Feb. 10, 1942. C. A. MAYNARD 2,272,719

MAGNETIC SEPARATOR

Filed Jan. 2, 1940

Fig-1

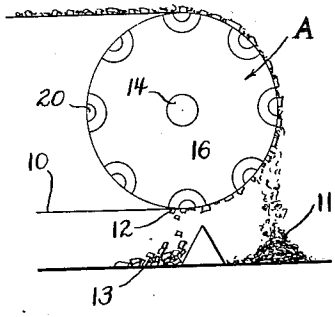


Fig-2

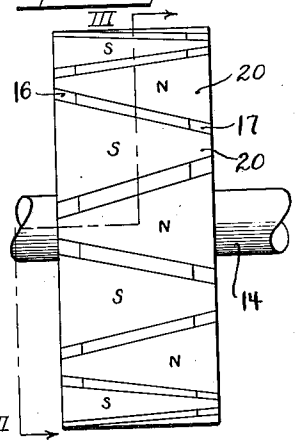


Fig-4

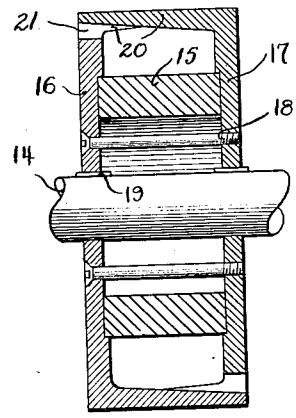


Fig-3

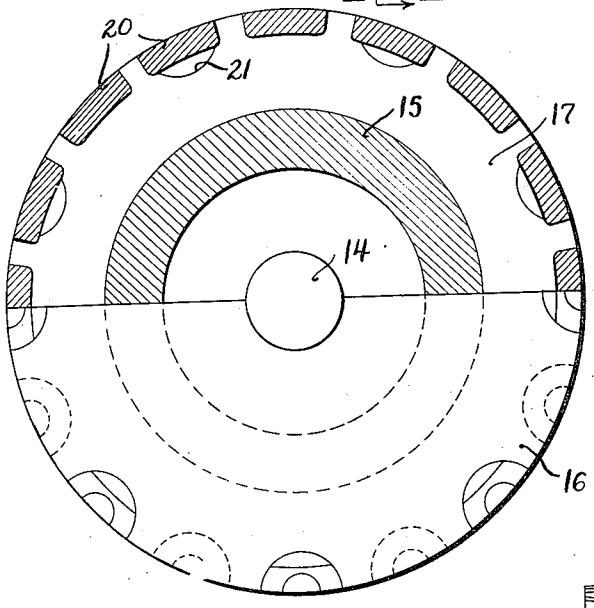


Fig-5

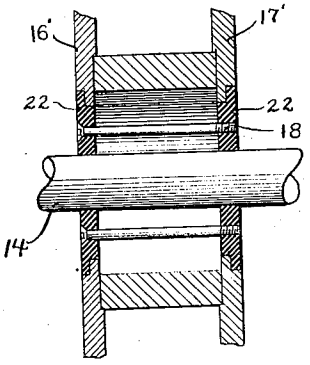


Fig-7

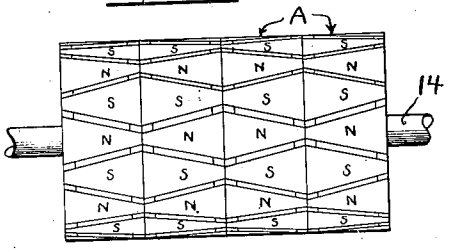
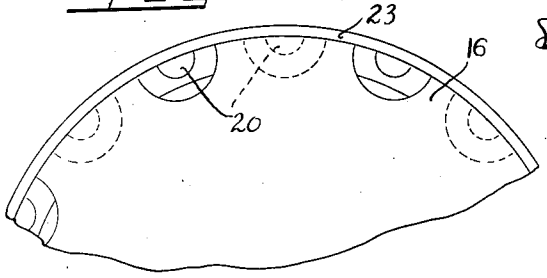


Fig-6



Inventor

Charles A. Maynard

by Charles Allen Attys

Patented Feb. 10, 1942 2,272,719

UNITED STATES PATENT OFFICE

2,272,719

MAGNETIC SEPARATOR

Charles A. Maynard, Valparaiso, Ind., assignor to The Indiana Steel Products Company, Chicago, Ill., a corporation of Indiana

Application January 2, 1940, Serial No. 312,024

3 Claims. (Cl. 209—219)

The present invention relates in general to material separating apparatus and is concerned more particularly with improvements in separator apparatus of the magnetic type for segregating magnetic and non-magnetic materials.

Conventional magnetic separators have in general utilized an electro-magnet consisting of one or more coils wound on a suitable core, and necessitating auxiliary equipment for energizing and controlling the electro-magnet. Such separators have proved inherently unsatisfactory in practice due to the possibility of failures occurring in the electrical circuits and connected appurtenances, with the result that the separator may be rendered inoperative and serious consequences or damage occur.

Even though the electrical circuits are provided with protective devices and indicating circuits, moving machinery cannot be stopped instantaneously, and failures may result in damage due to the passage of magnetic materials through the separator apparatus before operations can be terminated. Further, in some locations, inflammable or explosive materials may be ignited or exploded by sparks from the brushes constituting a part of the apparatus or due to electrical failures.

Having in mind the inherent disadvantages of and objections to the electromagnetic type of separator, the present invention in its broad concept contemplates the provision of improved magnetic separating apparatus utilizing permanent magnets, whereby the apparatus will be free from the above enumerated and other difficulties and effect operating economies heretofore unattainable, by eliminating the usual auxiliary equipment and the necessity for the constant supplying of electrical energy to the apparatus.

Another object of the herein described invention is to provide a magnetic separator embodying novel features of construction in which a material-separating drum may be composed of one or more unit sections to accommodate the apparatus for varied installation conditions.

Other objects and features of the invention will more readily appear from the following detailed description, taken in connection with the accompanying drawing which illustrates several embodiments thereof, and in which:

Figure 1 is a view schematically illustrating one manner in which the present invention may be utilized with a conveyor belt for separating magnetizable and non-magnetizable materials;

Figure 2 is an elevational view of a rotatable separator drum embodying the features of the present invention;

Figure 3 is an enlarged end view of the same, partly in section, illustrating constructional details thereof, the section being taken substantially on the line III—III of Figure 2.

Figure 4 is a diametric sectional view taken through the drum;

Figure 5 is a similar fragmentary view showing a modified mounting construction on the shaft of the drum;

Figure 6 is an enlarged fragmentary end view of a portion of the drum, illustrating the use of a peripheral sheet of non-magnetic material; and

Figure 7 is an elevational view showing a drum construction built up of a plurality of similar unit sections mounted in end-to-end relation on the drum shaft.

As shown on the drawing:

The present invention in its broad concept comprises a rotatable drum structure, as generally indicated at A in Figure 1, this drum being provided on its periphery with consequential polar areas which are alternately of opposite polarity. As shown, this drum may be utilized for the separation of magnetizable and non-magnetizable or only slightly magnetizable materials by rotating the drum by means of a conveyor belt 10 trained thereover. This belt may be utilized for conveying the mixed magnetizable and non-magnetizable materials to the drum. As the materials are carried over the drum surface, the magnetizable materials will be attracted by the polar areas of the drum and retained on the belt, while the non-magnetizable materials will be free to fall by gravity into a pile, as indicated at 11. As the successive portions of the conveyor belt leave the drum, as at the point 12, the belt will act to disengage the magnetizable materials relative to the drum surface, whereupon this material may fall into a separate pile, as indicated at 13, or be received in a suitable container.

More specifically, the drum structure as utilized in the present invention comprises a shaft 14 around which there is disposed a permanently magnetized annular member 15. Although shown herein as being of one-piece construction, the member 15 may if desired be constructed of a number of separate pieces or sections. This magnet is retained in symmetrical relation to the shaft, with the shaft passing through its axis by means of suitable annular end flanges 16 and 17 of material of high permeability forming polar pieces in engagement with the salient poles of

the member 15 at its ends. The flanges 16 and 17 may be clamped against the magnet ends in any suitable manner, and for this purpose there is disclosed a plurality of clamping bolts 18 which may be circumferentially spaced around the shaft. If desired, the end flanges may be affixed to the shaft by suitable keys 19, or any other suitable arrangement may be used for such purpose.

The peripheries of the members 16 and 17 are each provided with deflected projections 20, the projections on the member 16 being directed towards the member 17 and the projections on the member 17 being directed towards the member 16. These projections are preferably tapered towards their outermost ends and disposed in spaced-apart relation with the projections of one of the end members disposed in the interstices between the other projections of the other member. The end members 16 and 17 are recessed, as shown at 21, adjacent the outermost ends of the projections, in order to prevent these ends from contacting the adjacent end member.

With the foregoing construction, it will be noted that the projections provide a plurality of consequent poles which are spaced apart circumferentially around the magnet 15 at the periphery of the drum and provide alternate surface areas of opposite polarity.

The construction disclosed in Figure 4 would be primarily used with a non-magnetizable shaft. Where it is desired to utilize a magnetizable shaft, a construction as shown in Figure 5 may be used, where, instead of extending the magnetizable end flanges 16 and 17 into engagement with the shaft, end flanges 16' and 17' in this case are associated with shaft-contacting elements of non-magnetizable material. In this instance, these elements comprise a pair of clamping plates 22—22 which may be likewise secured by means of bolts 18 in a manner similar to that shown in Figure 4.

In some installations, the open spaces between the polar areas defined by the projections 20 might be objectionable. If desired, these spaces may be filled with a suitable non-magnetic material, or a shell 23 of non-magnetic material may be disposed around the outer surface of the drum, this shell overlying the polarized areas.

Each of the arrangements shown in Figures 2, 4 and 5 is so constructed as to form a standard unit. In some installations, it may be desirable to meet operating conditions to mount one or more of these units on a single shaft, as disclosed in Figure 7. In mounting the units on the shaft, the units are placed with like salient poles of adjacent units in abutting relation and with the polar projections disposed with the polar projections of the same polarity in abutting relation so that polarized areas extending throughout the length of the drum will be formed, and in a circumferential direction of the drum alternate polarized areas of opposite polarity will be effected. In such arrangement, it will be noted that each section of the drum or each unit contains its own permanent magnet, and all the ends of these magnets of one polarity are connected to one set of abutting polarized areas, whereas all the ends of the magnets of opposite polarity are connected to the other set of polarized areas.

From the foregoing description, it will be apparent that the present invention provides improved magnetic separating apparatus utilizing permanent magnets, whereby the apparatus will be free from many of the difficulties heretofore experienced with such apparatus and effects operating economies heretofore unattainable by eliminating the usual auxiliary equipment and the necessity for constant supplying of electrical energy to the apparatus, and which embodies novel features of construction in which a material separating drum may be composed of one or more standard unit sections to accommodate the apparatus for varied installation conditions.

It is, of course, to be understood that although I have described in detail several embodiments of my invention, the invention is not to be thus limited but only insofar as defined by the scope and spirit of the appended claims.

I claim as my invention:

1. A magnetic separator comprising a permanent magnet, pole pieces respectively associated with the poles of said magnet, said pole pieces each having a plate portion in contact with one end of the magnet and integral deflected projections at its periphery, the projections of the respective pole pieces extending over the magnet and being alternately disposed to form consequent spaced pole areas around the magnet, and peripheral notches respectively in each plate portion for the reception of the tip end portions of the projections of the other without contact therewith.

2. A magnetic separator comprising a permanent magnet, pole pieces respectively associated with the poles of said magnet, said pole pieces each having a plate portion in contact with one end of the magnet and integral tapered projections at its periphery, the projections of the respective pole pieces extending over the magnet and being alternately disposed to form consequent spaced pole areas around the magnet, and peripheral notches respectively in each plate portion for the reception of the tip end portions of the projections of the other without contacting the same.

3. A magnetic separator comprising an annular permanent magnet, pole pieces respectively associated with the poles of said magnet, the pole pieces each having a circular portion with an inner face contacting one end of the magnet and integral deflected projections at its periphery extending over the magnet, the projections of the pole pieces being alternately disposed and cooperating to form consequent magnetized surfaces spaced circumferentially around the magnet, and peripheral notches in each circular portion between the root ends of its integral projections for receiving therethrough without contact engagement the tip end portions of the projections of each other, the tip ends of the projections at each circular portion terminating in an extension of the plane of its outer face.

CHARLES A. MAYNARD.