a new and improved magnet assembly embodying the novel features of the present invention and showing the assembly in an exemplary operating environment.

FIG. 2 is an enlarged fragmentary cross-section taken substantially along the line 2—2 of FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in the drawings for purposes of illustration, the invention is embodied in a permanent magnet assembly **10** for separating magnetic particles such as iron nails, wire and the like from a non-magnetic material such as raw cotton as the latter is conveyed along a predetermined path past the magnet assembly. Herein, the cotton is conveyed on spikes **11** carried on a power driven and generally upright endless belt or apron **13** which is driven counterclockwise and trained around an upper roller **14** to carry the cotton first upwardly to the magnet assembly, then along an arcuate path past the assembly and finally downwardly away from the assembly for transfer to other processing stations.

The magnet assembly **10** is supported within a box-like frame **15** (FIG. 2) suspended above the roller **14** and comprises a pair of permanent magnets **16** and **17** which preferably are of rectangular cross-section and composed of ceramic magnet material, such material being of relatively low cost when compared with other popular magnet materials such as Alnico material. The magnets are bonded to the underside of a supporting plate **19** of magnetic material such as cold rolled steel and are housed within a non-magnetic casing **20** fastened to the supporting plate. Magnetic particles attracted from the cotton by the magnets collect on the undersurface of the casing rather than on the magnets themselves and thus may be more easily cleaned from the assembly. To facilitate cleaning of the casing **20**, the supporting plate **19** is hinged at one end to the frame **15** as indicated at **21** (FIG. 2) so that the casing may be swung upwardly from the roller **14** and the particles cleaned from the exposed collecting surface of the casing. A wing **23** projecting from the end of the casing opposite the hinge rests on part of the frame to keep the magnet assembly from swinging downwardly against the roller.

The magnet **16** is positioned on the plate **19** with its south pole face **24** facing the roller **14** as shown in FIG. 2 while the magnet **17** is spaced from the magnet **16** in the direction of rotation of the roller and is positioned with its north pole face **25** facing the roller. Thus, the magnetic flux flows past the roller from the magnet **17** to the magnet **16** in a direction generally perpendicular to the orientation of the spikes **11**. The physical force exerted by the magnets on the magnetic particles in the cotton at a given point between the magnets and the roller is proportional to the product of the intensity of the magnetic field and the gradient of the field at such point. Thus, the force F equals

$$KH\,(dH/dx)$$

where:

K is constant and is a factor of proportionality;

H is the absolute magnetic field intensity; and

dH/dx is the magnetic field gradient.

Accordingly, the force acting on the particles can be increased by increasing the absolute intensity of the field and/or the gradient of the field and, of course, the magnitude of the force for the most part determines the quantity and size of magnetic particles which can be extracted from the cotton.

I have discovered that, with magnets **16** and **17** composed of magnet material of a given quality and quantity, both the intensity and gradient of the magnetic field in the pick up zone between the magnets and the roller **14** can be greatly increased by inclining the magnets so that their pole faces **24** and **25** are at a preselected angle to one another and to the roller. In this way, the magnetic field is concentrated or "focused" in a preselected zone between the magnets and the path of the cotton to increase the ability of the assembly **10** to remove more and smaller magnetic particles from the cotton.

More specifically and as shown most clearly in FIG. 2, the pole faces **24** and **25** of the magnets **16** and **17** are disposed in oppositely inclined planes which converge upwardly toward one another as they progress outwardly from the roller **14**, the line *a* of intersection of such planes extending transversely of the path of movement of the cotton. The included angle *b* between the planes of the pole faces may vary depending upon the particular diameter of the roller and the particular spacing of the magnets from the roller. The angle *b* is, however, preferably kept less than 160° and preferably greater than the angle between similarly inclined planes extending tangential to the roller and intersecting at the line *a*. In this particular instance, the angle *b* between the planes of the pole faces is about 115°, and the line *a* of intersection of the planes is spaced radially a distance of 6 to 8 inches from the center of a roller **14** having a diameter of about 6 inches.

To provide the desired inclination to the pole faces **24** and **25** in an inexpensive manner, the supporting plate **19** is simply bent as shown in FIG. 2 to form two sections **26** and **27** whose lower surfaces parallel the planes in which it is desired to position the pole faces. Thus, the pole faces of the rectangular magnets **16** and **17** automatically will be positioned at the proper angle relative to one another when the magnets are bonded on the plate.

With the magnets **16** and **17** being inclined as shown, it has been found that significantly more of the force capable of being developed by the magnets is effectively used to attract the particles from the cotton than is the case with magnets whose pole faces are positioned in a common plane located generally tangent to an arc concentric to the roller **14**. In conjunction with the inclined pole faces **24** and **25**, even more effective particle separation can be accomplished by optimizing certain magnet parameters such as the magnet material employed, the ratio of magnet length to pole face area, the spacing used between the magnets, and the spacing of the magnets from the roller. Also, the best results are achieved when the assembly **10** is offset slightly toward the upwardly curving run of the belt **13** and is inclined at a slight angle to the horizontal as shown in FIG. 2.

I claim as my invention:

1. A magnet assembly for attracting and separating magnetic material from non-magnetic material as the material is conveyed along a predetermined arcuate path, said assembly comprising a supporting plate of magnetic material spaced radially outwardly of said path and having a pair of supporting surfaces facing said path in close proximity thereto and disposed in oppositely inclined planes which converge as they progress outwardly of said path and whose line of intersection extends transversely of said path, a stationary flat-faced ceramic permanent magnet mounted on each of said supporting surfaces and spaced along said path from one another, one of said magnets having one pole face facing said path and the other magnet having an opposite pole face facing said path, and said pole faces paralleling their respective supporting surfaces to concentrate the magnetic force on said path and increase the ability of said assembly to attract the magnetic material conveyed along the path.

2. A magnet assembly as defined in claim 1 in which the included angle between said planes is less than 160° but is greater than the angle between two similarly inclined planes

extending tangential to the path and intersecting one another at the line of intersection of said first planes.

3. A magnet assembly for attracting and separating magnetic material from non-magnetic material as the material is conveyed along a predetermined angular path, said assembly comprising a support of magnetic material spaced outwardly from said path in close proximity thereto, and a pair of stationary flat-faced ceramic permanent magnets mounted on said support and both disposed on the same side of said path while spaced from one another along said path, one of said magnets having one pole face facing said path and the other magnet having an opposite pole face facing said path, and said pole faces being disposed in oppositely inclined planes which converge as they progress outwardly from said path and whose line of intersection extends transversely of said path thereby to concentrate the magnetic force on said path and increase the ability of said assembly to attract the magnetic material conveyed along the path.

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